Morell River
Flood Management Scheme

Volume II: Environmental Impact Assessment Report

July 2017

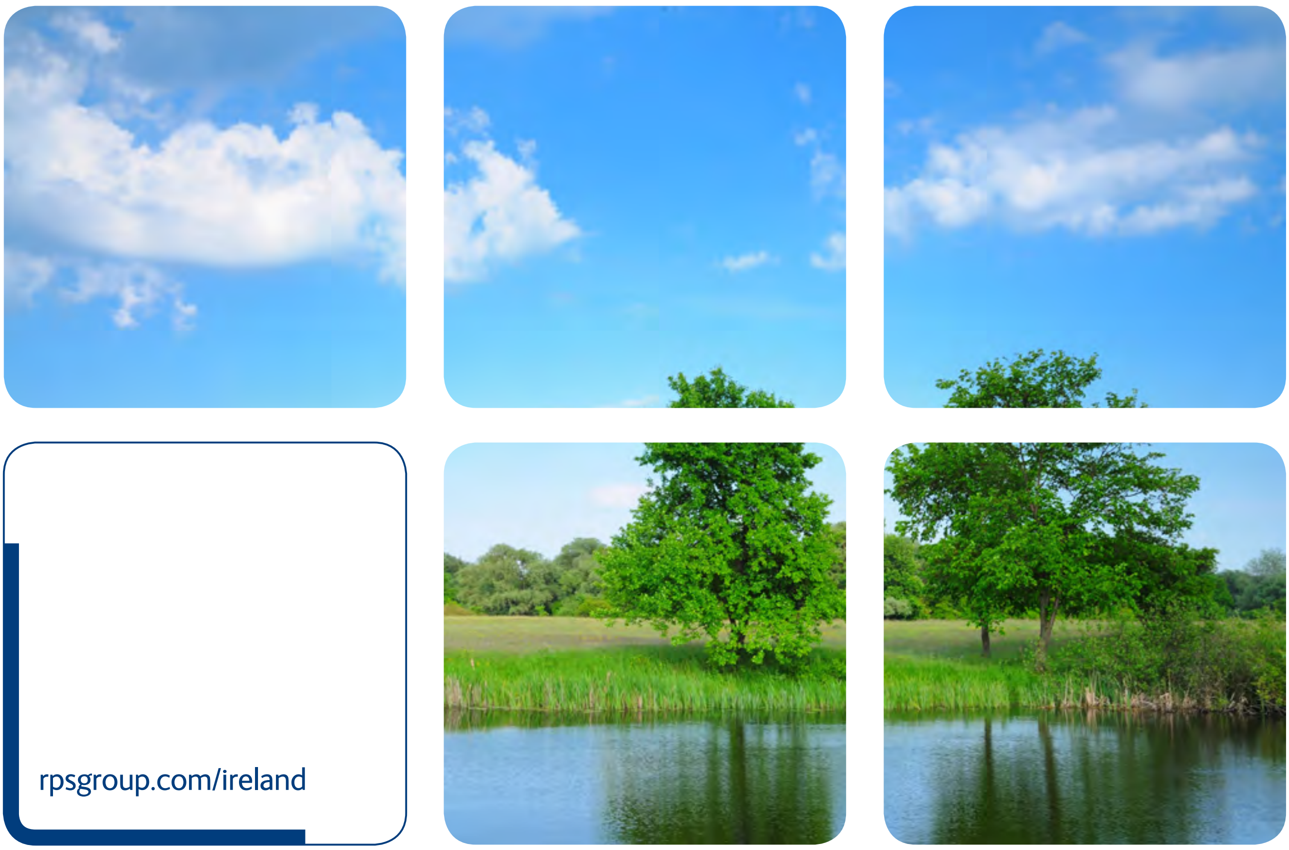


TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF IMAGES

LIST OF ABBREVIATIONS

AA	Appropriate Assessment
AFA	Area for Further Assessment
CFRAM	Catchment Flood Risk Assessment and Management
DAFM	Department of Agriculture, Food and the Marine
DAHG	Department of Arts, Heritage and the Gaeltacht
DAHRRG	Department of Arts, Heritage, Regional Rural and Gaeltacht Affairs
DARD	Department of Agriculture and Rural Development (Northern Ireland)
DCENR	Department of Communications, Energy and Natural Resources
DECLG	Department of Environment, Community and Local Government
DEHLG	Department of Environment, Heritage and Local Government
EC	European Commission
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPA	Environmental Protection Agency
ERBD	Eastern River Basin District
FEMFRAM	Fingal East Meath Flood Risk Assessment and Management Study
FRA	Flood Risk Assessment
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
GIS	Geographical Information System
GSI	Geological Survey Ireland
HA	Hydrometric Area
IFI	Inland Fisheries Ireland
IPP	Individual Property Protection
IRBD	International River Basin District
LA	Local Authority
LAP	Local Area Plan
MCA	Multi-Criteria Analysis
NHA	Natural Heritage Area
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Service
OPW	[The] Office of Public Works
OSI	Ordnance Survey Ireland
PFRA	Preliminary Flood Risk Assessment
RBD	River Basin District
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SI	Statutory Instrument
SOP	Standard Operating Procedure
SoP	Standard of Protection
SPA	Special Protection Area
SuDS	Sustainable Drainage Systems
UoM	Unit of Management
WFD	Water Framework Directive

1 INTRODUCTION

The Morell[1] River catchment in County Kildare is subject to fluvial flooding caused by intense rainfall events or following prolonged and heavy rainfall with antecedent wet conditions. As a consequence of the reccurence of significant flooding in the Morell catchment, coupled with health and safety concerns amongst its residents, the catchment was prioritised within the Eastern Catchment-based Flood Risk Assessment and Management (CFRAM) Study programme for the development of a Flood Alleviation Scheme (FAS) Study. The purpose of this study was to fully assess the flood risk within the Morell catchment and develop a series of potential Flood Risk Management (FRM) Options. This study was funded by the Office of Public Works (OPW) and undertaken by RPS, on behalf of Kildare County Council.

The FRM Options from the FAS study were presented to the public in October 2014 and then refined with input from the OPW in April 2015 to facilitate the final design of the Morell River Flood Management Scheme (FMS). The objective of the Morell River FMS is to provide optimum flood relief with minimal environmental impact, whilst also controlling the overall capital investment required. RPS was commissioned by Kildare County Council to complete the design of the proposed scheme; the details of which are provided in Chapter 4, 'Project Description'.

RPS was appointed by Kildare County Council to undertake an Environmental Impact Assessment (EIA) and produce an Environmental Impact Assessment Report (EIAR) for the Morell River FMS (hereafter referred to as the "the proposed scheme"). The EIAR forms an integral part of the applications for consent for the proposed scheme, which are discussed in Section1.4: 'Legislative & Policy Context'. In this regard, it will also act as a basis for public consultation and informed comment. In addition to the completion of the EIAR, an Appropriate Assessment Screening Statement was also undertaken for this project in order to fulfil the requirements of the Habitats Directive (92/43/EEC) and the Birds and Natural Habitats Regulations (S.I. 477 of 2011), and is included in Appendix D in Volume 3 of this EIAR.

This chapter provides details on the project background, project justification and consideration of alternatives (Section 1.1 to 1.3, planning legislation and policy (Section 1.4), EIA screening (Section 1.5), the scope of the EIAR (Section 0), the EIA study team (Section 1.8), the overall structure of the EIAR (Section 1.9), as well as any difficulties encountered during the preparation of this EIAR (Section 1.10).

1.1 STUDY AREA

The Morell River catchment is located in County Kildare and is situated in the Eastern River Basin District (ERBD) within Hydrometric Area (HA) 09 (also referred to as Unit of Management (UoM) 09). The main rivers in the catchment are the Morell River (itself a tributary of the River Liffey) and its tributaries the Hartwell, Haynestown, Slane and Kill Rivers (note that the Slane and Kill Rivers combine into the Painestown[2] River) as shown in Figure 1.1. The Grand Canal travels through the catchment from northeast to southwest.

[1] The alternate spelling 'Morrell' is also used for this river
[2] The alternate spelling 'Painstown' is also used for this river

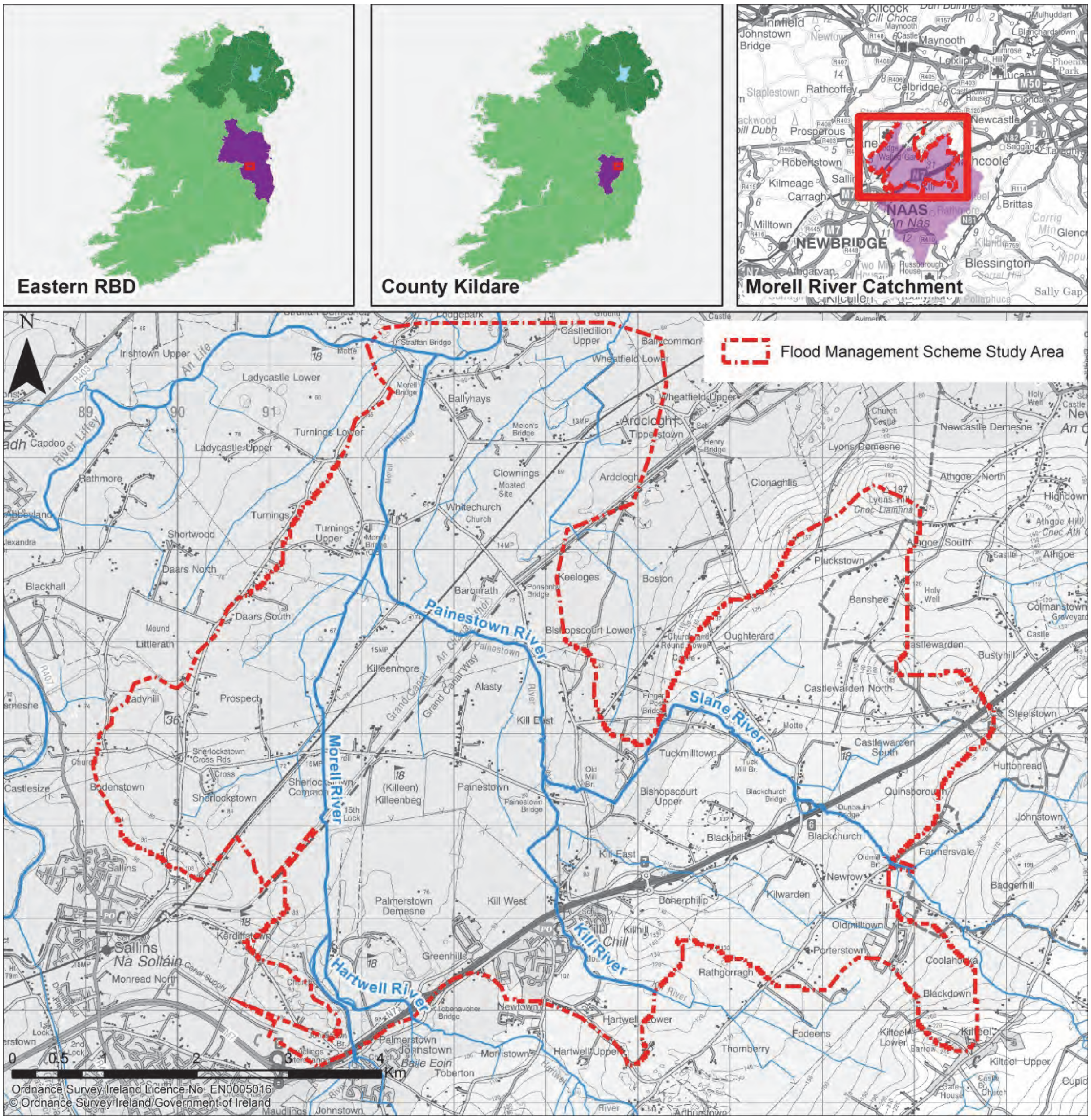


Figure 1.1: Study Area

1.2 PROJECT JUSTIFICATION

As discussed in Section 1.1, the Morell River and its tributaries; the Hartwell, Haynestown, Slane and Kill Rivers, have been responsible for serious flooding events resulting in significant damages to property and businesses.

1.2.1 Flood Alleviation Scheme Study Background

In 2011, RPS was appointed by the OPW to undertake the Eastern CFRAM Study, which was the second River Basin District (RBD) level CFRAM study to be commissioned in Ireland under the OPW's national CFRAM Programme. This programme was developed in response to the EC Directive on the Assessment and Management of Flood Risks 2007, known as the "Floods Directive", which was implemented in Ireland by the European Communities (Assessment and Management of Flood Risks) Regulations [S.I. 122 of 2010 and S.I. 495 of 2015]) and the National Flood Policy (2004).

The general objectives of the Eastern CFRAM Study are:

- 2014 - Identify and map the existing and potential future flood hazard and flood risk within the Eastern district;
- 2015 - Identify viable structural and non-structural Options and Measures for the effective and sustainable management of flood risk within the Eastern RBD;
- 2016 - Prepare a set of Flood Risk Management Plans (FRMPs) for the study area, and associated environmental assessments as necessary, that set out the policies, strategies, measures and actions that should be pursued by the relevant bodies, including OPW, Local Authorities and other stakeholders, to achieve the most cost effective and sustainable management of existing and potential future flood risk within the Eastern RBD; taking account of environmental plans, objectives and legislative requirements and other statutory plans and requirements.

Due to the significance of the flooding that has taken place in the Morell Catchment, as well as concern amongst residents, it was prioritised within the Eastern CFRAM Study programme, under which it is known as Turnings/Killeenmore Area for Further Assessment (AFA). As a result of the prioritisation an advanced project was carried out during 2013 to accelerate the development of flood mapping for this AFA.

The draft flood mapping, shown in Figure 1.2, was developed and delivered in summer 2013, and was subsequently used in the Morell FAS Study. The Morell Flood Management Scheme Feasibility Report (RPS, 2016 – included as Appendix A, in Volume 3 of this EIAR) documents the results of the FAS study, including the Flood Risk Assessment, Damage Assessment and the Assessment of Flood Risk Management Measures. The key points from this report are summarised in this section and section 1.3, but the report has also been included in full as Appendix A (contained in Volume 3 of this EIAR).

The Morell FAS Study focused on the impact of flooding on the four main receptors listed below:

- Society (including risk to people);
- The Environment;
- Cultural Heritage; and
- The Economy.

The Study resulted in the establishment of three potential Flood Risk Management (FRM) Options, plus a 'do nothing' Option. The Options, which are discussed in more detail in Section 1.3, were consulted on with the public, following which the preferred Option was refined, with the input of the OPW, resulting in the development of the final design of the proposed scheme.

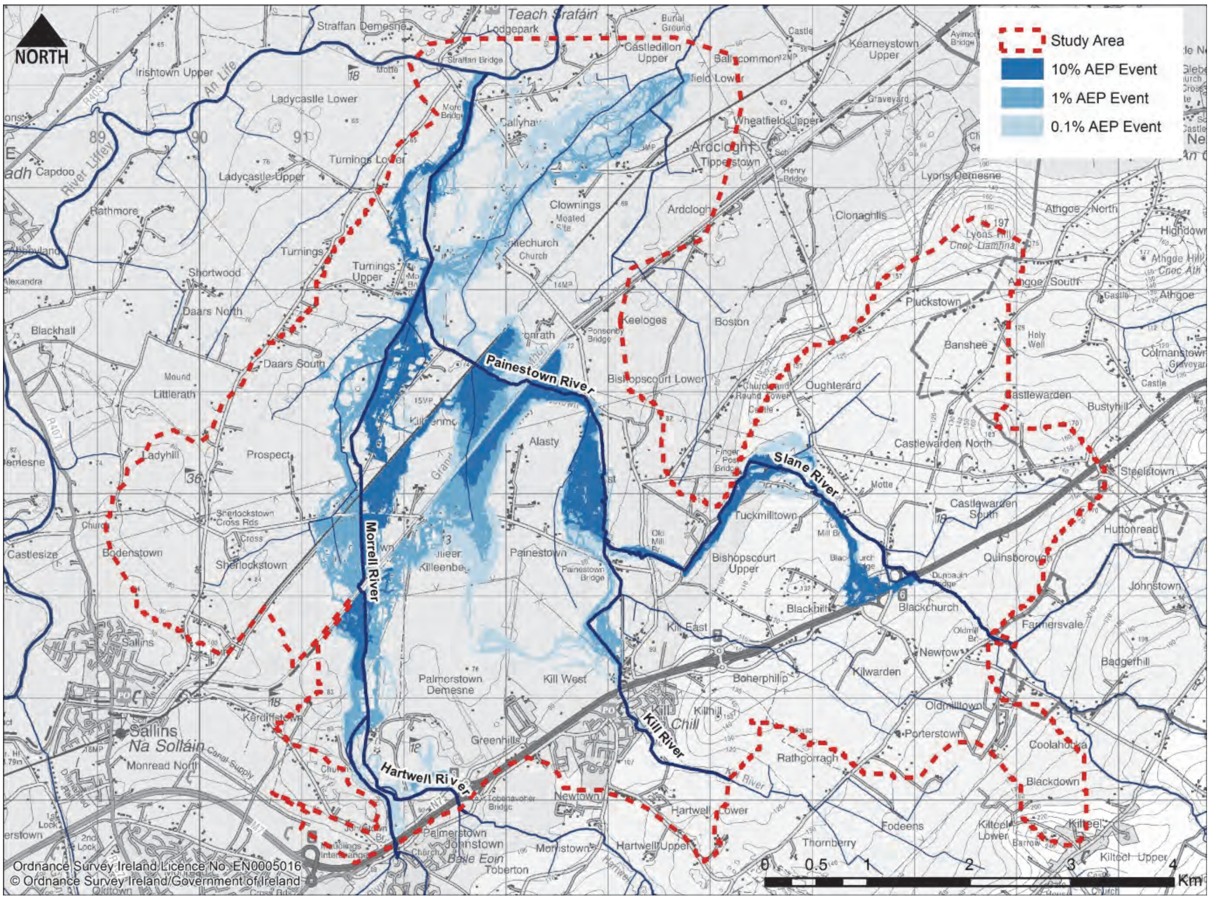


Figure 1.2: Present Day Flood Extent (derived from CFRAM Study - Turnings/Killeenmore AFA)

It should also be noted that the studies undertaken for the Morell FAS Study are in accordance with the specifications of the Eastern CFRAM study, but differ in terms of their level of detail and spatial scale. The Turnings /Killeenmore AFA remains within the Eastern CFRAM study and the results of the Morell FAS Study will ultimately be incorporated into the overall FRMP for HA09.

1.2.2 Flood Risk Assessment

The aim of a Flood Risk Assessment is to assess and map the potential adverse consequences (risk) associated with flooding events of varying frequency to the four receptor groups listed previously. The level of flood risk to a receptor can be affected by the location of the receptor within the flood extent or the proportion of the receptor within the flood extent, the depth to which it floods, the velocity of the water adjacent to the receptor, and the receptors' innate vulnerability to flooding.

The CFRAM Study resulted in the production of a series of flood risk maps which illustrated the source of the risk and the receptors at risk. Indicators, such as location, extent, type and number were used to quantify the risk. Table 1.1, from the FAS study, summarises the flood risk associated with the study area. It can be seen in this Table 1.1 that two principal Receptor groups are at risk from flooding during 10%, 1% and 0.1% Annual Exceedance Probability (AEP) events. These are Property Flooding and Road Flooding. The term Annual Exceedance Probability or 'AEP' is used to describe the probability of a flood event of this severity, or greater, occurring in any given year. A 1% AEP flood event has a 1% or 1 in a 100 chance of occurring in any given year. A 0.1% AEP flood event has a 1 in 1000 chance of occurring in any given year and a 10% AEP flood event has a 1 in 10 chance of occurring in any given year.

Table 1.1: Flood risk within the Morell Catchment

Flood Risk Receptor Group	Receptor	Risk
Social	Residential Properties.	61 residential properties are a risk from the 0.1% AEP flood event. 30 residential properties are a risk from the 1% AEP flood event. 15 residential properties are a risk from the 10% AEP flood event.
	Residential Homes (children, disabled, elderly).	None at risk within a 0.1% AEP flood event.
	Prisons, Schools (primary, post-primary, third level education), fire stations, Garda stations, civil defence, ambulance stations, hospitals, health centres, OPW buildings, government buildings, local authority buildings.	None at risk within the 0.1% AEP flood event.
	Social amenity sites.	There are no parks or open amenity spaces at risk from a 10%, 1% and 0.1% AEP flood events.
Environment	Special Area of Conservation, Special Protected Area, Groundwater Abstraction for Drinking Water, Pollution Sources, Recreational waters including bathing waters.	None at risk within the 0.1% AEP flood event.
Cultural Heritage	Architectural Heritage, National Monuments, National Heritage Area, Proposed National Heritage Area (pNHA), Sites and Monument Records, Record of Monuments and Places, UNESCO sites.	A section of the Grand Canal pNHA is at risk from a 1% and 0.1% AEP event.
Economic	Residential and Commercial Properties.	The total AAD[3] from residential and commercial properties is €4,296,094.
	ESB power stations, ESB HV substations, Bord Gáis assets, Eircom assets, Water supply, Data centres.	None at risk within a 0.1% AEP flood event.
	Road Networks, Rail Networks & Stations, Ports and Harbours.	The N7 at Castlewarden (Junction 6) is at risk from a 10%, 1% and 0.1% AEP flood event.

[3] Annual Average Damage (AAD) calculated from the Flood Risk Assessment damage assessment. The AAD is represented by the total damage occurring from all receptors in a square grid.

1.2.2.1 Property Flooding

The severity and frequency of the flood events has resulted in severe hardship for residents in approximately 60 households and five enterprises (excluding farms) in the area. Figure 1.3, derived from the Morell FAS Study, highlights the number of residential and commercial properties at risk of flooding, superimposed on the 0.1% AEP flood extents.

The hydraulic modelling undertaken as part of the Morell FAS Study demonstrated a number of contributing factors to the flooding; but the key issue is that the catchment's relatively flat topography, in conjunction with the railway and canal embankments traversing the Morell and Painestown Rivers, regularly results in extensive areas becoming inundated during flood events.

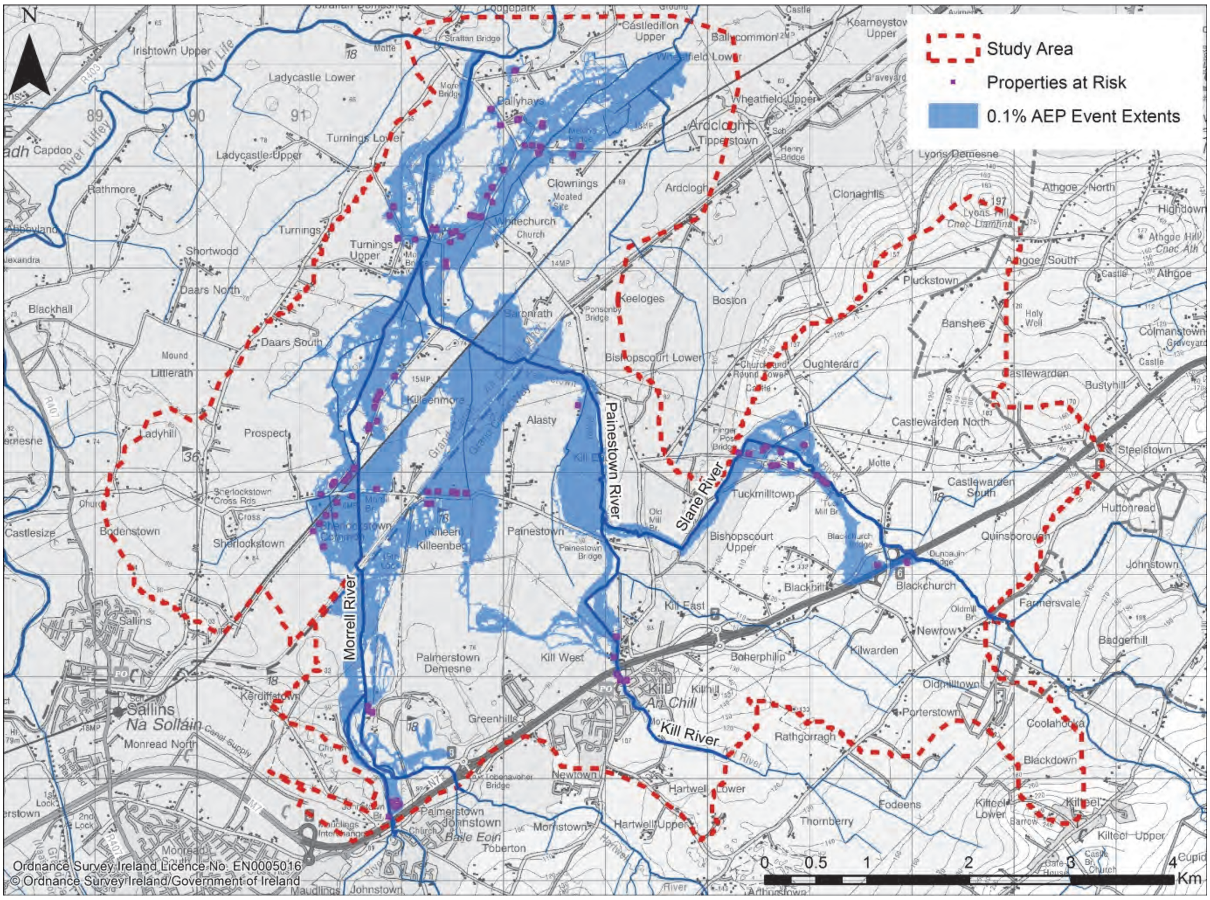


Figure 1.3: Properties at Risk of Flooding in a 0.1% AEP Flood Event

1.2.2.2 Road Flooding

The Morell, Hartwell, Kill and Slane rivers in the Morell catchment cross the N7 national roadway at four locations between Maudlins Interchange (south of Junction 9) and Junction 6 at Castlewarden. The latter of these crossings, the Slane crossing at Junction 6, poses a serious flood risk for the N7, as illustrated in Figure 1.4.

Severe and extensive flooding incidents in April 1998 were documented in the report "*Hydraulic Model & Flood Alleviation Measures"* prepared by J.B. Barry & Partners Limited in 2002 for the N7

Naas Road Interchange Scheme. At the time of the 2002 report, it was noted that the Morell river channel was under-capacity between the N7 and the canal. Substantial works were carried out to address the insufficient capacity and problematic flooding issue of the N7 by the National Roads Authority (NRA) in 2011 – 2012. This was in line with the "*Castlewarden - Flood Mitigation - Minor Works*" detailed design also completed by J.B. Barry & Partners in June 2011.

The Castlewarden minor works took place in 2012, prior to the development of the hydraulic model for the area. Due to concerns that implementing the works in full would result in an exacerbation to flooding of properties in downstream areas, not all the improvement works designed by J.B. Barry & Partners were fully implemented. As a consequence a severe flood risk remains at Castlewarden Junction 6 (shown in Figure 1.4 below). This issue highlights the importance of adopting a catchment-based approach to managing flood risk, rather than focusing resources on individual problem areas.

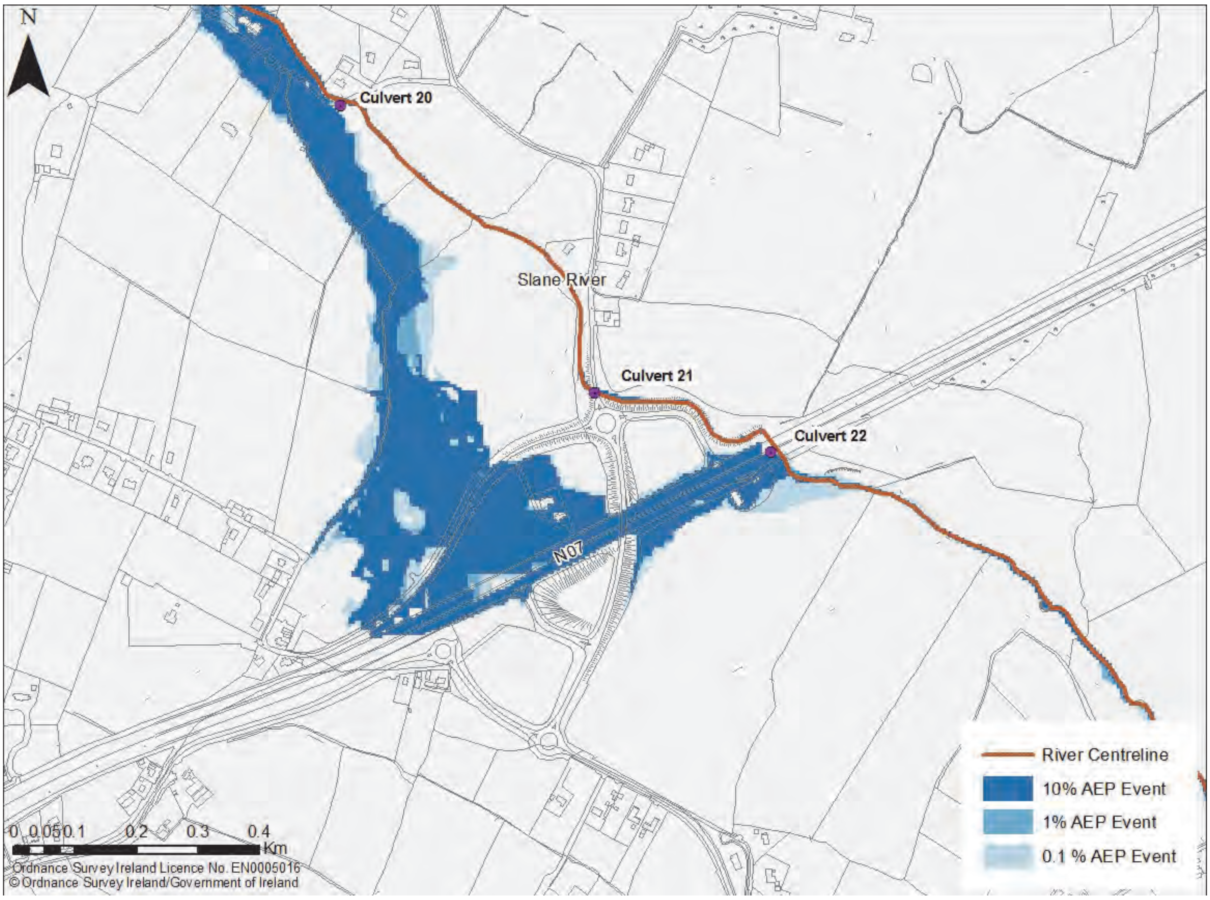


Figure 1.4: Hydraulic model analysis for N7 Junction 6 (Castlewarden)

Culvert 22 (shown above in Figure 1.4 and below in Figure 1.5) will be opened to increase the capacity at this point in the catchment, in combination with other downstream improvements. This, in turn, will alleviate concerns that the improvement works undertaken at the N7 – Castlewarden Junction 6 would exacerbate flooding of residential properties in the downstream catchment of the Turnings / Killeenmore AFA.

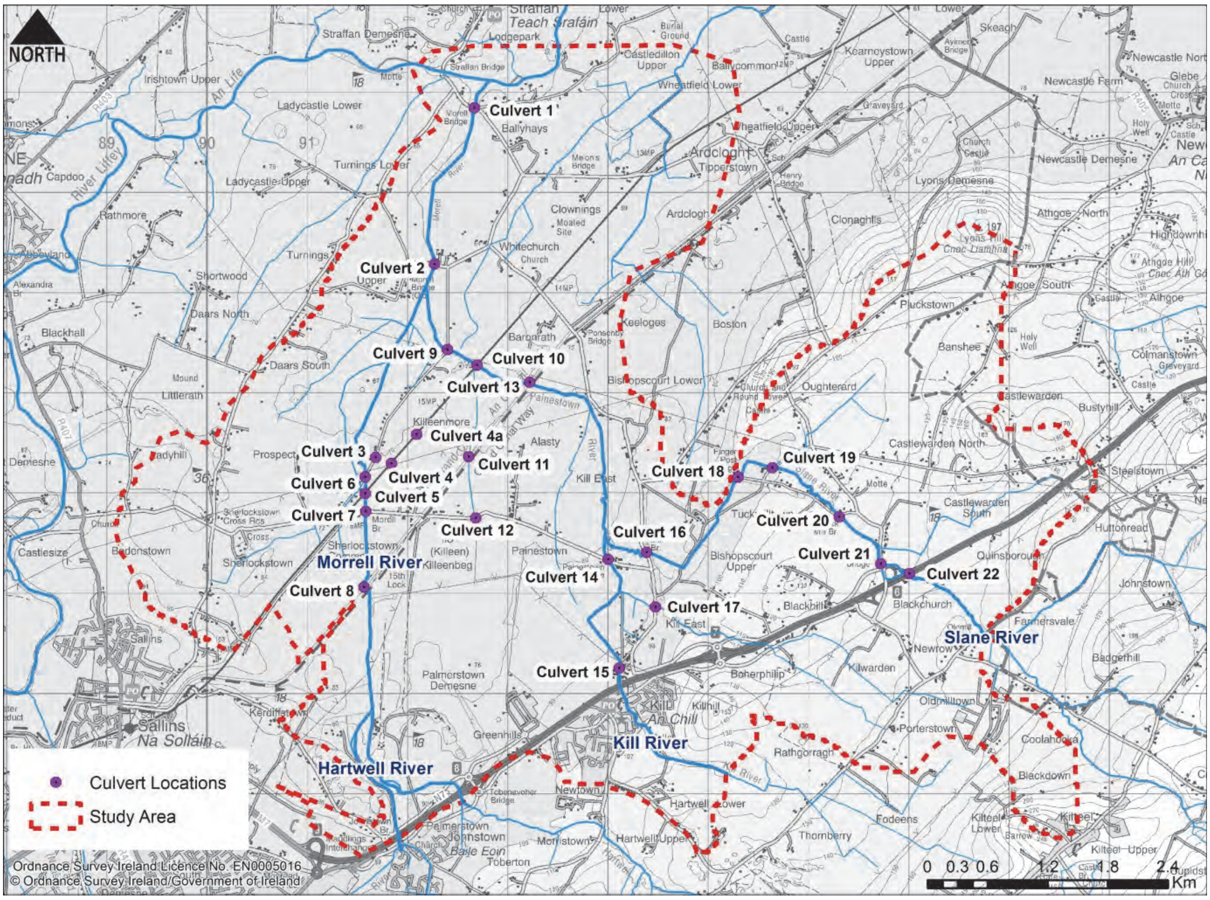


Figure 1.5: Culvert Location Map

As part of the economic risk assessment, in a Flood Risk Assessment study, a monetary damage is assigned to certain receptors at risk. This damage represents the costs to the State (calculated over the lifetime of the scheme) if the flood events being considered were to occur. In the Morell River FAS study a monetary damage value was assigned to the following three receptor groups:

- Properties:
  - Residential properties;
  - Non-residential (commercial) properties;
- Utility infrastructure, emergency services and intangibles;
- National road network (N7).

The total damage to the study area was used to quantify the economic risk and provide the amount of potential benefit that would occur if an FRM Option is put in place which would prevent the damage from occurring.

The FAS Study concluded that the overall total of the damages arising for flooding of the Lower Morell catchment, which includes the combined damages of flooding of the residential and non-residential properties, and the N7, is €20,005,648; of which €4,020,650 was from property damages and €15,984,998 from damages to the N7.

1.3 CONSIDERATION OF ALTERNATIVES

In order to deliver a project that was practicable and cost effective, several options were proposed, considered and assessed in the FAS Study. The methodology for this process is described below in sections 1.3.1 to 1.3.8.

1.3.1 General Flood Risk Management Measures

There are various measures that can be adopted to manage the flood risk within any study area. These can be grouped into four general types:

- ‘Protect’ measures - reduce the likelihood of flooding. Measures include flood walls, flow diversion and upstream storage.
- ‘Prepare’ measures - reduce the impact of flooding. Measures include individual property protection, flood forecasting and public awareness campaigns.
- ‘Prevent’ measures - avoids future flood risk. Measures include planning and development control.
- ‘Permit’ measures - accepts that flooding will occur. Measures include maintaining the existing regime and doing a minimal amount of maintenance.

The Morell FAS Study set an objective to identify viable structural and non-structural options and measures for the effective and sustainable management of flood risk within the study area. It was also an aspiration of the study to provide the highest standard of flood risk management. Generally, this would entail recommending ‘protect’ methods over ‘prepare’ methods and avoiding ‘permit’ methods where possible. ‘Prevent’ methods which consider future flood risk should always be included.

1.3.2 Standard of Protection

The standard of flood risk management is dependent on the design standard being applied, i.e. the maximum level of protection that the FRM measures provide. The current preferred design standard for development of FRM measures is the 1% AEP event for fluvial flood risk. The FRM measures achieving the design standard must also have provision for adaptability to the Mid-Range Future Scenario[4] (MRFS) flood risk, as recommended by the CFRAM process.

Where there is a clear technical, economic, social or environmental case as to why the preferred standards would not be appropriate or acceptable; or where the adoption of alternative standards would provide significant additional benefit in relation to costs and impacts, this is also considered.

1.3.3 Residual Risk

For any FRM Option, the flood risk to a study area can never be totally eliminated as a flood event greater than the design standard can occur; this is referred to as residual risk. The design standard

[4] The MRFS is a future scenario which incorporates the likely predicted changes in flood risk variables, such as increases in rainfall depth and sea level rise, in response to climate change, up to the year 2100.

for the Morell catchment is the 1% AEP event. It can therefore be assumed that despite the implementation of FRM measures there will remain a certain amount of residual damage potential for 0.5% and 0.1% AEP flood events (i.e. events with a 1 in 200 and 1 in 1,000 chance of occurring in any given year).

1.3.4 List of FRM Measures

It is required under national policy that certain non-structural FRM methods are applied regardless of other proposed measures; these include:

- Application of the "*Guidelines on the Planning System and Flood Risk Management*" (DoEHLG & OPW, November 2009);
- Preparation of emergency response plans for severe weather events, including flood events ("*A Framework for Emergency Management*" National Steering Group on Major Emergency Management, 2006).

These methods will be applied regardless of the outcome of the assessment process.

In accordance with the Eastern CFRAM study, the proposed flood risk management methods necessary at an AFA level were considered. For each AFA to be assessed the starting point was a 'long list' of flood risk management methods that could be implemented. These methods will go through an initial screening to determine their technical and economic feasibility, along with their anticipated high level environmental impacts.

Methods that are found to be technically, economically and environmentally acceptable in the preliminary screening were combined into groups of Options, which were subjected to detailed Multi-Criteria Analysis (MCA), looking at technical, economic, social and environmental criteria. The highest scoring Option was put forward into the draft FRMP as the Preferred Option.

Table 1.2 presents an extensive list of structural and non-structural FRM methods available and what flood risk management function they perform. RPS considered all of these measures in the screening process.

Table 1.2: 'Long list' of FRM Methods Considered

FRM Method	Method type	Description
Do Nothing	Permit	Implement no new flood risk management measures and abandon any existing practices.
Maintain Existing Regime	Permit	Continue any existing flood risk management practices, such as reactive maintenance.
Do Minimum	Permit	A measure that can be used as a baseline for testing other Options, as it assumes no active intervention but recognises on-going maintenance activities.

FRM Method	Method type	Description
Planning and Development Control	Prevent	Zoning of land for flood risk appropriate development, prevention of inappropriate incremental development, review of existing Local Authority policies in relation to planning and development and of inter-jurisdictional co-operation within the catchment.
Building Regulations	Prevent	Regulation relating to floor levels, flood proofing, flood resilience, sustainable drainage systems, prevention of reconstruction, or redevelopment in flood risk areas.
Catchment Wide SuDS	Prevent	Implement attenuating infrastructure to the existing drainage system in order to reduce the flow entering the river network. This may consist of swales, french drains, soak aways, larger culverts, underground storage tanks, ponds, green roofs, etc.
Land Use Management	Protect	Changing how the land is used in order to store or slow surface water runoff and slow in channel and out of bank flow along the river in order to store flood water in suitable locations. This may consist of the creation of wetlands, restoring river meanders, increasing the amount of boulders and vegetation in channel, perpendicular hedges or ditches in the floodplain, tree rows and planting in floodplain to either slow flow or direct flow, planting along banks parallel to flow, fencing off livestock from riparian strip, changing agricultural practices to decrease soil compaction and increase water infiltration.
Strategic Development Management	Prevent	Management of necessary floodplain development (proactive integration of structural measures into development designs and zoning, regulation on developer-funded communal retention, drainage and/or protection systems).
Maintenance Programme	Protect	Increased frequency of routine maintenance, targeting of problem culverts, bridges or other control structures, removal of debris and rubbish tipping, desilting of sedimentation prone areas.
Upstream Storage/Storage	Protect	Large scale dam and reservoir, offline washlands (embanked areas of floodplain to store water during larger flood events).
Tidal Barrage	Protect	A fixed or moveable barrier across the river to prevent tidal water progressing upstream.
Improvement of Channel Conveyance	Protect	Deepening of channel bed, widening of channel, realigning long section profile, removal of constraints, lining or smoothing channel.
Hard Defences	Protect	Reinforced concrete walls, earth embankments, demountable barriers.
Relocation of Properties	Protect	Abandoning flood risk area and properties within and providing alternative properties in suitable area.
Culverting	Protect	Routing the watercourse underground through culverts to prevent out of bank flooding along a specific stretch.
Diversion of Flow	Protect	Removing flow from the watercourse via a diversion and discharging to a suitable river or coastline or reintroducing the flow further downstream. This may consist of a culvert or an open channel.

FRM Method	Method type	Description
Overland Floodways	Protect	Using topographical features of the floodplain to convey out of bank flow and discharge to other suitable rivers, the coast line, further downstream on the same river or to an open area for storage. This may consist of fields, park land, roads, etc.
Sealing Manholes	Prevent	Preventing pressurised culverts from surcharging through manholes and flooding the surrounding area.
Rehabilitation of Existing Defences	Protect	Improvement of existing flood defences.
Localised Protection Works	Protect	Minor raising of existing defences/levels, infilling gaps in defences, etc.
Flood Warning/Forecasting	Prepare	Installation of flood forecasting and warning system and development of emergency flood response procedures.
Public Awareness Campaign	Prepare	Informing public who live, work or use a flood risk area on risks of flooding and how to prepare for flooding.
Individual Property Protection	Prepare	Flood protection and resilience measures such as flood gates, vent covers, use of flood resilient materials, raising electrical power points, etc.

1.3.5 Baseline Condition of Existing FRM Methods

The baseline condition of FRM methods in the Morell catchment includes some hard defences, culverts and very basic individual property protection.

The existing hard defences consist of embankments that have been built by the local landholders and previous flood management scheme in a number of fields adjacent to tributaries of Morell river system.

The existing culverts along the channel are old and in varying condition; some of the larger culverts / bridges are showing signs of disrepair, with the structural supports being undermined by scour erosion. A number of the smaller culverts are screened and require debris to be cleared. The culvert near Castlewarden at the N7 is under-capacity. Some relief works were completed in 2002, whereby box culvert sections were constructed beside a number of the older bridges in the catchment for overflow requirements. The design standard applied at the time of these works was for a 2% AEP flood event (Q50/50 year return period), in accordance with recommendations at that time.

In the past six years, Kildare County Council has undertaken some light maintenance work, specifically removing silt from the overflow culverts to restore them to full capacity, however the council has observed that the silt builds and blocks the culvert quite quickly each time after maintenance works have been completed. It should be noted that no silts or gravels have been removed from the river channel itself, in compliance with the Inland Fisheries Ireland (IFI) restrictions.

During site surveys of the catchment conducted during the FAS Study, it was evident that some existing individual property protection is provided through use of sand bags placed on the periphery of properties as a temporary barrier in flood events.

In terms of a baseline maintenance program, there is no current maintenance regime in place by Kildare County Council or the OPW for the Morell River System. Therefore, the baseline condition is such that the 'Do Nothing' measure is assumed to be equivalent to the 'Maintain Existing Regime' measure. At present any maintenance works are reactionary, and in the event of emergency works being required, i.e. as a result of severe weather events, fallen trees, large specific blockages, etc., Kildare County Council would manage such a situation on behalf of the OPW.

The baseline condition for flooding in the Morell catchment risks the inundation of approximately 60 properties and five commercial businesses (excluding farms), in addition to flooding the N7, and local roadways, fields and golf courses in the catchment. In order to provide a baseline scenario against which the proposed FRM Options can be assessed, The 'Do Nothing' scenario was proposed as Option 4 in the FAS Study. It provides a comparative function for other Options with the existing condition. The Feasibility Report's Appendix B includes detailed plan drawings which compare the existing Baseline Scenario (Option 4) for 1% AEP flood events in the catchment with the modelled flood plains for Options 1 & 2.

1.3.6 Proposed FRM Options

The FRM Options considered for the Morell River FAS Study are outlined in Table 1.3 below:

Table 1.3: Summary of FRM Options that were Assessed for the Morell FAS Study

Proposed FRM Option	Methods Included	
Option 1 Improved Conveyance / Defence	Storage adjacent to channel Localised protection works	Hard Defences Culverting
Option 2 Upstream Storage (Offline)	Retention Ponds Culverting	Hard Defences Localised protection works
Option 3 Full Channel Conveyance	Hard Defences	Culverting
Option 4 'Do Nothing'	-	-

A brief description of what each FRM Option would encompass is included below in sections 1.3.6.1 to 1.3.6.4.

1.3.6.1 FRM Option 1

Option 1 proposes to address the flood risk in the Morell river catchment by combining several FRM methods. The existing storage adjacent to the river would be controlled using hard defences, including retaining walls and embankments, which would be constructed at the top of banks and parallel to the river channel to protect vulnerable areas. This would provide natural flood management and natural habitats in designated green field sites which include some existing retention storage areas in the baseline floodplain. In certain areas the hard defences would be designed to convey up to 5% AEP flood events, but in more severe flood events retention storage would be utilised within the existing (baseline) floodplain. The storage adjacent to the river channel, and green field retention storage within the existing (baseline) flood extents, would not increase peak flows significantly at the confluence with the River Liffey, as flood waters will recede slowly after the rainfall event.

Localised protection works would also be employed in some areas, using hard defences to protect properties with flood risk in a 1% AEP event; these would protect clusters of properties and have been identified by assessing flow paths indicated in the hydraulic model. In total, it was estimated that around 6.5 km of hard defences would be required for Option 1.

Option 1 also proposes the upgrade of existing culverts to improve channel conveyance of the 1% AEP flows. This would include increasing the capacity of the culvert conveying the Slane River under the N7 at Junction 6 Castlewarden exit, and improvement works on culverts at various other locations including the Dublin-Cork Railway crossings.

1.3.6.2 FRM Option 2

Option 2 proposes to create offline retention storage for all major tributaries of the Morell river system, including the Slane, Kill, Hartwell, Haynestown, and Morell Rivers, to reduce the flood risk to the downstream areas in the Morell catchment. The tributaries originate in the foothills of the Wicklow Mountains, flowing north-east towards the N7. The retention storage areas, to be created offline, adjacent to each of the tributaries, would be designed to throttle the 1% AEP peak flow to 50% AEP (Q100 back to Q2). For the Haynestown and Morell Rivers, the retention storage would be located south of Kill and Johnstown respectively. The storage volume is calculated for the 1% AEP and the proposed area is calculated in hectares at 1m depth. Earth embankments from the excavated storage areas would be created with adequate freeboard to prevent overtopping and maintain flood water within the storage area, protecting nearby roads and properties, before releasing the flood water in a controlled manner during and after the rainfall event. Each retention pond would have an overflow weir that would divert flows from flood events greater than the 1% AEP back to the river tributary. This Option would require major land acquisition to provide for the upstream retention storage areas, and significant landholder liaison. The retention ponds would require engineered embankments to retain the water as the topography does not lend itself to providing this naturally.

Hard defences and localised protection works would also be required in certain areas along the tributaries upstream of the N7. In addition, the Morell and Painestown rivers downstream of the N7 would require some protection works in order to alleviate flooding of properties in a 1% AEP flood event, due to the localised rainfall within the lower catchment. These works would consist of embankments, flood walls and box-gabion scour defences. In total, approximately 3.3km of hard defences would be required in total for Option 2. This quantity is in addition to the engineered works required to create the upstream storage areas.

Option 2 also proposes the upgrade of existing culverts to improve channel conveyance of the 1% AEP flows. This would include increasing the capacity of the culvert conveying the Slane River under the N7 at Junction 6 Castlewarden exit, and improvement works on culverts at various other locations including the Dublin-Cork Railway crossings.

1.3.6.3 FRM Option 3

Option 3 proposes an extensive series of hard defences, including flood walls and embankments, which would be used to convey all 1% AEP flood flows from the Morell river system to the River

Liffey, to protect properties and avoid flooding local roads, fields, the Grand Canal embankments and the Dublin-Cork Railway crossings.

To alleviate flooding in the downstream Morell catchment, upgrades would be made to all existing culverts to allow full conveyance of the 1% AEP flows. This would include increasing the capacity of the culvert for the Slane River under the N7 at Junction 6 Castlewarden exit, upgrading and upsizing culverts under the railway and canal embankments, and upgrading and increasing capacity at all other culverts to convey 1% AEP flows to the Liffey. This Option eliminates all flooding in the downstream Morell catchment floodplain for a 1% AEP flood event, providing protection to all properties in the lower catchment, the N7, agricultural lands, the Grand Canal embankments and the Dublin-Cork Railway line. In total, approximately 35.3km of hard defences would be required for Option 3.

1.3.6.4 FRM Option 4

This Option is to 'Do Nothing', which is equivalent to the 'Maintain the Existing Regime' and 'Do Minimum' scenarios, as at present Kildare County Council and the OPW have no formal maintenance regime for the Morell River system. Option 4 has been used to provide a baseline scenario to enable a comparative analysis against which the benefits of the preferred Option will be established.

1.3.7 Assessment of Proposed FRM Options

1.3.7.1 Further Feasibility Analysis of Potential FRM Options

As a preliminary assessment, prior to progression to the full Multi-Criteria Analysis (MCA), the three potential Options (excluding the Option 4 – 'Do Nothing' scenario) were further analysed to ensure they were technically, socially, environmentally and economically feasible.

It was concluded that Option 1 and Option 2 both met the minimum required objectives, which were to ensure that the N7 and all properties are protected in a 1% AEP event with no residual property damage.

In each of Options 1 and 2 there are some residual damages that may occur within the catchment in the less frequent flood events (1% - 0.1% AEP flood events). For both Option 1 and Option 2 the areas that may experience residual flooding in a 1% AEP are rural fields which provide natural retention areas for the 1% AEP peak flows. In both of these Options it is proposed to construct flood defences adjacent to the river bank to contain flows up to 5% AEP (20yr return event), but in flood events of greater magnitude some of the surrounding green field rural areas will provide retention storage and experience residual flooding. Option 2 provides upstream retention storage which would reduce flows in a 1% AEP (Q100, 100 yr. return event) flood event back to a 50% AEP flow (Q2, 2yr return event) where the storage ponds are sited along each of the Morell tributaries upstream of the N7. This Option would require large tracts of land upstream of the N7, but would require less flood defences and result in slightly less natural residual flooding in the lower catchment.

In reviewing the hydraulic model for the River Liffey from the CFRAM study, it was concluded that Option 3 (full flow conveyance of the Morell river system channelled to the River Liffey) could not be progressed as a feasible Option. The peak flow in the River Liffey in a 1% AEP flood event at the point of confluence with the Morell River is estimated to be 145m^3/s. The hydraulic model for the Option 3 scenario showed that the peak flow in the Morell River at the point of confluence with the

River Liffey increased from 28 m³/s in the existing scenario to 73m³/s for the 1% AEP event. The 45 m³/s increase in flow rate would result in the total peak flow in a 1% AEP event from the Morell River being greater than 50% of the River Liffey peak flow at the point of confluence. This significant peak flow increase was unacceptable, as it would create a substantial increase in flood risk to the downstream catchment of the River Liffey, particularly at Celbridge, and would have significant socio-economic and technical consequences. For this reason, Option 3 was ruled out of any further Options assessment.

1.3.7.2 FRM Options Assessment Criteria

The FRM Option 1 and Option 2 that progressed to this stage were both found to be technically, socially, environmentally and economically feasible. In order to select the overall preferred Option for the Morell catchment, each Option was considered against a range of criteria and objectives to determine the optimum solution. As part of this process, the Option 4 – 'Do Nothing' provided a scenario against which the technical, social, environmental and economic feasibility could be compared. The comparative analysis was undertaken by scoring each Option against the following three criteria to provide an overall score for each:

- Economic Benefit Cost Ratio (BCR) - The ratio between the monetary benefit of adopting a FRM Option and the overall cost of constructing, operating and maintaining the Option. A ratio of one or greater must be achieved for an Option to be considered further.
- MCA Benefit Score - The sum weighted score of all of the objectives set in the MCA. This score represents the non-monetary benefit of adopting the FRM Option.
- Overall Net MCA BCR - This is a ratio between the non-monetary benefit of adopting a FRM Option and the overall cost of constructing, operating and maintaining the Option.

1.3.7.3 Economic Review of proposed FRM Options

A further economic review was carried out to ensure that a BCR of greater than 0.5 was still being achieved as it was possible that combining FRM measures could lead to an excessively costly Option being created that was unlikely to be cost beneficial.

To quantify the FRM Options, the individual rates for the FRM measures were applied and summated for each Option, and additional costs were included to those specific for construction to give a more accurate estimate of the overall cost of the Option. Costing of the individual FRM measures in an Option was carried out by hydraulic modelling and using the GIS software ESRI ArcMap to provide wall lengths and heights, lengths of culvert, volume of embankments, etc. The location and extent of FRM measures was delineated in GIS using detailed background mapping supplied by OSI, having consideration to the flood risk receptors. Once finalised, the design standard 1% AEP flood event was simulated in a hydraulic model, with the FRM measures for each FRM Option in place. The heights required to achieve the required standard of protection were calculated, and the construction rates applied to estimate the cost.

Costs additional to those for construction were included in the cost calculations, to give a complete estimate of the overall expenditure necessary for the Options. These calculations were based on standard methodological approach for "*Economic Damage and benefit Calculation and Cost-Benefit Analysis*" (Guidance Note No. 27) produced by the OPW in 2013. The costing includes items such as maintenance costs, detailed design and construction supervision, land acquisition/compensation, environmental monitoring / mitigation and other contingencies. Full information on the economic review is presented in the Feasibility Study Report (Appendix A in Volume 3 of the EIAR).

1.3.7.4 Estimation of BCR Ratio

Costs for the two potential Options remaining were calculated and compared to the damage avoided from the existing baseline condition (Option 4 – 'Do Nothing') to determine the BCR Ratio. The results of this exercise are summarised in Table 1.4 below:

Table 1.4: Economic Review of Potential FRM Options

Option	Description	Benefit	Whole Life Cost	BCR*
1	Improved Channel Conveyance	€20,005,648	€11,659,156	1.72
2	Upstream Storage (Offline)	€20,005,648	€89,265,507	0.22

*BCR is the ratio between the benefit and the whole life cost of each Option

1.3.7.5 The Multi-Criteria Analysis (MCA)

The assessment of FRM Options has, in the past, been primarily based on economic costs and benefits, with an EIA subsequently undertaken to minimise negative impacts on the environment, and public consultation undertaken to ensure social acceptability.

In response to the National Flood Policy Review (2004) and 'Floods' Directive, the OPW, as part of the national CFRAM programme, produced Guidance Note No. 28; "*Option Appraisal and Multi-Criteria Analysis Framework*" (2013) which sets out a standard methodological approach for MCA of FRM Options.

The MCA framework has been developed to broaden the range of potential impacts associated with flooding, the implementation of FRM Options considered in the development and selection of FRM Options / strategies, and their subsequent prioritisation. It is based on the numeric, but non-monetarised, assessment of Options against a range of objectives. Indicators are used to assign scores for each objective on the basis of the degree to which the Option being appraised goes beyond a specified basic requirement for that objective towards meeting a specified aspirational target for that objective.

Weightings are applied globally for each objective, with local weightings applied to reflect the local importance of that objective, and these weightings are applied to the scores derived as described above.

The sums of the weighted scores, set against the total costs of their achievement, represent the preference for a given Option (using all criteria) or the net benefits of an Option (using only the economic, social and environmental criteria). These total scores can be used to inform the decision on the selection of (a) preferred Option(s) for a given location and the prioritisation of potential schemes between locations.

Table 1.5 lists the criteria, objectives and sub-objectives used to undertake the MCA for the Morell catchment FRM Options 1 and 2. A full description of the MCA is found in section 6.3.5 to 6.3.9 of the Feasibility Report included in Appendix A (in Volume 3 of this EIAR).

Table 1.5: Criteria and Objectives of the MCA

Criteria		Objective		Sub-Objective	
1	Technical	a	Ensure flood risk management Options are operationally robust	i)	Ensure flood risk management Options are operationally robust
		b	Minimise health and safety risks associated with the construction and operation of flood risk management Options	i)	Minimise health and safety risks associated with the construction and operation of flood risk management Options
		c	Ensure flood risk management Options are adaptable to future flood risk	i)	Ensure flood risk management Options are adaptable to future flood risk i.e. can be managed effectively and sustainably into the future
2	Economic	a	Minimise economic risk / reduce economic damages	i)	Minimise economic risk / reduce economic damages
		b	Minimise risk to transport infrastructure	i)	Minimise risk to transport infrastructure
		c	Minimise risk to utility infrastructure	i)	Minimise risk to utility infrastructure
		d	Minimise risk to agriculture	i)	Minimise risk to agriculture
3	Social	a	Minimise risk to human health and life	i)	Minimise risk to human health and life - residents
				ii)	Minimise risk to human health and life - high vulnerability properties
		b	Minimise risk to community	i)	Minimise risk to community - social infrastructure
				ii)	Minimise risk to community - local employment
		c	Minimise risk to, and where possible enhance, social amenity sites	i)	Minimise risk to, and where possible enhance, social amenity sites
4	Environmental	a	Support the objectives of the WFD	i)	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives
		b	Support the objectives of the Habitats and Birds Directives	i)	Avoid detrimental effects to, and where possible enhance, European sites, protected species and their key habitats, recognising relevant landscape features and corridors
		c	Avoid damage to, and where possible enhance, the flora and fauna of the catchment	i)	Avoid damage to or loss of, and where possible enhance, legally protected sites / habitats of national, regional and local nature conservation importance
		d	Protect, and where possible enhance, fisheries resource within the catchment	i)	Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species
		e	Protect, and where possible enhance, landscape character and visual amenity within the zone of influence	i)	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the zone of influence
		f	Avoid damage to or loss of features of cultural heritage importance and their setting, and improve their protection from extreme floods	i)	Avoid damage to or loss of features of architectural value and their setting, and improve their protection from extreme floods where this is beneficial
				ii)	Avoid damage to or loss of features of archaeological value and their setting, and improve their protection from extreme floods where it is beneficial

1.3.7.6 Summary of MCA Scores of potential FRM Options

Table 1.6 summarises the results of the MCA on the two FRM Options using the methodology set out above in 1.3.7.5.

Table 1.6: FRM Options MCA score breakdown

Criteria	Option 1	Option 2
Technical score	1,200	900
Economic score	1,066	1,106
Social score	880	880
Environmental score	-240	-210
Overall score	**2,906**	**2,676**

1.3.8 Selection of Preferred Option

The economic review and the MCA both presented a clear conclusion that Option 1, the combination of improved conveyance and hard defences, was more economically viable and technically robust than Option 2, upstream storage and hard defences. For both Options, the potential environmental impacts were judged to be broadly equivalent, although Option 2 achieved a slightly better score for environment in the MCA.

Option 1 was consequently taken forward by Kildare County Council for further development and design by RPS and the OPW.

1.3.9 Refinement of Preferred Option

As discussed in Chapter 2, 'Consultations', the Feasibility Stage Option was put to consultation as part of the FAS Study in 2013-2014. Elected member briefings were held on 12th November 2013 and 2nd October 2014. A Public Consultation Day was held on 23rd October 2014 and correspondence with key statutory and non-statutory stakeholders was carried out throughout this period. Consultations in respect of the EIA for the scheme began in June 2015 and these are also discussed in more detail in Chapter 2.

Landowner liaison was an integral part of the development of the final flood management scheme. Approximately 40 individual meetings with landowners were held throughout the design phase to address affected landowners concerns and where possible incorporate them into the scheme. Improvements to the Option design were made through refinements in the hydraulic model to improve its accuracy at the site specific scale. Following a technical review of the feasibility stage scheme by the OPW in 2016, a reassessment of the flow paths underneath the Cork-Dublin railway line was carried out, as concerns had been raised about the increase in water levels on the southern side of the railway, which it was felt could have long term impacts on its structural stability.

As a result of the consultations and following feedback from the OPW's technical review, the original Feasibility Stage Option design evolved and was improved from that originally presented in the Morell Flood Management Scheme Feasibility Report. The *Morell River Flood Management Scheme Preliminary Design Report* (RPS, 2017), included in this EIAR as Appendix K, gives a full account of the refinements that have been made to the original Feasibility Stage Option design.

The principal modification to the scheme design over the Feasibility Study Option is the inclusion of a flood defence upstream of the railway line at any location where the scheme would cause an increase in flood levels upstream of the railway.

Design changes were assessed with the entire scheme in mind, to ensure that the core requirement of the scheme to protect properties was not compromised. The Preliminary Design Report verifies that there is a negligible increase in risk to areas to either upstream or downstream as a result of the changes to defences since the Feasibility stage.

The design being submitted for planning consent and which has been assessed within the EIA includes changes to embankment locations following landowner and stakeholder consultation to incorporate landowner requirements where possible, without being detrimental to the scheme. The changes to the scheme have been largely instigated by the following factors:

- Updating of the hydraulic model to account for an additional stream identified during public consultation;
- Review of embankment location and footprint following landowner liaison; and
- Concern that that the canalisation of the Morell River was causing flood levels to rise on the southern side of the Dublin-Cork railway line.

A public information day took place on 1st February 2017 in Killeen Golf Club to inform the public of the status of the current scheme design. The scheme design is discussed in more detail in Chapter 4.

1.4 PLANNING LEGISLATION AND POLICY

This section sets out current EU, national, regional and where relevant, local policy and legislation relating to flood management, its place within the planning and development system and how the Morell River Flood Management Scheme is considered in the context of this policy and legislation.

1.4.1 EU Legislation

In 2002 the European Commission (EC) recognised that flood events have the potential to undermine the EU's drive towards sustainable development and that the risk of flooding was on the increase. In response to severe flooding experienced along the Danube and Elbe Rivers in 2002, the Commission took the initiative to launch concerted action at Community level to help reduce the severity of flood events and the damage caused by these floods. A European Flood Action Programme was developed and in 2007 the EC implemented Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the Assessment and Management of Flood Risks or EU Flood Directive (2007/60/EC).

The overall aim of the Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. It also has the purpose of establishing a framework for the assessment and management of flood risks. The Directive has specific requirements which each member state must implement. These include the following:

- A Preliminary Flood Risk Assessment (PFRA), to be completed by the end of 2011, that shall identify areas of potentially significant flood risk based on available or readily-derivable information;
- The production of flood hazard and risk maps for the areas identified under the PFRA; and
- The preparation of Flood Risk Management Plans (FRMPs) at a catchment or river basin scale, setting out measures aimed at achieving objectives for the management of flood risks within the areas identified under the PFRA.

The Directive requires that the above is undertaken in a coordinated manner with the implementation of the Water Framework Directive [2000/60/EC] to promote integrated river basin management. The Directive further requires that the active involvement of the public and stakeholders be encouraged, and that the above requirements are made readily available to the public.

1.4.2 National Legislation, Policy and Guidelines

The EU Flood Directive (2007/60/EC) was transposed into Irish law through the European Communities (Assessment and Management of Flood Risks) Regulations 2010 (S.I. No. 122 of 2010, as amended by S.I. No 495 of 2015). The Regulations appoint the Commissioners of Public Works in Ireland as the Competent Authority under the Directive, reinforcing the Lead Agency role the OPW was given in 2004 under the National Flood Policy. The Regulations also identify roles for other organisations, such as the Local Authorities, Waterways Ireland, ESB and Irish Water, to undertake certain duties with respect to flood risk within their existing areas of responsibility.

1.4.2.1 Arterial Drainage Act, 1945 & Arterial Drainage (Amendment) Act 1995

The Browne Commission (Report of The Drainage Commission 1938-1940), which examined flooding and improvement of land through drainage, commenced its deliberations in 1938 and resulted in the development of the Arterial Drainage Act, 1945. This is the primary piece of legislation under which the OPW have operated for the last 50 years, and it empowers the OPW to undertake catchment-wide arterial drainage schemes to reduce flooding. The Act is described as:

"*An Act to make provision for the drainage and improvement of land by the execution of works of arterial drainage, to provide for the maintenance of those works and make further and better provision for the maintenance of existing drainage works, and to provide for matters incidental to or connected with the matter aforesaid or relating generally to the drainage of land*".

The emphasis of the 1945 Act was on the improvement of agricultural land. Following severe flooding of a number of towns in the mid to late 1980s and early 1990s, the Act was amended in 1995 by the Arterial Drainage (Amendment) Act 1995, when the emphasis of flood management activity shifted to the protection of urban areas subject to flooding. This amendment empowered the OPW to undertake localised flood relief schemes to protect and reduce flood risk in individual urban areas.

Under the Arterial Drainage Act, 1945 the OPW undertook a number of arterial drainage schemes to improve land for agricultural production. The OPW has a statutory duty to maintain these schemes, which is delivered through their arterial drainage maintenance programme. The OPW does not have powers to undertake river or channel maintenance other than where these rivers form part of an arterial drainage scheme or flood relief schemes.

1.4.2.2 Flood Policy Review

In September 2004, the Irish Government approved the *Flood Policy Review - Final Report* (OPW, 2004) which was published by the Flood Policy Review Group in 2004**.** It sets out the National Policy on Flooding as follows:

"…to minimise the national level of flood risk to people, businesses, infrastructure and the environment, through the identification and management of existing, and particularly potential future, flood risks in an integrated, proactive and catchment-based manner".

This Report also presents the possible causes, extents and impacts of flooding, responsible bodies, future policy proposals and resource requirements for same. Amongst other things, the report sets out the determining factors when considering the implementation of a flood relief scheme as follows:

- The scheme must be technically feasible;
- The scheme must generally be cost beneficial (a cost benefit analysis is undertaken to determine the economic merits of the project); and
- The scheme must also be environmentally compatible (an EIA is normally undertaken for each scheme and the scheme must satisfy the requirements of the EIAR.)

1.4.2.3 Planning System and Flood Risk Management – Guidelines for Local Authorities

In November 2009, the OPW in association with the Department of Environment, Heritage and Local Government[5] (DEHLG) published "*Planning System and Flood Risk Management – Guidelines for Local Authorities*" (Government of Ireland, 2009). The core objectives of these guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management.

The Guidelines recommend that Flood Risk Assessments (FRA) be carried out to identify the risk of flooding to land, property and people. FRAs should be carried out at different scales by government organisations, local authorities and for proposed developments appropriate to the level of information required to implement the core objectives of the Guidelines.

[5] Since 2016 known as the Department of Housing, Planning, Community and Local Government

The OPW has developed a national CFRAM Programme (discussed in section 0) which lies at the core of the assessment of flood risk and the long-term planning of the flood risk management measures throughout the country, including capital structural and non-structural measures.

1.4.2.1 National Spatial Strategy 2002 - 2020 (NSS)

The NSS sets out a twenty year planning framework. It aims to achieve a better balance of social, economic and physical development across Ireland, supported by more effective planning. In order to drive development in the regions, the NSS proposes that areas of sufficient scale and critical mass will be built up through a network of gateways and hubs. It's about people, places and potential and making the most of our cities, towns and rural places to bring a better spread of opportunities, better quality of life and better places to live in. Sustainability is placed at the centre of this plan.

The NSS recgonises the importance of our natural resources including water resources of high quality, in our rivers and lakes, in groundwater and off shore. The NSS considers that strategic planning and sustainable development will, among other things, require minimising the consumption of non-renewable resources like soils, groundwater, agricultural land and avoiding adverse impacts on environmental features such as river catchments.

A review of the NSS commenced in December 2015. The NSS is due to be updated and replaced by the National Planning Framework (NPF). A Roadmap for the delivery of the National Planning Framework 2016, published in December 2015, outlined the process and timeline for the delivery of the NPF. Pending completion and adoption of the National Planning Framework (referred to in Section 1.4.2.2 below) national planning police is defined by the NSS.

1.4.2.2 Ireland 2040 Our Plan National Planning Framework

The National Planning Framework (NPF) - "Ireland 2040 – Our Plan" - will set a new strategic planning and development context for Ireland and all of its regions between now and 2040, setting a strategic, high-level framework for the co-ordination of a range of national, regional and local authority policies and activities, planning and investment.

The NPF is a long term plan which will shape spatial, social and economic policy in Ireland for the coming decades. Preparation of the NPF has commenced and it is anticipated at present that it will be adopted in Q3, 2017.

Consultation papers were published on 2nd February 2017 for citizens, stakeholder organisations, public bodies or anyone with an interest in Ireland's future and willing to share their ideas, to inform and engage in creating the NPF. The purpose of the consultation paper is to set out the main issues and possible choices for the development of Ireland over the next twenty years or more, up to 2040. The issues paper sets out general principles including the importance of sustainable development and the need to protect our waterways. The NPF Issues and Choices paper notes that environmental challenges arising from climate change such as flooding will be important considerations. The consultation period will be followed by a series of regional events and communications activities which will support the development of NPF's preparation process during the course of 2017.

The NPF Issues and Choices paper recognises that the planning system has influence across a wide range of sectors, both directly and indirectly, and interacts with many common issues related to effective flood risk planning and emphasises a holistic approach including green infrastructure to develop flood protection.

A Strategic Environmental Assessment Scoping Report for the NPF has been prepared. The Scoping Report notes that as part of the environmental appraisal informing the NPF, a Strategic Flood Risk Assessment (SFRA) shall be undertaken. The SFRA will provide an assessment of all types of flood risk within a national context to assist the Department of Housing, Planning, Community and Local Government to make informed strategic planning decisions in respect of the NPF.

1.4.2.3 Building on Recovery: Infrastructure and Capital Investment 2016-2021

The *Building on Recovery: Infrastructure and Capital Investment* outlines the Government's €42 billion framework for infrastructure investment in Ireland over the period 2016 to 2021.

The 'Environment' is recognised as one of the key sectors with long term public investment requirements. Within this sector, flood prevention to mitigate the impact of climate change is identified. It is noted that in the period 2016 – 2021 €430m shall fund a new Flood Risk Management programme by the Office of Public Works which shall seek to systematically identify and mitigate the risk of flooding across the country.

1.4.3 Regional Policy

1.4.3.1 Regional Planning Guidelines for the Greater Dublin Area 2010-2022 (RPGs)

The RPGs seek to direct the future growth of the Greater Dublin Area Region over the medium to long term and aims to implement the strategic planning framework set out in the NSS.

The RPGs outline the need, particularly due to climate change, to address flooding and the preparation of CFRAMs is noted. The guiding principles of avoiding risk, substituting less vulnerable uses where avoidance is not possible and the mitigation and management of the risk where avoidance and substitution are not possible are outlined.

The RPGs' policies and recommendations for regional flood risk management advise that flood risk be managed pro-actively at all stages in the planning process, avoiding development in flood risk areas where possible and by reducing the risks of flooding to and from existing and future development.

The RPGs set out policies for Local Authorities with regard to avoiding risk, through prudent land use zoning and appropriate flood protection, including:

"Strategic Recommendation FR1 - New development should be avoided in areas at risk of flooding. Alongside this, the Regional Flood Risk Appraisal recognises the need for continuing investment and development within the urban centres of flood vulnerable designated growth towns and the City and for this to take place in tandem with the completion of CFRAM Studies and investment in comprehensive flood protection and management."

The need to ensure alignment between the core objectives of the Water Framework Directive, (including River Basin Management Plans and POMS affecting the Greater Dublin Area) and other related plans such as County Development Plans, Local Area Plans and Flood Management Plans is also set out in the RPGs.

1.4.4 Local Planning Context

1.4.4.1 Kildare County Development Plan 2017 – 2023 (CDP)

The Kildare County Development Plan 2017 – 2023 was adopted on 1st February 2017. It came into effect on 1st March 2017.

The CDP seeks to avoid inappropriate development in areas at risk of flooding, to ensure new development does not increase flood risk elsewhere and to ensure flood risk management is incorporated into the preparation of statutory Local Area Plans.

The CDP also seeks to ensure the implementation of any flood protection or alleviation scheme is in accordance with the RPGs, the *Planning System and Flood Risk Management – Guidelines for Local Authorities* (2009) and other pertinent policy.

An objective of the CDP is that Kildare County Council work with the OPW in preparing Catchment Based Flood Risk Assessment and Management Programme and associated Flood Management Plans. This is set out in SW3:

"SW 3 *To support and co-operate with the Office of Public Works (OPW) in delivering the Catchment Based Flood Risk Assessment and Management Programme in particular the Eastern and South Eastern CFRAM studies and associated Flood Management Plans (FRMP). The recommendations and outputs arising from these studies shall be incorporated in preparing plans and assessing development proposals.*"

The delivery of surface water / flood alleviation works on the Morell River is a specific objective of the CDP (and was also a specific objective of the previous CDP, 2011-2017):

"SW 19 *To liaise with the Office of Public Works (OPW) in delivering flood management and alleviation programmes to include, but not limited to, the following:*
Morrell River Flood Management Scheme."

Table 1.7 overleaf summarises the policy and legislation presented in this section and relates it directly to the Morell River Flood Management Scheme.

Table 1.7: Policy and Legislative Relative to Morell River Flood Alleviation Scheme

Policy / Legislation	Requirement / Objectives	Proposed Scheme
EU Policy		
Directive 2007/60/EC on the Assessment and Management of Flood Risks	▪ Aim is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. ▪ Establish a framework for the assessment and management of flood risks.	The proposed scheme is compatible with the requirements of the Directive and with Ireland's requirement to comply with it.
European Communities (Assessment and Management of Flood Risks) Regulations 2010 (S.I. No. 122 of 2010)	Integrates and enforces the (EU Flood Directive) (2007/60/EC) into Irish legislation.	The proposed scheme is compatible with the requirements of the Regulations
National Policy		
Arterial Drainage Act 1945, and 1995 amendments	▪ The 1945 Act empowered the OPW to undertake catchment-wide arterial drainage schemes, and to maintain all of these schemes in "*proper repair and effective condition*". ▪ The 1995 amendment empowers OPW to undertake localised flood relief schemes to protect and reduce flood risk in individual urban areas.	The proposed scheme is compatible with the requirements of the Arterial Drainage Act.
Flood Policy Review Group in 2004 - Flood Policy Review-Final Report	National Policy on flooding states: *"to minimise the national level of flood risk to people, businesses, infrastructure and the environment, through the identification and management of existing, and particularly potential future, flood risks in an integrated, proactive and catchment-based manner"*. In determining if a flood relief scheme is to be implemented the regard must be had to the following broad criteria: a) The scheme must be technically feasible; b) The scheme must generally be cost beneficial (a cost benefit analysis is undertaken to determine the economic merits of the project); and c) The scheme must also be environmentally compatible (an Environmental Impact Study is normally undertaken for each scheme and the scheme must satisfy the requirements of the EIAR).	The proposed scheme is compatible with the criteria set out in the Flood Policy Review, as it will reduce the risk of flooding and has been subject to technical, economic and environmental appraisal.
Catchment Flood Risk Assessment and Management (CFRAM) Programme	The Programme delivers on core components of the National Flood Policy, adopted in 2004, and on the requirements of the EU Floods Directive.	The proposed scheme will take the CFRAM Programme into consideration in its implementation.
Planning System and Flood Risk Management – Guidelines for Local Authorities, 2009	The core objectives of the Guidelines are to: ▪ Avoid inappropriate development in areas at risk of flooding; ▪ Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off; ▪ Ensure effective management of residual risks for development permitted in floodplains; ▪ Avoid unnecessary restriction of national, regional or local economic and social growth; ▪ Improve the understanding of flood risk among relevant stakeholders; and ▪ Ensure that the requirements of EU and national law in relation to the natural environment and nature	The proposed scheme will take full consideration of these Guidelines through proper design, layout and environmental assessment.

Policy / Legislation	Requirement / Objectives	Proposed Scheme
	conservation are complied with at all stages of flood risk management.	
Building on Recovery: Infrastructure and Capital Investment 2016-2021	Progress a Flood Risk Management programme by the Office of Public Works which shall seek to systematically identify and mitigate the risk of flooding across the country.	The proposed scheme is compatible with the Infrastructure and Capital Investment 2016-2021 as it addresses an identified flood risk.
National Spatial Strategy 2002 - 2020	The NSS requires that strategic planning and sustainable development, while supporting economic development, will minimise the consumption of non-renewable resources like soils, groundwater and agricultural land and avoiding adverse impacts on environmental features such as river catchments.	The proposed scheme is compatible with the requirement of the *National Spatial Strategy* in seeking to safeguard social infrastructure and delivering an engineered solution balancing environmental, economic and social dimensions.
National Planning Framework Issues and Choices Paper	The *NPF Issues and Choices Paper* recognises that the planning system has influence across a wide range of sectors, both directly and indirectly, and interacts with many common issues related to effective flood risk planning and emphasises a holistic approach including green infrastructure to develop flood protection.	The proposed scheme is compatible with the general principles outlined in the *National Planning Framework Issues and Choices Paper*.
Regional Policy		
Regional Planning Guidelines for the Greater Dublin Area 2010 - 2022	The RPGs' policies and recommendations for regional flood risk management advise that flood risk be managed pro-actively at all stages in the planning process avoiding development in flood risk areas where possible and by reducing the risks of flooding to and from existing and future development. The RPGs also support investment in comprehensive flood protection and management.	The proposed scheme protects and manages flooding and is compatible with the requirement of the *RPG for the Greater Dublin Area 2010 – 2022.*
Local Policy		
Kildare County Development Plan 2017 – 2023	The CDP seeks to avoid inappropriate development in areas at risk of flooding, to ensure new development does not increase flood risk elsewhere and to ensure flood risk management is incorporated into the preparation of statutory Local Area Plans. The CDP includes a specific objective for the Council to liaise with the OPW in delivering the Morell River Flood Management Scheme.	The proposed scheme directly addresses the CDP objective pertaining to delivery of the Morell River Flood Management Scheme.

1.5 EIA

Directive 2014/52/EU of the European Parliament and of the Council of 16th April 2014 amends the Directive 2011/92/EU of the European Parliament and of the Council of 13th December 2011 on the assessment of the effects of certain public and private projects on the environment.

At the time of writing, the necessary legislation to transpose the Directive into Irish law has not yet been adopted. Notwithstanding this, the provisions of the new Directive may be deemed to apply from 16th May 2017.

Directive 2014/52/EU of 16th April 2014 amends Directive 2011/92/EU in order to strengthen the quality of the environmental impact assessment procedure, align that procedure with the principles of smart regulation and enhance coherence and synergies with other Union legislation and policies, as well as strategies and policies developed by Member States in areas of national competence.

This provisions of the Directive includes *inter alia* information to be provided by the developer in an Environmental Impact Assessment Report (EIAR) – previously an Environmental Impact Statement (EIS). This EIAR has been prepared to include these requirements.

1.6 SCREENING

The Planning and Development Regulations 2001 Schedule 5 Part II, Section 10 (f) (ii) (as amended by Article 19 (e) of the Planning and Development (Amendment) (2) Regulations 2011) states that an EIAR is required for the following criteria of works:

> *"Canalisation and flood relief works, where the immediate contributing sub-catchment of the proposed works (i.e. the difference between the contributing catchments at the upper and lower extent of the works) would exceed 100 hectares or where more than 2 hectares of woodland would be affected or where the length of river channel on which works are proposed would be greater than 2 kilometres".*

The length of channel between the upper extent of the works (culvert at the N7) and the lower extent of the works (Horse Factory Bridge) is 8.6 kilometres. The contributing catchment in relation to this stretch of channel is 40 km^2 in area (including the tributaries).

EIA Screening was undertaken by RPS in 2014 and it was determined that, in line with the aforementioned criteria, the proposed scheme for the Morell catchment exceeded the thresholds in relation to flood relief works and therefore, an EIA would be required in relation to the proposed scheme.

Directive 2014/52/EU includes amendments to the EIA screening process. The amendments do not however impact on the EIA process undertaken in this instance or the conclusion of the screening; that an EIA is required in relation to the proposed scheme.

1.7 SCOPE OF EIA REPORT

This EIAR has considered the construction activities, operation and maintenance of the following elements of the proposed scheme:

- New Embankments (approximately 7,400m);
- Remediation of Existing Embankments (approximately 1,800m);
- New Flood Walls (approximately 480m);
- Culvert Alterations (6 No.) and new embankment/wall tie ins with 5 No. culverts;
- Stream Realignment Works on the Slane River (approximately 35m).

Once in place, no systems, controls or dedicated management practices are required to operate this scheme, however maintenance will be required (as outlined in Chapter 4 'Project Description').

It is not anticipated that the above elements will be decommissioned; hence the EIAR has not considered decommissioning of these elements.

Chapter 4 'Project Description' provides a detailed description of the proposed scheme and the proposed construction activities associated with the scheme.

It should be noted that this EIAR is based on the preliminary design as described in Chapter 4, 'Project Description'. During the detailed design process, undertaken by the Contractor, the scheme may be subject to some minor refinements prior to construction (See Section 1.9 below).

1.8 EIA STUDY TEAM AND REPORT

This Environmental Impact Assessment has been carried out in accordance with the requirements of the European Communities (Environmental Impact Assessment) Regulations, 1989 to 2006; the Planning and Development Act 2000 (as amended); and the Planning and Development Regulations 2001 (as amended) and the Directive 2014/52/EU. This legislation requires the assessment of the effects of certain public and private projects on the environment.

Article 3 of Directive 2014/52/EU 1 & 2 Schedule 6 of the Planning and Development Regulations (as amended) specifies the information to be contained within an EIAR. In this regard, Article 3 of Directive 2014/52/EU updates previous European Directives and Irish guidance and legislation. The factors now to be be condsidered as set out in Article 3 are:

"1. The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case the direct and indirect significant effects of a project on the following factors:

a) *population and human health;*

b) *biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;*

c) *land, soil, water, air and climate;*

d) *material assets, cultural heritage and the landscape;*

e) *the interaction between the factors referred to in points (a) to (d)."*

The consideration of the factors impacted by a project within this EIAR is in accordance with the factors set out in Article 3 of Directive 2014/52/EU.

The information specified in Article 94 & Paragraphs 1 & 2 Schedule 6 of the Planning and Development Regulations (as amended) to be contained within an EIAR largely accords with that set out in Article 5 of Directive 2014/52/EU which states:

"1. Where an environmental impact assessment is required, the developer shall prepare and submit an environmental impact assessment report. The information to be provided by the developer shall include at least:

a) *a description of the project comprising information on the site, design, size and other relevant features of the project;*

b) *a description of the likely significant effects of the project on the environment;*

c) *a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;*

d) *a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment;*

e) *a non-technical summary of the information referred to in points (a) to (d); and*

f) *any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected."*

The consideration of the factors impacted by a project within this EIAR is in accordance with the factors set out in Article 3 of Directive 2014/52/EU.

The information specificed to be contained within an EIAR, within this EIAR is in accordance with that set out in Article 5 of Directive 2014/52/EU.

1.8.1 EIA Guidance

The following guidance documents which were consulted in the preparation of this EIAR include:

- EIA Directive (2011/92/EU) and as subsequently amended, including
    - EIA Directive (2014/52/EU), not yet transposed into Irish law;

- Planning and Development Acts 2000-2016;
- Planning and Development Regulations 2001-2015;
- Guidelines on the Information to be contained in Environmental Impact Statements (EPA 2002);
- Guidelines on the Information to be contained in Environmental Impact Statements Draft version issued for consultation September 2015 (EPA 2015);
- Guidelines on the Information to be contained in Environmental Impact Assessment Reports Draft version May 2017 (EPA 2017);
- Advice notes for preparing Environmental Impact Statements Draft version issued for consultation September 2015 (EPA 2015);
- Advice Notes on Current Practice in the preparation of Environmental Impact Statements (EPA 2003); and
- Kildare County Development Plan 2017-2023.

This is expected to be transposed into Irish legislation in the near future.

Specific guidance, legislation and standards relevant to each environmental topic area are recorded in the relevant environmental chapters of this EIAR, Chapters 5 to 14.

This EIAR has been prepared by RPS on behalf of Kildare County Council. All specialist input assessments were undertaken by RPS except the Archaeology and Cultural Heritage Assessment which was completed by Irish Archaeological Consultancy.

1.9 EIAR STRUCTURE

This EIAR is contained within three volumes as follows.

Volume 1: EIAR – Non Technical Summary

This document provides a non-technical summary description of the proposed scheme. It also outlines the application processes and the statutory consultation process. A summary description of the main potential impacts associated with the proposed scheme and the proposed measures to mitigate against these impacts is also provided.

Volume 2: EIAR Main Report

The EIAR includes 15 chapters, which are grouped as follows:-

Introduction & Project Description - Chapters 1-4: These chapters provide an introduction to the EIA; describe the consultation process and set out the statutory application processes and legislative context. They also outline the need for the proposed scheme, the alternatives considered and describe the proposed scheme including the associated construction and, if necessary, demolition activities.

Human Environment - Chapters 5-9: These chapters provide details on the existing human environment prior to the proposed scheme, describe the potential impacts (including residual and indirect impacts) during the construction and operational phases, the mitigation measures proposed in order to eliminate or reduce these impacts and any residual impacts. These chapters address Population and Human Health (including the land use topic), Traffic, Transport and built services (the Material Assets topic), Air Quality and Climate, Noise and Vibration and Landscape and Visual.

Natural Environment - Chapters 10-13: These chapters address Soils, Geology, Waste, Hydrogeology, Hydrology and the Biodiversity topic (which is subdivided into Terrestrial and Aquatic elements). These chapters examine the existing natural environment prior to the proposed scheme, describe the potential impacts (including residual and indirect impacts) during the construction and operational phases, the mitigation measures proposed in order to eliminate or reduce these impacts and any residual impacts on the natural environment.

Archaeology & Cultural Heritage - Chapter 14: This chapter addresses the features of archaeological, architectural and cultural heritage interest. Mitigation measures proposed in order to eliminate or reduce any impacts are also outlined.

A summary of all the potential impacts and mitigation measures along with a description of the scheme's interactions within the EIA is presented in Chapter 15.

Volume 3 – Technical Appendices

Volume 3 includes the technical appendices, which contain supplementary information to the main EIAR as follows:

Appendix A - Flood Management Scheme Study - Feasibility Report 2016
Appendix B - Construction & Environmental Management Plan
Appendix C - Consultation Material
Appendix D - Appropriate Assessment Screening Statement
Appendix E - Aquatic Ecology
Appendix F - Land Use
Appendix G - Archaeology & Cultural Heritage
Appendix H - NRA Ecological Valuation Criteria
Appendix I - Water Framework Directive Assessment
Appendix J - Vegetation Removal Figures
Appendix K - Morell Flood Management Scheme - Preliminary Design Report 2017
Appendix L – Site Investigation Reports
Appendix M – outline Waste Management Plan

1.10 PROJECT CONSTRAINTS/DATA GAPS ENCOUNTERED DURING PREPARATION OF THE EIAR

No specific constraints have limited the assessment of likely significant impacts detailed in this EIAR. Where data limitations have been encountered, these are described within Chapters 5-14.

It has been necessary in respect of a number of design and construction details to make a number of assumptions. In these cases, the worst case scenario has been assessed in order to ensure all potential and likely impacts of the proposed scheme have been considered and to deliver a robust assessment. These include the width and height of the embankments (see Table 4.1). In order to fully assess the potential impacts of the scheme the maximum width and height of the embankments have been considered by all specialists. Similarly, the maximum amount of materials required for importation during construction has been considered in the traffic impact assessment. The maximum temporary working area required for construction has been assumed to be 15m wide, unless otherwise stated, e.g. at set down areas. Where works are adjacent to watercourses, this temporary construction area will be located on the field side of the embankment or wall i.e. on the side farthest away from the waterbody. This 15m wide construction area (unless otherwise stated), in addition to the footprint of the measures, has been considered by specialists in their assessment.

Due to the quantity of construction materials required to construct the scheme, three areas have been identified as potential locations for stockpiling / set down of materials; in the vicinity of Paines 1-3, Morr 19 and Morr 23, shown on Figure 4.1 in Chapter 4. These have been considered, where required, in specialist assessments (e.g. traffic in Chapter 6). The main site compound which will host the site offices and will be used for materials storage, staff car parking, etc. may be located at one of the identified stockpiling/compound areas and be established specifically for the project, or alternatively may use suitable existing premises, if one is available. The exact location of the compound will be chosen and agreed with the relevant Authorities in advance of works commencing.

This page has been left intentionally blank

2 CONSULTATIONS

This Chapter describes the consultation process carried out in relation to the proposed scheme. It also outlines the key issues raised during the process and how these issues have been considered and addressed by the RPS project team in the impact assessment Chapters (Chapters 5 - 14).

Proposed ongoing consultation activities associated with the application process for the proposed scheme are outlined in Section 2.5.

2.1 INTRODUCTION

Consultation forms an essential part in the preparation of an EIA Report. The early involvement of the public and other stakeholders helps to ensure that the views of various groups or individuals are taken into consideration throughout the EIA process and allows appropriate mitigation to be considered in the EIA for issues that are raised during consultation.

The consultation process to inform stakeholders of the proposed scheme was developed and led by Kildare County Council with assistance from RPS. The aim of the process was to:-

- Engage stakeholders as early as possible on the project and encourage feedback;
- Provide an open and transparent process for members of the public to participate in the project;
- Seek input from the public and from relevant stakeholders with respect to the proposed scheme and measures to reduce impacts during the construction phase;
- Provide opportunities for the public and stakeholders to provide baseline and other information with respect to the potential impacts that could arise as a result of implementing the project; and
- Keep the public informed of the project as it progresses.

The consultation process involved activities associated with the following two stages of the project.

2.2 STAGE 1 - PROJECT AWARENESS AND PRESENTATION OF PREFERRED OPTION

Stage 1 of the study ran from October 2013 to December 2014. It included technical tasks that culminated in the development of a preferred flood risk management option for the alleviation of flooding in the Morell River catchment. The consultation events and activities included:

- Development of a communications strategy, implementation programme and event plan (leaflets and information that were issued throughout Stage 1 are included in Appendix C, in Volume 3 of this EIS);
- Development of stakeholder databases;
- Development of communications registers;
- Resident and land owner letters & Elected member letters (see Appendix C of Volume 3 of this EIA Report);

- Elected member briefings held on 12th November 2013 and 2nd October 2014;
- Public Consultation Day held on 23rd October 2014 (See Section 2.2.3);
- Consultation with key stakeholders through correspondence (see below);
- On-going direct communications with stakeholders;
- Website-based consultation and use of functions to allow feedback[1]; and
- Media activities including issuing a press release (see Appendix C of Volume 3 of this EIA Report) to local newspapers and local radio stations in advance of the Public Consultation Day.

The principal aim of the consultation activities associated with Stage 1 were:

- To develop a geo-referenced stakeholder database;
- To undertake general project awareness raising;
- To increase stakeholder understanding in relation to the rationale and methodology behind the development of flood risk management options;
- To elicit and record the views of stakeholders with respect to:
  - Significant positive or negative social, technical or environmental issues with respect to the proposed and preferred options;
  - Identification of alternative solutions.
- To present the preferred option i.e. the proposed scheme.

The following organisations were identified as key stakeholders in relation to the proposed scheme for Stage 1:

- Department of Environment, Community and Local Government (DECLG)[2];
- Department of Communications, Energy and Natural Resources (DCENR)[3];
- Department of Agriculture, Food and the Marine (DAFM);
- Department of Arts, Heritage and the Gaeltacht (DAHG)[4];
- Environmental Protection Agency (EPA);
- National Parks and Wildlife Service (NPWS);
- Inland Fisheries Ireland (IFI);
- Waterways Ireland; and
- Irish Rail.

In June 2015, a letter was issued to the above organisations from Kildare County Council informing them of the work of the Morell FAS Study and inviting submissions. Submissions and observations, via letter and over the phone, were received from several of the organisations. A site walkover was also undertaken with a representative from Irish Rail.

[1] http://kildare.ie/CountyCouncil/PressReleasesAdverts/PublicConsultationontheDraftPreferredFloodRiskManagementoptionfortheRiverMorellCatchment.html

[2] Since 2016 known as the Department of Housing, Planning and Local Government (DHPLG).

[3] Since 2016 known as the Department of Communications, Climate Action and Environment (DCCAE).

[4] Since 2016 known as the Department of Arts, Heritage, Regional Rural and Gaeltacht Affairs.

The issues raised during the Stage 1 consultations and the influence that these have had on the process are discussed further in Section 2.4.1.

2.2.1 Correspondence with Residents, Landowners and Elected Members

Two letters were also issued to residents, land owners and the elected members during Stage 1 as follows:

- Preliminary letter - sent in November 2013 to all of the residents in the catchment, in order to raise awareness of the Morell FAS Study and to invite early comment. It was distributed by Kildare County Council via mail drop.
- Notification of public open day letter - sent in August/September 2014 to all of the stakeholders listed in the Landowner Database and Stakeholder Register, inviting them to attend the public consultation day which took place on 23rd October 2014. The letter was issued by Kildare County Council by ordinary post.

The issues raised as a result of this activity and the influence that these have had on the project's development are summarised in Section 2.4.1. Copies of all written correspondence issued to stakeholders are included within Appendix C, in Volume 3 of this EIA Report.

2.2.2 Elected Members Briefings

Two briefings were held with Elected Members, who were invited by Kildare County Council. The first briefing, in November 2013, was held to create initial project awareness and was presented by project team members from Kildare County Council only.

A second briefing, held in October 2014, had project team members from both RPS and Kildare County Council present to discuss the scheme options. A question and answer session was held during this briefing, from which the issues raised are summarised in Section 2.4.1.1.

2.2.3 Public Consultation Day

The Public Consultation Day (PCD) was held on 23rd October 2014 in Kildare County Hall from 3:00 – 8:00pm.

In order to make members of the public aware of the event, an advertisement was placed in the Leinster Leader (see Appendix C, in Volume 3 of this EIA Report). The event was also promoted on local radio by an Elected Member, who discussed the project during a broadcast interview.

Members of the project team from RPS and Kildare County Council were present at the event to discuss the information presented on display boards and to answer questions from interested stakeholders. Information leaflets and draft maps showing the three options were given to all who attended. Following the event all the project information on display was also uploaded to the project website. The event was attended by approximately 60 people.

Feedback forms were also circulated to all attendees. The Feedback Form template is provided within Appendix C in Volume 3 of this EIA Report. A summary of the key issues raised at the PCD is given in Section 2.4.1.4, including the key issues raised in the feedback forms.

2.3 STAGE 2 - EIA PROCESS

This stage involved consultation with a number of statutory and non-statutory consultees through correspondence, which informed them that the preparation of the EIA Report had commenced and inviting them to contribute to the EIA process. Table 2.1 lists the organisations contacted during this Stage. A copy of the correspondence issued in June 2015 is included within Appendix C in Volume 3 of this EIA Report.

Table 2.1: Statutory and Non-Statutory Consultees Contacted During Stage 2 - EIA Process

Organisation	
▪ An Taisce	▪ Irish Wildlife Trust
▪ Bat Conservation Ireland	▪ National Federation of Group Water Schemes
▪ Birdwatch Ireland	▪ National Parks and Wildlife Service
▪ Department of Agriculture, Food and the Marine	▪ National Roads Authority (now TII – Transport Infrastructure Ireland)
▪ Department of Arts, Heritage and the Gaeltacht	▪ National Roads Design Office
▪ Department of the Environment, Community and Local Government	▪ Office of Public Works
▪ Dept. of Communications, Energy and Natural Resources	▪ Railway Safety Commission
▪ Dublin Trout Anglers' Association	▪ Straffan Anglers Association
▪ EPA	▪ Teagasc
▪ Eastern River Basin District Coordinator	▪ The Arts Council
▪ Fáilte Ireland	▪ The Clane Trout & Salmon Anglers Association
▪ Geological Survey of Ireland	▪ The Heritage Council
▪ Health Service Executive	▪ The Irish Farmers Association
▪ Inland Fisheries Ireland	▪ The Kildare Hotel, Spa & Country Club
▪ Irish Rail	▪ Waterways Ireland
▪ Irish Water	

In addition to the above consultations, specialists also undertook direct consultations relevant to their assessment with organisation such as the NPWS, IFI, Kildare County Council, etc. and these are reported in the relevant impact assessments in Chapters 5-14.

2.3.1 Landowner Liaison

Following the Public Consultation Day in October 2014, Site visits were undertaken to landowners in 2015 that were identified as affected by the scheme. The landowners were contacted by Kildare County Council and site meetings were organised to discuss the scheme in further detail. Following this consultation, further amendments were made to the scheme design as a result of information collected from the site visits.

2.3.2 Irish Rail Consultation

Further Consultation was also undertaken with Irish Rail in January 2017 as a result of changes to the proposed scheme design. The new design proposes to protect the Irish Rail embankment with a new flood defence embankment and to throttle the existing culverts under the railway that are causing flooding in Killeenmore.

2.3.3 Pre-Planning Submission Public Information Day

A public information day was organised on 1st February 2017 in Killeen Golf Club from 2:00 – 7:00pm to inform the public of the status of the current scheme design. In order to make members of the public aware of the event, notification of public information day was sent to local residents in advance of the meeting. The letter was issued by Kildare County Council by ordinary post. Copies of all written correspondence issued to stakeholders are included within Appendix C, in Volume 3 of this EIA Report.

The issues raised as a result of the various consultations and the influence that these have had on the project's development are summarised in Section 2.4.1.

2.4 CONSULTATION FEEDBACK

2.4.1 Stage 1

Table 2.2 outlines the numbers of responses and submissions received through the various consultation processes in Stage 1. Sections 2.4.1.1 to 2.4.1.4 summarise the issues raised in the various responses.

Table 2.2: Number of responses received during Stage 1.

Event	Number
Elected member briefing comment	n/a *(see Section 2.4.1.1)*
Submissions from Stat./Non stat. organisations	3 *(see Section 2.4.1.2)*
Emails/comments via websites	39 *(see Section 2.4.1.3)*
Letters	4 *(see Section 2.4.1.3)*
Phonecalls	6 *(see Section 2.4.1.3)*
Public Consultation Day - comment sheets	46 *(see Section 2.4.1.4)*

2.4.1.1 Elected Member Briefing

During the question and answer session held as part of the second briefing in October 2014, a number of queries were raised. These are summarised below with the responses given at the briefing.

- **What criteria are used in the cost-benefit analysis?** It was explained that statistics are available to put values on receptors in order to estimate the damage due to flooding. The cost of the damage is then compared to the cost of the proposed flood management option or scheme. If the benefit out-weighs the cost, the scheme is cost-beneficial and can proceed.
- **Are changes in the channel over time reflected in the model?** It was explained that the channel was surveyed in 2012 for the purpose of the model build and therefore the information used is the most up-to-date available.
- **How are flood events recorded?** It was explained that flood event response is built into the study whereby study team members visit locations after flooding has occurred to collect information to make the process, and the maps, more robust. In addition, OPW's flood maps website (*www.floodmaps.ie*) records flood events. It was also pointed out the frequent flooding can actually contribute to the cost-benefit ratio of schemes.
- **How will the scheme relate to the issue of the difficulty that property owners are experiencing in obtaining insurance cover**. This query was raised by several councillors. Insurance companies are commercial entities that use their own information to set premiums. Kildare County Council issue standard insurance letters to help property owners in their dealings with insurance companies. These letters state that works have been completed in specific areas and to specific design standards. No guarantees are given as to whether or not there will be future flooding.
- **Where will the funding come from for the schemes and is it likely to come from the EU**? There is unlikely to be specific funding made available from the EU for any future works in the Morell River catchment. A national prioritisation of all of the options in all of the Flood Risk Management Plans will be undertaken and options will be paid for from OPW funding. In the meantime, Flood Relief Schemes and minor works are being progressed in many areas. It was pointed out that it can often be easier to get funding for smaller schemes as the overall costs are generally less than larger schemes.
- **The issue and importance of channel maintenance was discussed**. Kildare County Council carry out as much maintenance as possible with the funds available.
- **Is there any danger that this Area for Further Assessment (AFA) will not come through the cost-benefit analysis as cost-effective?** It was pointed out that this AFA has been prioritised within the overall study programme. It will be clear within a few months whether a scheme is likely to progress.
- **Is the drainage from the M7 motorway having a serious impact on the flooding in the Morell River catchment?** The M7 motorway is considered to be adequately represented in the model. The hydrological inputs used in the model account for the M7 as urbanised contributing catchment area input as lateral inflow to the adjacent reach of the channel. The investigation did not involve identifying specific drainage discharge points along the motorway as RPS are confident that the model adequately represents the flow regime in this area, particularly as there are a number of gauging station locations downstream of the M7 at which the total flow in the model can be verified. It would only be necessary to model specific discharge points where there is evidence indicating that the point discharges from a road drainage system are the source of the critical flood flow in the watercourse being modelled. In the case of the Morell, Hartwell, Kill and Slane watercourses there is a significant contributing catchment upstream which is the dominant source of flood flow in the watercourses.

2.4.1.2 Stage 1 Feedback from Statutory/non statutory Stakeholders

Table 2.3: Responses and key issues by Key Stakeholders during Stage 1.

Consultee	Event:	Responses & Key Issues raised:	Refer to EIA Report Section:
IFI	Stage 1 Stakeholder Correspondence	Concern over Morell River which is extremely important for salmonids particularly if works were to include dredging, removal of silts and gravels, river widening etc.	Chapters 4 (Project Description) and 11 Biodiversity - Aquatic Ecology
GSI	Correspondence (dated 13th October 2014)	Acknowledgement and references to Datasets.	Chapter 13 (Soils, Geology and Hydrogeology)
DAFM	Correspondence (dated 13th October 2014)	Statement to say that the DAFM have no observations to make (Dated 5th November 2014).	n/a
Irish Rail	Meeting on site	Irish Rail agrees with overall scheme principles. Further details of interaction with Railway embankment will be required at a later stage.	n/a

2.4.1.3 Stage 1 Feedback from Public Submissions

Table 2.4: Summary of key issues raised in written submissions received during Stage 1

Summary of Topics & Key Issues raised:	Refer to EIA Report Chapter
The positive effects of the project were welcomed by many who contacted the RPS project team.	n/a
Impacts (including visual, loss of value, loss of amenity) of embankments and walls on residential houses.	Chapter 9 Landscape & Visual.
Watercourses not identified on flood maps, which do flood.	Addressed in project design/hydraulic model updated (Chapter 12).
Concerns that the scheme will not lessen the flood impacts on some residents and their lands.	All properties at risk of flooding for the 1% AEP event will be protected as part of the scheme.
Recommendations on where to put flood defences.	Recommendations were incorporated into the scheme design where possible/practical.
Concerns on the design of the proposed scheme.	Addressed in project design (Chapter 4) and hydraulic model (Chapter 12).
Agricultural impacts and related compensation issues for areas that will flood post scheme implementation.	Chapter 5 (Population and Human Health) (*Note that although the impact assessment considers the effects on agriculture, the issue of compensation is not a matter for the EIA Report).
No details given on the size and construction of embankments and concerns relating to environmental impact in particular traffic impact.	See Chapter 6 (Traffic).
Concerns regarding current erosion of the river banks.	Concerns incorporated into the scheme design. Stream diversion proposed to reduce erosion of river banks.

Concerns that the public consultation is not meaningful.	See Sections 2.2 to 2.5 which set out the extent of the consultation process.

2.4.1.4 Stage 1 Feedback from Public Consultation Day

Table 2.5 Summary of Topics/key Issues Raised during Public Consultation Day

Summary of Topics & Key Issues raised:	Refer to EIA Report Chapter
The positive effects of the project was welcomed by many who attended.	n/a
Concerns regarding a delayed programme for completion of works.	Programme is included in EIA Report Chapter 4 Project Description. However, project timeline is subject to statutory approvals.
Problems relating to obtaining insurance.	Socio-economic issues relating to flooding are discussed in Chapter 5 (Population and Human Health) however it is not within the remit of an EIA Report to petition commercial entities.
The importance of maintenance of the channel to reduce blockages and increase conveyance.	Chapter 4 Project Description.
Several stakeholders identified drainage features e.g. culverts, streams not included in the model, areas with a history of flooding not represented in the model, areas they felt that should have been considered by the scheme, areas that predicted flooding is not reflective of what happens in reality, areas where embanksments have been removed or constructed.	All submissions investigated by RPS and, where applicable, alterations made to hydraulic model and design of scheme by design team.
Concerns that the scheme will result in houses and lands being flooded that are not shown on the scheme mapping.	Houses identified and to be added to scheme drawings.
Recommendations on where to put flood defences.	Recommendations were incorporated into the scheme design where possible/practical.
Concerns regarding placement of embankments and planning and land value issues.	Individual landowners have been consulted with in relation to placement of embankments.
Concerns regarding impact to environmental, historical and ecological features of the watercourse. Request made to maintain old style bridges (particular reference to potential structural issues of Finger Post Bridge), old beech trees.	Chapter 10 & 11 (Biodiversity - Terrestrial and Biodiversity - Aquatic Ecology). Chapter 14 Cultural Heritage.
Concerns regarding the visual impact of the embankments and their integration into the landscape.	Chapter 9 Landscape & Visual Impact
Concerns regarding the condition of existing embankments.	Chapter 4 Project Description.
Residents in Killeenmore raised concerns that the levels for the proposed works crossing the road are not suitable.	Changes to design in this location. Killenmore road crossing culvert upgrade is no longer required.
Concerns that the proposed scheme is not cognisant of the high water levels in the Liffey, which may not facilitate flood waters from the Morell River.	Sensitivity Analysis Model Runs carried out with high water levels in River Liffey.
Concerns re: planning and agricultural implications.	Chapter 5 Population and Human Health.
Concerns if project will impact on wells.	Chapter 12 Soils, Geology and Hydrogeology.

All of the concerns or issues that were raised during the Public Consultation day, or via the associated feedback forms, were considered by the Project Team and where necessary, the hydraulic model and/or design of the scheme were updated to incorporate relevant new information. In many cases, this resulted in the elimination of the concerns and issues raised by many of the consultees during Stage 1.

2.4.2 Stage 2

Table 2.6 summarises the key issues raised, and responses made, during Stage 2 of the process and identifies where these issues have been addressed in this EIA Report. Where concerns were raised, a member of the RPS project team responded by telephoning/meeting the consultee to explain the design of the proposed scheme.

Table 2.6: Responses and Topics/Key Issues Raised Through Stage 2 EIA Consultation Process

Organisation	Summary of Responses and Key Issues Raised by Consultees	Form of Consultation	Refer to EIA Report Chapter
Department of Agriculture, Food and the Marine	Acknowledgement only.	Letter	N/A
Health Services Executive	Prevention of flooding is welcome. Kerdiffs Town house is used as an amenity. River Liffey is a major source of drinking water and any activity which could cause potential contamination should be reported to Fingal Co. Co./ Irish Water. Include risk assessment, management and reporting structure in the EIS.	Letter	N/A Chapter 5 (Population and Human Health) Chapter 4 (Project Description) Appendix B (CEMP)
Dublin Trout Anglers' Association	Query if project team had consulted with Inland Fisheries Ireland.	Telephone	Chapter 11 (Biodiversity - Aquatic Ecology)
Inland Fisheries Ireland	The Morell is an important salmonid system holding significant populations of Atlantic salmon, (Annex II and V of the Habitats Directive) Sea trout, Brown trout, Lamprey and Crayfish(both Annex II species). The Morell is hugely important in that it provides a valuable salmonid spawning and nursery habitat contribution to the Liffey main channel . As with any development, all measures necessary should be taken to ensure comprehensive protection of local aquatic ecological integrity, in the first place by complete impact avoidance and as a secondary approach through mitigation by reduction and remedy. The maintenance of habitat integrity (both in-stream and riparian) is essential in safeguarding the ecological value of this important system. The EIA should consider impacts of the embankments and walls on the riparian zone and the river channel. Instream works. Impact of the built structures i.e. embankments and walls on the capacity of downstream culverts. The need for ongoing maintenance, Construction Compound locations and facilities, including the safe storage of materials.	Email	Chapter 11 (Biodiversity - Aquatic Ecology) Chapter 11 (Biodiversity - Aquatic Ecology) Chapter 12 (Hydrology & Drainage) Chapter 4 Project Description

Organisation	Summary of Responses and Key Issues Raised by Consultees	Form of Consultation	Refer to EIA Report Chapter
	Invasive species control.		Chapter 11 Terrestrial Ecology
National Federation of Group Water Schemes.	No comment on theproposed scheme.	Email	N/A
GSI	The EIS should provide information about the Soils and Geology of the existing environment. References to datasets and guidelines are provided for consideration in the EIS.	Letter	Chapter 13 (Soil, Geology and Hydrogeology)
Railway Safety Commission	Consult Iarnrod Éireann (IE) to ensure risks associated with railway trespass are not increased during the works, to ensure works that may affect the safe operation of the railway are undertaken in accordance with RSC Guidelines; and Road Rail interfaces on access routes.	Letter	Chapter 4 (Project Description)
Iarnrod Éireann	Concerns re: the railway being used as a dam to protect houses downstream and how flood defence works will interface with the railway embankment.	Email	Concerns acknowledged. Scheme design changed to include embankment protecting the railway line. Chapter 4 (Project Description)
Waterways Ireland	Does the proposed scheme affect the Grand Canal at either the Morell culverts or the Painestown culverts, both of which pass under the canal. Has the scheme model considered that the Morell also serves as a feeder stream for the canal? The proposed NHA designation of the Grand Canal should be considered as part of your assessment.	Email	Chapter 12 (Hydrology and Drainage) Chapter 12 (Hydrology and Drainage) Chapter 11 (Biodiversity - Aquatic Ecology)
NRA (now TII – Transport Infrastructure Ireland)	Consult with the Local Authority/Regional Design Office Assess impacts on the national road network . The EIS should identify areas where works will traverse or exist in close proximity to the national road network. Consult with NRA DMRB if road safety audit is required Identify haul routes and fully assess the road network. All structures on haul route should be checked to confirm capacity for abnormal loads. Complete traffic and transport assessment.	Letter	Chapter 6 (Traffic & Transportation) Chapter 6 (Traffic & Transportation)
NPWS	Archaeology: The Department would recommend that an Archaeological Impact Assessment be included in the EIS for the River Morell Flood Management Scheme in County Kildare. Nature Conservation: An ecological survey should be carried out of the site of the proposed development site including the route of any access roads, pipelines or cables etc. to survey the habitats and species present. Any improvement or reinforcement works required for access and transport anywhere along any proposed haul route(s) should be included in the EIS and subjected to ecological impact assessment with the inclusion of mitigation measures, as appropriate. The EIS should include the results of the surveys, and	Letter	Chapter 14 (Cultural Heritage) Chapter 10 (Biodiversity - Terrestrial Ecology) Chapter 6 (Traffic & Transportation)

Organisation	Summary of Responses and Key Issues Raised by Consultees	Form of Consultation	Refer to EIA Report Chapter
	detail the survey methodology and timing of such surveys. The EIS should cover the whole project, including construction, operation and, if applicable, restoration or decommissioning phases. Alternatives examined should also be included in the EIS. Inland Fisheries Ireland should be consulted with regard to fish species if applicable. For information on Geological and Geomorphological sites the Geological Survey of Ireland should be consulted. In particular any impact on water table levels or groundwater flows may impact on wetland sites some distance away. The EIS should assess cumulative impacts with other plans or projects if applicable. The EIS should also address the issue of invasive alien plant and animal species, such as Japanese Knotweed, and detail the methods required to ensure they are not accidentally introduced or spread during construction. The EIS should provide an estimate of the length of hedgerow that will be lost, if any. Where trees or hedgerows have to be removed there should be suitable planting of native species in mitigation. Any watercourse or wetland impacted on should be surveyed for the presence of protected species and species listed on the Annexes II and IV of the Habitats Directive. A suitable riparian habitat should be left along each watercourse. Construction work should not be allowed impact on water quality and measures should be detailed in the EIS to prevent sediment and/or fuel runoff from getting into watercourses which could adversely impact on aquatic species. Complete project details including construction management plans (CMPs) need to be provided in order to allow an adequate assessment to be undertaken. Should the original survey work take place well before construction commences it is recommended that an ecological survey of the development site should take place immediately prior to construction to ensure no significant change in the baseline ecological survey has occurred.		Chapters 10 & 11 Biodiversity - Terrestrial and Biodiversity - Aquatic Ecology) Chapters 5-14 Chapter 1 (Introduction) Chapter 11(Biodiversity - Aquatic Ecology) Chapter 13 (Geology, Soils and Hydrogeology) Chapter 11 (Biodiversity - Aquatic Ecology) Chapter 15 (Summary & Interactions) Chapter 10 (Biodiversity - Terrestrial Ecology) Chapters 4 (Project Description) & 10 (Biodiversity - Terrestrial Ecology) Chapters 11 & 12 (Biodiversity - Aquatic Ecology & Hydrology and Drainage) Chapter 4 (Project Description) and Appendix B (CEMP) Chapter 10 (Biodiversity - Terrestrial Ecology) and 11 (Biodiversity - Aquatic Ecology)

Following consultation with the stakeholders listed above and a technical review; in 2016 the scheme design was revised to incorporate a new embankment upstream of the railway line in order to prevent the railway line from acting as a dam. Full details are provided in Section 1.3.

2.4.3 Pre- Planning Submission Public Information Day

The purpose of this event was to inform the public on the current status of the project and the revised scheme design following Public Consultation at Stage 1 and Consultation with Scheme Stakeholders as part of the EIA Consultation Process. In total, 62 people registered for the event with 15 of these people providing feedback through one of the comment forms. The submitted comments were mainly requesting copies of the drawings to be sent to them. Other issues previously highlighted in earlier consultation stages were also repeated.

Table 2.7: Summary of Topics/key Issues Raised during pre- Planning Public Consultation Day

Summary of Topics & Key Issues raised:	Refer to EIA Report Chapter
Concern that embankments at Painestown would restrict access to land and would trap water and increase flooding locally. Concern that the construction of the N7 has exacerbated flooding by increasing runoff.	Issues were investigated and hydraulic model was reviewed and updated. Maintenance requirements were noted. Chapter 12 (Hydrology and Drainage)
Information supplied regarding flood water flow path along route of water main in vicinity of where the Morell River passes beneath the railway and concern raised regarding banks overtopping.	Issues were investigated. Flow path has been included in hydraulic model and also noted for detailed design. Additional embankments not required. Chapter 12 (Hydrology and Drainage)

2.5 STATUTORY CONSULTATION

After the applications for the proposed scheme have been submitted, Kildare County Council will continue to address any issues or concerns raised by the public through to the proposed construction phase for the project, if approvals are successful. They will also serve to keep the public and other stakeholders updated in relation to the various stages of the statutory approvals process (e.g., statutory consultation, oral hearing, etc.) through the continued use of the project website.

This EIA Report, including a Non-Technical Summary (Volume 1), Appendices (Volume 3) and Appropriate Assessment Screening Statement (in Volume 3), will be available on public display in the Offices of Kildare County Council at County Hall during the statutory consultation period. Hard copies will be made available for purchase or digital copies may be obtained on request to Kildare County Council.

Prior to the commencement of works, Kildare County Council will notify the public via updates on the project website of the intended project programme. The project website will also be updated as necessary to inform the public of progress prior to, and during, construction.

During the construction phase the contractor will appoint a key liaison officer/contact point who will be responsible for dealing with public queries, updates, monitoring of complaints, etc.

3 SITE DESCRIPTION

This chapter describes the location of the site and gives a brief description of the existing land use within the surrounding catchment.

3.1 SITE LOCATION AND CONTEXT

The Morell catchment in County Kildare is situated within the Eastern River Basin District (ERBD) and Hydrometric Area (HA) 09. The study area incorporates a region approximately 45km² in area. The upper extents of the Morell catchment incorporates the tributary catchments of the Hartwell, Kill and Slane Rivers (the latter two which combine to form the Painestown River north of the N7), which extend into the foothills of the Wicklow Mountains. The rivers rise in elevated lands to the south-east, east and north-east of Naas and flow generally in a north westerly direction. As shown in Figure 3.1, the tributary rivers merge into the Morell River before discharging to the Liffey.

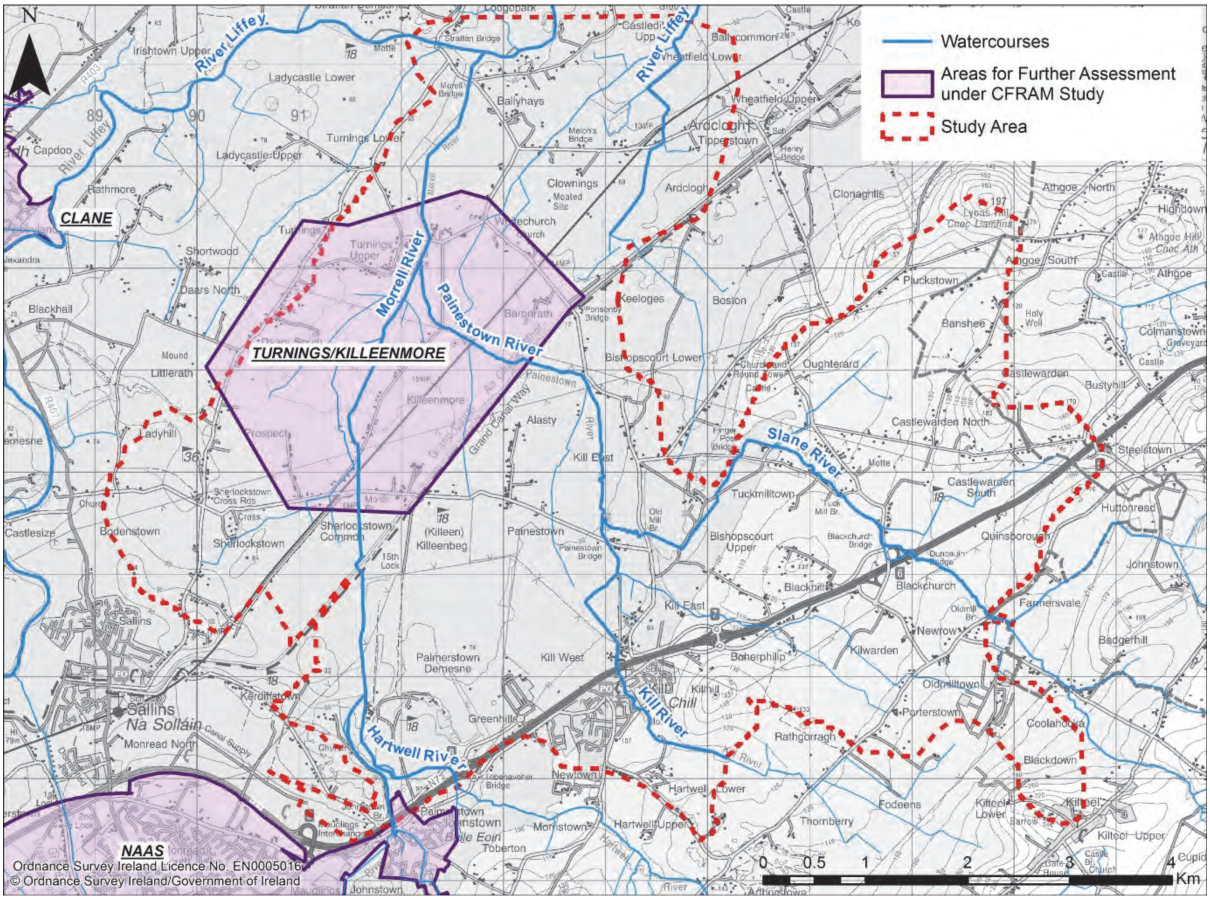


Figure 3.1: Study Area and Areas for Further Assessment under the CFRAM Study

Where the rivers cross the N7 the topography changes from undulating to relatively flat and this flat terrain persists as the rivers flow beneath the Grand Canal and Dublin-Cork Railway line towards the confluence with the River Liffey. The catchment has been and continues to be subject to flooding caused by intense rainfall events, or prolonged and heavy rainfall with antecedent wet conditions causing an impact to the road network in addition to residential, agricultural and industrial properties.

Recognising the significant flood risk that exists, the Office of Public Works has designated the Morell catchment (Turnings/Killeenmore) as an Area for Further Assessment (AFA) under the Eastern Catchment-based Flood Risk Assessment and Management (CFRAM) study. Other nearby AFAs include Naas to the south and Clane to the east.

3.2 EXISTING LAND USE

3.2.1 Catchment

The Morell and Painestown tributary systems flow through moderately intensive agricultural areas with small but significant urban areas (see Figure 3.2 and Figure 3.3 overleaf). The catchment is largely rural in nature and is characterised by individual detached homes dispersed throughout the catchment. The main settlement is Kill, to the south of the catchment, with a population of 3,095 according to the most recent census of population carried out in 2011 (CSO, 2012).

Beyond the urban settlement of Kill, the main land use of the study area is agricultural. The Morell catchment is characterised by generally flat terrain and open lands with regular (medium sized) field patterns. The lands are low-lying and are composed of good, well drained soils suitable for cattle rearing and milk production as well as tillage.

3.2.2 Proposed Scheme

Figure 3.2 shows the Proposed Morell Flood Management Scheme. The scheme comprises of works to be undertaken in the following areas:

1. Along the Morell River (Between Morell Bridge and Johnstown, including the Hartwell River)
2. Along the Painestown River (Between the Old Morell Bridge and Painestown)
3. Slane River (Between Tuckmilltown and Blackchurch)
4. Kill River (Kill East)

The proposed works areas are in areas characterised as rural. According to the EPA CORINE Land use Map 2012 (Figure 3.2), the land uses in close proximity to the proposed sites are identified as ‘Pastures’, ‘Non Irrigated Arable Land’, ‘Discontinuous urban fabric’, ‘Sport and Leisure Facilities’ and ‘Broad Leafed Forest’.

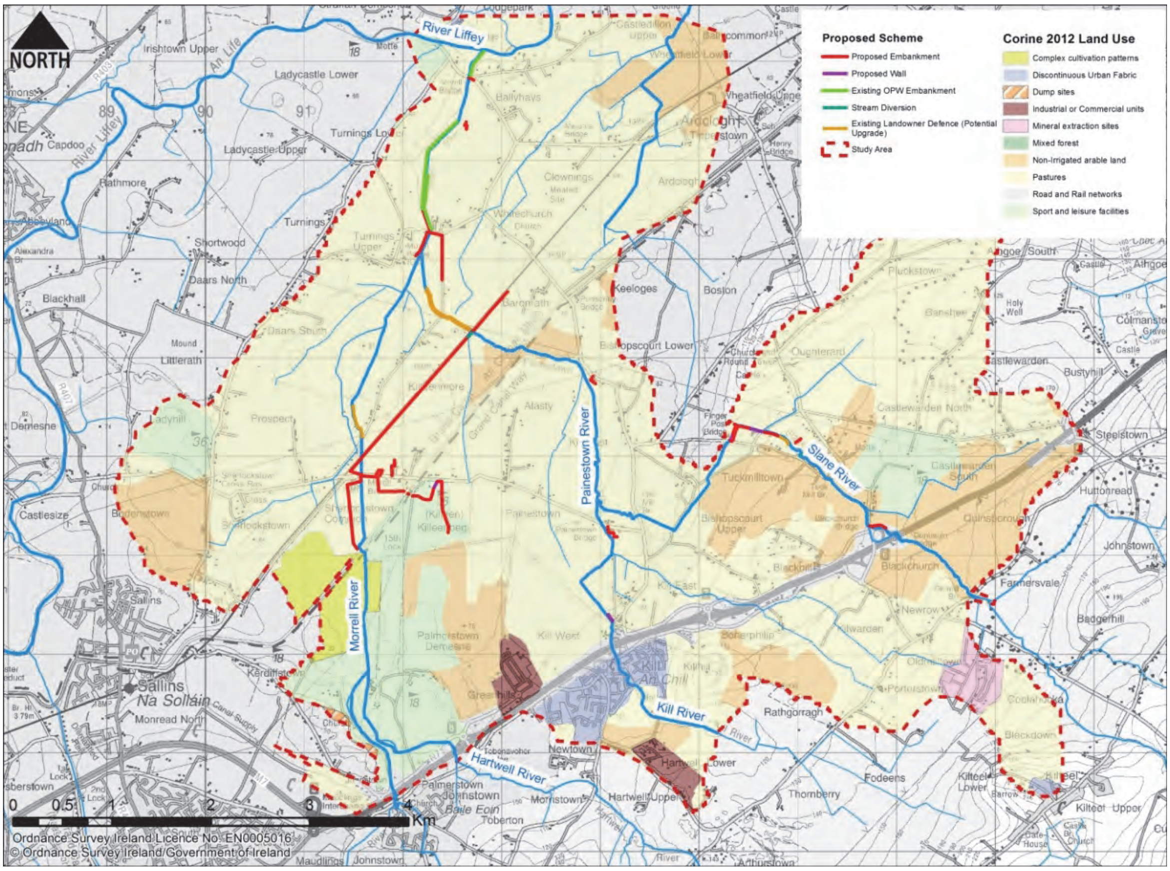


Figure 3.2 Proposed Flood Management Scheme (including Corine Land Use Dataset 2012)

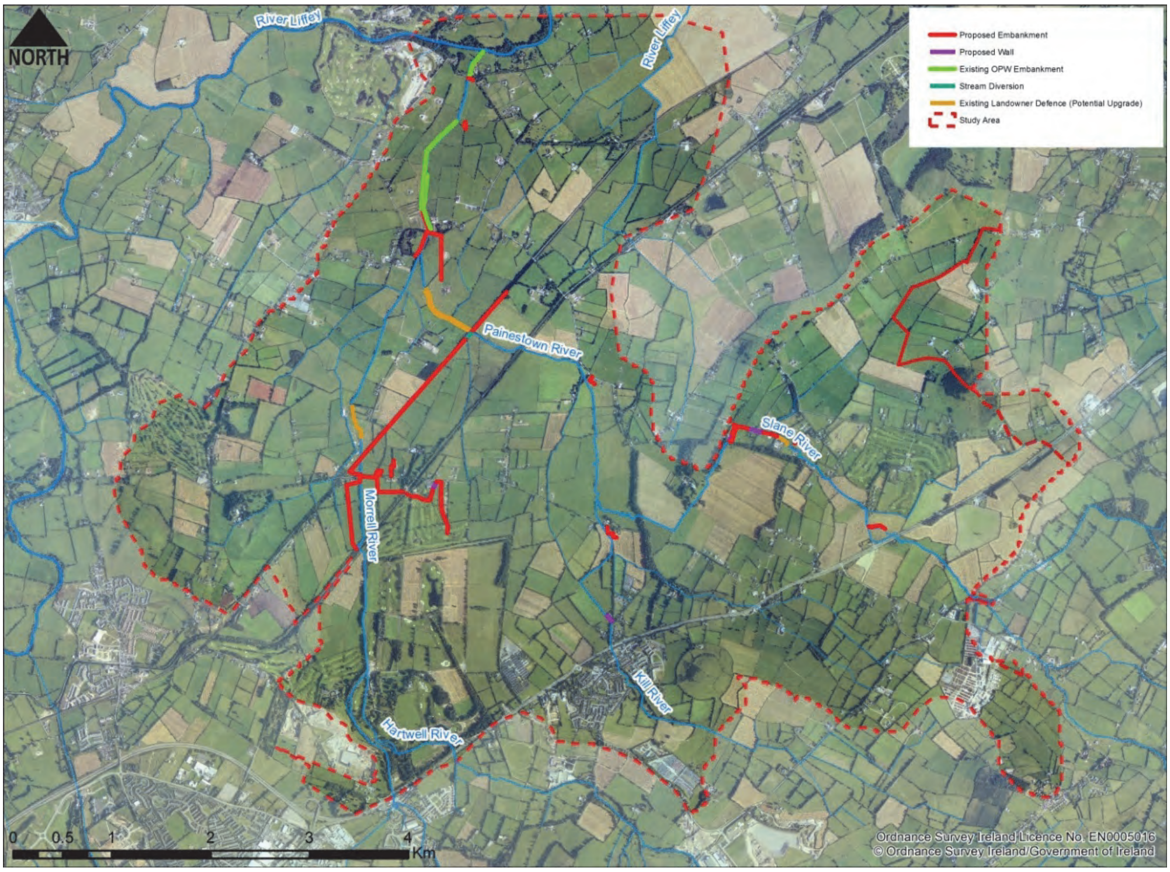


Figure 3.3 Proposed Flood Management Scheme on Aerial Photography

The study area's location in the context of the surrounding national and European level designations (Natural Heritage Areas (NHAs) and proposed NHAs, Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and wetlands of international importance, as designated under the Ramsar convention, are shown in Figure 3.4 below. Two pNHAs are within the catchment area; the Grand Canal pNHA and Kilteel Wood pNHA.

Red Bog, Kildare pNHA and SAC immediately borders the catchment at its south east extent. The potential impacts on terrestrial and aquatic ecology are discussed in detail in Chapters 10 and 11 respectively.

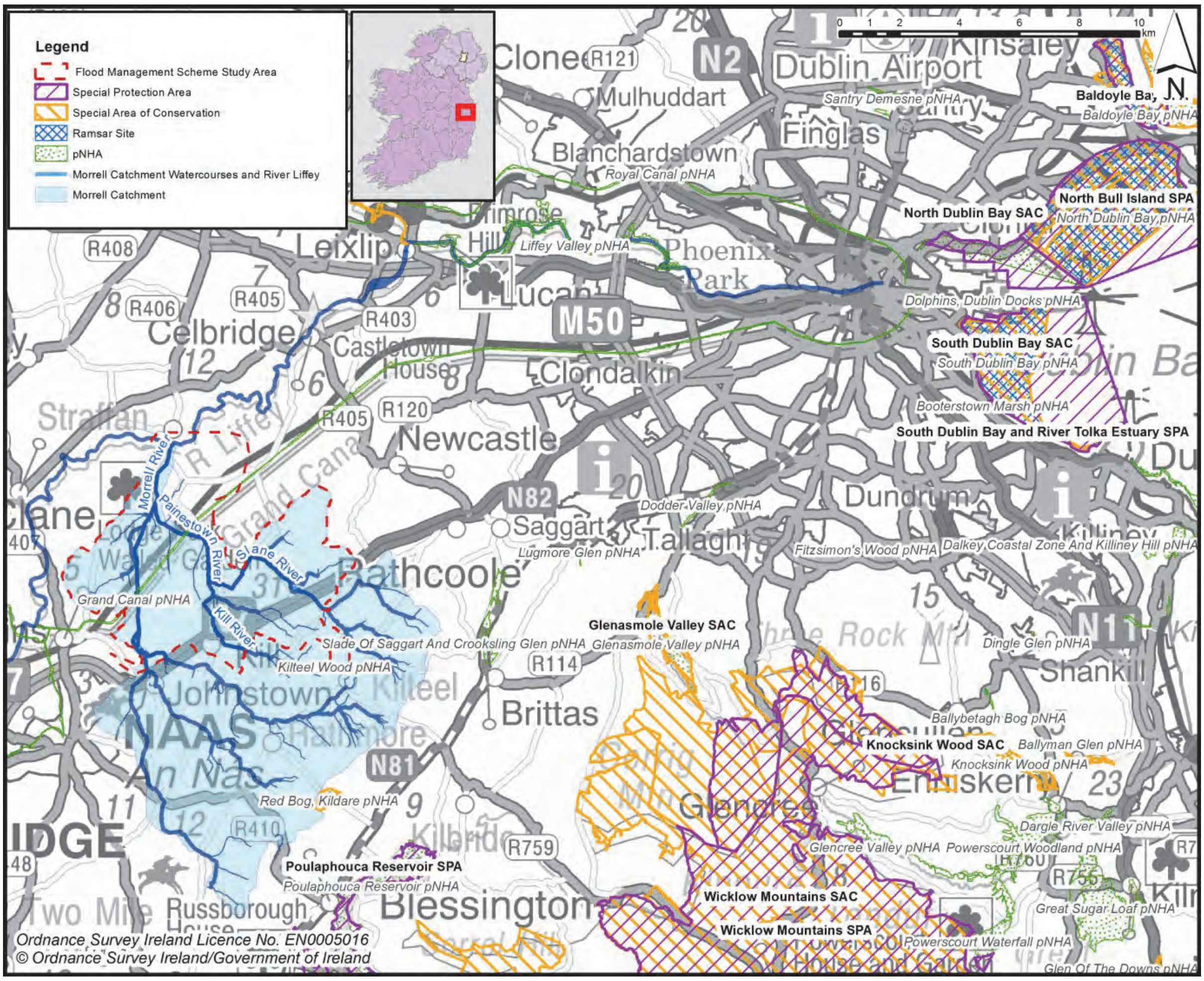


Figure 3.4 Overview of Environmental Designations surrounding and Downstream of Catchment

A full description of the proposed scheme is given in Chapter 4, 'Project Description'.

4 PROJECT DESCRIPTION

4.1 INTRODUCTION

This chapter describes the basis of design for the proposed scheme and the main features of the proposed scheme. The information presented is based on the outline design of the scheme, which includes comprehensive information on all aspects of the works and which is sufficient to allow a robust impact assessment of the works to be undertaken. It should be noted however, that certain aspects of the scheme may be subject to minor refinements in the detailed design phase. To ensure that these are included and mitigated for in the impact assessment, the EIAR has presented a 'worst case' scenario in those areas where the detailed design may result in minor alterations to the options, e.g. footprint of embankments.

A description of the activities required to construct the proposed development including temporary works is provided in Sections 4.3 and 4.4. The issue of decommissioning will not be addressed in this EIAR, as it is not anticipated that the proposed scheme will be required to be taken out of use at any point in the future. However, the scheme will require ongoing maintenance and this is further discussed in Section 4.7.

4.2 PROPOSED SCHEME

4.2.1 Basis of Scheme Design

In accordance with the preferred design standards identified by the OPW (i.e. flood event probabilities that the Scheme and risk management measures and options should address), the scheme has been designed to alleviate flooding to properties for the 1% AEP, with provision for future adaptability to the Mid-Range Future Scenario for climate change.

The brief also required the Consultant to consider flood risks associated with more significant events than those of the preferred or proposed design standard (e.g., 0.1% AEP or 1 in 1000 probability) as part of the appraisal, to assess the impacts of failure of the Scheme or other measures, and, if appropriate, include for in the design of the Scheme.

4.2.2 Design Flood Estimation

A design flood may be determined by either of two broad categories of methods, namely;

- Methods based on statistical analysis of flood peak data, or
- Methods based on a design rainstorm and a rainfall-runoff model which converts the design rainstorm into a design flood.

A hydraulic model of the Morell River and its tributaries the Kill River, Slane River (the two of which combine within the study area to form the Painestown River), the Hartwell River and the Haynestown River was developed to predict the peak flood level profile within the modelled reach under existing conditions and under various proposed flood risk management measures for a range of return period flood events. The hydraulic model is discussed in more detail in Chapter 12 (Hydrology and Drainage).

4.2.3 Climate Change and Future Flow Scenarios

As discussed in section 4.3.1, the proposed Flood Management Scheme has been designed to alleviate flooding to properties for up to a 1% AEP event. The selected design permits for future expansion / adaption to the Mid-Range Future Scenario for climate change, should additional flood mitigation measures be required in the future.

4.2.4 Recommended Scheme

Chapter 1 has outlined the project justification, the alternatives considered and the final recommended scheme design. The proposed Option 1 was selected in conjunction with the OPW and was refined following a Feasibility Study (Appendix A), an Environmental Constraints Study, additional flood modelling and consultations with statutory and non-statutory bodies between October 2013 and December 2014. Following a technical review of the feasibility stage scheme by the OPW and consultation with Irish Rail, the scheme design was modified in late 2016 to include a flood defence upstream of the railway line at any location where the scheme would cause an increase in flood levels upstream of the railway. Further details on the evolution of the Option design process have been given in Section 1.3.9 of Chapter 1.

The proposed Option, shown overleaf in Figure 4.1, consists of the construction or restoration of over 9,000 metres of embankment, the construction of up to 480m of flood walls to direct the flood water away from high risk areas, two stream re-alignments and up to 11 culvert alterations. The key characteristics of the flood management scheme are described in Section 4.3 below.

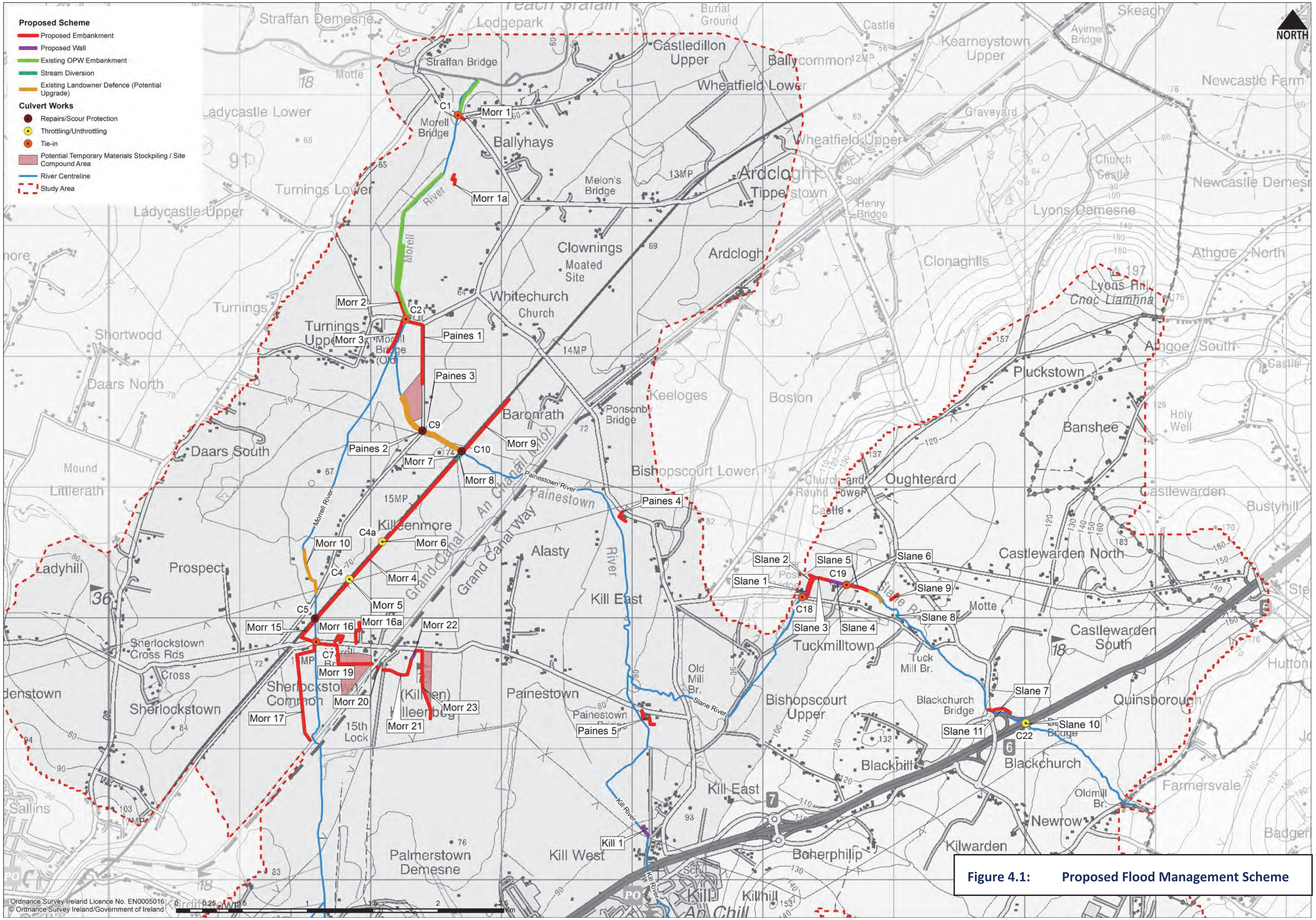


Figure 4.1: Proposed Flood Management Scheme

4.3 KEY CHARACTERISTICS OF THE PROPOSED SCHEME

4.3.1 Construction of New Embankments

The proposed scheme involves the construction of approximately 7,423 metres of new embankments. These new embankments will consist of a clay core with surrounding fill materials covered in topsoil. The required height of the embankment will determine the overall width, as the slope will have to be appropriate for the location. For example, some embankments will have low gradient slopes to allow vehicular access to the enclosed area and others will have steep slopes, to prevent access and act as a boundary for the site. Generic details for embankments are shown in Figure 4.4 and whilst specific details of each of the proposed embankments are described in Table 4.3. Where required, emergency spillways will be designed into the embankments in order to provide a safe overtopping mechanism in the event where flood flows larger than the design event occur.

Image 4.1: Example of an Embankment During Construction

Image 4.2: Example of an Embankment Post Construction, Being Re-seeded

Approximately 70,000m³ of fill material will be required for construction of the new embankments. Fill material will be sourced from licenced quarries/suppliers, however consideration will also be given to the potential for re-use of suitable construction fill from complementary engineering projects elsewhere in the local region, subject to obtaining the relevant permissions. Opportunities for sourcing suitable material available for beneficial re-use will be investigated prior to construction.

Once completed, embankments will be seeded with grass. Any temporary working areas used during the construction activities will also be reinstated to their original condition. Where treeline, hedgerow or scrub removal as part of the proposed scheme was unavoidable, a new native planting scheme will be implemented to function as replacement habitat for that removed.

4.3.2 Examination and Restoration of Existing Embankments

In addition to the proposed 7,423m of new embankments, there are approximately 1,842m of existing embankments that may require remedial/restoration works to be carried out in order to meet the minimum standard of protection required under the scheme. These embankments will be assessed for structural integrity prior to the scheme's detailed design. The report on this integrity will determine the level and extent of the restoration required. The type of restoration work required is expected to range from stripping back and expanding the width and/or height of the embankment up to complete removal and reconstruction. Where a requirement for restoration is identified, existing embankment materials may require to be tested to Waste Acceptance Criteria during detailed design (refer to section 4.4.3 and Chapter 13 for more information). The typical details for the remediated embankments will be the same as those for new embankments as detailed in Figure 4.4.

Additional fill required for remediation of existing embankments will be sourced as per 4.3.1 above for new embankments. Restoration of vegetation in temporary working areas will also be as per that for new embankments, see 4.3.1 above.

It should be noted that Figure 4.1 also shows a number of existing embankments which have previously been constructed by the OPW (displayed as green lines on this figure). These embankments have been shown on this figure and throughout the EIAR for information purposes only and no works are proposed at these embankments.

4.3.3 Construction of New Flood Walls

The scheme will require *c.* 474m of new flood walls, ranging in height from 1.0m to 2.0m. Walls will be constructed from reinforced concrete poured in situ. A cross-section for a typical flood wall is shown in Figure 4.3.

The contractor will be required to excavate foundations for the proposed flood walls. Where possible, foundations will be kept as shallow as possible to minimise the amount of exposed earth and temporary works required to support excavations. Excavated materials will be stockpiled in the temporary working area (away from the watercourse, see Section 4.4.2), with topsoil kept separately, and reused.

4.3.4 Culvert Alterations

Figure 4.2 overleaf shows the location of existing culverts in the study area. In-channel works relating to the upgrade of three existing culverts within the Morell catchment will be required. These works will include works to open up the blocked culvert (C22) beneath the N7, which currently has the inlet opening partially blocked over.

Culverts 5 and 10 will require in stream works for the installation of scour protection measures.

At Culvert 5, the construction of a new headwall and the reconstruction of an existing wall will be undertaken along the river edge. Embankments will be constructed to tie into headwalls protruding from the railway bridge. Please refer to Figure 4.10 (located at the end of this chapter) for a drawing of the preliminary design for the headwall configuration. Underpinning of the existing piers will be assessed by a structural engineer at detailed design stage.

At Culvert 10, construction of new headwalls will be undertaken along the river edge. The embankment and flood wall will be constructed to tie into headwalls protruding from the railway bridge. Please refer to Figure 4.9 (located at the end of this chapter) for a drawing of the preliminary design for the headwall configuration.

Culvert 9, which brings the Painestown River beneath the Killeenmore Road, is in a poor state of repair and will require restoration work to bring it to the required standard. The extent of restoration will be determined at the detailed design stage however these works will also be subject to an approved Method Statement and the same mitigation protocols as per culverts C5 and C10.

Scour protection shall be provided at the upstream and downstream ends of culverts, at the base of bridge piers and diverted stream bends where required. This shall be in the form of large stone pitching / cobbles placed along the slopes of the associated banks. The extent of such protection shall be agreed in consultation with IFI. Scour protection at bridge piers will include excavating below the bed level to ensure that the protection is deep enough to mitigate against undermining of the pier.

There are two small culverts crossing the railway line (identified in Figure 4.2 as Culverts 4 and 4a) that will be throttled in order to limit flow through them. The throttling will be carried out by modifying the inlet to incorporate a headwall and pipe, sized to accommodate greenfield runoff rates and designed to permit the passage of fish in accordance with the recommendations contained in *Guidelines on Protection of Fisheries during Construction works in or adjacent to Waters*' (IFI, 2016).

It is proposed that flood defences will tie into culverts 1, 2, 7, 18 and 19. These culverts will be structurally assessed at the detailed design stage to determine if they require scour protection measures or underpinning. Where such works are found to be required, these works will also be subject to an approved Method Statement and the same mitigation protocols in the impact assessment chapters 5-14 will be adhered to as per for culverts C5, C10 and C9 .

It is proposed that any in-channel works are carried out 'in the dry'. A temporary enclosure to keep out water will be constructed in the "work zone" to permit dewatering and to allow the necessary construction works to be carried out in safe, dry conditions.

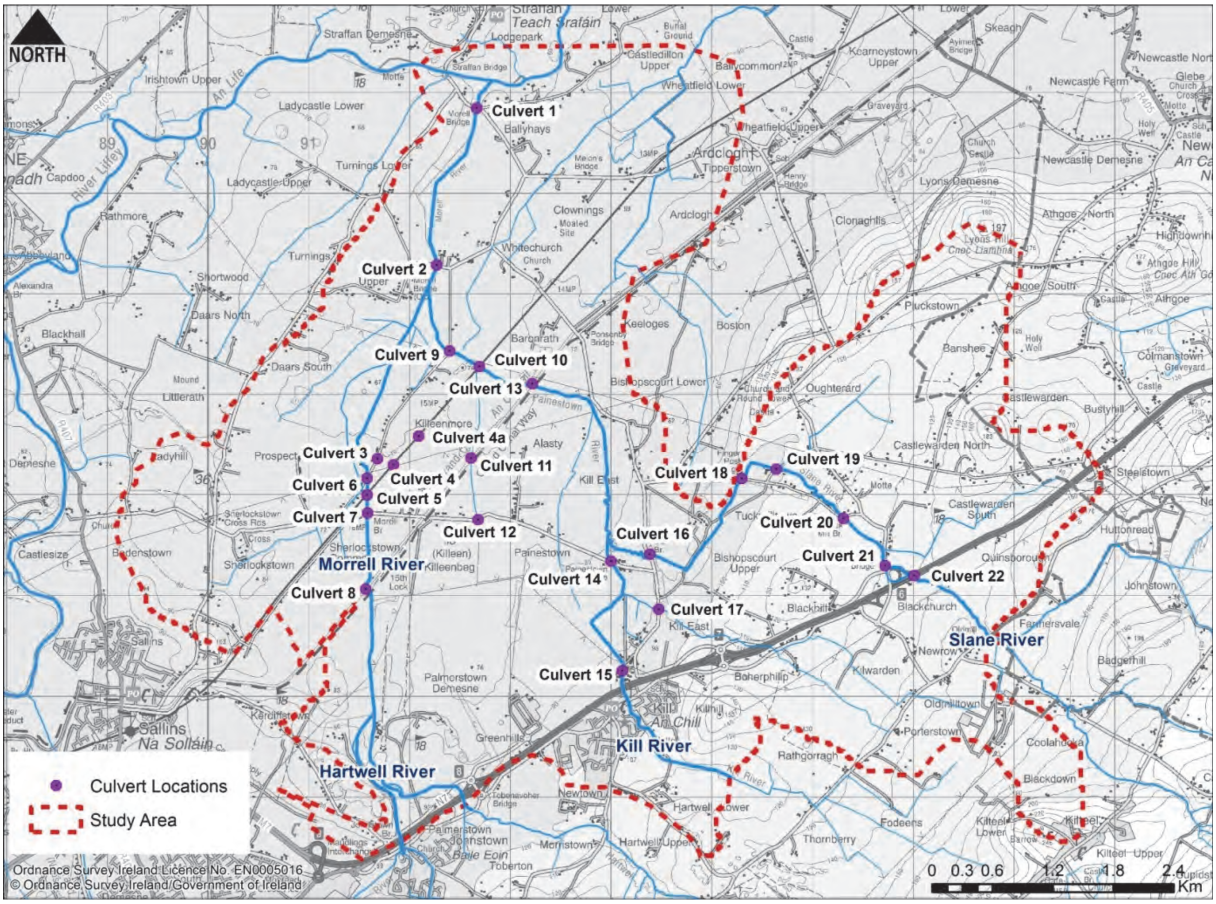


Figure 4.2: Existing Culverts

4.3.5 Stream Realignment and Tie Ins

4.3.5.1 Stream Realignment

Stream realignment works are also proposed at Slane 08 and Morr 08 in Tuckmilltown and Killeenmore. The stream realignments are to be carried out in accordance with the recommendations within the Inland Fisheries Ireland (IFI) document '*Requirements for the protection of Fisheries Habitat during construction and Development Works at River Sites*' (ERFB, 2003).

The proposed realignment in Tuckmilltown (Slane 08) will remove the sharp ox-bow bend that currently exists, as shown in Images 4.3-4.5, by excavating a new channel to divert the flow. The river flow will be diverted through the new channel which will improve the flow regime and reduce the level of erosion that occurs during periods of high flow. The proposed design of the new channel is given in Figure 4.8 (located at the end of this Chapter). The proposed diversion in Killeenmore (Morr 08), shown in Figure 4.9 (located at the end of this Chapter) is required to allow a flood defence to be constructed between the stream and the railway embankment.

Image 4.3: Slane 08 Re-alignment Location

Image 4.4: Bend for Re-Alignment (angle 1)

Image 4.5: Bend for Re-Alignment (angle 2)

It is proposed that the plant required to construct the diversion can operate from the river bank without need to enter the stream. However, works have the potential for significant sediment disturbance and run-off during this operation. Mitigation measures, described in more detail in Chapters 11 (Aquatic Ecology) and 13 (Soil, Geology and Hydrogeology), include methods to prevent silt being discharged into the watercourse. A detailed Method Statement for the realignment will be discussed and agreed with the relevant authorities in advance of the works commencing. An outline methodology for the construction of the stream diversion has been included in the Construction & Environmental Management Plan (CEMP) attached in Appendix B, in Volume 3 of the EIAR.

For the proposed channel realignments at Slane 08 and Morr 08, the excavation works to construct the new channel alignment will be carried out in dry conditions without connection to the existing watercourse. The stream diversions will have a natural stream bed and will replicate insofar as practicable the stream bed material characteristics of the watercourse.

The connection of the new stream channel to the existing watercourse shall only be made during timing window agreed with IFI for in-stream works. IFI shall be consulted on the construction of in-stream features as outlined in the IFI document: '*Guidelines on Protection of Fisheries during Construction works in or adjacent to Waters*' (IFI, 2016). The IFI will be consulted on the need to relocate resident fish stocks from the sections of watercourse to be abandoned. The relocation of resident fish stocks will be undertaken without delay and with minimum stress to the fish stocks.

Chapter 11, Section 11.4.1.3, includes further details of mitigation measures which will be required for the proposed stream realignments.

4.3.5.2 Tie-ins

At a number of locations across the scheme, embankments are specified to tie into culvert headwalls. These tie-ins are detailed in Tables 4.1 and 4.2. Tie-ins will be made to culverts 1, 2, 3, 4, 7, 15, 18, and 19. The works involved in these tie-ins will be similar to that involved in the construction of the embankments; the tie-ins arise from the termination of the embankments as they meet the culverts. Image 4.1 in section 4.3.1 shows an example of an embankment tie-in with an existing culvert.

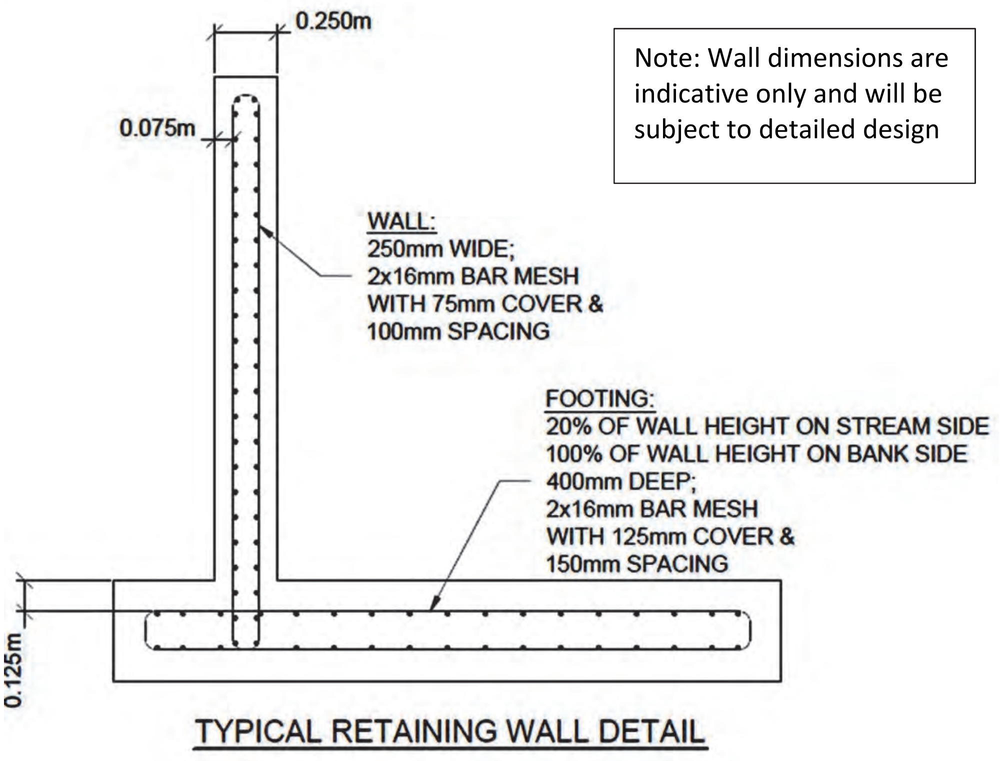
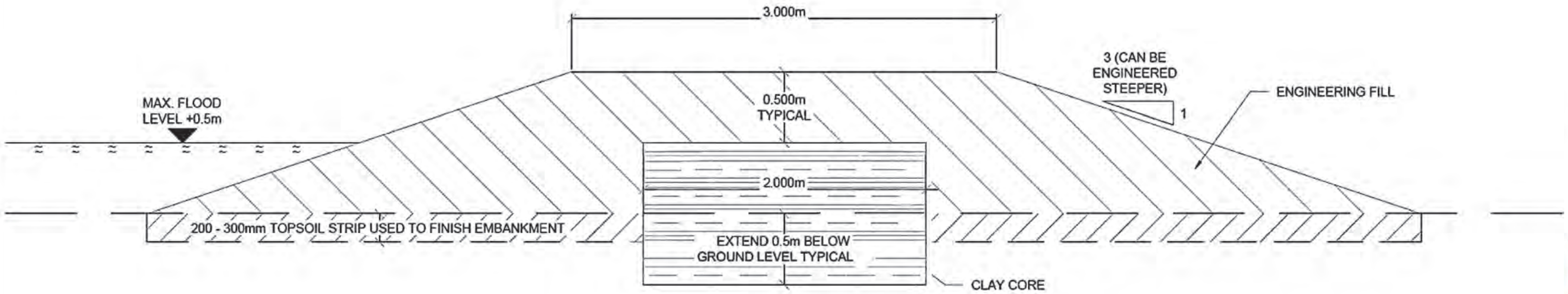


Figure 4.3: Section view of Typical Flood Wall



TYPICAL FLOOD EMBANKMENT DETAIL

Note
- Subject to Detailed Design

Legend

Project: River Morell FMS

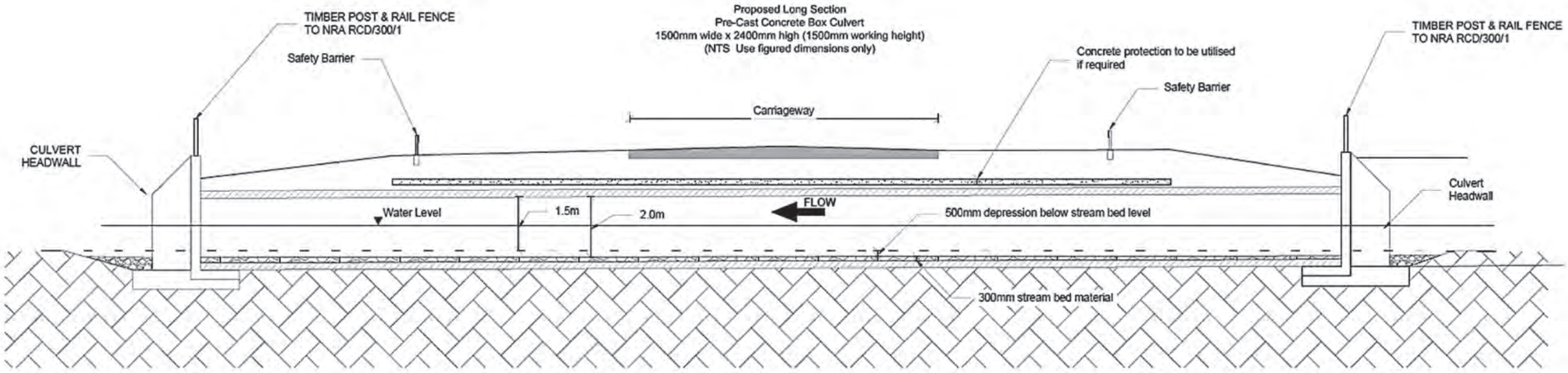
Title: **Typical Flood Embankment Detail**

Figure 4.4

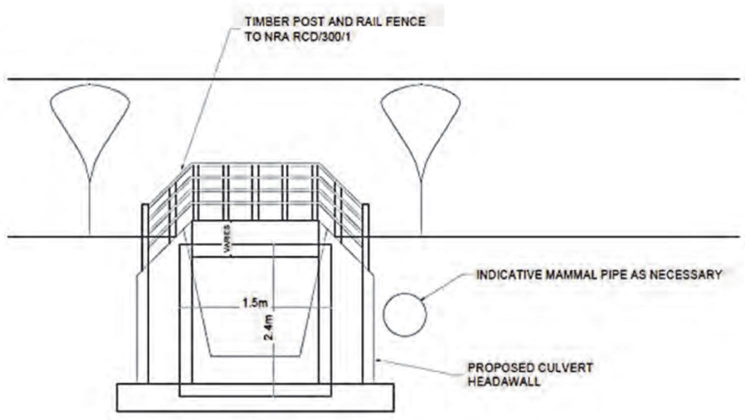
RPS Consulting Engineers
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900
Fax: +353 1 462 0814

Issue Details

Drawn: BT	**Project No.** MDW0575
Checked: SM	**File Ref:** MDW0575QG1090D02
Approved: PM	
Scale: NTS	**Map Projection:** N/A
Date: 28/02/2017	



TYPICAL CULVERT SECTION



TYPICAL HEADWALL DETAIL

Note
- Subject to Detailed Design

Legend

Kildare County Council

Project	River Morell FMS
Title	Typical Culvert & Headwall Detail

Figure 4.5

RPS

RPS Consulting Engineers
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900
Fax: +353 1 462 0814

Issue Details

Drawn: BT	**Project No.** MDW0575
Checked: SM	**File Ref:**
Approved: PM	MDW0575QG1092D02
Scale: NTS	**Map Projection:**
Date: 28/02/2017	N/A

Table 4.1: Proposed Scheme Measures - Embankments and Walls

Layer	Townland	EIA Report Ref	Length (m)	Max Height (m)	Average Height (m)	Description
Embankment	Ballyhays	Morr 1	50	1.1	0.9	Located along edge of field and road boundary. Will tie into Culvert 1 beneath R406.
Embankment	Ballyhays	Morr 1a	100	0.84	0.7	Located along field boundary. Required to cut off new overland flow path caused by additional flows through culvert 2
Embankment	Turnings Lower	Morr 2	217	1.25	1.18	Located along riverbank - upgrade to existing embankment. Will tie into Culvert 2 beneath L6016. Required to cut off overland flow path created by additional flows flowing through culvert 2.
Embankment	Turnings	Morr 3	293	1.40	1.14	Located along riverbank in agricultural field. Access adjacent to Road L6016 needs to be maintained. Will tie into Culvert 2 beneath L6016. Will tie into existing high ground at other end.
Embankment	Turnings	Paines 1	569	2.06	1.69	Located on boundary of agricultural field adjacent to the L60161. Local field access needs to be maintained. Will tie into Culvert 2 beneath L6016.
Existing Landowner Embankment (Remediation)	Turnings	Paines 2	649	2.00	NA	Located along riverbank in agricultural field.
Existing Landowner Embankment (Remediation)	Turnings	Paines 3	665	1.80	NA	Western and Eastern end - riverbank agricultural field. Middle Section (either side of road) - riverbank residential garden
Embankment	Killeenmore	Morr 4	1613	1.6	1.18	Located upstream of railway. Tie ins to culvert 5, culvert 4 and culvert 4a required.
Culvert Upgrade	Killeenmore	Morr 5	NA	NA	NA	Throttle required on culvert 4
Culvert Upgrade	Killeenmore	Morr 6	NA	NA	NA	Throttle required on culvert 4a
Wall	Killeenmore	Morr 7	76	1.69	1.4	For this section, tributary of Painestown runs adjacent to the rail line. Wall required rather than embankment due to space restrictions. Tie in to culvert 10 required.
Stream Diversion	Killeenmore	Morr 8	79	NA	NA	Painestown Tributary to be diverted to allow for construction of flood defence. Stream currently adjacent to railway embankment in this location.
Embankment	Baronrath	Morr 9	532	1.52	1.31	Located upstream of railway. Eastern side of Painestown River. Tie in to culvert 10 required.
Existing Landowner Embankment (Remediation)	Killeenmore	Morr 10	374	NA	NA	Riverbank - Field Boundary Agricultural field
Embankment	Killeenmore	Morr 15	290	1.47	1.25	Located at boundary of agricultural field, runs adjacent to the Dublin-cork railway line and L2010. Local field access needs to be maintained. Will tie into upgraded Culvert 5 beneath Dublin-Cork Railway. Will tie into Culvert 7 beneath L2010.
Embankment	Killeenmore	Morr 16	143	0.75	0.65	Located at boundary of agricultural field but also around the boundary of a property.
Embankment	Killeenmore	Morr 16a	187	0.82	0.7	Located along boundary of agricultural fields and laneway. Local field access needs to be maintained.
Embankment	Sherlockstown	Morr 17	867	1.70	1.13	Located along field boundary and through agricultural field – as agreed with landowner. Local field access needs to be maintained. Will tie into Culvert 7 beneath L2010. Internal field access required.
Embankment	Killeenmore	Morr 19	555	1.73	1.32	Located along field boundary in agricultural field adjacent to the L2010. Path agreed with landowner. Local field access needs to be maintained. Will tie into Culvert 7 beneath L2010.

Layer	Townland	EIA Report Ref	Length (m)	Max Height (m)	Average Height (m)	Description
Embankment + Culvert	Killeenmore	Morr 20	11	1.05	1.05	Located in ditch running along canal – Throttle introduced to limit flows through ditch during floods. Low flows to be unaffected.
Embankment	Killeenmore	Morr 21	314	1.73	1.73	Located within golf course lands. Defences will tie into existing landscape of Golf Course.
Wall	Killeenmore	Morr 22	76	1.9	1.8	Located within golf course lands. Upgrade to existing boundary wall for golf club car park and tie into the other golf club defences
Embankment	Killeenmore	Morr 23	578	2.06	1.51	Located within golf course lands. Defences will tie into existing landscape of Golf Course and down along the boundary of the golf club.
Embankment	Alasty	Paines 4	107	0.50	0.50	Located along agricultural field and property boundary. Internal field access required.
Embankment	Painestown	Paines 5	186	1.20	1.20	Located along riverbank and adjacent to property boundaries.
Wall	Tuckmilltown	Slane 1	90	1.40	1.40	Riverbank - Boundary residential garden / field. Will tie into Culvert 18 beneath L6021.
Embankment	Tuckmilltown	Slane 2	121	1.40	1.40	Riverbank - Boundary residential garden / field.
Embankment	Tuckmilltown	Slane 3	302	1.80	1.40	Riverbank - Boundary residential garden / field. Will tie into Culvert 18 beneath L6021.
Wall	Tuckmilltown	Slane 4	131	1.60	1.40	Riverbank - Boundary residential garden. Will tie into Culvert 19 beneath L6019.
Embankment	Tuckmilltown	Slane 5	144	1.30	1.30	Riverbank - Boundary residential garden. Will tie into Culvert 19 beneath L6019.
Existing Landowner Embankment (Remediation)	Tuckmilltown	Slane 6	155	2.00	2.00	Riverbank - Boundary commercial yard
Embankment	Blackchurch	Slane 7	177	1.50	1.50	Located along riverbank. Boundary with agricultural field. Access to retention area required.
Stream Realignment	Tuckmilltown	Slane 8	21	N/A	N/A	Field - realignment of stream to prevent further erosion of river bank.
Embankment	Tuckmilltown	Slane 9	67	0.75	0.6	Located along field boundary to cut off overland flow path
Culvert Opening	Blackchurch	Slane 10	NA	NA	NA	Opening of throttle installed on culvert below N7
Excavation	Blackchurch	Slane 11	NA	NA	NA	Excavation of a flood storage zone between the Slane River and Slane 7 embankment.
Wall	Kill East	Kill 1	101	1.5	1.5	Riverbank - Boundary residential garden. Will tie into Culvert 15 beneath L6014.

Table 4.2: Proposed Scheme Measures - Culverts

Name	Townland	River	Road / Railway / Canal	Scheme Interaction
Culvert 1	Ballyhays	Morell	R406	Morr 1 will tie into culvert.
Culvert 2	Turnings Lower	Morell	L6016	Morr 2, Morr 3 and Paines 1 will tie into culvert.
Culvert 3	Killeenmore	Morell	L60161	
Culvert 4	Killeenmore	Morell	Dublin-Cork Railway	Throttle to be installed upstream of culvert. Morr 4 to tie into culvert.
Culvert 4a	Killeenmore	Morell	Dublin-Cork Railway	Throttle to be installed upstream of culvert. Morr 4 to tie into culvert.
Culvert 5	Killeenmore	Morell	Dublin-Cork Railway	N/A
Culvert 6	Killeenmore	Morell	L60161	Morr 4, Morr 15 will tie into culvert.
Culvert 7	Sherlockstown	Morell	L2010	Morr 15, Morr 17 and Morr 19 will tie into culvert.
Culvert 8	Sherlockstown	Morell	Grand Canal	No Change
Culvert 9	Killeenmore	Painestown	L60161	Possible upgrade required. Culvert in poor condition.
Culvert 10	Baronrath	Painestown	Dublin-Cork Railway	Morr 7 and Morr 9 will tie into culvert. Morr 8 Stream diversion will join Painestown upstream of this culvert.
Culvert 11	Alasty	Alasty Stream	Grand Canal	No Change
Culvert 12	Killeenbeg	Alasty Stream	L2010	No Change
Culvert 13	Alasty	Painestown	Grand Canal	No Change
Culvert 14	Painestown	Painestown	L2010	No Change
Culvert 15	Kill West	Kill	L6014	Kill 1 will tie into culvert.
Culvert 16	Painestown	Slane	L2007	No Change
Culvert 17	Kill East	Painestown	L2007	No Change
Culvert 18	Tuckmilltown	Slane	L6021	Slane 1 and Slane 3 will tie into culvert.
Culvert 19	Tuckmilltown	Slane	L6019	Slane 4 and Slane 5 will tie into culvert.
Culvert 20	Tuckmilltown	Slane	L6021	No Change
Culvert 21	Blackchurch	Slane	L6021	No Change
Culvert 22	Blackchurch	Slane	N7	Opening Culvert, the existing culvert is partially sealed, the ends of the culvert will opened to facilitate the scheme

Table 4.3: Embankment Construction - Quantity Estimates

	Embankment Cross Section						Core Cross Section		Fill Import			Excavation		
EIA Report Ref	Slope	Full Height	Crest Width	Embankment Footprint (m)	Embankment Length (m)	Overall Embankment Cross Sectional Area	Core above GL	Core below GL	Total Eng Fill Quantity (m³)	Total Core Quantity (m³)	Total Fill (m³)	Total Excavation for Core	Total Topsoil Strip	
Morr 1	1.00 3.00	0.90	3	8.4	50	5.13	1.71	0.75	171	123	294	38	105	Group 1
Morr 1a	1.00 3.00	0.70	3	7.2	100	3.57	1.19	0.75	238	194	432	75	180	
Morr 2	1.00 3.00	1.18	3	10.08	217	7.72	2.57	0.75	1116	721	1837	163	547	
Morr 3	1.00 3.00	1.14	3	9.84	293	7.32	2.44	0.75	1430	935	2364	220	721	
Paines 1	1.00 3.00	1.69	3	13.14	569	13.64	4.55	0.75	5173	3013	8187	427	1869	
Morr 4	1.00 3.00	1.18	3	10.08	1613	7.72	2.57	0.75	8299	5359	13658	1210	4065	Group 2A
Morr 9	1.00 3.00	1.31	3	10.86	532	9.08	3.03	0.75	3220	2009	5229	399	1444	
Morr 15	1.00 3.00	1.25	3	10.5	290	8.44	2.81	0.75	1631	1033	2664	218	761	
Morr 16	1.00 3.00	0.65	3	6.9	143	3.22	1.07	0.75	307	261	567	107	247	
Morr 16a	1.00 3.00	0.70	3	7.2	187	3.57	1.19	0.75	445	363	808	140	337	
Morr 17	1.00 3.00	1.13	3	9.78	867	7.22	2.41	0.75	4174	2737	6911	650	2120	
Morr 19	1.00 3.00	1.32	3	10.92	555	9.19	3.06	0.75	3399	2116	5515	416	1515	
Morr 20	1.00 3.00	1.05	3	9.3	11	6.46	2.15	0.75	47	32	79	8	26	Group 2B
Morr 21	1.00 3.00	1.73	3	13.38	314	14.17	4.72	0.75	2966	1718	4684	236	1050	
Morr 23	1.00 3.00	1.51	3	12.06	578	11.37	3.79	0.75	4381	2624	7006	434	1743	
Paines 4	1.00 3.00	0.50	3	6	107	2.25	0.75	0.75	161	161	321	80	161	Group 3
Paines 5	1.00 3.00	1.20	3	10.2	186	7.92	2.64	0.75	982	631	1613	140	474	
Slane 2	1.00 3.00	1.40	3	11.4	121	10.08	3.36	0.75	813	497	1310	91	345	
Slane 3	1.00 3.00	1.40	3	11.4	302	10.08	3.36	0.75	2029	1241	3271	227	861	
Slane 5	1.00 3.00	1.30	3	10.8	144	8.97	2.99	0.75	861	539	1400	108	389	
Slane 7	1.00 3.00	1.50	3	12	177	11.25	3.75	0.75	1328	797	2124	133	531	
Slane 9	1.00 3.00	0.60	3	6.6	67	2.88	0.96	0.75	129	115	243	50	111	
				Totals	**7,423**				**43,300**	**27,217**	**70,517**	**5,567**	**19,600**	

4.4 CONSTRUCTION ACTIVITIES

4.4.1 Programme and Phasing of Works

The construction works are proposed to commence at the confluence of the Rivers Morell and Liffey and from there the works will progress upstream, subject to the availability of suitable construction material. Within the works, the main artery of the scheme will be prioritised from embankments and associated tie-ins and culverts.

As shown in Tables 4.4 and 4.5 below, the scheme will require approximately 61 weeks of construction in total, however the nature of the works dictate that they should be undertaken in settled weather, without flood risk. As such, it is hoped that the construction of the scheme will be completed within three years; however it may require up to four years, particularly if adverse/extreme weather conditions are encountered for prolonged periods of any particular year.

As discussed in Section 4.4.3, approximately 70,000m³ of suitable fill material will be required to construct the new embankments. During the construction phase, there will be an average of 40 HGV deliveries per day (80 HGV movements) bringing the required construction materials to the embankment or flood wall under construction. Thus, on an average day there would be around 5 deliveries per hour over the 8 hour working day. A maximum of 60 HGV deliveries will be permitted in any single day.

The “best case” scenario, based on completing all works within three years, considers the following groupings of works:

- **Group One**: The section from the confluence of the River Morell/River Liffey to Killeenmore (Morr 1 to 3 and Paines 1 to 3) which should hopefully be completed as a single phase.
- **Group Two**: The second group of works consists of the embankments, walls, culverts and stream diversions from Morr 4 to 23 and may be divided across two years, depending on construction delivery time. If this is the case, Morr 4 to Morr 19 would most likely be completed as phase 2A in year one and Morr 20 to 23 as phase 2B in year two.
- **Group Three:** encompasses Paines 4 & 5, Kill 1 and Slane 1 to 11.

It is proposed that any excavated materials will be reused, where suitable, for restoring the existing embankments and building the new embankments.

Table 4.4: Phasing Estimates – New Embankments

Haul Phase	Section	Proposed Haul Route	No. HGV movements per day (average)	Construction timeframe (weeks)
1	Morr 1	N7(Jn.7) & R406	80	0.2
2	Morr 1a		80	0.3
3	Morr2	N7(Jn.7), R406& local Road (off L6016/Killeenmore Road)	80	1.1
4	Morr 3		80	1.5
5	Paines 1		80	5.1

Haul Phase	Section	Proposed Haul Route	No. HGV movements per day (average)	Construction timeframe (weeks)
6	Morr 4	N7 (Jn.9), R407, L2010	80	8.5
11	Morr 9		80	3.3
12	Morr 15		80	1.7
13	Morr 16		80	0.4
14	Morr 16a		80	0.5
15	Morr 17		80	4.3
16	Morr 19		80	3.4
17	Morr 20	N7(Jn.7), R406 & L2010	80	0.0
18	Morr 21		80	2.9
19	Morr 23		80	4.4
20	Paines 4	N7 (Jn. 7), R406	80	0.2
21	Paines 5	N7 (Jn. 7), R406, L2010	80	1.0
22	Slane 2	N7 (Jn. 7) R406, L6021, L6019	80	0.8
23	Slane 3		80	2.0
24	Slane 5		80	0.9
25	Slane 7	N7 (Jn. 6), L2011	80	1.3
26	Slane 9	N7 (Jn. 7), R406, L6021	80	0.2
			Total	**44.1**

Table 4.5: Phasing Estimates – Other Elements

Haul Phase	Section	Proposed Haul Route	No. HGV movements per day (average)	Construction timeframe (weeks)
1	Morr 5	N7(Jn.9), R407, L2010	80	1.0
2	Morr 6		80	1.0
3	Morr7		80	3.0
4	Morr 8		80	1.0
5	Morr 22	N7(Jn.7), R406 & L2010	80	3.0
6	Slane 1	N7 (Jn. 7), R406, L6021, L6019	80	2
7	Slane 4		80	2
8	Slane 8		80	1.0
9	Slane 10	N7 (Jn. 6)	80	0.5
10	Kill 1	N7 (Jn. 7), R406, Local Road off R406	80	2.0
			Total	**16.5**

4.4.2 Site Preparation

The contractor will establish a temporary main site compound during construction, which will include the following amenities:

- Adequate materials drop-off and storage area
- Canteen complete with tables, chairs, sink, fridge, kettle, etc.
- Drying area
- Toilets and washing facilities
- Adequate Parking
- Offices
- First aid room (stocked)
- Bunded fuel storage

Perimeter hoarding or fencing will be provided around the main site compound to provide a barrier against unauthorised access from the public. Controlled access points to the main site compound, in the form of gates or doors, will be kept locked for any time that these areas are not monitored (e.g. outside working hours). All hoarding or fencing will be kept well maintained.

To assist with the local distribution of construction materials required to build the embankments, three areas have been identified as potential locations for temporary stockpiling / set down of materials; in the vicinity of Paines 1-3, Morr 19 and Morr 23, shown on Figure 4.1. The main compound may be located at one of these identified stockpiling/compound areas and be established specifically for the project, or may alternatively use suitable existing premises, if one is available. It should be noted that the archaeological impact assessment (Chapter 14) has identified the compound area at Paines 1-3 as having archaeological potential and therefore topsoil stripping at this compound will only be carried out if archaeological testing has been completed (see section 14.4.1). To avoid the need for topsoil stripping at this site, the contractor will instead temporarily stockpile fill material on top of a geotextile layer at this location if it is required for material storage.

Each embankment, wall and culvert upgrade will be a small satellite compound for the project. The satellite sites will contain only basic welfare facilities (i.e. portable toilet) at the temporary working area.

The temporary working area around each of the satellite sites will be clearly marked out and, where necessary, appropriate temporary fencing erected e.g. heras type fencing and/or livestock fencing. For the majority of the works, the working area will consist of a 15m wide temporary work zone on the land side of the feature being constructed, in addition to the footprint of the feature being constructed.

Measures to prevent silt run-off will be deployed as part of the rolling construction methodology (see also Chapter 11, Aquatic Ecology). For works within 10m of river banks, the river side of the embankment or flood wall excavation will be separated from the river by a sediment barrier. This barrier will prevent silt run-off into the river. The construction of the sediment barrier will be a priority during site setup and will remain in situ until the works have been completed. Vegetation will be removed as required within the temporary working area. The work areas will be accessed through existing farm tracks and it is not expected that any new access tracks will be required for the construction. Plant machinery may also travel on top of the embankments as they are being constructed to reach the working area.

With the exception of the works required for Morr 4 and Morr 7-9 which will require temporary bridging of two tributary streams and potentially the Painestown River, access through the working areas will not traverse any rivers. Further details of temporary bridging are provided in Section 4.4.2.3. Should the need for alternative access tracks / routes arise during the detailed design phase, then these will be agreed with the project ecologists and the relevant authorities during the development of the CEMP, in advance of works commencing.

All machinery used for the works will be inspected prior to works and regularly during the works, to ensure it is maintained in good working condition. Works adjacent to a riverbank will be carried out from the land side of the works, i.e. further away from the watercourse, or on the top of the embankment itself. The refuelling of mobile plant in the working area will be undertaken well away from any drains or water bodies.

Excavated material will be stockpiled on the land side of the works within the temporary working area. Additional fill material will be delivered as required. However, if material becomes available before it is ready to be used for the embankment construction, a number of potential stockpiling locations have been identified. Their locations are recorded in Figure 4.1.

Third party services information will be sourced and included in contract documents for issue to tender. Warning signs and bunting will be erected for overhead cables and temporary crossing points clearly indicated.

4.4.2.1 General Mitigation

General mitigation measures are proposed below to address potentially adverse effects of the proposed scheme on the aquatic ecology of the rivers involved in the proposed scheme, i.e. the Morell, Kill, Painestown and Slane Rivers – the ‘Morell Catchment’. More detailed mitigation measures for all aspects of the scheme are included in the various individual impact assessment chapters (Chapters 5-14). A summary of all the recommended mitigation measures is presented in Chapter 15.

An over-arching mitigation measure will be for Kildare County Council and the contractor to draw up a Construction Environmental Management Plan (CEMP) with a Method Statement that details the specific mitigation measures to be employed for each works area. An outline example of the CEMP is included as Appendix B.

This Method Statement is to be strictly adhered to by staff and contractors involved in the works and will be overseen by the contractor’s representative/foreman. The Environmental Management Protocols and Standard Operating Procedures (SOPs) will form the backbone of the Method Statements, supplemented by specific additional measures proposed below. There should be ongoing consultation by the Contractor and Kildare County Council with IFI and NPWS throughout all phases of the works.

All instream works should be carried out in times of low flow (where possible) and in accordance with stakeholders’ requirements regarding protection of local ecology. Mitigation measures in relation to control of the stream flow may include methods such as:

- Incorporating a flume;

- Construction of a temporary diversion channel;
- Construction of a temporary dam, or
- Over pumping, etc.

Instream construction activity has the potential to disturb sediment. In order to mitigate against the transport of sediment through the watercourses; silt management devices should be installed prior to any construction operations commencing. The specific silt management methods to be used at each works area shall be detailed in the contractor's Method Statement and shall be agreed with all stakeholders prior to their implementation in relation to the most appropriate method to adopt (e.g. silt fences, straw bales, sedi mats, etc.). The Method Statement should include how these mitigation measures will be monitored for effectiveness by both Kildare County Council themselves and independently, e.g. through water quality monitoring.

A robust mechanism for reporting of pollution incidents will be agreed in advance between the Contractor, Kildare County Council and the IFI and NPWS. A draft example is included in the outline CEMP in Appendix B, however if the main contractor already has a standard spill response procedure in operation then this will instead be amended to reflect the local conditions on site.

The works are proposed to take place during settled weather which should reduce the risk of a flood event occurring during construction. However, should a flood warning be raised during the construction phase, every effort will be made to make any active working areas safe, e.g. removal of plant machinery and all stores of fuels, oils and wastes from areas within range of flood waters. Open excavations will be backfilled and compacted to replicate the original condition insofar as is possible. Measures to be taken in the event of a flood warning for each of the works area will be described within the Method Statement.

4.4.2.2 Construction Phase

Pollution Prevention strategies will be implemented by the contractor as part of their construction methodology to ensure best practice on-site in preventing pollution and suspended sediment release to surface watercourses and groundwater. The Contractor will be referred to the following guidance documents from CIRIA: Technical guidance C648: *'Control of Water Pollution from Linear Construction Projects*' (CIRIA, 2006), Technical Guidance C532 '*Control of water Pollution from Construction Sites: Guidance for Consultants and Contractors'* (CIRIA, 2001) and Technical guidance C649 '*Control of Water Pollution from Linear Construction Projects - Site Guide'* (CIRIA, 2006).

All necessary measures should be taken to ensure comprehensive protection of local aquatic ecological integrity; in the first place by complete impact avoidance and as a secondary approach through mitigation by reduction and remedy. The guidance document "*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*" (ERFB, 2003) includes a number of fisheries-specific constraints which will apply to this works programme. This document should be consulted by the Contractor when preparing the Method Statement to undertake these works. The maintenance of habitat integrity (both in-stream and riparian) is essential in safeguarding the ecological value of these important systems. Any works directly affecting watercourses or riparian habitats should first be submitted for assessment and approval in the Method Statement.

The proposed scheme may potentially give rise to adverse effects on water quality within the Morell catchment. The effective protection of water quality within the proposed scheme works areas during construction will minimise the risk to fish and aquatic features of the catchment. Standard pollution control and mitigation measures, as outlined in Table 4.6, should be employed where relevant when working in and near the watercourse affected by the proposed works, to prevent the transport of deleterious substances to nearby watercourses and their associated water-dependent habitats and species.

The CEMP will include how these mitigation measures will be monitored for effectiveness. It is recommended a programme of water quality monitoring is established and agreed between the Contractor, Kildare County Council, the IFI and the NPWS.

Table 4.6: Standard Pollution Prevention Control Measures

Potential Impact	Mitigation Measure
General	▪ Prior to any works, all construction personnel will receive an on-site induction relating to operations within and adjacent to watercourses and the environmentally sensitive nature of working within and in proximity to the watercourses within the Morell catchment and re-emphasise the precautions that are required as well as the mitigation measures to be implemented. ▪ The Contractor will ensure that the engineer setting out the works is fully aware of the ecological constraints and mitigation requirements. Kildare County Council will ensure that a Corrective Action procedure is put in place in the event of an incident onsite. ▪ The amount of bare ground created by excavation and vegetation removal will be minimised to prevent run-off. ▪ Direct instream works such as culvert upgrades and proposed measures along the riverbank have the greatest potential for negative impacts during spawning / breeding and early nursery periods for aquatic protected species in the study area. No instream works or out-of-river works with potential for significant damage should occur during restricted periods for relevant species (see Table 11.22 in Chapter 11). Consultation should be undertaken with the IFI by the Contractor in this regard. ▪ Storage areas will be clearly identified, ensuring that similar items are stored together to prevent wastage. ▪ Perishable materials will be stored inside, under cover or in containers. ▪ Where possible, materials will be stored off the ground by using pallets or racking. ▪ Materials will be used within their shelf life. ▪ Materials will be stored in accordance with manufacturer's guidelines to prevent damage. ▪ Regular housekeeping checks will be made to ensure the site remains safe (in terms of reducing slip, trip and fall hazards) and environmentally sound. ▪ The amount of materials actually stored on site should be kept to a minimum to help instil the concept of the law of diminishing returns amongst operatives (i.e. resources will be used more wisely when less abundant).
Pollution of Watercourses	**General** ▪ To prevent the spread of invasive aquatic / riparian species, all plant and equipment employed on the construction site (e.g. excavator, footwear, etc.) must be thoroughly cleaned down using a power washer unit and washed into a dedicated and contained area prior to arrival on site. A sign off sheet must be maintained by the contractor to confirm cleaning. ▪ Tools and equipment are not to be cleaned in rivers. ▪ Chemicals/fuels used shall be stored in sealed containers in the site lockup prior to use. ▪ The chemicals shall be applied in such a way as to avoid any spillage or leakage. Any and all excavated material is not to be temporarily stored adjacent to watercourses ▪ Storage areas will be identified in advance of any deliveries and will be located in the area of least risk to environmental receptors. For example; should there be any storm water drainage systems on site, raw materials and hazardous liquids will be stored away from this area. ▪ Any spoil will be stored a minimum of 10 metres from watercourses, covered if practicable and sandbagged or other suitable measures employed to prevent silt run-off. ▪ Materials such as cement will be covered from the weather to prevent spoiling and caustic runoff. ▪ All hazardous liquids below 200 litres in capacity will be stored in drip trays, under cover and larger

Potential Impact	Mitigation Measure

	volumes divided into smaller containers e.g. 20 litre cans in preference to 190 litre drums.
	▪ All hazardous liquids above 200 litres will be fully bunded to 110% of their capacity. Steel drums should be avoided in favour of bunded, bulk stores with integral dispensing systems e.g. fuel cube mounted in a refuelling bay.
	
	<u>Fuelling and Lubrication</u>
	▪ The Contractor shall provide designated areas for fuel transfer away from any watercourses or drainage channels. The refuelling of mobile plant in the working area will be undertaken well away from any drains or water bodies. Oil contaminated water will be disposed of at an appropriate oil recovery plant or licensed tip site.
	▪ Vehicles will not be left unattended during refuelling. All machinery will be checked regularly for any leaks or signs of wear and tear. The Contractor will ensure that personnel are nominated as being responsible for the supervision of the filling of vehicles. Any standing machinery will have drip trays placed underneath to prevent oil and fuel leaks causing pollution.
	▪ Adequately sized spill kits will be available on site, with additional material available for restocking. Emergency spill control training will be provided for all operatives working on site including emergency communication. When crossing rivers, floating booms and silt traps will also be held onsite.
	▪ All fuels, lubricants and hydraulic fluids will be kept in secure bunded areas at a minimum of 10m from the river.
	▪ The bunded area will accommodate 110% of the total capacity of the containers within it. Containers will be properly secured to prevent unauthorised access and misuse. An effective spillage procedure will be put in place with all staff properly briefed. Any waste oils or hydraulic fluids will be collected, stored in appropriate containers and disposed of offsite in an appropriate manner.
	▪ All plant shall be well maintained with any fuel or oil drips attended to on an ongoing basis.
	▪ Any minor spillage during this process will be cleaned up immediately. Should any incident occur, the situation will be dealt with and coordinated by the nearest supervisor who will be responsible for instructions by Kildare County Council.
	▪ Disposal of unused liquids will be via a specialist, licensed contractor fully complying with relevant legislation. This will include run off from drip trays.
	
	<u>Cement/Concrete Runoff</u>
	▪ Measures relating to concrete/cement management will apply to the construction of the flood walls Morr 7, Morr 22, Slane 1, Slane 4 and Kill 1. Such measures include:
	  ▫ Disposal of raw or uncured waste concrete will be controlled to ensure that the watercourse will not be impacted;
	  ▫ Best practice in bulk-liquid concrete management addressing pouring and handling, secure shuttering / form-work, adequate curing times;
	  ▫ Where shuttering is used, measures should be put in place to prevent against shutter failure and control storage, handling and disposal of shutter oils;
	  ▫ All working materials and excavated material should be stockpiled on the land side of the works within the assigned temporary working area;
	  ▫ For works within 10m of river banks, the river side of the flood wall excavation will be separated from the river by a sediment barrier. Once the flood wall is complete the sediment barrier should be left in-situ to allow the reinstated ground around the wall to settle in. The sediment barrier should only be removed after inspection of the reinstated ground confirms that it is stable;
	  ▫ Wash water from cleaning ready mix concrete lorries and mixers may be contaminated with cement and is therefore highly alkaline. Due to the size of the site and the proximity of sensitive watercourses, it is recommended that lorries and mixers are washed out offsite.
	▪ The following activities associated with the construction of flood defence walls should be noted:
	  ▫ <u>Bank Protection</u> – Refer to OPW's Environmental Management Protocols and Standard Operating Procedures (OPW, 2011).
	  ▫ <u>Bush Cutting / Branch Trimming</u> - Refer to OPW's Environmental Management Protocols and Standard Operating Procedures (OPW, 2011).

Potential Impact	Mitigation Measure
	<u>Silt Runoff</u> Measures relating to management of silt runoff will mostly apply to the construction of the embankments. ▪ The following measures should be employed during proposed works: o Works should be carried out ideally during a period of settled weather with no flood risk which will allow sufficient time for construction materials to settle; o Embankment material should be selected that has low silt content; o All working materials and excavated material should be stockpiled on the land side of the works within the temporary working area; and o For works within 10m of river banks, the river side of the embankment excavation will be separated from the river by a sediment barrier. Once the embankment is complete the sediment barrier should be left in-situ to allow the reinstated ground around the wall to settle in. The sediment barrier should only be removed after inspection of the reinstated ground confirms that it is stable. o A silt trap will be located downstream of works. ▪ The following activities associated with the construction of embankments should be noted: □ <u>Bank Protection</u> – Refer to the OPW’s Environmental Management Protocols and Standard Operating Procedures (OPW, 2011). □ <u>Bush Cutting / Branch Trimming</u> - Refer to the OPW’s Environmental Management Protocols and Standard Operating Procedures (OPW, 2011). Additionally,the Contractor’s Method Statement will indicate what measures will be taken to avoid sediment or soil loss associated with all aspects of the construction and how these will be monitored for effectiveness. These mitigation measures in combination with the implementation of buffer areas between the works and watercourses will to reduce the likelihood of silt mobilisation.

4.4.2.3 Temporary Bridging of Watercourses

For the majority of the construction activity, the working areas will be accessed via existing farm tracks and it will not be necessary for plant machinery to cross any rivers or streams within the temporary working areas.

The measures at Morr 4 - Morr 8 (see Figure 4.6), which comprise approximately 1.6km of flood embankment, 76m of flood wall, a stream diversion and alterations to culverts 4 and 4a, will require temporary bridging to allow vehicles travelling along the temporary working area to cross the watercourse at Culvert 4 and the Painestown tributary stream at Morr 8. The temporary working area may also travel through a number of field drains. If these are required to be disturbed, practical measures will be undertaken during the construction phase to prevent soils from entering the watercourse and these will be included in the Method Statement.

The works at Culvert 10 and Morr 9 are also likely to require a temporary crossing over the Painestown River, upstream of Culvert 10, to facilitate construction of the *c.* 0.5km embankment at this location, as it may not be possible to gain access to the working area for these measures from the R406.

At the conclusion of stream diversion works at Slane 8, plant will be required to cross the newly-diverted Slane River to exit the working area.

Each temporary crossing will be included in the Method Statement for its associated works area. The design of each crossing will take into account the recommendations on temporary crossing structures in '*Guidelines on Protection of Fisheries during Construction works in or adjacent to Waters*' (IFI, 2016). Clear-span bridges are IFI's preferred approach for crossing rivers with fisheries and fish habitat (e.g. the Painestown River) but the use of a piped ford/causeway may be proposed for the smaller watercourses.

If instream works are required for the installation of a temporary crossing at the Painestown River or Slane river, these will be subject to the same timing restrictions for aquatic protected species of the Morell Catchment (Table 7.1) as other instream works.

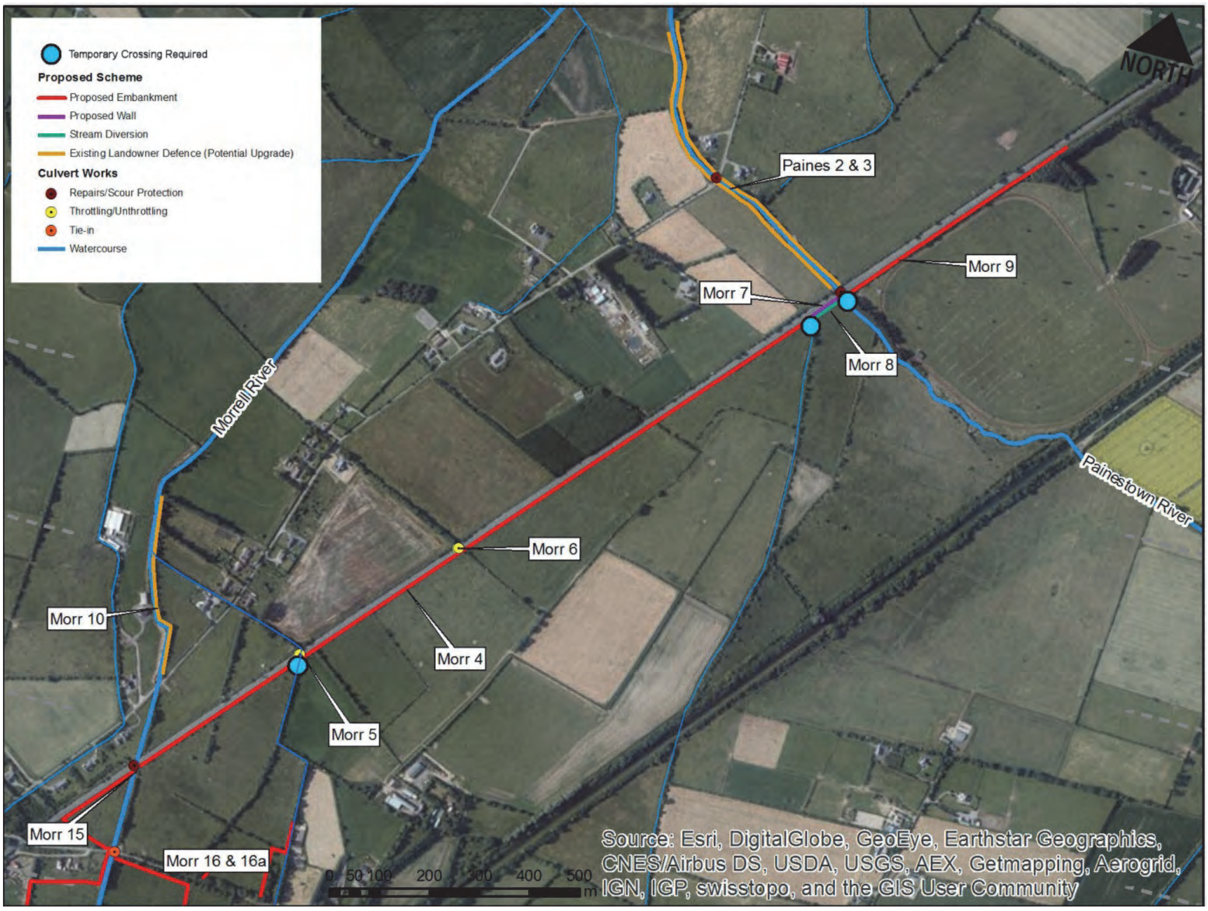


Figure 4.6: Proposed Temporary Crossings for Morr 4 - Morr 9 Works

4.4.2.4 Drainage

Toe drains will be included at the base of the embankments, where required, in order to ensure that adjacent fields can continue to drain. Existing field drains that intersect the proposed embankments will be dealt with, by diverting them to adjacent field drains or by maintaining a limited flow path through the proposed defence.

4.4.3 Excavation Works and Quantities

All embankment works will be undertaken using tracked vehicles which, for those measures sited adjacent to watercourses, will travel along the temporary works area on the side of the embankment/wall furthest away from the watercourse. Any excavated materials will be reused, where suitable, in embankment construction or remediation. As discussed earlier in Section 4.3.2 and Chapter 13, Soils, Geology and Hydrogeology, there exists the potential to encounter contaminated ground as part of the embankment excavation works, particularly towards the north of the study area at Morr 2 and Paines 1-3, but also at Slane 6. It is considered that further testing to Waste Acceptance Criteria (WAC) will need to be carried out at design stage on any of the above embankments where it is required to excavate existing material as part of the works. Should any contaminated material emerge during construction, it will be disposed of via licenced waste facilities and records maintained of transits and disposal.

It is anticipated that approximately 70,000m^3 of suitable fill material will be required to construct the new embankments. This quantity assumes that all side slopes will be 1 in 3 (see Table 4.3), however detailed design will most likely determine a range of slopes, which will mean material volumes required may vary.

The type of material required is clean stone for construction fill surrounding a clay core, with a capping layer of topsoil (Figure 4.4).

It is envisaged that different techniques will be adopted with regard to the reuse or recovery of excavated material. However, the overall intention will be to reuse surplus excavated material for side slope protection, the creation of embankments and/or the spreading of the material on the bank and adjacent lands where topsoil will be removed, excavated material will be spread and topsoil will be reinstated. These works will be undertaken with a view to minimising the transport of material off-site.

4.4.4 Vegetation Removal

Vegetation removal will be limited to removal only where necessary, this is discussed in more detail in Chapter 10 (Terrestrial Ecology). In general, trees and other vegetation will be maintained along the river bank. Scrub and overgrowth will be removed where they impede the works. Hedgerows and trees will not be removed during nesting season (i.e. March 1st to August 31st). If this seasonal restriction cannot be accommodated, a suitably qualified ecologist with experience in nest-finding will be required to check all vegetation for nests (under licence from NPWS to permit potential disturbance to nesting birds) prior to removal/trimming.

Prior to undertaking any construction works along the scheme measures, access routes or compound areas, the OPW shall engage a suitably qualified ecologist to carry out an invasive plant species survey, in the appropriate botanical season (April through to September). This should entail a walkover of the stockpiling areas and the scheme measures due for construction (including temporary working areas and access tracks) to identify any stands of invasive plants species that may have become established in the intervening period between the ecological surveys to support the EIA and the scheme’s construction. Particular attention should be given to identifying those invasive plant species listed on the Third Schedule of the Birds and Natural Habitats Regulations 2011 (as amended). If any invasive alien plant species are identified then the suitably qualified ecologist shall outline the appropriate course of action to be taken with regard to treatment prior to construction.

4.4.5 Welfare Facilities & Site Access

Welfare facilities (Canteen & Drying Room) will be provided during construction at a central location. These facilities will not be adjacent to the works but portable toilets will be provided adjacent to the works area.

Access routes to the various works areas will be agreed with landowners and will be set out during site preparation. Should route reinforcement be required, it will consist of compacted granular material which will be removed following completion of construction, or left by agreement with the landowner.

4.4.6 Working Hours

The normal working hours for the construction of this scheme will be 7.30am – 4:30pm Monday to Friday. Working hours may be extended to 7.00am - 7.00pm Monday to Friday; and 9.00am and 4.00pm on Saturdays on occasion. There will be no activity on Sundays or Bank Holidays.

Where additional or alternative working hours outside those stated above are required, these will require notification to Kildare County Council and to be agreed in advance.

4.5 SITE SAFETY

Safety will be of prime importance during the construction works. The works will be subject to the Safety, Health and Welfare at Work Act 2005 (S.I. No. 10 of 2005) and at a minimum the Safety, Health and Welfare at Work (Construction) Regulations, 2013 (S.I. No. 291 of 2013). All aspects of design construction will be reviewed with regard to health and safety and risk assessments will be carried out.

A project supervisor design process (PSDP) has been appointed. As part of their duties they will be required to produce a Preliminary Safety and Health Plan for the project. The main contractor will be appointed as project supervisor construction stage (PSCS) and will be responsible for the control and co-ordination of health and safety during the construction phase of the works. The following are the main responsibilities of the PSCS during construction:

- Liaise with the client, PSDP and contractors;
- Develop a Health and Safety Plan before commencement of construction work and maintain it for the duration of the construction activities;
- Obtain from all contractors involved in the works information for inclusion in the safety file and provide this information to the PSDP in a timely manner;
- Co-ordinate arrangements for checking the implementation of safe working procedures;
- Co-ordinate implementation of the ‘General Principles of Prevention’;
- Keep a record of information concerning accidents and comply with any request from the HSA in respect of such a record.

The Safety Plan will be based on the Preliminary Safety and Health Plan prepared by the PSDP at the design stage. The principles of the Safety Plan should be:

- Conformance with the Health and Safety legislation;
- The establishment and maintenance of a safe working environment in accordance with Health and Safety legislation;
- A clear focus on prevention.

4.6 WASTE DISPOSAL

European Directive 2008/98/EC "The Waste Framework Directive" sets the basic concepts related to waste management, such as definitions of waste, recycling and recovery. The Directive explains when waste ceases to be waste and becomes a secondary raw material, and how to distinguish between waste and by-products. The Directive outlines the requirement that waste be managed without endangering human health and harming the environment. The Directive introduces the 'polluter pays' principle and the 'extended producer responsibility'. It incorporates provisions on hazardous waste and includes new recycling and recovery targets to be achieved by 2020. Article 4 in this Directive sets out the waste hierarchy which prioritises waste management options to reduce and manage waste ranking from waste avoidance - the preferred option, followed by resource recovery and as a final option, safe disposal of waste (Figure 4.7).

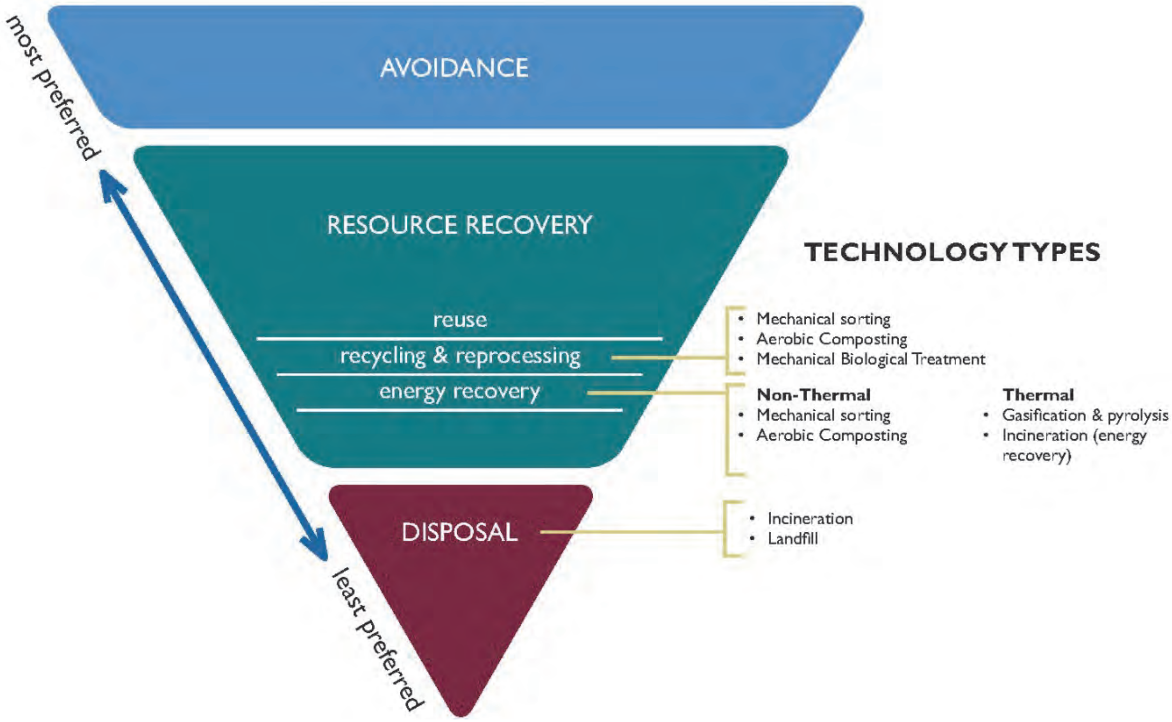


Figure 4.7: Waste Management Hierarchy

Contractors working on site during the works will be responsible for the collection, control and disposal of all wastes generated by the works. An outline Waste Management Plan is attached in Appendix M, in Volume III of the EIAR. The Contractor will be responsible for developing and updating the Waste Management Plan as required in advance of the construction phase. The Waste Management Plan will identify likely waste arisings, approximate quantities and appropriate handling and disposal methods. An important aspect of the Waste Management Plan will be to collect and control waste on site.

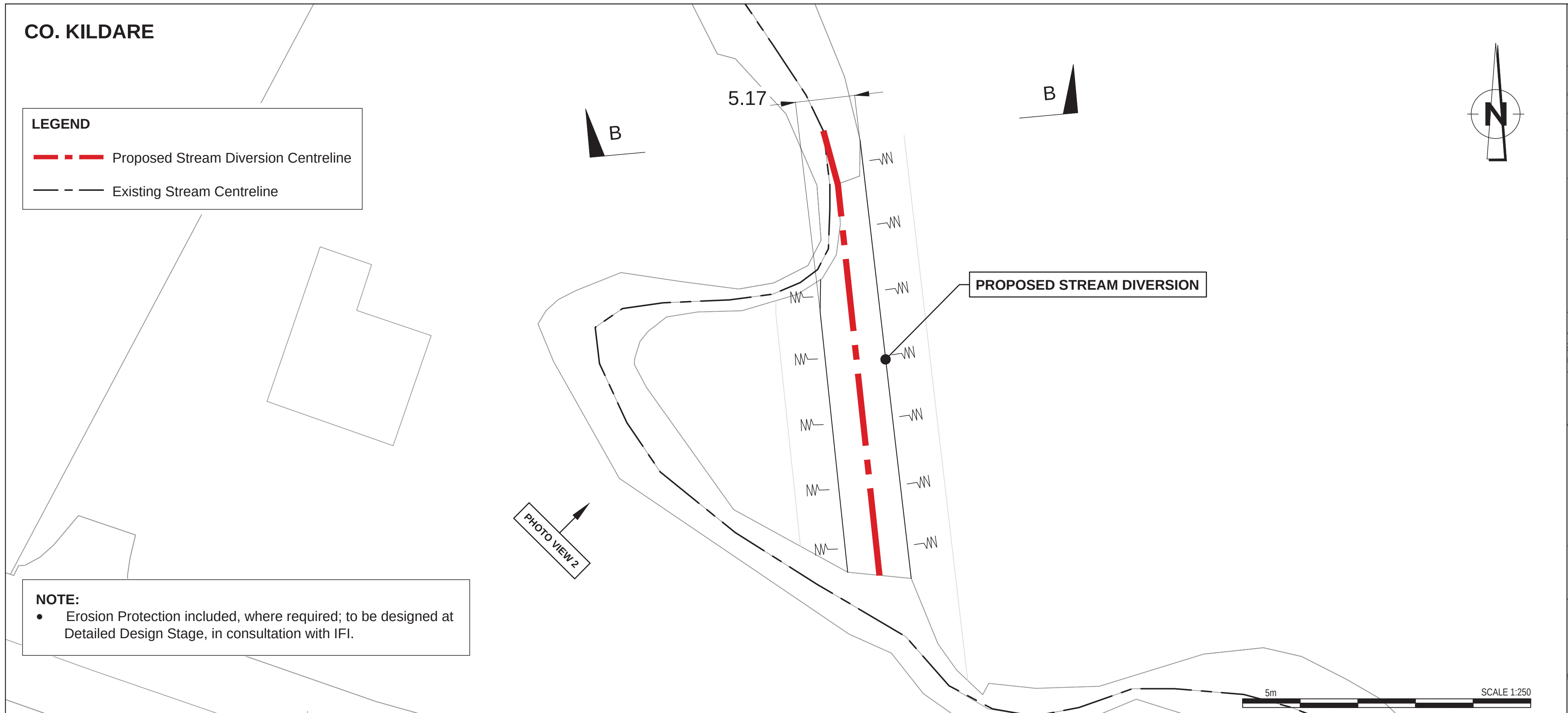
4.7 OPERATION OF THE PROPOSED SCHEME

The proposed scheme has been designed to cater for a 1% AEP event. Regular maintenance of the river channel and in particular culverts will be required to ensure it retains its conveyance capacity. This will be performed as part of the Council's regular maintenance activities. Inspection of the flood measures will take place on an annual basis and basic tasks carried out such as clearance of obstructions to flows, removal of debris or fallen trees.

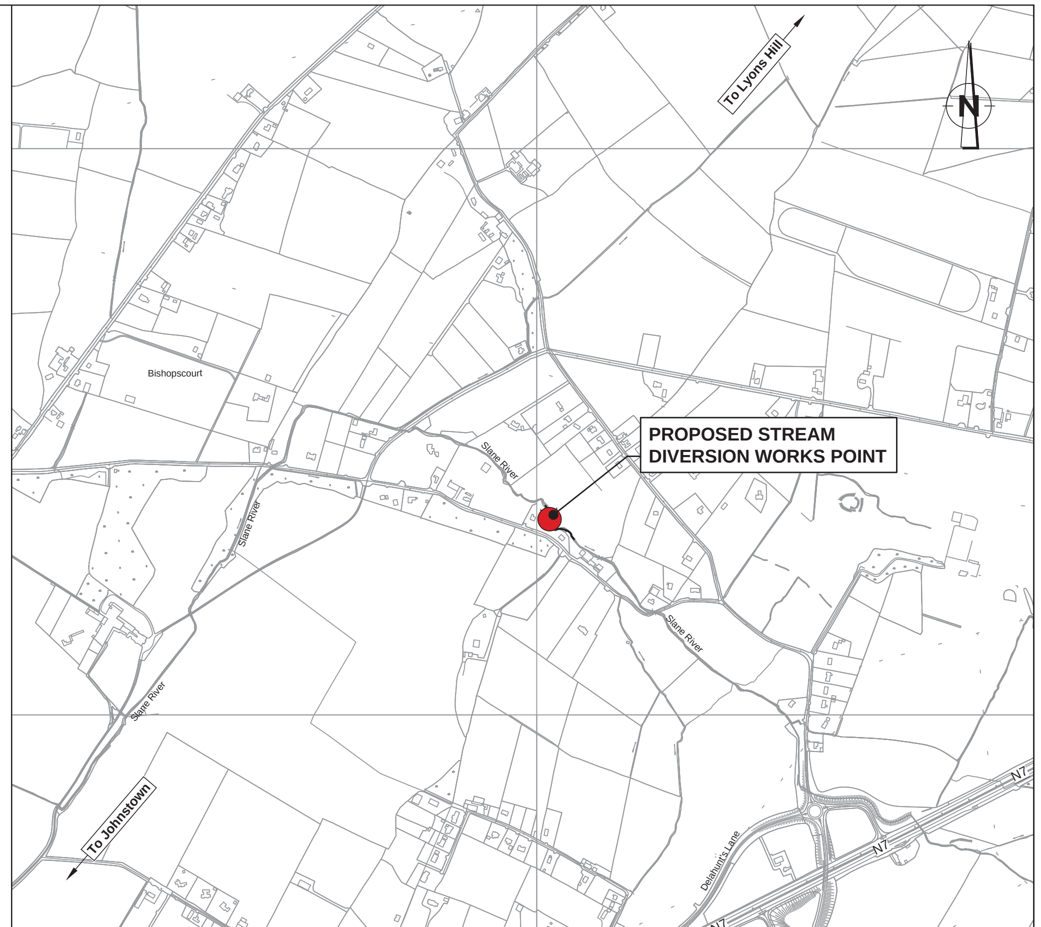
More complex maintenance activities, such as repairing and rebuilding structures (walls and embankments) will only be carried out as and when required, most likely on a six to ten year cycle. All maintenance works will be carried out in line with current best practice at the time of maintenance, e.g. the OPW's Standard Operating Procedures for Arterial Drainage Maintenance Service (OPW, 2011) and will be subject to the relevant environmental assessment requirements, including Screening for Appropriate Assessment.

This page has been left intentionally blank.

CO. KILDARE

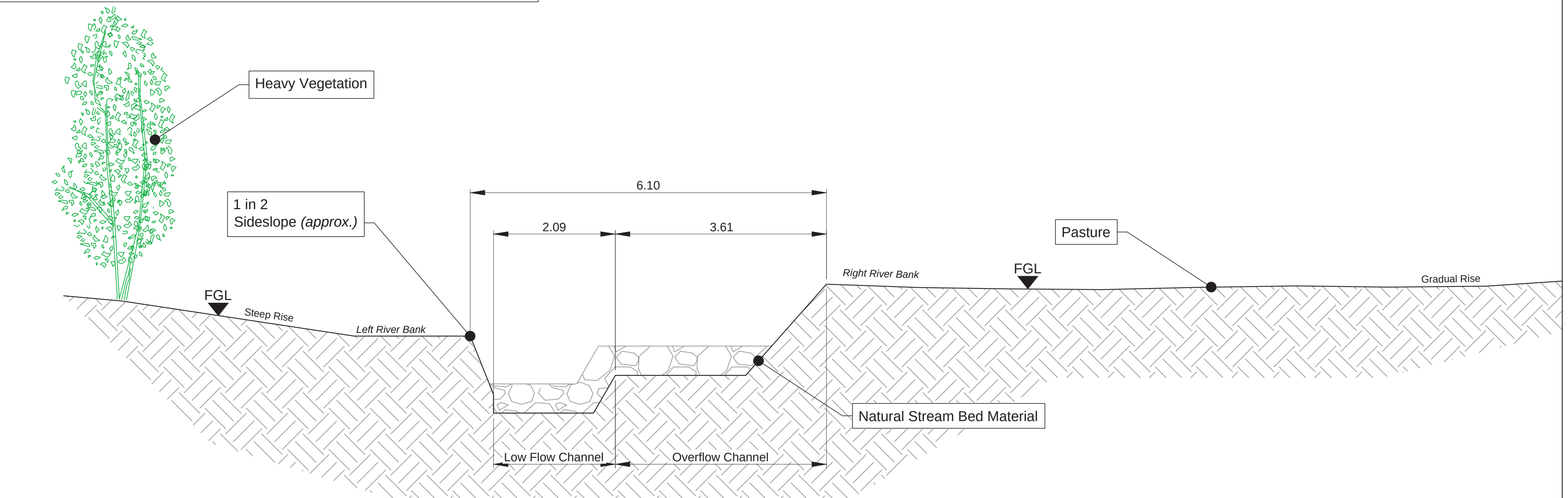


PROPOSED WORKS AREA PLAN: Proposed Stream Diversion Works Scale:1:250 @ A1



LOCATION MAP Scale:1:10,000 @ A1

NOTE:
- Guidelines for Protection of Fisheries, during Construction Work in or adjacent to Waters *(2016)*.
- Erosion Protection Measures to be put in place at Detailed Design.
- Stream Realignment to be Constructed, in accordance with the recommendations of IFI document; "Requirements for the Protection of Fisheries Habitat, during Construction and development works at river sites," and IFI document.



SECTIONAL DETAIL B-B: Proposed Stream Diversion Works Scale:1:50 @ A1

PHOTO VIEW 2 *(Not to Scale)*

Client

KILDARE COUNTY COUNCIL

Ordnance Survey Ireland

Ordnance Survey data © Ordnance Survey Ireland and Government of Ireland. Unauthorised copying prohibited. Ordnance Survey Ireland Licence number EN 0005017

General Notes
(i) This drawing is the property of RPS Consulting Engineers, it is a confidential document and must not be copied, used, or its content divulged without prior written consent.
(ii) All Levels refer to Ordnance Survey Datum, Malin Head.
(iii) DO NOT SCALE, use figured dimensions only, if in doubt ask.
(iv) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.

No.	Date	Drn. Chk.	Amendment / Issue	App
D01	27/02/17	DB CD	DRAFT	JH

RPS
West Pier
Business Campus
Dun Laoghaire
Co Dublin
T +353 1 4882900
F +353 1 2835676
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

Drawn	DB
Checked	CD
Approved	JH
Date	27/02/17
Scale	As Shown @ A3 / As Shown @ A1
Job No.	MDW0575

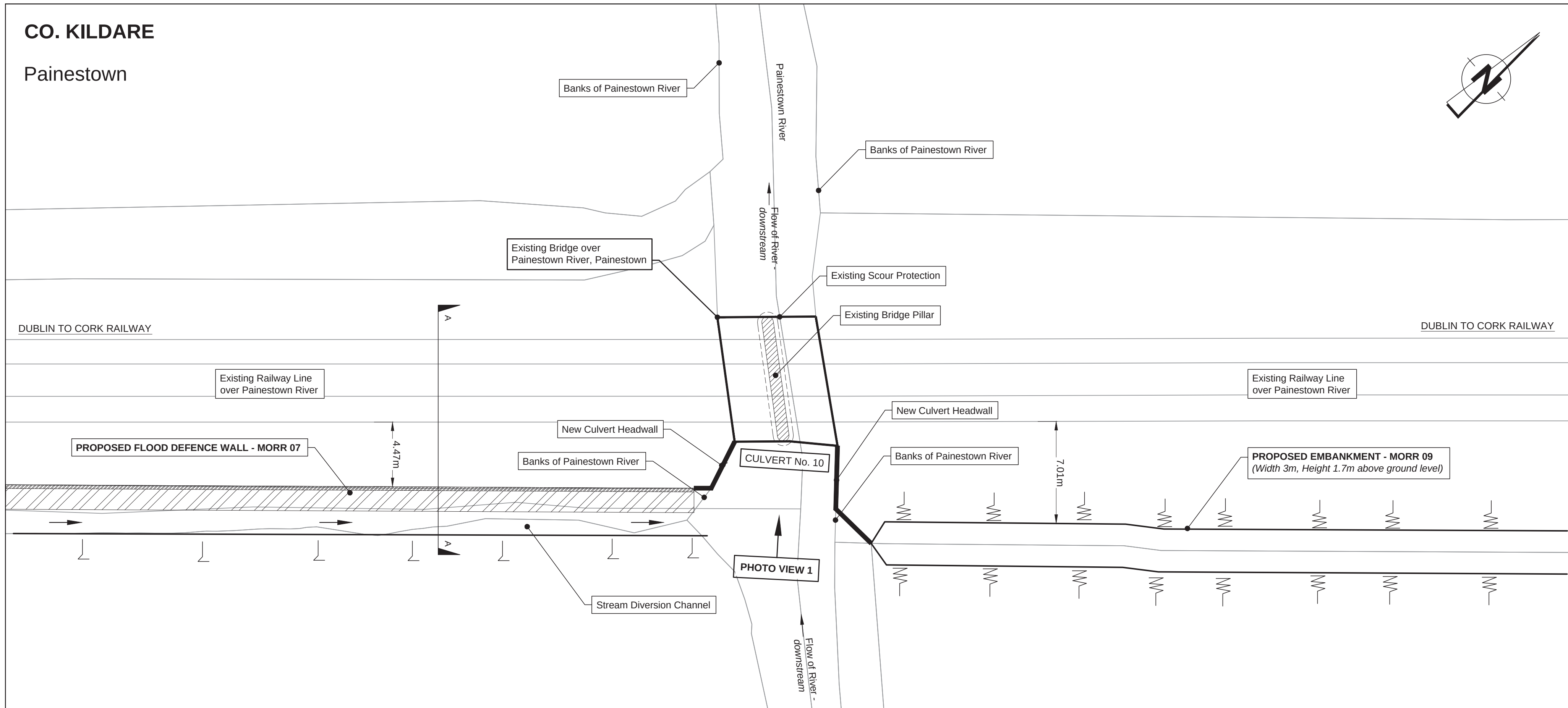
Project: RIVER MORREL FLOOD MANAGEMENT

Title: Slane 8 River Diversion Plan, Sectional Detail and Appropriate View

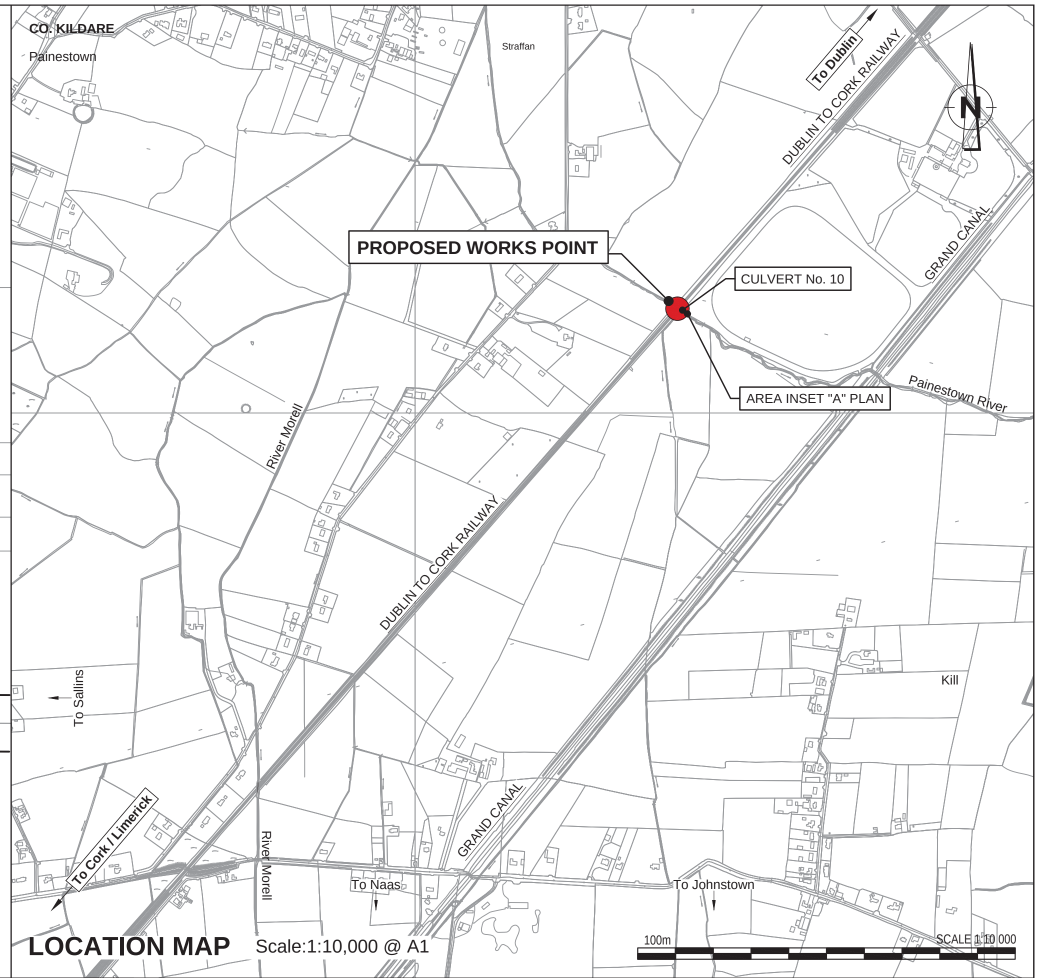
File Ref. MDW0575DG0100.dwg | Drg. No. DG0102 | Rev. D01

CO. KILDARE

Painestown



AREA INSET "A" PLAN: Proposed Works Scale:1:200 @ A1



LOCATION MAP Scale:1:10,000 @ A1

NOTE:

- Stream Realignment to be Constructed, in accordance with the recommendations of IFI document: "Requirements for the Protection of Fisheries Habitat, during Construction and development works at river sites," and IFI document "Guidelines for Protection of Fisheries, during Construction Work in or adjacent to Waters *(2016)".*

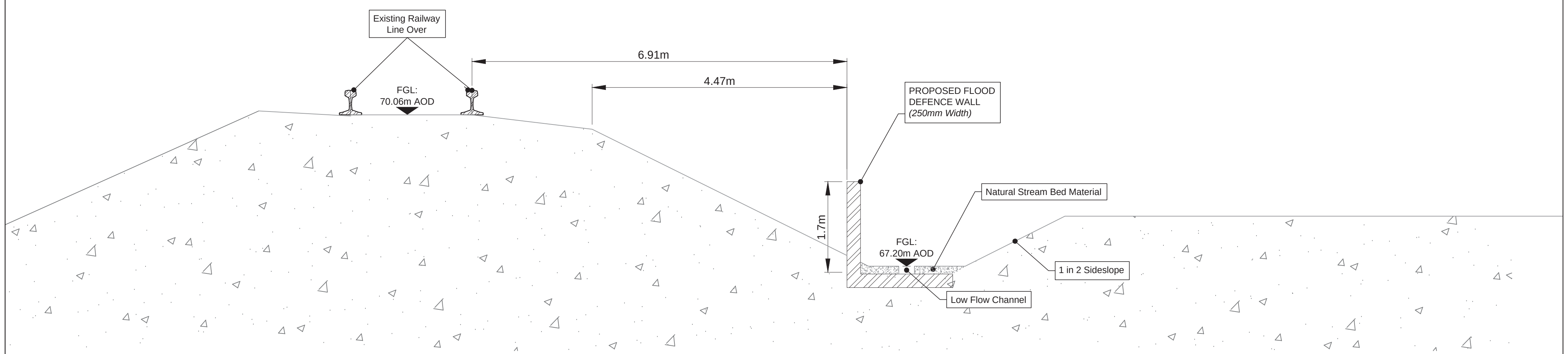


PHOTO VIEW 1 - Existing Bridge at Painestown River / Culvert No. 10, Painestown

(Not to Scale - Downstream View)

SECTIONAL DETAIL A-A: Proposed Works Scale:1:50 @ A1

Client

KILDARE COUNTY COUNCIL

No.	Date	Drn. Chk.	Amendment / Issue	App
D01	09/03/17	DB BT	DRAFT	PM

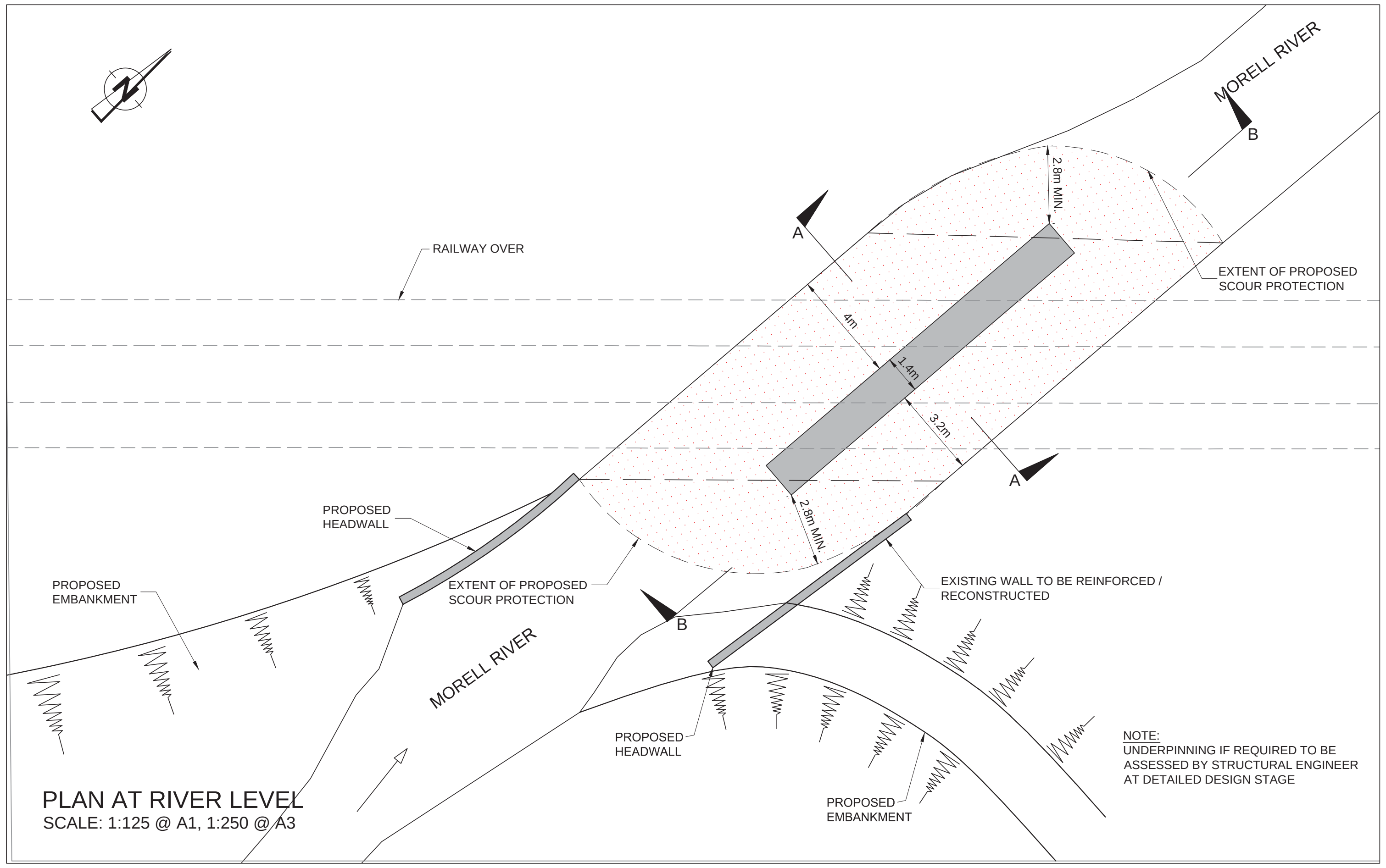
RPS
West Pier
Business Campus
Dun Laoghaire
Co Dublin
T +353 1 4882900
F +353 1 2835676
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

Drawn	DB
Checked	BT
Approved	PM
Date	09/03/17
Scale	As Shown @ A3 / As Shown @ A1
Job No.	MDW0575

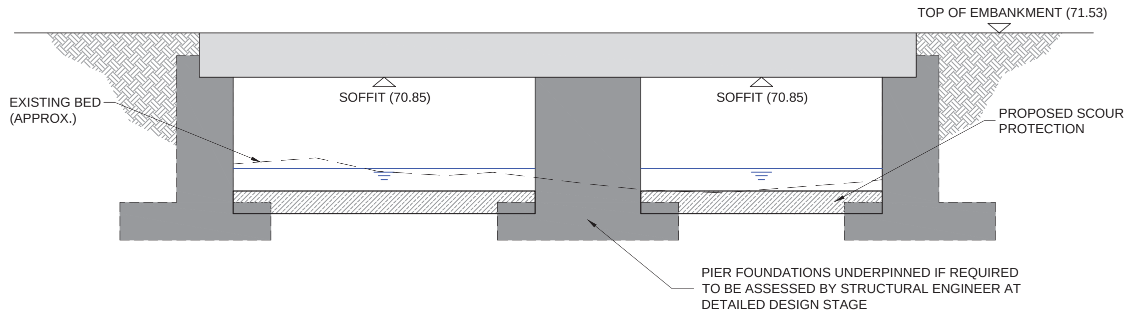
Project: **MORELL RIVER FLOOD MANAGEMENT**

Title: PAINESTOWN Bridge Detail

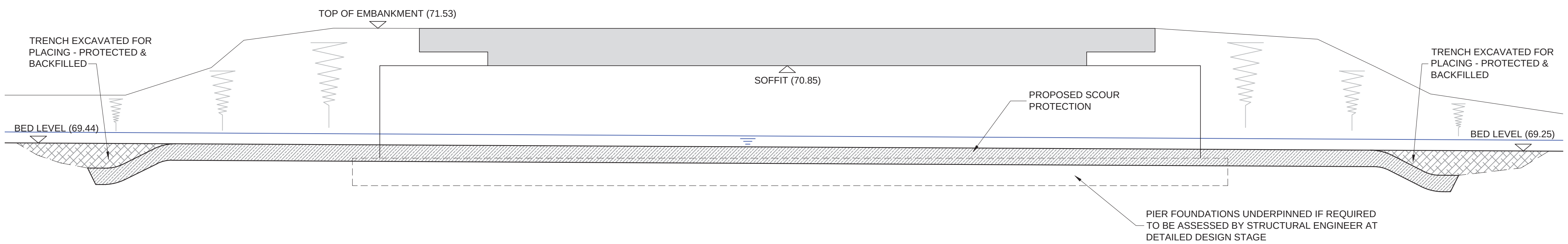
File Ref. MDW0575DG0100.dwg | Drg. No. DG0101 | Rev. D01



PLAN AT RIVER LEVEL
SCALE: 1:125 @ A1, 1:250 @ A3



SCHEMATIC SECTION A-A
SCALE: 1/50 @A1, 1/100 @ A3



SCHEMATIC SECTION B-B
SCALE: 1/50 @A1, 1/100 @ A3

RAIL BRIDGE OVER RIVER MORELL
(DOWNSTREAM)

Client
KILDARE COUNTY COUNCIL

Ordnance Survey Ireland
Ordnance Survey data © Ordnance Survey Ireland and Government of Ireland. Unauthorised copying prohibited. Ordnance Survey Ireland Licence number EN 0005017

General Notes
(i) This drawing is the property of RPS Consulting Engineers, it is a confidential document and must not be copied, used, or its content divulged without prior written consent.
(ii) All Levels refer to Ordnance Survey Datum, Malin Head.
(iii) DO NOT SCALE, use figured dimensions only, if in doubt ask.
(iv) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.

No.	Date	Drn. / Chk.	Amendment / Issue	App
D02	24/02/17	DB / CD	DRAFT	JH
D01	15/01/16	PH / CD	DRAFT	JH

RPS
West Pier
Business Campus
Dun Laoghaire
Co Dublin
T +353 1 4882900
F +353 1 2835676
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

Drawn	PH
Checked	CD
Approved	JH
Date	JAN 2016
Scale	AS @ A3 AS @ A1
Job No.	MDW0575

Project
MORELL RIVER
FLOOD MANAGEMENT SCHEME

Title
SCOUR PROTECTION DETAILS
IRISH RAIL CONSULTATION

File Ref. MDW0575DG0001D02.dwg
Drg. No. DG0001
Rev. D02

This page has been left intentionally blank.

5 POPULATION AND HUMAN HEALTH

This chapter of the EIAR describes the human environment of the hinterland within and surrounding the Morell catchment and the potential impacts of the Morell Flood Management Scheme (FMS) on population and human health. It also discusses the potential impact of the proposed scheme on land use, amenity and socio-economic activity such as tourism within the catchment. The Chapter should be read in conjunction with the layout plan for the scheme (Figure 4.1) and the Project Description (Chapter 4).

Some of the issues discussed in this chapter, including Traffic, Air Quality and Climate, Noise, and Vibration, Landscape and Visual Intrusion, are addressed in greater detail in the relevant chapters of the EIAR:

- Impact of Traffic - Chapter 6
- Impact of Air Quality and Climate - Chapter 7
- Impact of Noise and Vibration - Chapter 8
- Impact of Landscape and Visual intrusion – Chapter 9

The potential impacts of the construction and operation aspects of the Morell River FMS are described in detail within these chapters and, where appropriate, mitigation measures are presented.

5.1 METHODOLOGY

This assessment was undertaken in accordance with the Draft *Advice Notes on Current Practice in the preparation of Environmental Impact Statements* originally published by the EPA in 2002, and the revised version which was published in draft format in September 2015 (EPA 2002, 2015). The 2003 *Guidelines on the Information to be contained in Environmental Impact Statements* (EPA, 2003) and subsequent revised draft versions issued September 2015 and May 2017 (EPA, 2015 and EPA, 2017) have also been consulted. An examination of the following information was undertaken in order to establish the existing population profile, land use pattern, location of residences and services.

The fundamental goal of the proposed scheme is to protect human beings and their activities from adverse impacts associated with flood events to their properties. However, the impacts associated with the construction and operation of the scheme must be considered, particularly in light of the location of the works adjacent to residential and agricultural properties.

The EPA '*Advice Notes on Current Practice in the preparation of an EIS*' (draft version, September 2015) set out a framework methodology which has been followed in preparing this assessment. Issues under the general heading of Population and Human Health are stated to include:

- Economic Activity – will the proposed flood management scheme stimulate additional development and/or reduce economic activity, and if either, what type, how much and where?

- Social Consideration - Will the proposed flood management scheme change the intensity of patterns and types of activity and land use?

- Land Use – will there be severance, loss of rights of way or amenities, conflicts, or other changes likely to ultimately alter the character and use of the surroundings?

- Tourism – will the development affect the tourism profile of the area?

- Health – have the vectors through which human health impacts could be caused been assessed, including adequate consideration of inter-relationships between those assessments?

In order to ensure a robust assessment, this chapter separately addresses matters of population, employment, community aspects and land use. In terms of population and employment, the primary official record and analysis of demographic trends is the Central Statistics Office (CSO), Census of Population. The Census, the most recent of which was conducted in 2016, records demographic information at State, County, and local levels.

A desktop survey of the scheme area, as well as a desktop analysis of the local area and its facilities, was undertaken. The desktop analysis included a review of demographic characteristics of the area as ascertained from Census of Population data and other statistics released by the CSO.

In undertaking the assessment of the impact of the proposal on human beings, community and the local socio-economic environment the following impact criteria was employed. Both positive and negative impacts are considered and the significance of the impacts rated as imperceptible, slight, moderate, significant and profound as per the draft EPA *Guidelines on the Information to be contained in Environmental Impact Statements* (2015). Table 5.1 below presents criteria for the impact levels used in this study, as defined by the EPA. Where appropriate we have examined impacts on the population and human health topics and sub-topics as impacts on different groupings of people in general, rather than specific individuals.

The focus of the chapter is therefore to establish the potential for impacts on population, health, and economic activity in the area and on potential impacts to the community, including the resident, working and visiting community.

Land use has also been considered in this chapter in the context of addressing potential impacts on the resident and working community. In this regard, any particularly sensitive land uses are identified and considered in this assessment. Each section will set out the detail of the existing environment, the characteristics of the scheme that could have socio-economic impacts; the consequences of such impacts; and mitigation measures where considered necessary.

Table 5.1: Criteria for describing Significance of Impacts under EPA Guidelines (draft, 2017)

EPA Rating	
Imperceptible	An effect capable of measurement but without noticeable consequences
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities

Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends
Significant	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound	An effect which obliterates sensitive characteristics

Source: Draft Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2015)

As the proposed scheme will largely be constructed within agricultural lands, an impact assessment of the proposed scheme on agricultural property has also been carried out. A scheme such as the one proposed will have both positive and negative impacts on agricultural properties.

The assessment criteria used to measure the degree of significance a potentially negative impact may have on agricultural property is shown in Table 5.2.

Table 5.2: Assessment Criteria used for agricultural property

	Significance of Impact	Criteria
Positive	**Positive**	The proposed scheme reduces flooding of the property from the current predicted status.
Neutral	**No impact**	The current status regarding flooding remains the same and the proposed scheme has no impact on the property
Negative	**Imperceptible**	The proposed scheme does not encroach on the property but the associated works cause a slight inconvenience.
	Not significant	The works associated with the proposed scheme may encroach slightly on the property causing a slight inconvenience or there may be a slight increase of the area that be affected by a flood.
	Minor	The proposed scheme causes a small inconvenience due to additional flooding. There be an area of reduced land usage but does not require a significant change in current management practices. Mitigation would overcome any problems.
	Moderate	The proposed scheme causes possible additional flooding and an area of reduced land usage that will cause a change in current practices. No changes will occur in current land use although there may be an increase in labour charges or machinery costs. Mitigation measures will overcome most difficulties.
	Major	Change in land use due to possible additional flooding and area of reduced land usage or loss of buildings. The impact would require a significant change in practices with associated costs. This level of impact would require considerable mitigation measures and not all difficulties will be overcome.
	Severe	Current land uses can no longer continue due to possible additional flooding and area of reduced land usage. No mitigation measures will overcome impact to allow current land use to continue.

Table 5.3 shows the criteria used for this assessment to describe the duration of an impact.

Table 5.3: Duration of Impact

Description	Duration
Momentary	Effects lasting seconds to minutes
Brief	<1 day
Temporary	<1 year
Short term	1 to 7 years
Medium term	7 to 15 years
Long term	15 to 60 years
Permanent	>60 years

5.2 RECEIVING ENVIRONMENT

5.2.1 Baseline Data Collection

5.2.1.1 Data Sources

A Desktop study was carried out using the following datasets to establish an initial understanding of the study area and the likely significant impacts that may occur.

- Central Statistics Office, Census Data;
- Central Statistics Office, Census of Agriculture, 2010;
- Kildare County Development Plan 2017 - 2023
- Fáilte Ireland Tourism records
- GeoDirectory
- Soils of Co. Kildare, An Foras Talántais, National Soil Survey of Ireland, 1970;
- CORINE National Landcover Data, 2006 & 2012 (level 3);
- EPA/Teagasc/GSI GIS Map of National Soil Types, 2006;
- OSI, 50,000 and 5,000 maps;
- Aerial photography; and
- GIS derived from hydraulic model depicting;
    - Lands flooded pre proposed scheme; and
    - Lands flooded post proposed scheme.

- To assess potential impacts to agricultural activity, in conjunction with the desktop study a windscreen survey was under taken around the catchment to determine;
    - enterprises farmed;
    - current farm management practices; and
    - expected level of intensity.

- As reported in Chapter 2, 'Consultations', discussions with landowners (undertaken by Kildare Co. Co. and RPS) have also been carried out, to determine;

- validation of windscreen observations; and
- concerns/issues raised by landowners.

The most recent Census of Population was undertaken in April 2016, however at the time of writing only preliminary results are available from this census. The majority of the population information presented in this chapter is therefore derived from the 2011 census.

The smallest geographical units distinguished by the CSO are Electoral Divisions (EDs) for general statistical use. It can be seen in Figure 5.1 below that the study area is largely located within four of the CSO's Electoral Divisions: Bodenstown, Donaghcumper, Kill and Oughterard, however the study area also encompasses small areas of Kilteel and Newcastle (in South Dublin) EDs. These two EDs have been excluded from the assessment as over 90% of the extent of these EDs lies outside the study area.

EDs are further broken down into "Small Areas" for certain statistics, also shown in Figure 5.1. Demographic trends have been analysed at state, county, and local levels for the purposes of this EIA. The scheme catchment area is determined on a river catchment basis and therefore does not directly relate to any political or administrative boundaries; therefore for the purposes of statistical analysis figures provided cover the entire areas of each ED/Small Area which the overall scheme catchment area fully or partially contains. While these EDs and Small Areas do not correlate precisely to the scheme catchment area (see Figure 5.1), they are considered the best fit for the purposes of providing meaningful statistics for the scheme.

5.2.1.2 Site Visit

A site visit to inform this chapter was carried out on the 12th June 2015. The site visit comprised a general drive through and confirmed general land uses and provided an overview of the proposed scheme and environs.

5.2.2 Existing Environment

The Morell River catchment is largely rural in nature and is characterised by individual detached homes dispersed throughout the catchment. As shown in Figure 3.3 in Chapter 3, *Site Description,* The pattern of residential dwellings within the Morell River catchment study area is generally linear in nature along roads (ribbon development).

The main settlement within the river catchment is Kill, in the southern portion of the study area, straddling the N7 (see Figure 5.1). The most recent available census population data for Kill, from the 2011 census, showed that Kill had a population of 3,095 - however this is likely to show an increase when the 2016 figures are published in full. The population recorded by the 2006 census was 2,510, suggesting that the town is growing.

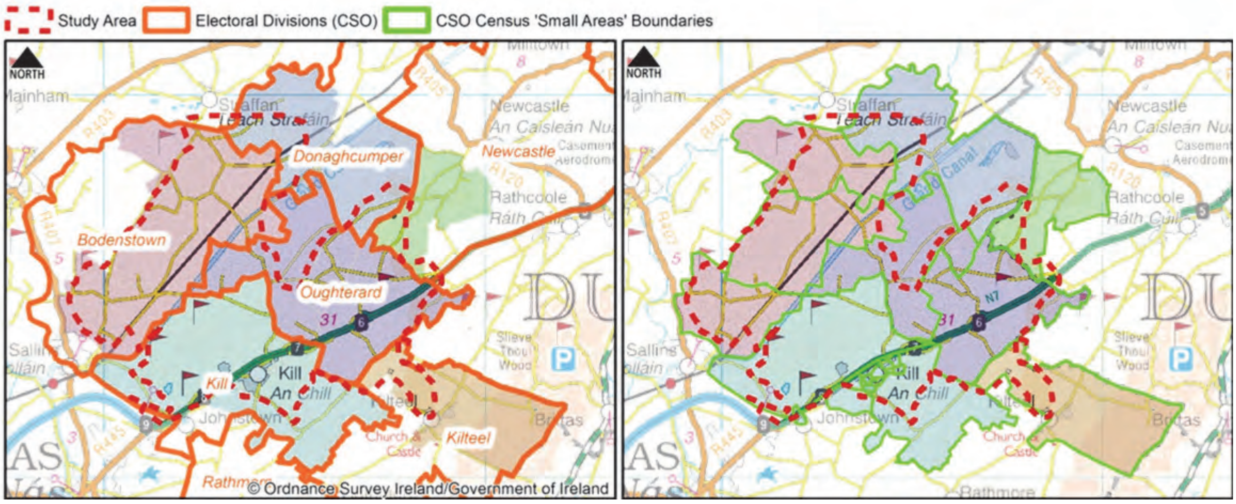


Figure 5.1: CSO Electoral Districts and Small Areas boundaries on Study Area

Smaller agglomerations, such as Turnings and Killeenmore, located in the northern section of the catchment are not classified as settlements by the Central Statistics Office (CSO). Additional areas with dispersed residences within the catchment include the townlands of Johnstown, Sherlockstown Common and between Oughterard and Blackchurch. Two larger towns, Naas and Sallins are located immediately to the south west of the Morell catchment, outside the study area. The population of the study area downstream (north) of the N7 at the 2011 census, calculated using the "Small Areas" dataset, was approximately 2,659.

5.2.2.1 Demographics

Population

The change in the population between successive censuses can be broken down into the combined effect of natural increase (births less deaths) and net migration (immigration less emigration). The 2016 census (preliminary results, CSO 2016a) has shown that nationally, the population has risen by 3.7% since 2011 from 4,588,252 to 4,757,976.

According to the CSO (2016a), rising emigration since 2008 has led to net population outflows since 2010, resulting in an annual average outward migration of -5,712 for the inter-censal period 2011 to 2016. This most recent inter-censal period is the first time Ireland has experienced net outward migration between successive censuses since the 1991 census. For comparison an annual average inflow of 24,977 was recorded during the previous inter-censal period of 2006 to 2011.

Within County Kildare, the population has risen in the period 2011-2016 by 5.6%, higher than the national average and one of the highest growth areas in the in the State, alongside the four administrative counties of Dublin and the other commuter belt counties of Meath and Laois (CSO, 2016a). This pattern of increasing population, above the national average rate, has been evident in the figures since 1996 shown in Tables 5.3 and 5.4 below, however the increase 2011-2016 is not as marked as in previous years.

Table 5.4: CSO Census - National population 1996-2016

Year	Population	% Change
1996	3,626,087	2.8%
2002	3,917,203	8.0%
2006	4,239,848	8.2%
2011	4,588,252	8.2%
2016	4,757,976	3.7%

Table 5.5: CSO Census – County Kildare population 1996-2016

Year	Population	% Change
1996	134,992	10.1%
2002	163,944	21.4%
2006	186,335	13.7%
2011	210,312	12.7%
2016	222,130	5.6%

Table 5.6: CSO Census – Local EDs population 1996-2016

ED	2006	2011		2016	
	population	population	*% change*	population	*% change*
037 Donaghcumper, Co. Kildare	4233	5,710	*(+34.9%)*	6,227	*(+9.1%)*
059 Bodenstown, Co. Kildare	3734	4,643	*(+24.3%)*	4,959	*(+6.8%)*
072 Kill, Co. Kildare	3734	4,449	*(+19.1%)*	4,675	*(+5.1%)*
082 Oughterard, Co. Kildare	690	726	*(+5.2%)*	702	*(-3.3%)*
076 Kilteel, Co. Kildare	552	577	*(+4.5%)*	571	*(-1%)*
018 Newcastle, South Dublin	2631	3,749	(+42.5%)	4,258	(+13.6%)

At the local level, it can be seen in Table 5.6 that between 2006 and 2011 there were very significant population increases in three out of the four principal EDs covering the study area (Donaghcumper +34.9%, Bodenstown +24.3% and Kill +19.1%. Kilteel and Oughterard recorded more modest increases of +4.5 and +5.2% respectively over this period while Newcastle ED, which is largely outside the study area and only covers a very small portion of the eastern side of the catchment recorded very significant increases of +42.5%.

In the period 2011-2016, the EDs of Donaghcumper, Bodenstown, and Kill recorded smaller increases from the previous inter-censal period, showing growth of between +5.1% (at Kill) and +9.1% at Donaghcumper. Oughterard and Kilteel went against the local, county and national trends by recording net population losses of -3.3% and -1.0% respectively. Newcastle again showed the strongest population growth within the local area, of +13.6%.

Age Structure

The age profile of the catchment population of the State, Kildare County and the combined 4 no. most relevant Electoral Divisions (Bodenstown, Donaghcumper, Kill, and Oughterard) for 2006 and 2011 are highlighted in Table 5.7.

It shows that the overall proportion of the 0-14 age group increased between 2006 and 2011 for all of the areas studied. The combined 4 No. EDs experienced a percentage point increase of 1.9% increasing from 23.6 to 26.1% of the population – the highest proportion of 0-14 age cohort/group.

The 15-24 age group/cohort showed an overall decrease of population for all of the population area levels where the -2.3% point drop for the State was similar to that of County Kildare which experienced a similar but slightly higher percentage point drop of -2.5%. The combined 4 No. EDs experienced a lower percentage point drop of -2.4%. The drop in population in the cohort is possibly as a result of emigration and normal population dynamics as the population ages.

The 25-44 age cohort also experienced a drop in population during the period 2006-2011 for the population areas studied. For Kildare there was a -1.1 percentage point drop, the EDs experienced a drop of 0.8% while for the State it was relatively stable with a percentage point drop of -0.1. Unsurprisingly the 65+ age group experienced an increase in population for all of the areas. This is reflective of a generally aging population.

Table 5.7: Population Structure 2006 and 2011 (%)

Area/Age	0-14	15-24	25-44	45-64	65+
State 2006	20.4	14.9	31.7	21.9	11
State 2011	21.3	12.6	31.6	22.7	11.7
Change	***0.9***	***-2.3***	***-0.1***	***0.8***	***0.7***
Kildare County 2006	23.1	15	34.6	20.5	6.9
Kildare County 2011	24.5	12.5	33.5	21.6	7.9
Change	***1.4***	***-2.5***	***-1.1***	***1.1***	***1***
EDs 2006*	23.6	12	34.3	21.4	6.1
EDs 2011*	26.1	10.5	33.5	22.2	7.7
Change	***1.9***	***-2.4***	***-0.8***	***-0.2***	***1.6***

Source: Census of Population 2006 & 2011. *4 no. EDs

5.2.2.2 Economic Activity

Employment

The 2011 Census of Population was examined to determine trends in relation to employment including the number of persons at work, unemployment levels and the sectoral composition of the population.

Figure 5.2 below shows the breakdown of broad industrial sectors in which the workforce of County Kildare is employed, versus that of the State as a whole, derived from Profile 3 “*At Work*” of the Census 2011. It can be seen that the largest employment sectors in County Kildare in 2011 were *Wholesale and Retail Trade* and *Manufacturing*, which between them employed more than a quarter

27.0%) of the workforce, slightly higher than the national values. Employment in *Health and Social Work* and *Accommodation and Food Service Activities* were slightly lower (14.3% combined) in County Kildare than nationally (16.7%) and a lower proportion of workers in County Kildare are employed in the *Agriculture, Forestry and Fishing* sector, 3.7% versus the national average of 5.1%.

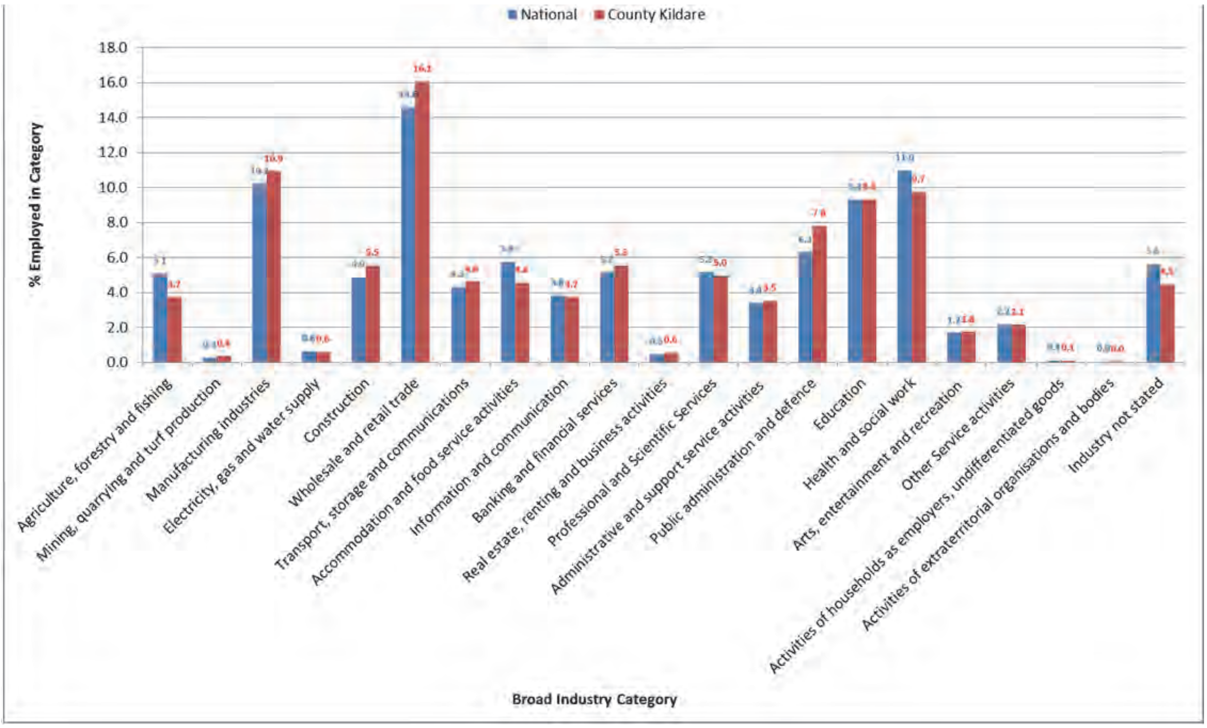


Figure 5.2: % of Employed Persons by Broad Industrial Group, Co. Kildare vs National, from 2011 census

The CSO provides a summary of the broad industry categories of employment for the four principal EDs in the study area, which are accessible via the Small Area Population Maps (SAPMAP) feature http://census.cso.ie/sapmap/. Table 5.8 below shows the broad employment industry categories for the four EDs, which are grouped into fewer categories than at County/National level, however it is apparent that the EDs have a much higher proportion of the workforce employed in *Commerce and Trade* (almost 30%) than the county/national average and proportionately lower numbers employed in *Manufacturing Industries* (averaging 11.8%). It can be seen that the ED of Oughterard has a much higher proportion (6.8%) employed in *Agriculture, Forestry and Fishing* than the other EDs, which have between 1.3 and 2.6% employed in this industry.

Table 5.8: Census 2011 Morell Catchment Local EDs Persons at work by Industry

	Bodenstown		Donaghcumper		Oughterard		Kill		Average of 4 EDs
Industry	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**	**%**
Agriculture, Forestry and Fishing	49	*2.6*	36	*1.3*	19	*6.8*	39	*2.0*	***3.2***
Building and Construction	104	*5.5*	140	*5.2*	24	*8.5*	137	*7.1*	***6.6***
Manufacturing Industries	219	*11.6*	313	*11.7*	31	*11.0*	249	*12.9*	***11.8***
Commerce and Trade	552	*29.3*	795	*29.7*	80	*28.5*	585	*30.2*	***29.4***
Transport and communications	181	*9.6*	254	*9.5*	31	*11.0*	222	*11.5*	***10.4***
Public administration	142	*7.5*	193	*7.2*	20	*7.1*	149	*7.7*	***7.4***
Professional services	394	*20.9*	653	*24.4*	46	*16.4*	346	*17.9*	***19.9***

	Bodenstown		Donaghcumper		Oughterard		Kill		Average of 4 EDs
Industry	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**	**%**
Other	240	*12.8*	292	*10.9*	30	*10.7*	209	*10.8*	***11.3***
Total	**1881**		**2676**		**281**		**1936**		

Unemployment

Table 5.9 shows the overall unemployment rate as measured by the responses to the question on principal economic status in the Census for 2011. The unemployment rate is calculated by adding the number of persons unemployed to first time job seekers, and then dividing the total by the overall labour force (i.e., total amount of unemployed persons and employed persons.

It can be seen that the unemployment rate (as measured in the Census) in 2011 had increased significantly, doubling to 19% for the State (compared with 8.5% in the 2006 Census). The unemployment rate for Kildare increased to 17.9% in 2011 (compared with 6.3% in 2006). For the four EDs relevant to the study area, the overall rate of unemployment was lower than that of the State and County Kildare. The average rate of unemployment was 13.7% at the 2011 census, below the average for the State and for County Kildare.

Within the four EDs, Oughterard had the lowest unemployment rate measured by the 2011 Census at 12.2%, while the highest was Bodenstown at 16.3%. For reference, the unemployment rate for Oughterard in the 2006 census was just 2.5% and Bodenstown 5.9%.

Table 5.9: Census 2011 Principal Economic Status Local EDs, County, National

	State	Kildare	EDs Total	*Bodenstown*	*Donagh-cumper*	*Kill*	*Oughterard*
At work	1,807,360	85,587	6,774	*1,881*	*2,676*	*1,936*	*281*
Looking for first regular job	34,166	1,371	78	*29*	*34*	*9*	*6*
Unemployed or given up previous job	390,677	17,268	1,017	*336*	*355*	*293*	*33*
Overall Unemployed	424,843	18,639	1,095	*365*	*389*	*302*	*39*
Labour Force	2,232,203	104,226	7,869	*2,246*	*3,065*	*2,238*	*320*
Unemployment Rate %	***19.0%***	***17.9%***	***13.68%***	***16.3%***	***12.7%***	***13.5%***	***12.2%***

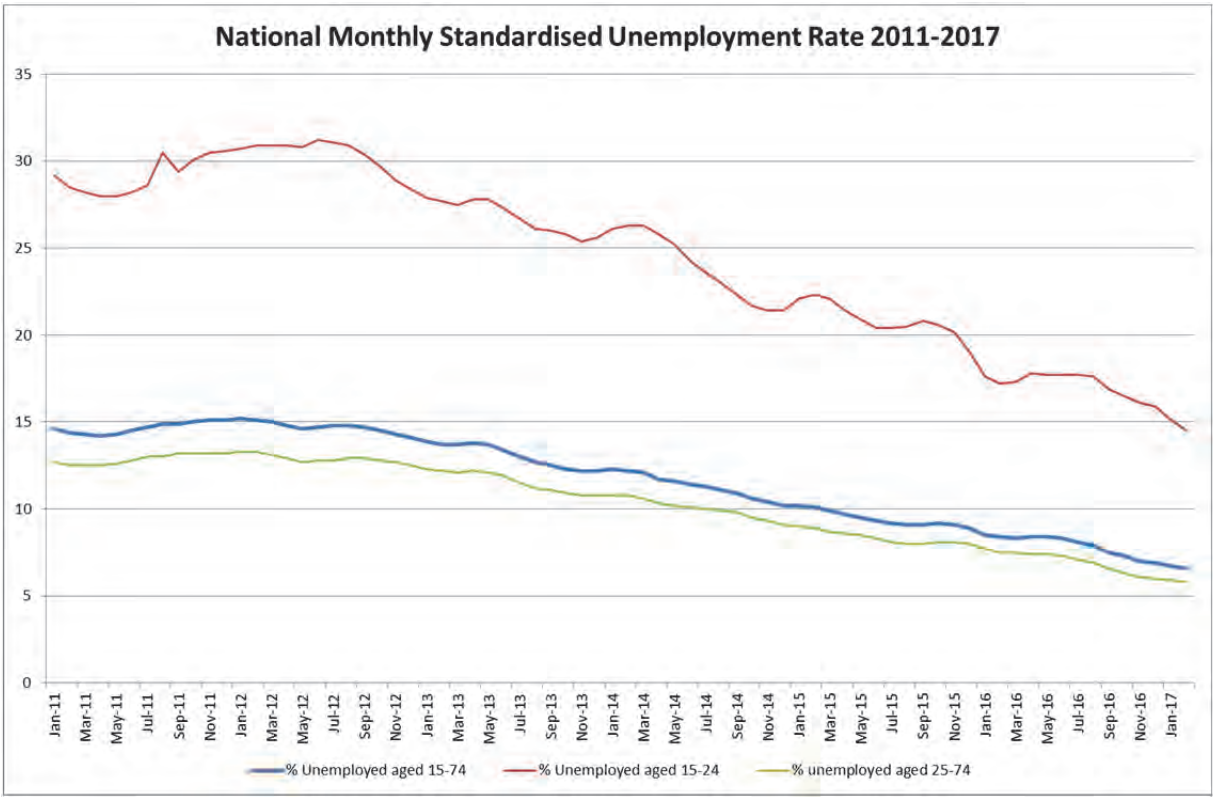
Source: Census of Population 2011 - CSO

While there are no unemployment statistics at an ED level between Census periods, Figure 5.3 shows a chart of the CSO's monthly published statistics on national unemployment[1] since 2011. This chart shows that on a national scale, unemployment has been generally decreasing since the peak of just over 15% for all persons aged 15-74 in January 2012.

[1] These statistics are based on the Quarterly National Household Survey – QNHS) together with Administrative Data from the Department of Social Protection and since June 2015 have been published as the Monthly Unemployment Release. Prior to this figures were published as the seasonally adjusted Standardised Unemployment Rate (SUR) in the Live Register monthly release).

Figure 5.3 also shows that the unemployment rate amongst 15-24 year olds has been particularly high, with over 30% of young people under 25 unemployed during the period between August 2011 and September 2012.

At the time of writing, the seasonally adjusted national unemployment rate for February 2017 was 6.6%, down from 6.7% in January 2017 and down from 8.4% in February 2016. The seasonally adjusted number of persons unemployed was 145,100 in February 2017, down from 148,000 when compared to the January 2017 figure and a decrease of 36,200 when compared to February 2016. The seasonally adjusted unemployment rate for persons aged 15-24 years (i.e. the youth unemployment rate) was 14.5% in February 2017, a decrease from 15.1% in January 2017.



*figures prior to June 2015 are derived from the SUR.

Figure 5.3: National Unemployment Rate 2011-2017

The results of the Quarterly National Household Survey (QNHS) provide the basis for the official series of quarterly labour force estimates. Table 5.10 shows the quarterly International Labour Organisation (ILO) classified unemployment rate between 2011 and the end of 2016 for the State. It can be seen that the average rate of unemployment has fallen from 14.7% in 2012 to 7.9% for 2016.

Table 5.10: ILO Economic Status Unemployment Rate for State 2001-2017

	Q1 (%)	Q2 (%)	Q3 (%)	Q4 (%)	Average (%)
2011	14.4	14.6	15.1	14.6	14.7
2012	15.0	15.0	15.0	13.8	14.7
2013	13.7	13.9	13.0	11.8	13.1
2014	12.1	11.9	11.3	10.0	11.3
2015	10.0	9.8	9.3	8.7	9.5

	Q1 (%)	Q2 (%)	Q3 (%)	Q4 (%)	Average (%)
2016	8.4	8.6	8.0	6.7	7.9
2017	6.7	-	-	-	-

Note: Source www.CSO.ie Home / StatBank / Quarterly National Household Survey Main Results / QNQ24

The 2011 Census recorded 79,174 houses in County Kildare of which 8% (6,311) were vacant (CSO 2011). Preliminary figures published from the 2016 Census indicate that the housing stock in the County has increased to 80,746 with 5,113 (6.3%) recorded as vacant.

Commercial Activity within the Study Area

At present, the N7 as well as a number of local roads flood in low return period events, preventing local residents from travelling in the area, and in some cases preventing access or egress to their properties. Currently, flooding events of 20%AEP and greater can present difficulties in navigating local roads. Routes that are affected include:

- N7 main route and the roadway at Junction 6 – Castlewarden exit;
- Straffan Road (where the Slane River crosses the road, just after the Barberstown Rd junction);
- Straffan Road (in Bishopscourt Lower where the Painestown River runs adjacent to the road);
- Straffan Demesne, (in the area near the K Club, where the road crosses the River Liffey).

Road flooding may result in significant increases to resident and commuter travelling times to places of work, or in extreme cases, completely preventing residents from reaching their place of work. The Feasibility Study (Appendix A) reports that in the event that the N7 is closed due to flooding, the anticipated diversion route will add approximately 2.7 hours to journey times for HGVs and 2.6 hours for cars and LGVs wishing to travel on the N7 between the M50 at Dublin and Naas town.

Many of the businesses local to the proposed scheme are in the agri-food industry; these include McCarthy's Strawberry Farm - a large fruit growing enterprise, employing up to 30 staff, located on the western boundary of the study area at Turnings Upper. The site is over 1 kilometre from the nearest scheme measures (Morr 10 and Paines 2&3). Shannonside Foods is an abattoir and meat wholesaler which is located close to the scheme features Morr 2 and Morr 3 (50 and 100 metres respectively) as well as Paines 1 works (100 metres). The premises are protected from flooding by existing embankments. Keane's Fish and Poultry is on the north western boundary of the study area, at Turnings Upper, around 600 metres north west of Morr 2.

Baronrath Stud is located to the east of Morr 9; the main premises are located approximately 250 metres east of Morr 9 and part of the exercise track, which is within the 100 year event flood plain, runs adjacent to this proposed measure. The Quantum Equestrian Centre is located in Whitechurch, Straffan, at the northern boundary of the study area and runs pony-trekking and horse-riding lessons for children. This site is around 200 metres east of measures Morr 1 and 1a. Goffs Bloodstock Sales is located at the southern boundary of the study area, on the north side of the N7 at Kill. It is located over 1 km south of the nearest measures, Morr 15. Kill International Equestrian Centre is located a short distance south of the study area.

The Kill River passes through Kill Main Street on the south side of the N7. Two commercial premises including a public house are adjacent to the river. Other businesses within the study area that are close to the proposed flood management measures include hauliers, storage and mechanical services.

The preliminary Feasibility Study for the scheme (see Appendix A) identified ten commercial properties (excluding farms) within the study area that have a potential flood risk during the 0.1%AEP flood event. Of these, six were identified as being 'local businesses'.

Consultations with businesses and landowners have taken place during the development of the scheme, as discussed in Chapter 2.

5.2.2.3 Education & Health

Saint Brigid's National School, Kill is located within the catchment. 624 pupils attend the school, with 325 boys and 299 girls. The school has 22 teachers, 6 learning support teachers, 12 special needs teachers and 2 teachers for children with autism. The school was formerly located approximately 200m from the Kill River, before it moved to its current location at the top of the village (approximately 0.6km from the Kill River). This was due to the rapid growth of the school and the new campus was opened in 2011. It is not at risk for being flooded in a 0.1% AEP flood event.

During a 0.1% AEP flood event, there is significant out of bank flooding with flood water spilling from the Kill River onto the N7 and Main Street, Kill. This could have a significant impact on school attendance as any children or staff living south-west of the river may be unable to travel past the flood waters on these roads. School traffic will not be affected directly outside the school campus. However, traffic may build up at the points where the flood water spills onto the N7 and Main Street if the depth of the flood is low enough for vehicles to travel through.

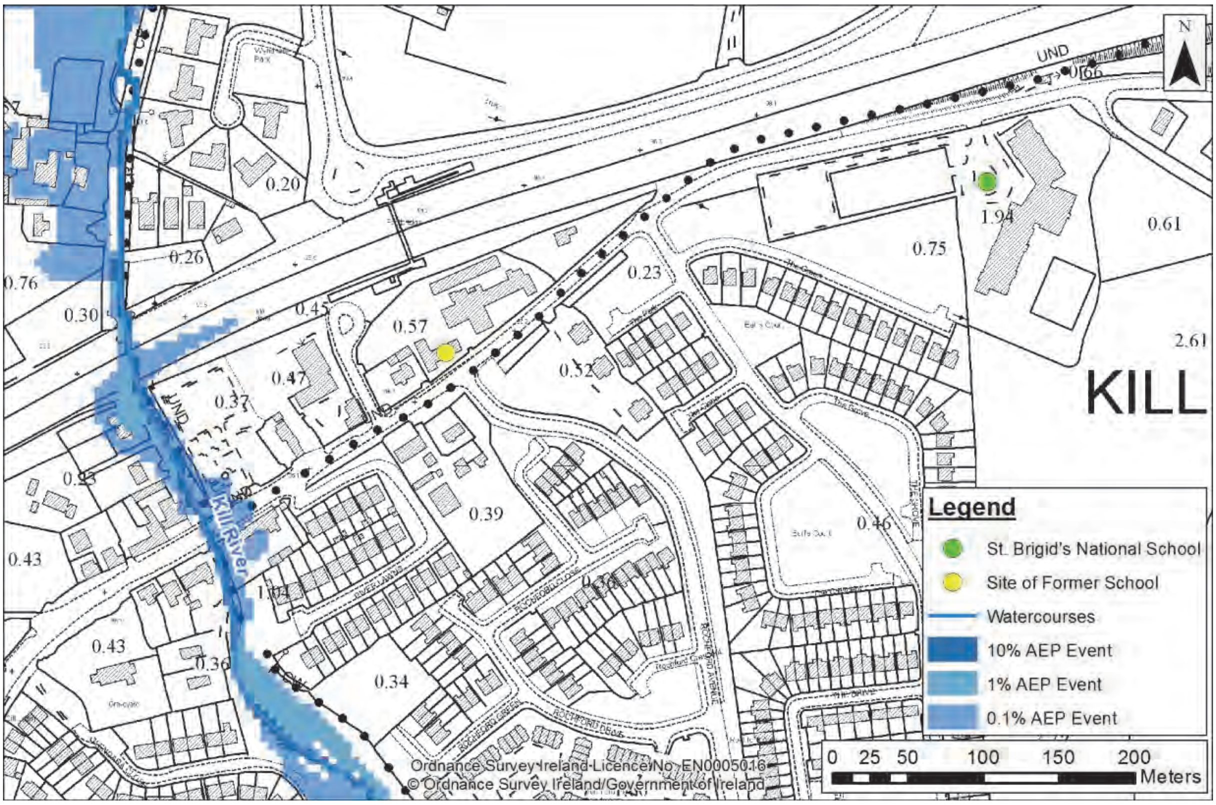


Figure 5.4: School Location in Kill

Kill Medical Centre is the only health centre located within the study area. It is 0.93km removed from the Kill River and therefore is not subject to flood risk. There are no hospitals or nursing homes located within the study area.

As discussed in 5.2.2.2 above, at present the N7 as well as a number of local roads in the study area flood in low return period events. Currently, flooding events of 20%AEP and greater can present difficulties in navigating local roads and the N7, which may result in significant increases to travelling times for medical appointments or to school. During extreme events, residents of the study area may be unable to reach schools or health providers by road, resulting in missing school or missed medical appointments. In a wider context, closure of the N7 may result in very significant diversions and delays for persons requiring to travel between Dublin and the southwest for maternity or acute hospital services.

In consultation, the Health Services Executive has indicated that the River Liffey is a major source of drinking water. The lower reaches of the River Liffey including Leixlip Reservoir are downstream of the Morell catchment.

5.2.2.4 Tourism and Leisure

Regional/County

Tourism is one of the major contributors to the national economy and is a significant source of full time and seasonal employment. The midlands east tourism area, which encompasses County Kildare, is one of the less-visited regions in Ireland, only coming ahead of the South East region and North West region in terms of overseas visitor numbers and revenues in 2015 (Fáilte Ireland, 2016).

Table 5.11: Domestic and Overseas Tourism Visitor Numbers and Revenues, Co Kildare 2010-15

Year	2010	2011	2012	2013	2014	2015
Overseas Tourist revenue (€millions) Co. Kildare	n/a	n/a	36	52	70	89
Overseas Tourist numbers (‘000s) Co. Kildare	n/a	n/a	139	168	183	214
Irish Residents’ Trip Expenditure (€Millions) by Main County Visited – Co. Kildare and Carlow	26	29	35.1	24.9	30.4	39.9
Domestic tourists ('000s) by Main County Visited – Co. Kildare and Carlow	174	210	250	228	253	306

Figures taken from Fáilte Ireland Regional Tourism Performance reports 2012-2015

Table 5.11 above shows annual overseas and domestic visitor numbers to County Kildare published by Fáilte Ireland for the years 2010-2015. It can be seen that both domestic and overseas visitors and tourist revenues have been steadily increasing. Overseas visitor numbers increased by around 150% between 2012 and 2015 however the spending revenues increased by almost 250% over the same period, indicating that overseas visitors spent significantly more money during their visits in 2015 than they would have in 2012. The figures below also show a small dip in domestic visitor numbers and revenues occurred in 2013 which is perhaps a reflection of an unexpected contraction in the economy which occurred during 2013 due to a reduction in net exports (Kennedy, E., 2014).

Within County Kildare the principal tourist attractions include the Newbridge Silverware Museum of Style Icons, which ranked seventh amongst the top ten free visitor attractions in Ireland in 2015 with around 350,000 visitors and the Irish National Stud and Japanese Gardens, which welcomed 120,138 visitors in 2015 (Fáilte Ireland, 2016b). These attractions are located off the M7 and thus some of the visitors planning to visit the site from the Dublin area would potentially access these attractions by road via the N7, passing through the study area.

Punchestown Racecourse is *c.* 5km south of the study area and the upper reaches of the Morell River run adjacent to the property. It is beyond the influence of the proposed flood management scheme however may be influenced by disruption to the N7 and regional roads passing through the study area.

Other attractions close to the study area include the Steam Museum at Straffan, which attracted between 3,000 and 4,000 visitors per year between 2009-2013 (Fáilte Ireland, 2014a).

Other attractions with high visitor numbers In Kildare include Maynooth Castle (23,326 visitors in 2013) and Castletown House and Parklands (244,416 visitors in 2013 however more typical numbers 2009-2012 were in the region of 36,000) – these are located along the M4 corridor, well away from the influence of the study area.

Study Area

Golf Ireland (2017) lists 21 Golf Clubs in County Kildare, of which five are located within the study area. These are: Naas Golf Club, Palmerstown Stud Golf Club, Killeen Golf Club, Bodenstown Golf Club and Castlewarden Golf and Country Club. The K Club, which hosted the Ryder Cup in 2006 and has hosted a number of events on the European Tour, is located at the northern (downstream) boundary of the study area, close to where the Morell River meets the River Liffey at Straffan.

Parts of Naas Golf Club, Palmerstown House Estate Golf Club and Killeen Golf Club may be subject to flooding during a 1% AEP flood event with water spilling from the Hartwell River and Morell River.

Kill GAA Club is a local club with three pitches to the west of Kill. The club is located near the southern boundary of the study area and is far removed from the Kill River. It will not be subject to any fluvial flooding.

A desktop review of the angling amenity within the study area has been carried out and consultation letters were issued to three angling clubs; the Straffan Anglers Association, the Clane Trout and Salmon Anglers Association and the Dublin Trout Anglers Association (see Chapter 2). Whilst the Morell system is acknowledged as being an important salmonid system and may have some local importance for angling, recreational angling and tourism in the region is mainly focused on the Liffey system. The Celbridge-Straffan fishery which extends for approximately 4.5 miles on the Liffey is leased by the Dublin Trout Anglers Association. This stretch is noted to be a very rich trout water where many trout over 1lb in weight are regularly taken. The Dublin Trout Anglers Association responded to the EIA consultation and recommended that Inland Fisheries Ireland should be contacted in respect of the scheme.

Fáilte Ireland (2016) accommodation listings dataset does not identify any accommodation providers within the study area. When a 2km buffer was applied to the study area, the Kildare Hotel and

Country Club and Woodbine House B&B are the only providers identified; these are located at Straffan and Kill respectively.

The Feasibility Study (Appendix A) has not identified any parks or open amenity spaces that are at risk from 10%, 1% and 0.1% AEP flood events and none are within the vicinity of the proposed flood risk management measures.

5.2.2.5 Land Use

Much of the land use in the environs of the proposed Morell Flood Management Scheme (the proposed scheme) is agricultural. There are 2,578 farms in County Kildare, utilising approximately 113,765 hectares (CSO 2010). The average farm size in the County is 44.13 hectares. Table 5.12 shows the breakdown of the numbers and percentages of farms specialising in different enterprises in Kildare.

Table 5.12: Numbers of Farms in Co. Kildare in Different Enterprises

Enterprise Type	Number of Farms	Percentage of Total
Specialist Tillage	401	16
Specialist Dairy	134	5
Specialist Beef Production	1095	42
Specialist Sheep	220	9
Mixed Grazing Livestock	371	14
Mixed Crops and Livestock	119	5
Mixed field crops	201	8
Other	37	1
Total	**2578**	**100**

From the above table it can be seen that the majority of the farms in Kildare are involved in grass based livestock farming (>70%) with a large number of farmers specialising in beef production. Considerable tillage farming is practiced in the county.

The catchment area is approximately 45km^2. The EPA CORINE Land use Map (2012) (see Figure 3.2 in Chapter 3) classifies the main land uses within the catchment as ‘Pastures’ (67.7%), ‘Non Irrigated Arable Land’ (15.58%) and ‘Sport and Leisure Facilities’ (8.54%) as shown in Table 5.13 below. It can be seen from the CORINE information that the land use classified as ‘Pastures’ has remained largely consistent over the period 2006-2012, however land use for sports and leisure facilities has increased by around 4% and non-irrigated arable land has decreased by around 6%.

Table 5.13: Catchment Land Use (Derived from CORINE 2012)

Land Use (CORINE)	2006 Area (Km^2)	2006 Area (%)	2012 Area (Km^2)	2012 Area (%)
Pastures	30.884	68.9	30.35	67.7
Non-irrigated arable land	9.7110	21.7	6.98	15.58
Sport and leisure facilities	1.942	4.3	3.83	8.54
Discontinuous urban fabric	1.1770	2.6	0.73	1.62

Land Use (CORINE)	2006 Area (Km^2)	2006 Area (%)	2012 Area (Km^2)	2012 Area (%)
Broad Leaved forest	0.452	1.0	0.006*	0.0
Mineral extraction sites	0.296	0.7	0.31	0.7
Industrial or commercial units	0.267	0.6	0.46	1.03
Dump	0.091	0.2	0.05	0.1
Complex Cultivation Patterns	-	-	0.81	1.8
Total	**45 Km^2**	**100.0 %**	**45 Km^2**	**100.0 %**

**Classed as 'Mixed Forest' in 2012*

Properties within the Scheme Area

To assist with landowner liaison and the design of the scheme, folio data was acquired for the lands within the flood scheme area. This information was entered into a GIS which was then developed and updated with more detailed land use information, obtained through examination of aerial photography, landowner discussions and public consultations.

Agricultural Properties in Vicinity of the Proposed Scheme

There are 140 agricultural properties affected by the proposed scheme. Farming in the vicinity is primarily grassed based and drystock (93%). Table 5.14 below summarises the principal statistics for agriculture in the study area, full details are presented in Appendix F.

Table 5.14: Agricultural Properties in the Vicinity of the Proposed Scheme

Description	Numbers
Number of agricultural properties	140
Number with buildings	36
Grass based enterprises	130
Mixed enterprises	2
Cereals	8
Agricultural area affected by current flooding (ha)	372

Non-agricultural Properties in Vicinity of the Proposed Scheme

Table 5.15 below summarises the principal statistics for non-agricultural properties in the vicinity of the proposed scheme.

Table 5.15: Non-Agricultural Properties in the Vicinity of the Proposed Scheme

Description	Numbers
Number of non-agricultural properties	63
Number with buildings	62
Number with golf courses	1
Number with tennis courts	1
Non-agricultural area affected by current flooding (ha)	31

5.2.2.6 Health and Safety

The Morell River and tributaries have had a long history of serious flood events, which pose a risk to the health and safety of residents and visitors within the catchment area. Major recent flood events have been recorded in 1954, 1993, 1998, 2000, 2002 and 2009 and less severe flood events have occurred more frequently. A substantial health and safety risk exists with regard to the flooding of residences and commercial premises within the catchment, with up to 30 residential properties at risk of flooding during the 1%AEP event (see Chapter 1, Table 1.1 for more details) as well as disruption to important infrastructure such as the N7 National Primary Road, Regional Roads, the Grand Canal and the Dublin Cork Railway.

5.3 POTENTIAL IMPACTS

This section deals with the impacts of the proposed flood management scheme on the population of the study area with regards to, employment and economic activity, land use, services and tourism and Health and Safety.

Temporary impacts will arise particularly to the residential amenity of the occupants of specific residential properties within the study area where some of the proposed flood defences are to be constructed adjacent to residential properties (i.e. embankments constructed close to residence boundaries). Potential impacts in respect of construction activities on residential amenity in terms of traffic, noise, air quality and visual impact are described in Chapters 6-9 and mitigation measures presented therein.

5.3.1 Do Nothing

Under a '*Do-Nothing'* scenario the flood relief works would not be undertaken and the area would not benefit from a reduction in flooding risk to properties.

- 30 residences and commercial properties would remain at flood risk in a 1% AEP event.
- The risk to the important transport routes such as the N7 National Primary Road and the Dublin Cork Railway would remain.

5.3.2 Construction Phase Impacts

5.3.2.1 Demographics

It is expected that the construction of the proposed scheme will take approximately 61 weeks spread in phases over a period of 3-4 years. The construction phase of the proposed scheme does not have the potential to impact on population levels or the profile of the local population.

5.3.2.2 Economic Activity

There is potential for the proposed scheme to influence commercial activity and existing businesses within the study area during the construction phase of the flood management scheme, primarily due to disruption and disturbance from traffic and noise.

The effects will be greatest where construction activities including temporary working areas and access routes occur in closest proximity to business premises and may also include indirect effects such as road restrictions, etc. These effects will occur for a temporary period only and no significant impacts such as job losses due to the construction are likely.

Up to 20 construction workers may move into the area on a temporary basis for the duration of the construction phase, which could support existing employment through local spending, e.g. on fuel, food, building supplies, haulage services, etc. This could have a slight short-term positive impact for local businesses and accommodation providers, but is not likely to impact on population levels.

Overall, in the absence of mitigation, during the construction phase the impacts to economic activity within the study area are likely to be short term slight negative for the majority of commercial activities and businesses but with the potential for short term significant negative impacts for businesses in closest proximity to construction areas.

5.3.2.3 Education and Health

During construction, potential impacts in respect of education are not expected to be significantly different from the existing situation. There will be a temporary increase in the number of HGVs on routes within the works areas during construction and the resultant temporary traffic management procedures may result in some minor disruption to local traffic which may include increases to typical journey times. In the absence of mitigation, potential impacts to education during construction are predicted to be short term slight negative.

Potential impacts to health in respect of noise, vibration and air quality have been assessed separately in their respective chapters and impacts from these activities during construction have been assessed as being below the threshold for potential impacts to health.

As is further discussed in Chapter 13 (section 13.3.2.3), construction of new embankments and the restoration of existing embankments will require excavations at locations where made ground has been identified in the ground investigations. Although studies carried out to date have not found evidence of contamination, further site investigations are required to assess for potential contamination in accordance with BS5930:2015 and BS10175:2011+A1:2013. The excavation and handling of contaminated made ground could result in the increased mobilisation of contaminants which could increase the potential impacts on the surrounding areas. Dependant on the contaminant of concern; these impacts could include:

- Leaching of any contaminants from the made ground to the surrounding area could lead to further areas of soils within the vicinity becoming impacted and the impacting of groundwater and surface water;
- Risk from gas production; and,
- Human health risk, as excavation of made ground could expose construction works to potential contaminants. If contaminant levels exceed soil guideline values (SGVs) this could present a risk to human health from direct contact and from volatile or semi-volatile vapours.

In the absence of mitigation the excavation of contaminated made ground would have a temporary to short term negative effect on the soils, geology and hydrogeology of the study area. There may be slight to significant negative impacts on health depending on the nature of the contamination and the sensitivity of the receiving environment.

The River Liffey is an important drinking water catchment and adverse impacts to water quality, within the Morell catchment may result in adverse impacts to the quality of the raw drinking water downstream and to groundwater. Spillages of fuels, oils or chemicals would present the greatest hazard. Municipal treatment processes will remove the risk to health from contamination of public water supplies; however private supplies and wells reliant on groundwater may be vulnerable. An assessment of potential impacts and mitigation measures to protect groundwater has been included in Chapter 13.

In the absence of mitigation, potential impacts to human health from release of pollutants during construction are predicted to be short term moderate negative.

5.3.2.4 Tourism and Leisure

In general, construction of the proposed scheme will not impact on regional or local tourism and leisure activities or providers as the majority of these are outside the study area and will not be influenced by construction activities.

However, part of the scheme is located within the property of Killeen Golf Club and in the absence of mitigation there is the potential for temporary significant negative impacts to the club while construction is carried out. Construction work may result in increased traffic, noise and dust, examined separately in Chapters 6, 7 & 8, but in addition to these, various parts of the works footprint will be on the golf course itself, which will result in areas of the course being made temporarily inaccessible to players and staff during construction. In the absence of mitigation, this may have a temporary significant negative impact on the club. No other leisure/tourism amenity sites are anticipated to be affected by construction activities.

Whilst construction activities will have little impact on many sectors of the tourism industry within the catchment, there is potential for impacts to angling activity. The proposed scheme will have a temporary adverse impact on the angling amenity during any in-stream works. Where embankments or flood walls are proposed adjacent to river banks, the temporary working area will not be accessible to the public for health and safety reasons, thus access to the river at these locations will be prohibited during construction.

In the absence of mitigation there is also potential for a temporary significant negative impact to the water quality as a result of accidental spillages/sediment releases. Any impact to the water quality would have a direct impact to the fish stocks of the Liffey, Morell and associated tributaries and thus potentially result in a temporary moderate negative impact to the local angling resource.

5.3.2.5 Land Use

The majority of the proposed flood management scheme will be constructed on agricultural land. Potential impacts during construction in respect of land use for agriculture within the study area include:

- Noise – The operation of large machinery and lorries will generate a level of noise and noise can be an issue with certain types of livestock such as dairy cows and horses;

- Dust - The activity of earth moving machinery, transport lorries and other ancillary vehicles could generate significant dust in the immediate vicinity of the proposed scheme. The proliferation of dust has a nuisance value with livestock and other farming activities;
- Traffic - There will be an increase in traffic during the construction and operation phases of the proposed development. Increased traffic associated with the proposed scheme may run concurrently with farming operations such as silage production, grain harvesting and the general and/or predicted movements of livestock;
- Construction of the proposed development may disturb or sever water supplies for livestock in fields and properties.
- Severance – Access will be potentially severed during the construction of the proposed scheme. This, if it does occur, will be temporary;
- Disease – The spread of disease, such bovine tuberculosis, is a potential impact associated with all linear schemes involving the movement of machinery between different farm holdings.

In the absence of mitigation, the potential impacts during construction to agricultural activities are predicted to be temporary significant negative.

5.3.2.6 Health and Safety

During construction, potential impacts in respect of health and safety are not expected to be significantly different from the existing situation. There will be a temporary increase in the number of HGVs on routes within the works areas during construction. Potential impacts to health in respect of noise, vibration and air quality have been assessed separately in their respective chapters.

In the absence of mitigation, potential impacts to health and safety during construction are predicted to be short term moderate negative.

5.3.3 Operational Phase Impacts

5.3.3.1 Demographics

There are no potential impacts associated with the operation of the scheme on population/demographics, however the reduction in the flood plain area may result in planning applications for new dwellings in areas which might previously have been affected by flooding and would thus have not been likely to be granted planning permission.

Predicted impacts are long term moderate positive. For the residential and working community, no mitigation is required, provided that plans to reinstate and landscape areas damaged or disturbed during the construction phase are implemented in a timely manner following the carrying out of the works. Impacts on the visiting community will also be generally moderate long term positive.

5.3.3.2 Economic Activity

Predicted impacts during the operation phase on commercial activity are anticipated to be significant long term positive. Local roads and at-risk commercial premises will be protected from flooding for events up to 1% AEP, representing a significant improvement on the existing situation.

5.3.3.3 Education and Health

Predicted impacts during the operation phase on education and health are anticipated to be significant long term positive. Local roads will be protected from flooding for events up to 1% AEP, thus presenting a significant improvement on the existing situation.

5.3.3.4 Tourism and Leisure

In general, predicted impacts during the operation phase on tourism and leisure are anticipated to be significant long term positive. Local roads will be protected from flooding for events up to 1% AEP thus presenting a significant improvement on the existing situation.

Killeen Golf Club will experience increased water depths on the northern parts of the golf course during a 1%AEP flood event. However, the new walls and embankments will ensure that the clubhouse buildings, which are currently subject to flood risk, will be protected. In the absence of mitigation, impacts would be long term slight negative. The golf club lands are not predicted to flood for the 10% AEP in the existing or proposed scenario.

5.3.3.5 Land Use

In terms of the overall scheme area, predicted impacts will be generally positive, significant and long-term.

However localised areas will be subject to reduced land usage due to embankment location. While most of the land affected by the proposed scheme is used for grazing and, as such, will not be significantly impacted by embankment location, some of the land used for tillage or grass conservation will potentially be impacted.

Approximately 7,423 metres of new embankments will be constructed as part of this proposed scheme. This will equate to approximately 7.8 hectares of agricultural land that will potentially have reduced usage.

In the existing scenario approximately 471 hectares of land would experience flooding for the 1% AEP flood event. In the post scheme scenario, it is predicted that 300 hectares of land would experience flooding for the same return period. However, the aforementioned is predicated on a whole catchment basis. On an individual basis, a small number of landowners (Nos. 25) will experience greater flooding of their lands for this return period.

Table 5.16: Predicted Operational Phase Impacts – Agricultural Land Use

Description	Numbers
Agricultural area affected by current flooding (ha)	440
Agricultural area affected post scheme (ha)	273
Agricultural properties affected - positive	107
Agricultural properties affected - neutral	13
Agricultural properties affected - negative	25

Table 5.17 below summarises the predicted impacts for non-agricultural properties in the vicinity of the proposed scheme. A small number (4 No.) of non-agricultural landowners will experience increased flooding of their land for this return period.

Table 5.17: Non-Agricultural Properties in the Vicinity of the Proposed Scheme

Description	Numbers
Non-agricultural area affected by current flooding (ha)	31
Non-agricultural area affected post scheme (ha)	27
Non-agricultural properties affected - positive	57
Non-agricultural properties affected - neutral	2
Non-agricultural properties affected - negative	4

5.3.3.6 Health and Safety

In general, predicted impacts during the operation phase on health and safety are anticipated to be significant long term positive. Local roads will be protected from flooding for events up to 1% AEP thus presenting a significant improvement on the existing situation. There will be a significant reduction in flood extents during extreme flood events. This is also considered to be a long term positive impact.

5.4 MITIGATION MEASURES

5.4.1 Construction Phase

5.4.1.1 Demographics

During construction, no significant adverse predicted impacts on demography are identified. Accordingly no mitigation measures are considered necessary.

5.4.1.2 Economic Activity

The local resident and working population may be moderately negatively impacted upon by the construction phase. These impacts will also be mitigated by the adoption of good construction and traffic management measures and by the effective dissemination of information to residents and owners and operators of places of work.

Such measures should be identified in a formal Construction and Environmental Management Plan (CEMP) and Construction Traffic Management Plan (CTMP). The working and resident community would also benefit from an organised information campaign on temporary access arrangements and proposed construction detail.

The CEMP will be implemented by the contractor to mitigate against adverse impacts during construction. The CEMP will incorporate mitigation measures to avoid nuisance from construction activities including dust and noise, further details of which are included in Sections 7.4 and 8.4

respectively. In respect of visual impacts, mitigation is proposed in Chapter 9 and includes the use of appropriate fencing and lighting to minimise the visual impact of the temporary stockpiling /construction compound areas.

The CTMP will also be prepared in advance of the proposed works to minimise any impacts on other road users and to maximise road safety along the haul routes. The aim of a CTMP is to put in place procedures to manage construction traffic effectively. The plan will consider construction traffic accessing the site via the public road network as well as traffic circulation within the construction site.

The underlying design of traffic management arrangements should be to produce a safety performance no worse than the rate for non-works conditions, whilst minimising delays for traffic passing the works. Traffic mitigation is fully discussed in Section 6.5 of Chapter 6.

It is recommended that proposed temporary circulation, access and parking arrangements are circulated via the local media prior to the commencement of construction works. Any proposals for work outside the normal working hours of 07:30-16:30 Monday to Friday will also be made known to local residents and businesses.

It is proposed that a complaints procedure should be operated by the Contractor throughout the construction phase. Residents and businesses will be made aware of the complaints procedure.

Landowners have been consulted with extensively in the development of the scheme design and for those affected landowners which are involved in commercial activities; an appropriate accommodation works compensation package will be agreed. Ongoing consultation with other land users specifically affected by proposed construction works will be required.

5.4.1.3 Education and Health

Construction phase impacts in respect of education and health will be mitigated in the same way as for the resident/working population in 5.4.1.2 above, by the adoption of good construction and traffic management measures and by the dissemination of information to schools and healthcare providers. Such measures should be identified in the CEMP and CTMP plan as previously outlined, and an organised information campaign on temporary access arrangements and proposed construction detail as previously identified.

Should evidence of contamination be encountered in the identified areas of made ground or other excavated areas, appropriate health and safety measures shall be implemented as outlined in the CEMP. A site specific waste management plan shall be implemented onsite to mitigate any potential impacts from potentially contaminated made ground. The plan will include steps for the excavation, handling, storage and disposal of potentially contaminated material in accordance with industry best practices and waste management regulations.

General mitigation measures for the preservation of water quality are set out in detail in Chapter 11, Aquatic Ecology. In the unlikely event that these measures fail, a robust mechanism for reporting of pollution incidents will be agreed in advance between the OPW, Kildare County Council, the IFI and other relevant statutory agencies. An outline emergency spill response plan has been included in the outline CEMP; this will be developed and amended by the Contractor to reflect the local conditions on site.

5.4.1.4 Tourism and Leisure

Construction phase impacts in respect of tourism and leisure will be mitigated in the same way as for the resident/working population in 5.4.1.2 above, by the adoption of good construction and traffic management measures and by the dissemination of information to schools and healthcare providers. Such measures should be identified in the CEMP and CTMP plan as previously outlined, and an organised information campaign on temporary access arrangements and proposed construction detail as previously identified.

Phasing of works around peak user times of other uses such as specific sports facilities, in particular Killeen Golf Club, and seasonal tourist facilities should be considered and regular updates and consultation with any sports clubs affected by construction works will be required.

Local angling clubs and IFI have been included in the consultation process and will be kept informed throughout the construction process. Mitigation and control measures to address the impact from suspended sediments associated with construction activities should follow good work practices and sound design principles (see also Chapter 11, Aquatic Ecology). Contractors shall establish contact with the relevant authorities, e.g. IFI before works commence, with ongoing liaison throughout the construction.

5.4.1.5 Land Use

General access to some land uses will suffer some unavoidable localised slight temporary negative impacts during construction. Extensive landowner consultation has been carried out during the development of the proposed scheme and a stakeholder database has been developed to record the particular mitigation requirements for individual land parcels. Consultation with landowners will continue throughout detailed design and construction of the scheme to ensure that appropriate mitigation for individual landowners is agreed between the landowner and the Contractor and will be implemented.

The following mitigation measures are proposed in respect of land use in the proposed scheme area:

- Mitigation measures regarding construction traffic, dust and noise are outlined in the Chapters 6, 7 and 8 of the EIAR.
- Any disruption to water supply will be reinstated immediately by the Contractor or an alternative source supplied until the original source is reinstated, unless otherwise agreed with the landowner. Discussions have taken place with landowners in this regard and these discussions will continue throughout the construction period.
- Existing accesses to all properties will, where practicable, be maintained during construction otherwise reasonable temporary access will be provided.
- Where necessary, suitable stock proof temporary fencing will be erected for the duration of construction.
- Where any fences, walls or hedges are damaged they will be made stock proof immediately, where necessary. Any necessary permanent restoration of fences, walls, drains or land will be completed as soon as practicable after work has concluded
- During the construction stage the contractor will be instructed that any gates used by them are closed so as to prevent animals from straying.

- All machines will be treated with appropriate disinfectant prior to arrival on site. The contractor will verify to the construction manager engineer that this has been done.
- The construction manager will liaise with the local District Veterinary Office (DVO) to establish the location of any restricted herds along the proposed scheme. The liaison will continue on a regular basis throughout the construction period.
- Where the construction manager has been informed of a restricted herd along the scheme, all machinery and personnel will be disinfected appropriately before leaving the land concerned. The contractor will arrange for disinfectant mats/baths to be replenished with disinfectants, as required.
- In the event of an outbreak of a serious Class A Disease, the project will be subject to such operational restrictions as are imposed by the Department of Agriculture, Food and Marine.

All lands, temporarily acquired, will be re-instated to pre-construction conditions.

5.4.1.6 Health and Safety

A Construction Traffic Management Plan (CTMP) will be prepared in advance of the proposed works to minimise any impacts on other road users and to maximise road safety along the haul routes. The aim of a CTMP is to put in place procedures to manage construction traffic effectively. The plan will consider construction traffic accessing the site via the public road network as well as traffic circulation within the construction site. The underlying design of traffic management arrangements should be to produce a safety performance no worse than the rate for non-works conditions, whilst minimising delays for traffic passing the works. Traffic mitigation is fully discussed in Section 6.5 of Chapter 6.

The works will be subject to the Safety, Health and Welfare at Work Act 2005 (S.I. No. 10 of 2005) and at a minimum the Safety, Health and Welfare at Work (Construction) Regulations, 2013 (S.I. No. 291 of 2013). All aspects of design construction will be reviewed with regard to health and safety and risk assessments will be carried out.

A project supervisor design process (PSDP) has been appointed. As part of their duties they will be required to produce a Preliminary Safety and Health Plan for the project. The main contractor will be appointed as project supervisor construction stage (PSCS) and will be responsible for the control and co-ordination of health and safety during the construction phase of the works.

5.4.2 Operational Phase

5.4.2.1 Demographics

During operation, no predicted adverse impacts on demography are identified. Accordingly no mitigation measures are considered necessary.

5.4.2.2 Economic Activity

During operation, no predicted adverse impacts on economic activity are identified. Accordingly no mitigation measures are considered necessary.

5.4.2.3 Education and Health

During operation, no predicted adverse impacts on education and health are identified. Accordingly no mitigation measures are considered necessary.

5.4.2.4 Tourism and Leisure

In general, during operation, no predicted adverse impacts on tourism and leisure are identified. Accordingly, no mitigation measures are considered necessary. At a local scale, Killeen Golf Club will experience increased water depths on the northern parts of the golf course during a 1%AEP flood event. The golf club has been extensively consulted with in the development of the scheme design, which has been developed to ensure the club's key economic assets, including the clubhouse buildings, are protected and areas of the course that will experience flooding will have the ability to recover in a short time period.

5.4.2.5 Land Use

During the operation phase, significant areas of land and a wide range of land uses such as residential and agricultural will benefit from reduced flood risk, though some agricultural areas will be included in the post scheme floodplain.

There are no mitigation measures to off-set significantly reduced land usage due to new embankment and wall locations. Landowners have been consulted with extensively in the development of the scheme design and for those affected landowners an appropriate accommodation works compensation package will be agreed.

There are also no mitigation measures to off-set those areas that will experience significantly increased flooding due to the proposed scheme. Adversely affected landowners have been accommodated through either an appropriate accommodation works compensation package, or by protecting adjacent land parcels, where possible without being detrimental to the scheme.

5.4.2.6 Health and Safety

During operation, no predicted adverse impacts on health and safety are identified. Accordingly no mitigation measures are considered necessary.

5.5 RESIDUAL IMPACTS

5.5.1 Construction Phase

5.5.1.1 Demographics

There will be no residual impacts on demographics due to the activities undertaken during the construction phase of the proposed scheme.

5.5.1.2 Economic Activity

The reduction of flood risk will have a long-term significant positive impact on the residential and working communities. The proposed scheme will generally have a long-term significant positive impact on the visiting community through the reduction of flood risk.

Provided mitigation measures such as a CEMP (see outline example provided in Appendix B) and Construction Traffic Management Plans (see Chapter 6) will be put in place, impacts will be minimised to slight to moderate negative impacts, short-term in the context of the resident community at large and temporary for individual properties. These will be unavoidable given the nature of the works required and should be considered in the context of the positive operation impacts.

The generation of a number of construction jobs for an approximate 61 week period is considered a slight positive short-term impact. The knock on benefits to building suppliers and local service providers will reinforce this positive impact.

5.5.1.3 Education and Health

Provided mitigation measures such as a CEMP and Construction Traffic Management Plan and information provision through schools and health services are put in place, impacts will be minimised to slight, temporary, negative impacts. These will be unavoidable given the nature of the works required. The removal of potentially contaminated made ground encountered during excavations can be viewed as a long term slight positive impact.

5.5.1.4 Tourism and Leisure

Provided mitigation measures such as a CEMP and Construction Traffic Management Plan and information provision through tourist services are put in place, impacts will be minimised to slight, temporary, negative impacts. These will be unavoidable given the nature of the works required.

5.5.1.5 Land Use

Provided that mitigation in respect of reinstatement of temporary working areas is carried out, restoring land to its original condition, there will be no residual impacts on agriculture due to the activities undertaken during construction phase of the proposed scheme.

5.5.1.6 Health and Safety

Provided mitigation measures as outlined above in 5.5.1.2 such as a CEMP, Construction Traffic Management Plan, Health and Safety Plan and Emergency Pollution Response Plan are put in place, and that information provision measures to local residents and businesses are carried out, impacts in respect of health and safety during construction will be neutral.

5.5.2 Operational Phase

5.5.2.1 Demographics

There will be no residual impacts on demographics due to the operation of the proposed scheme.

5.5.2.2 Economic Activity

In the existing situation, the N7 as well as a number of local roads flood for low return period events, preventing local residents from travelling in the area, and in some cases preventing access or egress to their properties.

As a result of the scheme, a number of roads will be protected from flooding for events up to the 1% AEP. These include the N7, the L6016, the L2010, the L6021 and the Killeenmore Road. This will, as a minimum, allow access to all properties in the area from one direction and will prevent properties from being isolated during flood events. The scheme will also prevent major diversions as a result of the closure of the N7 for flood events up to the 1% AEP. Overall the predicted impacts of the scheme once operational are long term positive.

5.5.2.3 Education and Health

The proposed scheme will reduce the impact to residents, commuters and businesses on a regional scale by significantly reducing the flood risk to the N7 at Junction 6. On a local scale, the proposed scheme will also significantly reduce the impact to the local road network. The significant reduction in the extent of the flood plain during flooding events will reduce pollution risk to water supplies fed by surface water and groundwater, by reducing the occurrence of flood waters carrying pollutants from inundated areas back into the rivers and groundwater. The residual impacts of the operation of the scheme are anticipated to be long term positive.

5.5.2.4 Tourism and Leisure

The proposed scheme will reduce the impact to residents, commuters and businesses on a regional scale by significantly reducing the flood risk to the N7 at Junction 6. On a local scale, the proposed scheme will also significantly reduce the impact to the local road network. The residual impacts of the operation of the scheme will be long term positive.

At a local scale, Killeen Golf Club will experience increased water depths on the northern parts of the golf course during a 1%AEP flood event. However, the scheme has been designed such that the new walls and embankments will protect the clubhouse buildings, which are currently subject to flood risk. Overall, the predicted impacts are considered to be long term neutral.

5.5.2.5 Land Use

The proposed scheme will reduce flood risk on residential dwellings within the catchment area. Therefore, the overall impacts will be significant, long-term and positive.

Provided appropriate mitigation is agreed with the specified land owners, significant adverse long-term impacts can be avoided or the significance of these impacts reduced to slight or even imperceptible levels. However, where agreements and/or appropriate design solutions cannot be developed to address impacts identified, there may be long-term adverse impacts for some specified land uses.

The proposed scheme will have a long term positive impact on agriculture from a national and regional perspective. The proposed scheme will have a long term negative impact on some individuals. However, there will be no additional residual impacts on agriculture during the operational phase, other than those identified in Section 5.3.2.5.

The overriding benefits to the area are considered to outweigh any localised negative impacts. Significant areas of land and a wide range of users will benefit from reduced flood risk.

5.5.2.6 Health and Safety

In general, predicted impacts during the operation phase on health and safety are anticipated to be significant long term positive. Local roads will be protected from flooding for events up to 1% AEP thus presenting a significant improvement on the existing situation. There will be a significant reduction in flood extents during extreme flood events. This is also considered to be a long term positive impact.

6 TRAFFIC, TRANSPORT AND BUILT SERVICES

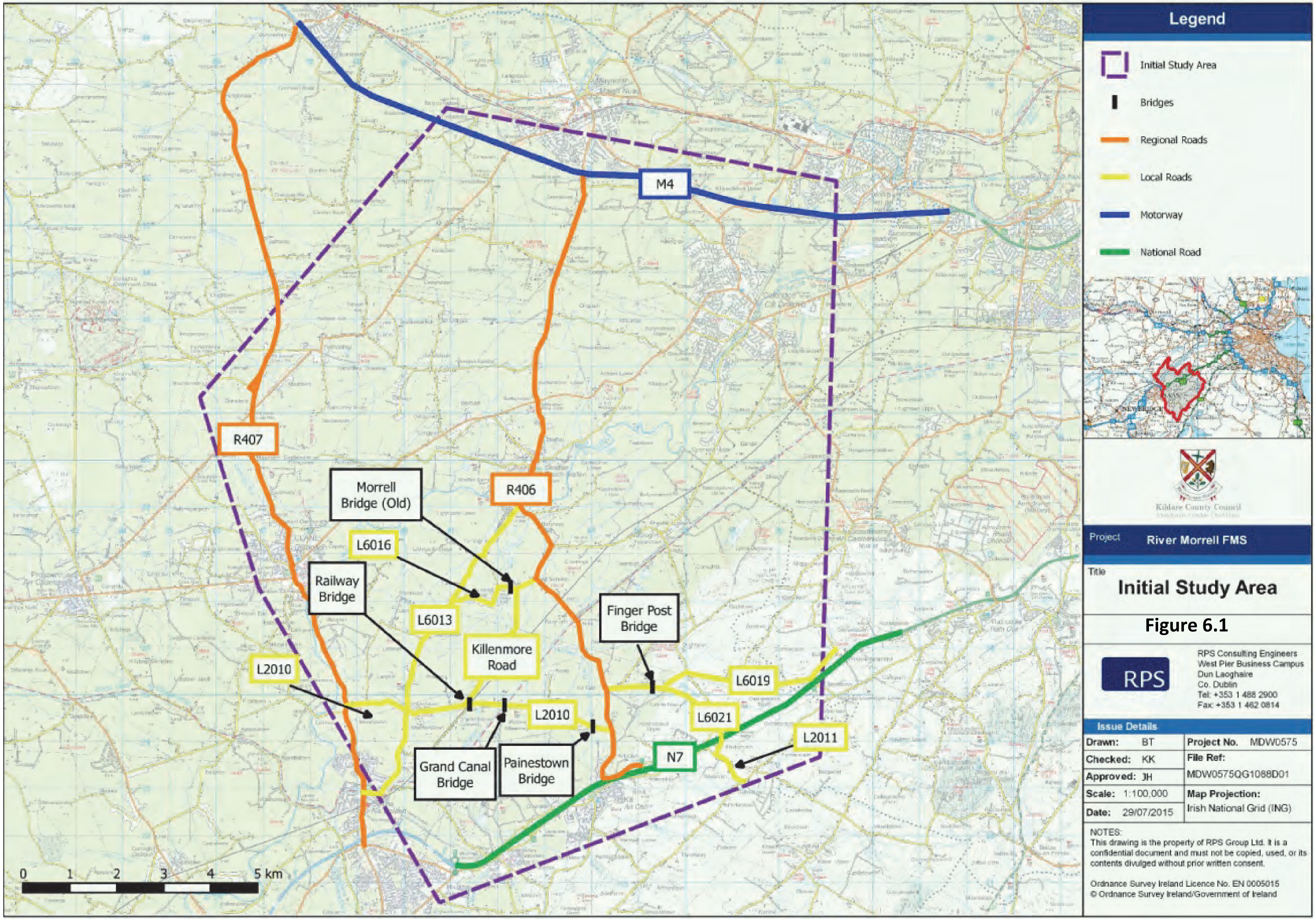
This chapter of the EIAR describes the impact of the proposed Morell River Flood Management Scheme in relation to the traffic associated with the construction and operational phase of the development and its interaction with existing built services.

6.1 METHODOLOGY

The study area is outlined in Figure 6.1 and was defined as being between the M4 and N7 national roads, the R406 / R407 regional roads and a number of local roads in between. In order to determine the predicted impact of the proposed scheme on the surrounding road network, the following methodology was used:

- Identify potential roads on the surrounding network in the vicinity of the works sites that might be considered for use by the haul routes;
- A site visit was undertaken to examine the suitability of the identified roads within the study area and to determine the most suitable haul routes for the proposed scheme;
- Examination of construction material requirements to determine the number of daily two-way HGV movements required for the construction of each embankment;
- Using the estimate of the total materials required for each embankment (as outlined in Chapter 4 'Project Description'), the duration of the HGV movements on each haul route and, by extension, on each section of the surrounding road network was determined; and
- Based on the assessment of potential traffic impacts associated with the scheme, a number of traffic management measures were determined to mitigate any potential impacts caused by the scheme.

This chapter should be read in conjunction with Chapter 4 which identifies the various construction areas and phases for the proposed scheme on the Painestown, Morell, Slane and Kill Rivers.


Legend
Initial Study Area
Bridges
Regional Roads
Local Roads
Motorway
National Road
M4
R407
R406
Morrell Bridge (Old)
L6016
Railway Bridge
L6013
Killenmore Road
Finger Post Bridge
L2010
L2010
L6019
L6021
L2011
N7
Grand Canal Bridge
Painestown Bridge
0 1 2 3 4 5 km
Kildare County Council
Project River Morrell FMS
Title Initial Study Area
Figure 6.1
RPS
RPS Consulting Engineers
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900
Fax: +353 1 462 0814
Issue Details
Drawn: BT
Checked: KK
Approved: JH
Scale: 1:100,000
Date: 29/07/2015
Project No. MDW0575
File Ref: MDW0575QG1088D01
Map Projection: Irish National Grid (ING)
NOTES:
This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
Ordnance Survey Ireland Licence No. EN 0005015
© Ordnance Survey Ireland/Government of Ireland

6.2 TRANSPORTATION NETWORK

As identified in Figure 4.1 within Chapter 4, a significant proportion of the proposed scheme works will be focused in close proximity to the R406, L2010, L6021 and Killeenmore Road. A cordon area was therefore identified, to highlight the area of works in relation to the surrounding road network. Figure 6.2 illustrates the location of the proposed scheme works in the context of the surrounding road network.

6.2.1 Road Network

The proposed scheme is located in County Kildare, to the east of the villages of Clane and Sallins. The national road network in the vicinity of the scheme consists of the M4 / N4 Dublin to Sligo Road to the north of the scheme and the N7 Dublin to Limerick Road to the south. There are a number of regional roads in the vicinity, namely the R406 and R407.

In order to avoid scheme traffic haul routes through towns / villages, it is anticipated that the N7 national road would be utilised, where possible, rather than the M4. Routing scheme haul traffic via the N7 would thereby avoid the local towns of Clane, Straffan and Celbridge.

National Road Network - N7

The N7 is a national strategic road that connects Dublin in the east to Limerick in the west via the M7 and a number of settlements in between. In the vicinity of the proposed scheme, between Junction 5 and Junction 9, the N7 is of a dual carriageway construction with three lanes in both directions.

Regional Road Network – R406 & R407

The R406 is a good quality regional road, with a carriageway width of approximately 7.0 metres for the majority of its route between section Morr 1 and the N7.

The R407 is a good quality regional road, with a carriageway width of approximately 6.5 metres for the majority of its route between the N7 and the L2010.

Local Road Network

There are a number of local rural roads identified within the scheme area including the L2010 and L6021. These are single carriageway two-way roads and are approximately 6 metres wide in the vicinity of the scheme selections.

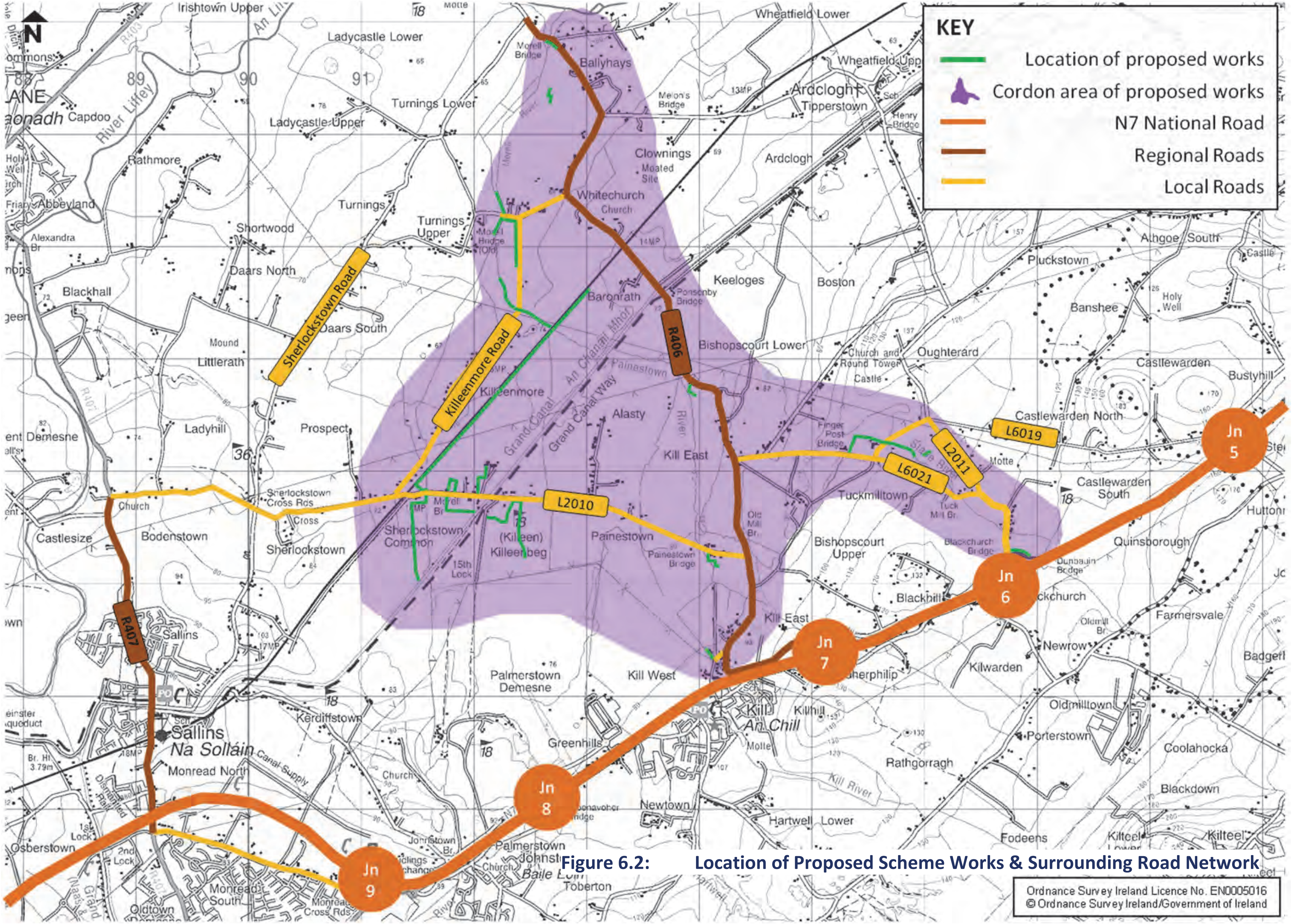


Figure 6.2: Location of Proposed Scheme Works & Surrounding Road Network

6.2.2 Flooding Issues on National and Local Roads

At present, the N7 as well as a number of local roads flood for low return period events, preventing local residents from travelling in the area, and in some cases preventing access or egress to their properties.

As a result of the scheme, a number of roads will be protected from flooding for events up to the 1% AEP.

The local roads which will be protected from flooding events up to the 1% AEP as a result of the scheme include the N7, L6016, L2010, L6021 and Killeenmore Road. The scheme will, as a minimum, allow access to all properties in the area from one direction and will prevent properties from being isolated during flood events. The scheme will also prevent major diversions as a result of the closure of the N7 for flood events up to the 1% AEP.

6.2.3 Traffic Flows

In order to establish the level of daily two-way traffic on the surrounding road network, new Automatic Traffic Count (ATC) surveys were undertaken at a number of locations on the surrounding regional and local roads. Transport Infrastructure Ireland's (TII) national road ATC database was also interrogated to determine Annual Average Daily Traffic (AADT) flows on the N7 in the vicinity of the proposed scheme and on approach to the cordoned area of works.

The location of the ATC surveys on the national and local road network, including the corresponding two-way AADT and percentage HGV is presented in Figure 6.3.

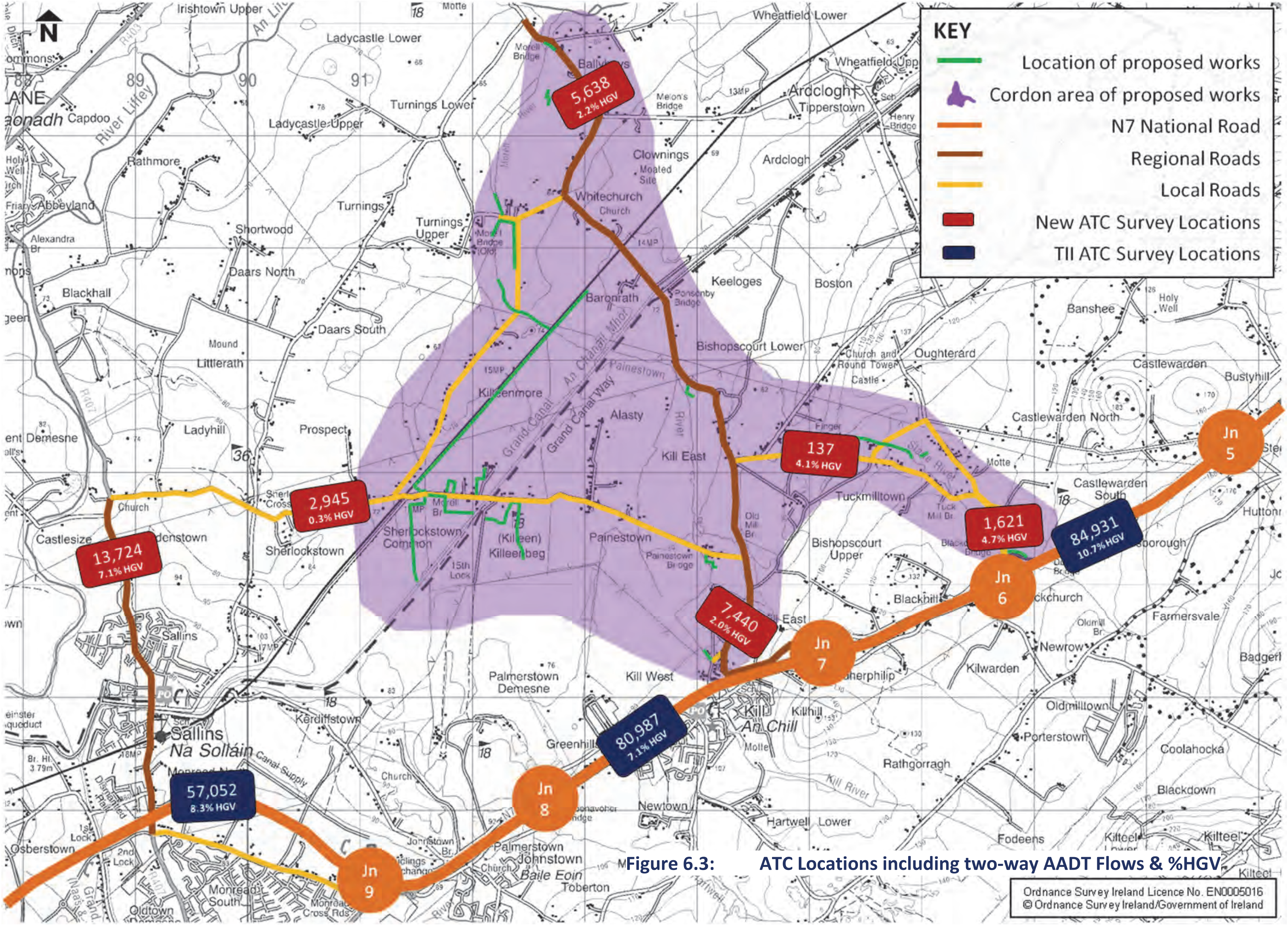
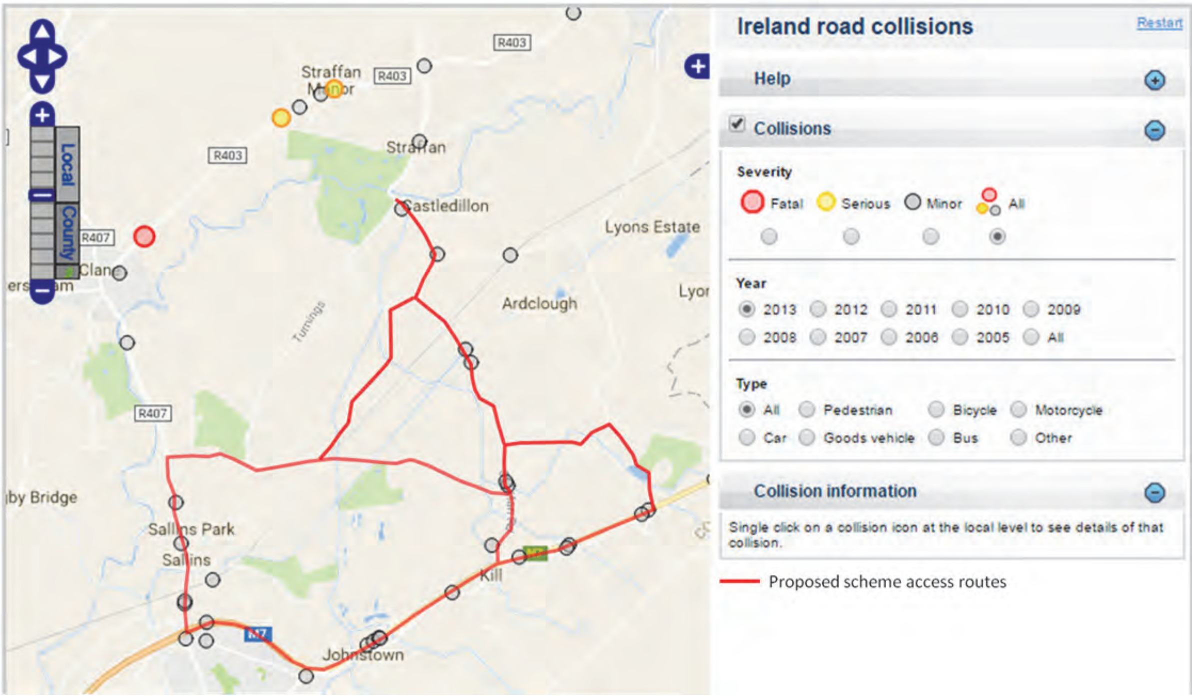


Figure 6.3: ATC Locations including two-way AADT Flows & %HGV

6.2.4 Accident Statistics

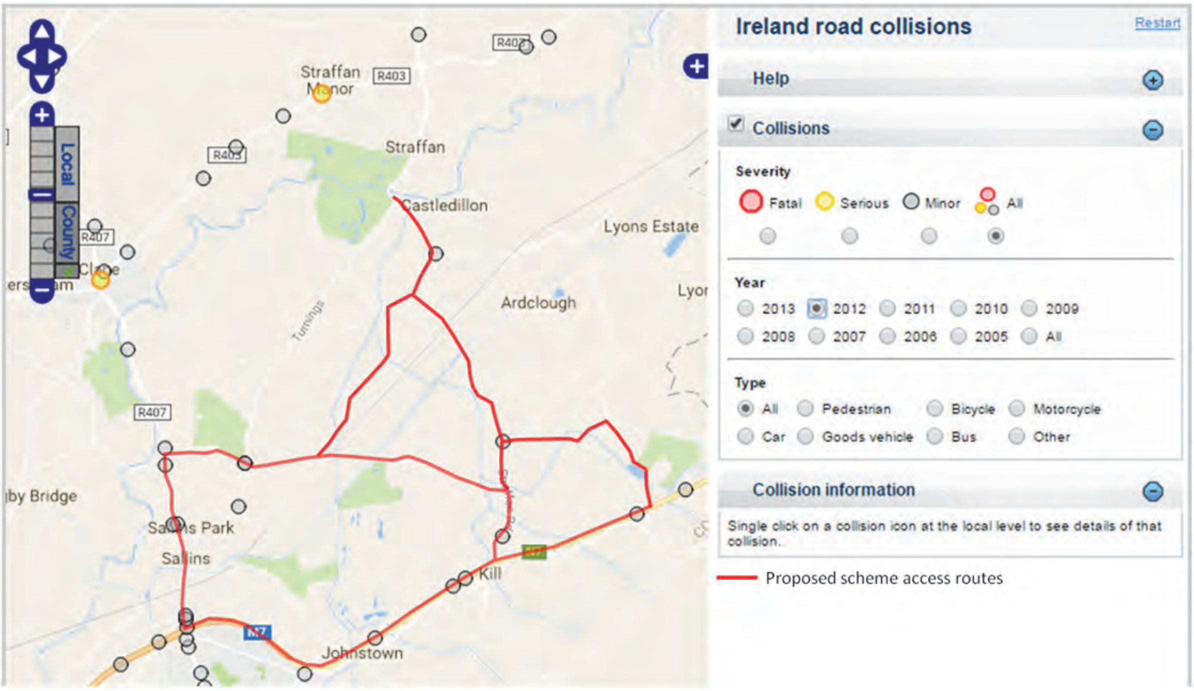
In order to determine if there was a significant level of accidents within the study area, road collision statistics for the previous three years' available data was gathered from the Road Safety Authority's (RSA) online database. Figures 6.4 to 6.6 illustrate the accident locations which occurred between 2011 and 2013 in the context of the proposed development scheme access routes.

Figure: 6.4 –Accident Locations 2013 *(source RSA)*



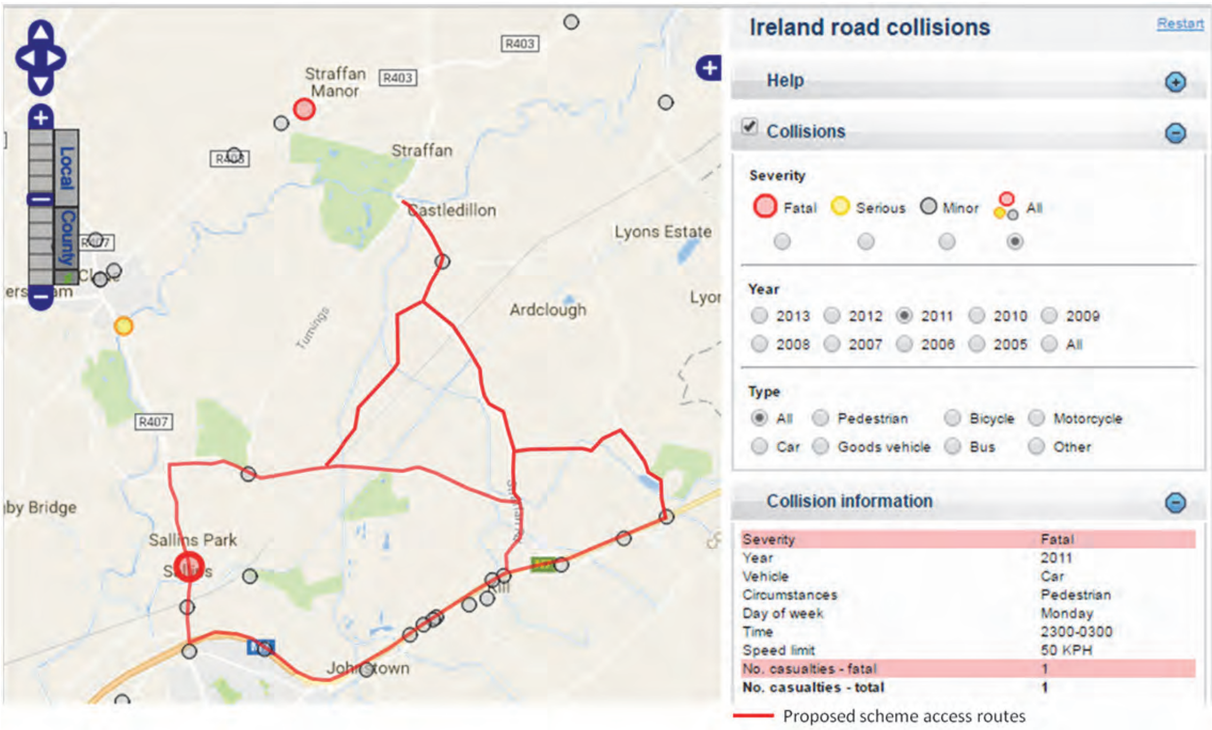
It can be seen from the above that there were no serious or fatal collisions within the proposed scheme access routes.

Figure: 6.5 –Accident Locations 2012 *(source RSA)*



It can be seen from Figure 6.5 that there were no serious or fatal collisions within the proposed scheme access routes.

Figure: 6.6 –Accident Locations 2011 *(source RSA)*



It can be seen from Figure 6.6 that there was one fatal collision recorded in 2011 on the R407 within Sallins town centre, which involved a car and a pedestrian. Full details of the collision are not available, however it can be seen that the accident occurred late at night/early hours of the morning.

The summary presented in Table 6.1 shows that there were no serious or fatal incidents for the past three years involving a HGV within the study area.

Table 6.1: Summary of Road Collision Statistics within Scheme Cordon Area (2013-2011)

Year	Type	
	Fatal	Serious
2013	-	-
2012	-	-
2011	1	-

6.3 PROPOSED SCHEME PHASING & HAUL ROUTES

A site visit was undertaken by RPS on the 31st March 2015 to visually observe the roads in the vicinity of the scheme and determine the most suitable haul routes to cater for deliveries to/from the proposed construction sites. The proposed haul routes are outlined and described in the following sections, along with a description of their associated roads.

6.3.1 Proposed Scheme Phasing

The construction works will commence at the confluence of the Rivers Morell and Liffey and from there the works will progress upstream, subject to the availability of construction materials. Within the works, the main artery of the scheme will be prioritised from embankments and associated tie-ins and culverts.

The scheme will require approximately 61 weeks of construction in total, however the nature of the works dictate that they should be undertaken in settled weather, without flood risk. As such, it is hoped that the construction of the scheme will be completed within three years; however it may require up to four years, particularly if adverse/extreme weather conditions are encountered for prolonged periods of any particular year.

The 'best case' scenario, based on completing all works within three years, considers the following groupings of works:

- **Group 1**: The section from the confluence of the River Morell/River Liffey to Killeenmore (Morr 1 to 3 and Paines 1 to 3) which should hopefully be completed as a single phase;
- **Group 2**: The second phase consists of the embankments, walls, culverts and stream diversions from Morr 4 to 23 and may be divided across two years, depending on construction delivery time, if this is the case Morr 4 to Morr 19 would most likely be completed as Phase 2a in year one and Morr 20 to 23 as Phase 2b in year two; and
- **Group 3:** encompasses Paines 4 & 5, Kill 1 and Slane 1 to 11.

The normal working hours for the construction of this scheme will be 7.30am – 4:30pm Monday to Friday. Working hours may be extended to 7.00am - 7.00pm Monday to Friday; and 9.00am and 4.00pm on Saturdays on occasion. There will be no activity on Sundays or Bank Holidays. Where additional or alternative working hours outside those stated above are required, these will require notification to Kildare County Council (KCC) and to be agreed in advance.

During the construction phase, there will be an average of 40 HGV deliveries per day (80 HGV two-way movements) bringing the required construction materials to the embankment or flood wall under construction. An average day, therefore, would consist of approximately 5 deliveries per hour over the 8 hour working day. Although an average of 40 HGV deliveries is anticipated, a maximum of 60 HGV deliveries will be proposed in any single day. It should be noted that some construction phases may occur simultaneously, however, where this may occur, deliveries will not exceed the maximum 60 HGV (120 two-way) movements per day as proposed.

It is proposed that any excavated materials will be reused, where suitable, for restoring the existing embankments and building the new embankments.

6.3.1.1 Stockpiling Locations

A desktop and on-site observation study was undertaken to determine the most suitable sites for potential stockpiling of material during the construction phases. Three stockpiling locations were identified as shown in Figure 6.7, located off Killeenmore Road and the L2010 to the east and west of the Grand Canal.

It is anticipated that the Contractor will use the best placed stockpiling site for each section, where possible, to minimise any unnecessary vehicular trips on the local road network. Furthermore, it is anticipated that one of the stockpiling sites may also be used as a construction compound; however, the final location will be agreed when a contractor has been appointed.

All three stockpiling sites have frontage on sections of road which are relatively straight and with good visibility in both directions. As Killeenmore Road is a narrow rural road with minimal passing places, it is not advised that two-way HGVs should be in operation during construction. It is proposed therefore, that a one-way operation be employed for HGVs, with the embankment route associated with Paines 1 being used for opposing HGV movements adjacent to Killeenmore Road.

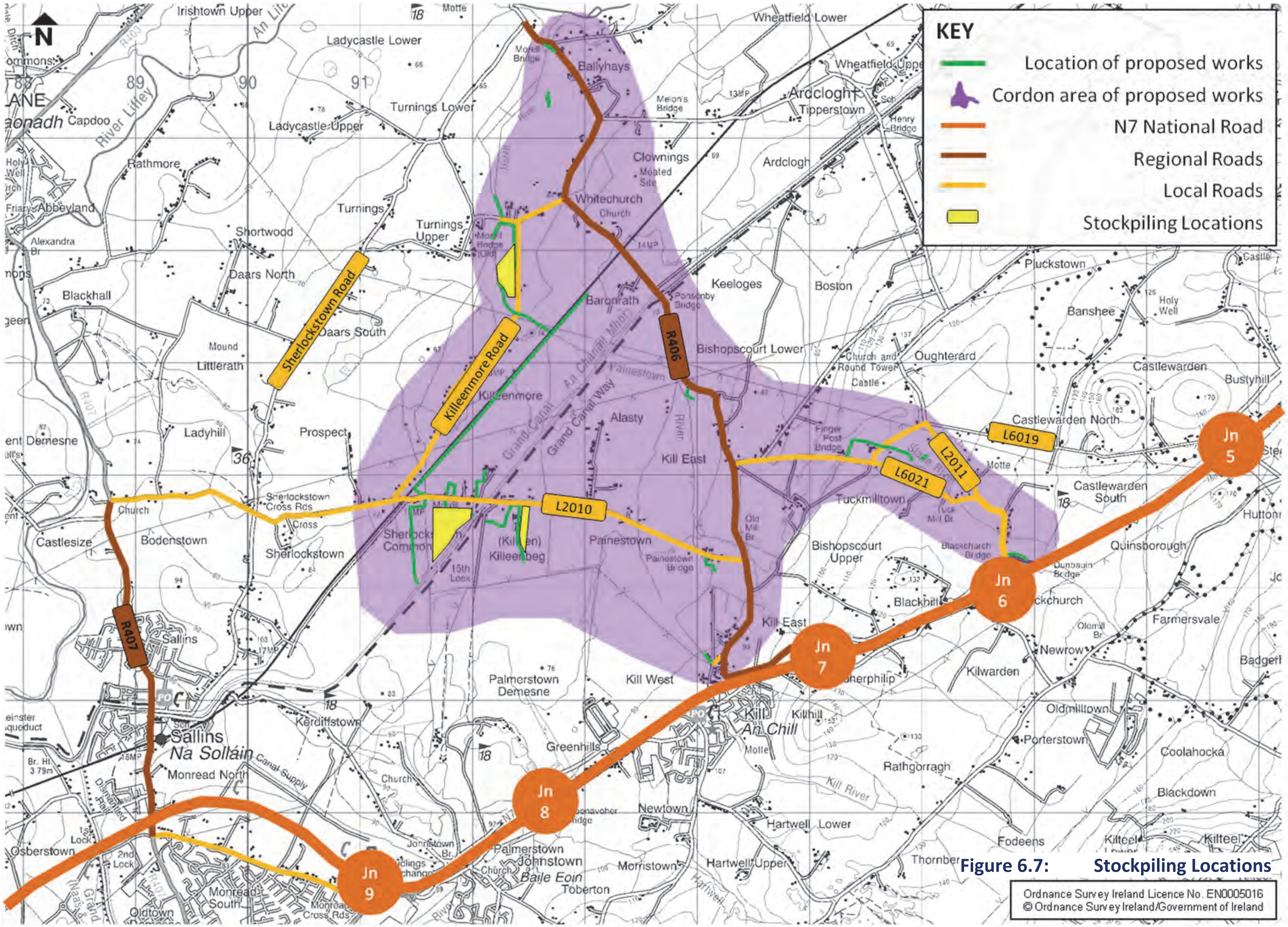


Figure 6.7: Stockpiling Locations

A number of haul routes were therefore identified for each Group of works, which would provide the most reasonable route options for deliveries to / from the proposed construction sites.

6.3.2 Group 1

Group 1 of the proposed scheme consists of the construction of Sections Morr 1-3 and Paines 1-3. It is proposed that this phase will take approximately 8 weeks to complete, with each section being constructed independently, i.e. the construction of one section will be completed before another section can begin. This is to minimise the level of HGV traffic on the surrounding road network during construction. An indicative construction timeframe for each section, together with the proposed haul route for each is provided in Table 6.2, with the haul routes illustrated in Figure 6.8.

Table 6.2: Group 1 Construction – New Embankments

Haul Phase	Section	Proposed Haul Route	Average no. of construction HGV movements per day (two-way)	Construction timeframe (weeks)
1	Morr 1	N7(Jn.7) & R406	80	0.2
2	Morr 1a			0.3
3	Morr 2	N7(Jn.7), R406 & Local Road (off L6016/Killeenmore Road)		1.1
4	Morr 3			1.5
5	Paines 1			5.1
Total				**8.2**

N7 (Junction 7)

It is proposed that HGVs will exit the N7 at Junction 7 in order to access the proposed section locations. Junction 7 of the N7 has been designed to cater for large HGV, and therefore, will be able to cater for the additional traffic and HGVs associated with Group 1.

R406

The proposed scheme sections associated with Group 1 consists of a route option that includes approximately 7.6 kilometres along the R406 to and from the N7. The R406 is a good quality regional road, with a carriageway width of approximately 7.0 metres for the majority of its route between section Morr 1 section and the N7.

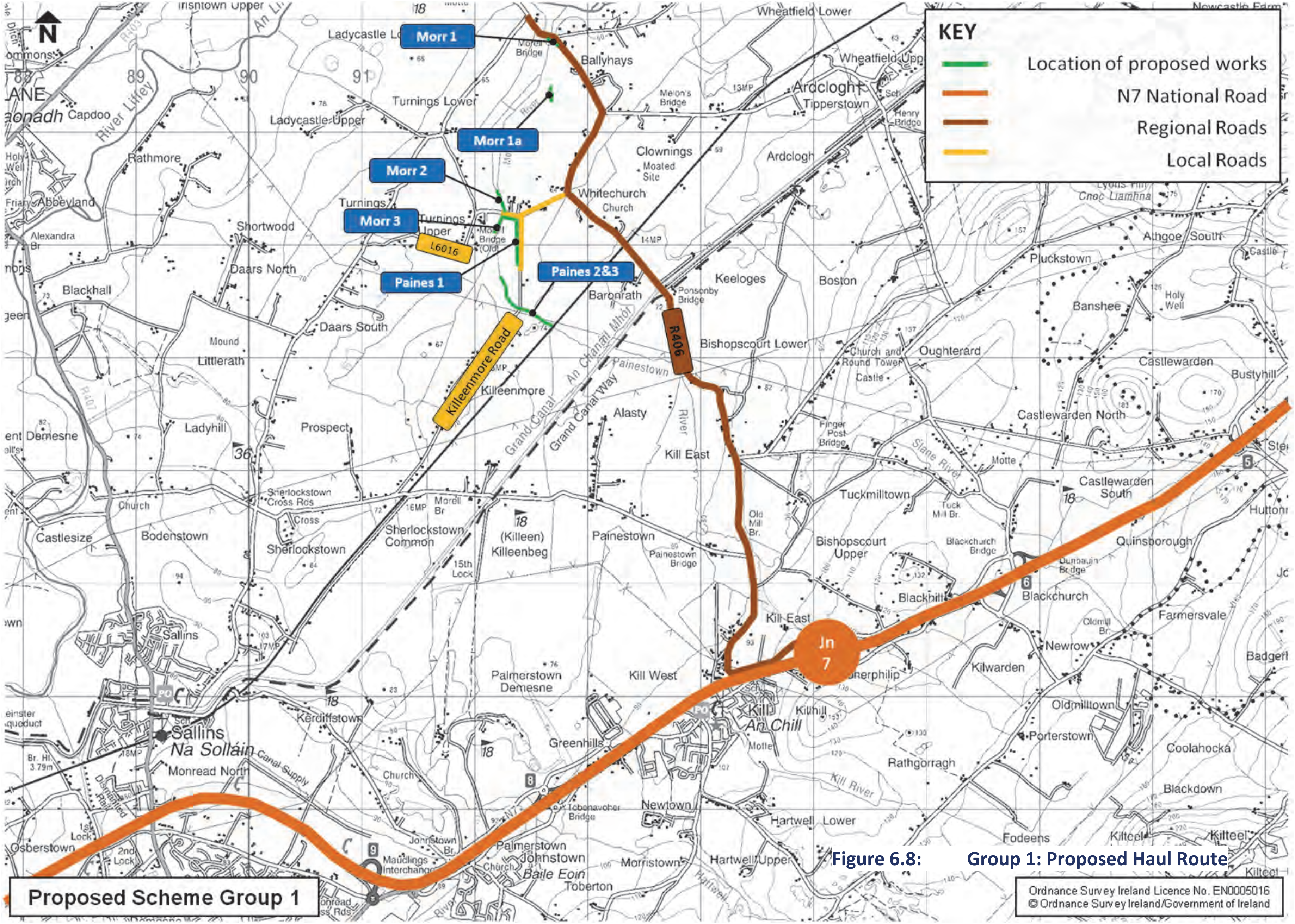


Figure 6.8: Group 1: Proposed Haul Route

While there are a number of bends along this section of the road (Images 6.1 and 6.2) as well as a small number of sections where the carriageway width narrows (Images 6.3 and 6.4), the route is considered appropriate for HGV movements. Furthermore, the new ATC traffic flows undertaken demonstrates that HGVs are currently travelling along this route, as shown in Figure 6.3.

Image 6.1: Example of Bend on R406

Image 6.2: Example of Bend on R406

Image 6.3: Example of Narrow Section of R406

Image 6.4: Example of Narrow Section of R406

6.3.2.1 Local Access Road

The local access road which forms part of the L6016 and which is located between the R406 and Killeenmore Road will serve sections Morell 2, 3 and Paines 1.

The L6016 has a carriageway width of approximately 4.0 metres, with grass verges on either side and a relatively straight alignment for the section that forms part of the access for Group 1 (Image 6.5). The bridge over the Morell River is approximately 3.9 metres wide and has reduced visibility on approach (Image 6.6) and is therefore not considered appropriate for regular HGV use.

Image 6.5: L6016 Alignment

Image 6.6: Morell Bridge (old) on L6016

A number of vehicle access control measures could be implemented in order to manage two-way passing of HGVs to access Morr 2 and Morr 3. These are discussed in Section 6.5.

6.3.3 Group 2

Group 2 of the proposed scheme consists of the construction of Sections Morr 4-23. The second group consists of the embankments, walls, culverts and stream diversions and may be phased across two years, depending on construction delivery time. If this is the case, Morr 4 to Morr 19 would most likely be completed as Phase 2a in year one and Morr 20 - 23 as Phase 2b in year two.

It is proposed that the new embankments element of this group of works will take approximately 28 weeks to complete, with other elements taking approximately 10 weeks, again, with each section being constructed independently. An indicative construction timeframe for each section, together with the proposed haul route for each is provided in Table 6.3 and 6.4, with the haul routes illustrated in Figure 6.10.

Table 6.3: Group 2, Phase 2a Construction – New Embankments

Haul Phase	Section	Proposed Haul Route	Average no. of construction HGV movements per day (two-way)	Construction timeframe (weeks)
6	Morr 4	N7 (Jn.9), R407, L2010	80	8.5
11	Morr 9			3.3
12	Morr 15			1.7
13	Morr 16			0.4
14	Morr 16a			0.5
15	Morr 17			4.3
16	Morr 19			3.4
Total				**22.1**

Table 6.4: Group 2, Phase 2a Construction – Other Elements

Haul Phase	Section	Proposed Haul Route	Average no. of construction HGV movements per day (two-way)	Construction timeframe (weeks)
1	Morr 5	N7(Jn.9), R407, L2010	80	1.0
2	Morr 6			1.0
3	Morr 7			3.0
4	Morr 8			1.0
Total				**6.0**

A number of vehicle access control measures could be implemented in order to manage two-way passing of HGVs to access Morr 4 - 19. These are discussed in Section 6.5.

Table 6.5: Group 2, Phase 2b Construction – New Embankments

Haul Phase	Section	Proposed Haul Route	Average no. of construction HGV movements per day (two-way)	Construction timeframe (weeks)
17	Morr 20	N7(Jn.7), R406 & L2010	80	0.0
18	Morr 21			2.9
19	Morr 23			4.4
Total				**7.4**

Table 6.6: Group 2, Phase 2b Construction – Other Elements

Haul Phase	Section	Proposed Haul Route	Average no. of construction HGV movements per day (two-way)	Construction timeframe (weeks)
5	Morr 22	N7(Jn.7), R406 & L2010	80	3.0
Total				**3.0**

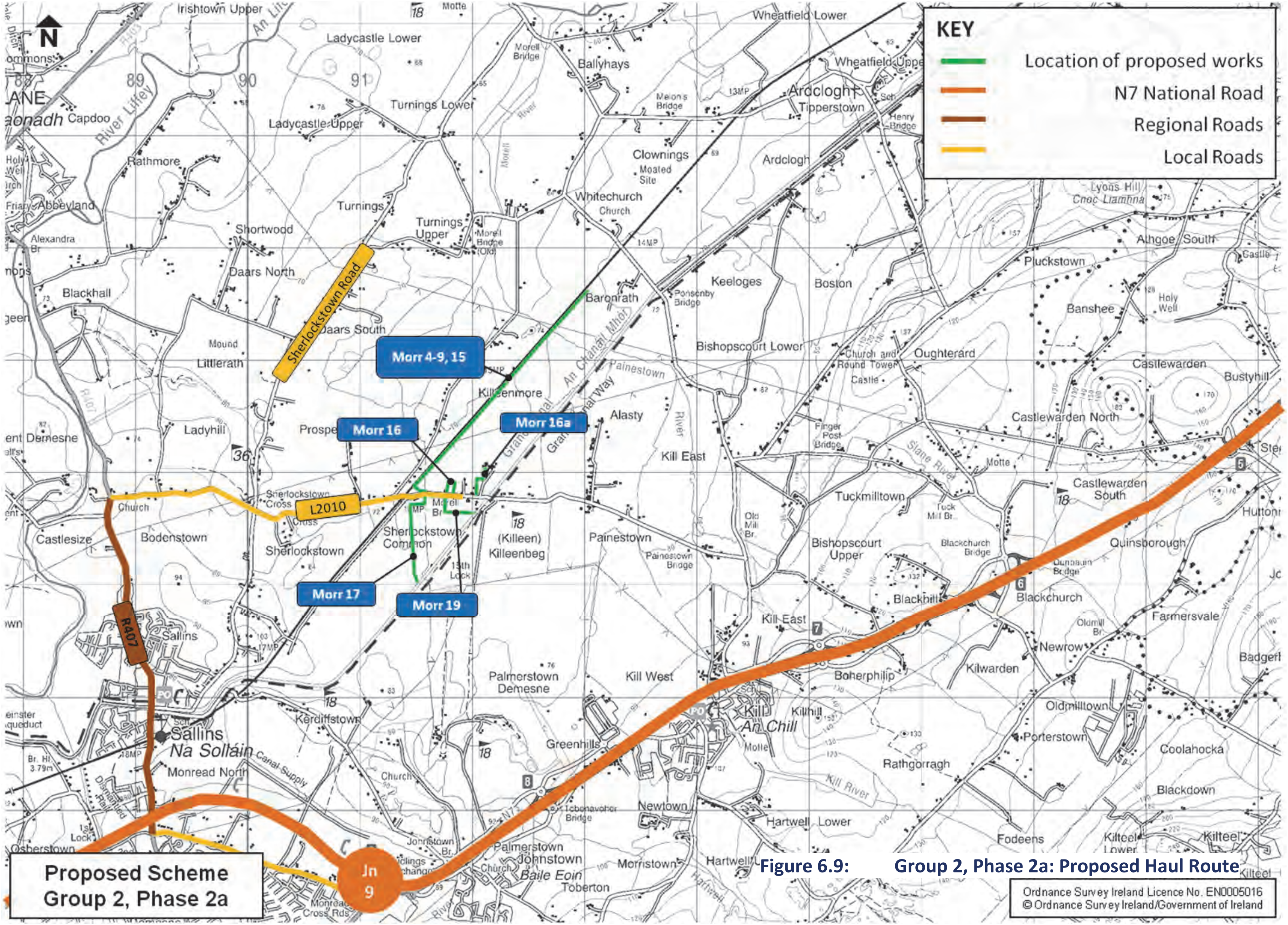


Figure 6.9: Group 2, Phase 2a: Proposed Haul Route

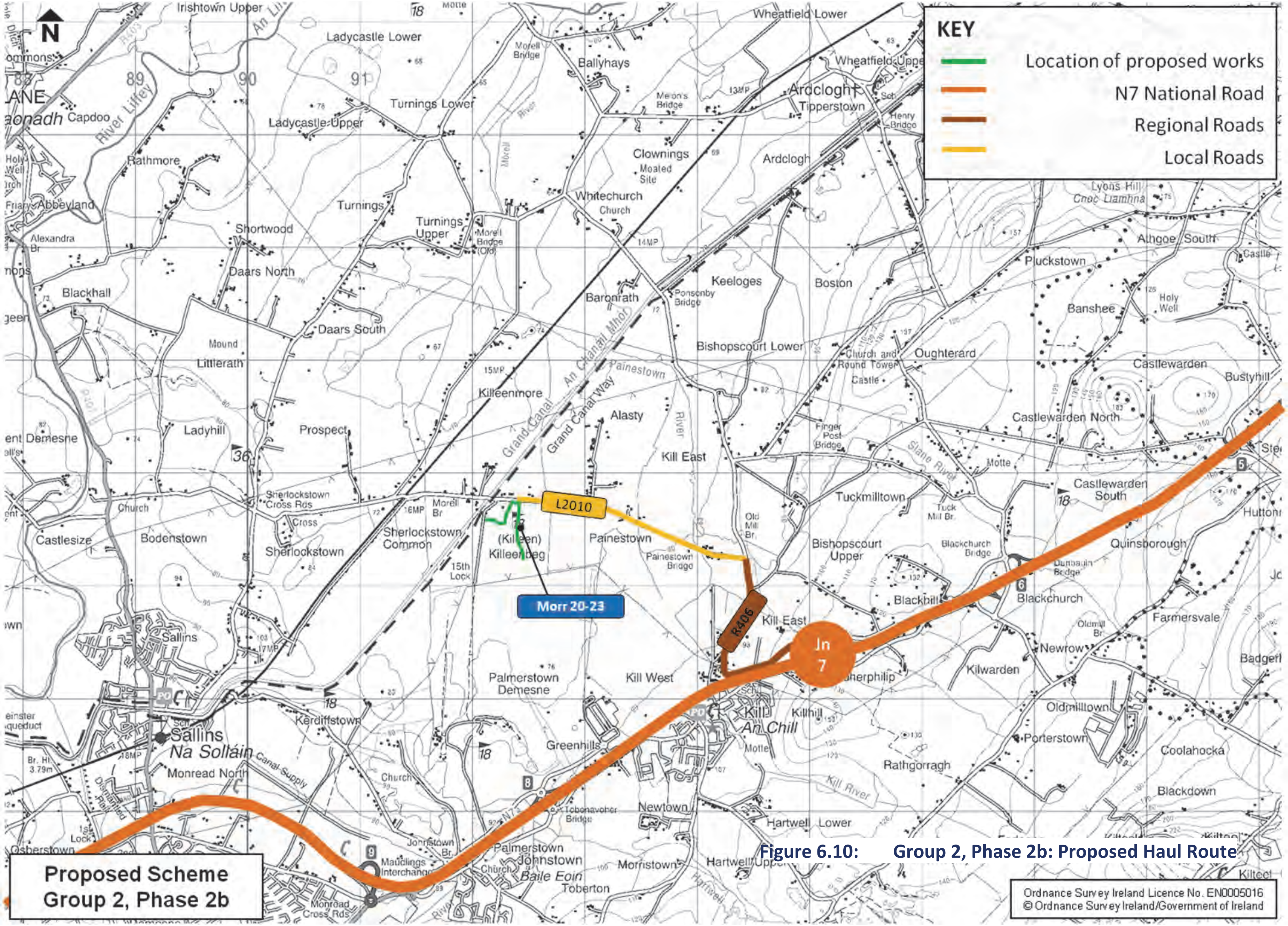


Figure 6.10: Group 2, Phase 2b: Proposed Haul Route

A number of vehicle access control measures could be implemented in order to manage two-way passing of HGVs to access Morr 20 - 23. These are discussed in Section 6.5.

N7 (Junction 9)

It is proposed that HGVs will exit the N7 at Junction 9 in order to access the proposed section locations for Phase 2a. Junction 9 of the N7 has been designed to cater for large HGVs, and therefore, will be able to cater for the additional traffic and HGVs associated with Group 2a.

R407

From Junction 9 of the N7, HGVs will travel along the link road connecting the N7 to the R407. This link road provides access to a number of industrial and commercial developments and is therefore designed to cater for large HGV traffic.

The R407 is a regional road that connects Naas to the south, to Kilcock and the M4 to the north. The route for Phase 2a travels along approximately 5.2 kilometres of the R407 and through the town of Sallins, before connecting to the L2010. The R407 is a good quality regional road with adequate carriageway width to cater for HGV movements.

L2010 (Phase 2a)

The haul route for Phase 2a is proposed to operate along approximately 3 kilometres of the L2010. The L2010 has a good quality road surface and a carriageway width of approximately 5.1 metres along its length (Images 6.7 and 6.8), although this reduces to approximately 4.6 metres at the Railway Bridge.

The bridge over the Grand Canal beyond the eastern end of the section works leads to the haul route for Phase 2b, however, due to extremely poor visibility and a narrowing of the carriageway width at the bridge (Image 6.9) it is not proposed to use this stretch of the L2010 for Phase 2a or 2b.

Image 6.7: L2010

Image 6.8: L2010

There is reduced visibility at the priority junction of the L2010 / L6013 Sherlockstown Crossroads (Image 6.10), with the L2010 operating as the minor arm traffic priority and requiring all vehicles to come to a complete stop at the junction.

Image 6.9: Reduced Visibility and Carriageway Width at Canal Bridge

Image 6.10: Reduced Visibility at Sherlockstown Crossroads (looking westbound on the L2010)

L2010 (Phase 2b)

This section of the L2010 is proposed to serve sections Morell 20- 23 in Phase 2b and section Paines 5 in Group 3. The route operates along approximately 2 kilometres of the L2010 from the R406. The L2010 is a good quality local route, with a carriageway width of approximately 5.5 metres and a good quality road surface (Image 6.11). The carriageway narrows to approximately 3.9 metres and there is reduced visibility at Painestown Bridge (Image 6.12), however there is good visibility at the L2010 / R406 priority junction and HGV traffic currently operates along the L2010 as identified in Figure 6.3.

Image 6.11: L2010 General Alignment

Image 6.12: L2010 Painestown Bridge

6.3.4 Group 3

Group 3 of the proposed scheme consists of the construction of Sections Paines 4 and 5, Slane 1-10 and Kill 1. It is proposed that this group will take approximately 14 weeks to complete, with each section being constructed independently. An indicative construction timeframe for each section, together with the proposed haul route for each is provided in Table 6.7 and 6.8 for the new embankment and other elements, respectively, with the haul routes illustrated in Figure 6.11.

Table 6.7: Group 3 Construction – New Embankments

Haul Phase	Section	Proposed Haul Route	Average no. of construction HGV movements per day (two-way)	Construction timeframe (weeks)
20	Paines 4	N7 (Jn. 7), R406	80	0.2
21	Paines 5	N7 (Jn. 7), R406, L2010		1.0
22	Slane 2	N7 (Jn. 7) R406, L6021, L6019		0.8
23	Slane 3			2.0
24	Slane 5			0.9
25	Slane 7	N7 (Jn. 6), L2011		1.3
26	Slane 9	N7 (Jn. 7), R406, L6021		0.2
Total				**6.4**

Table 6.8: Group 3 Construction – Other Elements

Haul Phase	Section	Proposed Haul Route	Average no. of construction HGV movements per day (two-way)	Construction timeframe (weeks)
6	Slane 1	N7 (Jn. 7), R406, L6021, L6019	80	2.0
7	Slane 4			2.0
8	Slane 8			1.0
9	Slane 10	N7 (Jn. 6)		0.5
10	Kill 1	N7 (Jn. 7), R406, Local Road off R406		2.0
Total				**7.5**

A number of vehicle access control measures could be implemented in order to manage two-way passing of HGVs to access Paines 5. These are discussed in Section 6.5.

N7 (Junction 6)

It is proposed that HGVs will exit the N7 at Junction 6 in order to access the proposed sections Slane 7 and 10. The embankment for Slane 7 is located adjacent to the N7; therefore, access to this section will comprise a short (approximate 200 metre) section of the L2011 to and from Junction 6.

Junction 6 of the N7 has been designed to cater for large HGVs, and therefore, will be able to cater for the additional traffic and HGVs associated with the Group 3 works.

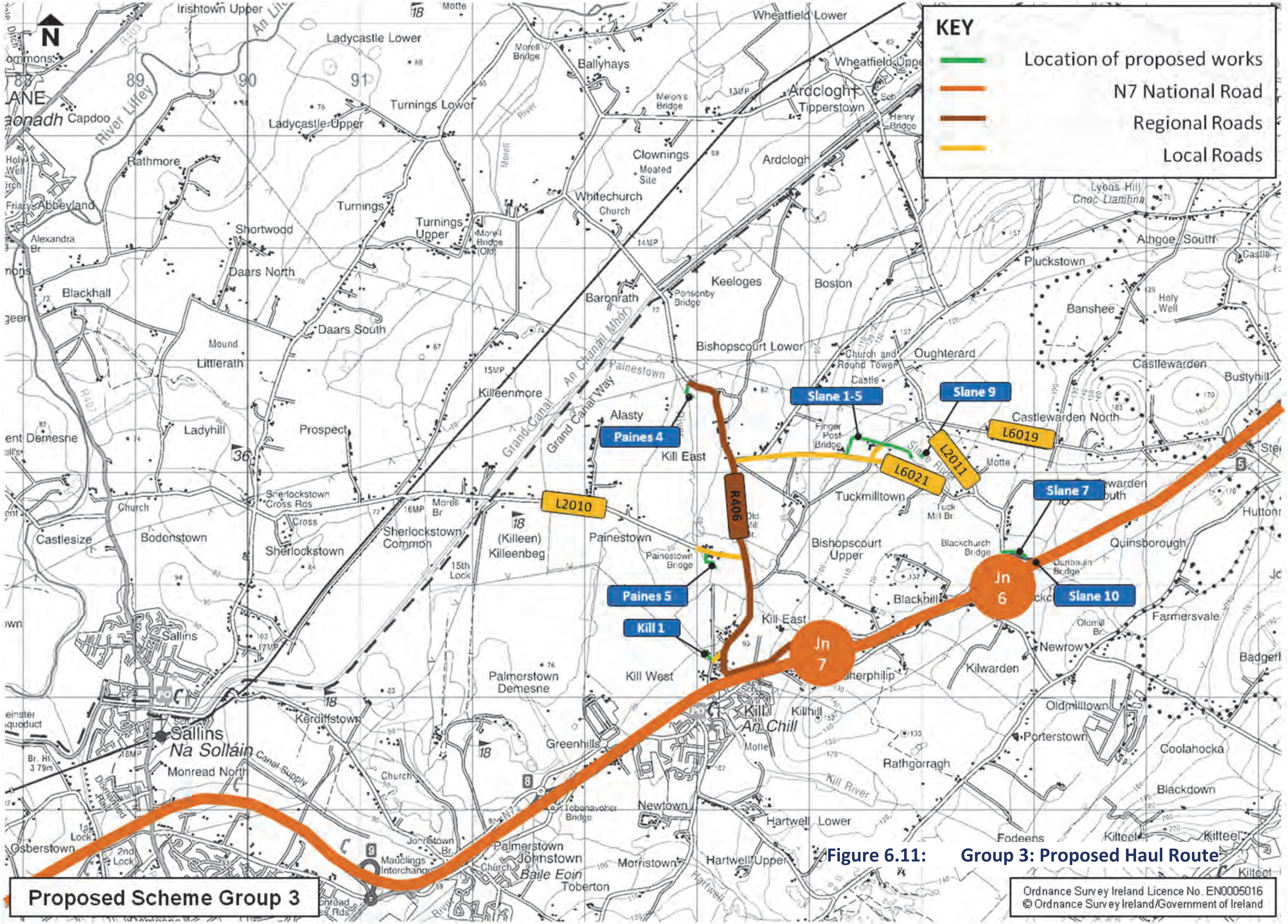


Figure 6.11: Group 3: Proposed Haul Route

R406

Section Paines 4 is accessed from the R406, approximately 4 kilometres from the N7 at Junction 7 and follows the same route from the N7 as per Group 1, until it reaches Paines 4.

L6021

Sections Slane 1-5 and 9 are proposed to be accessed via the L6021, approximately 1 to 1.5 kilometres from the R406. The L6021 is a good quality local road with a relatively straight alignment, good visibility and adequate width for HGV movements (Image 6.13). The road does not narrow significantly at the Fingerpost Bridge over the Slane River (Image 6.14).

Image 6.13: L6021 General Alignment

Image 6.14: L6021 Fingerpost Bridge

L6019

Access to Section Slane 5 is provided via the L6019, approximately 350 metres from its junction with the L6021. The L6019 is a local road with a carriageway width of approximately 4.5 metres along the section proposed to be used for the haul route. This section is relatively straight, with a good quality surface and good visibility (Image 6.15). Visibility at the junction with the L6021 is obscured by vegetation (Image 6.16); however, a stop sign is visible on the L6019 on approach to its priority junction with the L6021.

Image 6.15: L6019 General Alignment

Image 6.16: L6019 Junction with L6021

Any changes to the haulage routes identified for Groups 1-3 would be subject to agreement from KCC and the associated local road authority.

6.4 POTENTIAL IMPACTS

6.4.1 Construction Phase Traffic Impacts

As outlined in Chapter 4 'Project Description', subject to the availability of materials, only one section is proposed to be built at a time, starting downstream and working upstream in an approximate north to south order. The assumed construction phasing has been set out in Tables 6.2 to 6.8 for the three proposed Groups of works.

The number of HGV movements associated with the delivery of the earthworks is assumed to be constant throughout the duration of the construction period, with each section generating approximately 5 deliveries per hour, for eight hours a day. This equates to a total of 80 two-way HGV movements (40 inbound and 40 outbound) per day. There may however, on occasion, be the requirement of up to a maximum of 60 deliveries in any given day.

The total predicted timeframe required to construct each embankment presented within Tables 6.2 to 6.8 were based on calculated volumes of earthworks required for each embankment (as outlined in Chapter 3).

The proposed increase in HGV traffic associated with the scheme in relation to the existing AADT traffic observed from the ATC traffic surveys is presented in Table 6.9.

Table 6.9: Impact of Predicted Construction Traffic

Road Route	2016 Background		Proposed Peak During Construction		Increase	
	AADT	% HGV	AADT	%HGV	AADT	%HGV
National Road Network						
N7 (between Jn.9 & 10)	57,052	8.3%	57,132	8.4%	80	0.1%
N7 (between Jn.7 & 8)	80,987	7.1%	81,067	7.2%	80	0.1%
N7 (between Jn.5 & 6)	84,831	10.7%	84,911	10.8%	80	0.1%
Regional Road Network						
R407	13,724	7.1%	13,804	7.7%	80	0.6%
R406 (off Jn.7)	7,440	2.0%	7,520	3.1%	80	1.1%
R406 (north)	5,638	2.2%	5,718	3.5%	80	1.4%
Regional Road Network						
L2010	2945	0.3%	3,025	2.9%	80	2.6%
L2011	1621	4.7%	1,701	6.9%	80	4.7%

Table 6.9 indicates that the overall impact of the construction traffic on the surrounding national and regional road network, in terms of absolute traffic volumes, is minimal.

Since the number of daily HGV movements will remain relatively constant for the duration of the construction works, the impact of the construction traffic will only vary in duration, with certain sections of the local road network impacted for longer periods than others.

The largest increase in HGV traffic on the periphery of the cordoned area can be seen on the L2011, adjacent to Junction 6 of the N7. Although it is predicted to have an increase of 4.7% in HGV traffic on this section of road, it should be noted that only scheme section Slane 7 is proposed to be accessed at this location, with an approximate construction timescale of one week.

Scheme section Morr 4 is predicted to have the longest construction timescale, approximately 9 weeks; however it is proposed to be accessed via the R407 and L2010, with a predicted increase of less than 1% and 3% respectively. Furthermore, it can be seen that HGV activity already exists on these sections of regional and local roads as identified in Figure 6.3.

Another impact to consider during the construction phase is the volume of trips generated by construction staff. It is proposed that each stockpiling site could be used as a staff compound. The total number of construction staff has been estimated at approximately 20 as a worst case. With this in mind, the impact of construction staff trips is predicted to be minimal.

Furthermore, ground investigations undertaken to date (see Chapter 13) have identified made ground in the vicinity of the following works areas totalling approximately 17,391m^3:

- Morr 2, 3, 10 & 23;
- Paines 1, 2, 3 & 5;
- Slane 5, 6, 7 & 11.

The ground investigations identified made ground to be composed of re-worked gravelly clays with occasional inclusions of glass, brick, concrete fragments and brown hardcore fill. There is also the potential that additional areas of made ground may be encountered during the construction works which were not identified during the initial site investigations. Non-contaminated made ground will be reused onsite during the construction, however, excavated made ground which is unsuitable for reuse onsite and / or which has evidence of contamination will have to be classified and taken away for offsite disposal.

An outline Waste Management Plan was prepared to support the proposed development. It is anticipated that dedicated HGVs should be used for the transport of any contaminated soils identified as unsuitable for onsite use. Any additional traffic associated with removal of unsuitable waste material will not exceed the maximum 60 vehicles per day threshold; however, the construction programme might extend slightly as a result of the necessity to remove any contaminated soils.

A dedicated waste management company which holds a valid Waste Collection Permit will be used for the transport of any contaminated material identified as unsuitable for onsite use. The outline Waste Management Plan states that any waste removed from the site shall be taken to facilities which hold either a valid Waste Facility Permit issued by KCC or a Waste Licence issued by the EPA.

6.4.2 Operational Phase

As there will be a minimal number of infrequent vehicle trips associated with the maintenance of the embankments, it is not considered that the operational phase of the scheme will have a significant impact on the surrounding road network.

6.5 MITIGATION MEASURES

6.5.1 Design Standards for Traffic Management

Statutory Undertakers are required to agree temporary traffic management procedures with the local authority to carry out their works. The traffic management proposals will be carried out using the following industry recognised standards:

- Traffic Signs Manual 2010 Chapter 8 – temporary Traffic Measures and Signs for Roadworks (Department of Transport, Tourism and Sport).

Chapter 8 assists with planning all works activities and temporary closures to optimise safety, road space and work efficiency, whilst minimising road user congestion, delay and inconvenience. Safe and efficient traffic management is founded upon the following simple principles:

- Provision of clear and early warning of obstructions in the highway;
- Optimisation of road space and the provision of adequate safety zones and working space at works locations;
- Clear directions relating to decisions/actions required from the road users;
- Minimisation of potential conflict between road users, and between road users and road workers and their operations;
- Credibility of traffic signs and temporary requirements;
- Speed limits and restrictions appropriate for the temporary highway geometry and safety features.

The underlying design of traffic management arrangements should be to produce a safety performance no worse than the rate for non-works conditions, whilst minimising delays for traffic passing the works. Therefore, the use of these measures will mitigate the potential temporary, localised traffic delays that may be caused by the construction of the scheme.

6.5.2 Construction Phase

Construction Traffic Management Plan

A Construction Traffic Management Plan (CTMP) will be prepared in advance of the proposed works to minimise any impacts on other road users and to maximise road safety along the haul routes. It is proposed that the CTMP will be prepared by the contractor and included in the Contract Documents for the appointed contractor to implement as part of their role and responsibilities with a supervision element remaining with the developer.

The aim of a CTMP is to put in place procedures to manage construction traffic effectively. The plan will consider construction traffic accessing the site via the public road network as well as traffic circulation within the construction site. It should also outline measures to enhance the efficient transportation of construction materials and machinery whilst minimising delay and disruption to the general traffic.

The main contractor appointed to complete the works will be responsible for ensuring all haulage contractors abide by the recommendations of the CTMP, which will address, but not be limited to, the following issues:

- Consultation with Kildare County Council / TII to minimise road works on the N7 during the construction programme;
- Maintenance of the haul route – ensuring that it is adequately swept to avoid the safety hazard of mud building up on the road, and pavement condition monitored so that developing potholes are dealt with promptly;
- Ensuring that Emergency Response Systems are in place to deal with incidents, written notification of the commencement of the delivery periods shall be given to the Gardaí, Fire and Ambulance services, and TII to allow the coordination of the work and the mobilisation of the safety procedures;
- Local residents in the area would also be notified prior to the commencement of works;
- Systems to encourage HGV drivers not to exceed the speed limit, not to over-rev engines etc. and to drive with consideration for other road users;
- Application of maintenance standards to minimise emissions by ensuring all HGVs are well-maintained;
- Systems to ensure that roles and responsibilities of all parties are clearly appreciated;
- Reuse of materials on site where possible to reduce HGV movements; and
- Backloading - removing waste material from site using the return journeys of HGVs that bring material to site - would reduce the amount of empty running associated with the transport of materials. Backloading options will be explored at the project progresses to detailed design.

The location of key constraints along the proposed haul routes are presented in Figure 6.12 overleaf, with Table 6.10 below describing each mitigation measure proposed to alleviate potential traffic impacts on the local road network caused by the construction traffic. The mitigation measures outlined will form part of a CTMP which will be developed by the successful contractor in consultation with Kildare County Council.

Table 6.10: CTMP Mitigation Measures

Haul Route	No.	Constraint Identified
Group 1	1	Bridge over Morell River on L6016 is too narrow to safely accommodate regular HGV Movements
Group 2, Phase 2a	2	Severely restricted visibility on the L2010 at its cross road junction with Sherlockstown Road.
	3	Reduced visibility at railway bridge on L2010.
Group 2, Phase 2b	4	Reduced visibility at Painestown Bridge on L2010.

The proposed mitigation measures for the above and provision of a CTMP may include, but not limited to, the following:

- Signage and temporary traffic control measures and devices at specific locations;
- Plan drawings providing the details of the proposed traffic management measures including the text and location of the proposed temporary signage:- advisory, warning and Variable Message Signage (VMS);
- Details of times that the heavy vehicles are permitted on the public roads;
- Details of speed limits for the heavy vehicles;
- Details of the Public information Strategies; and
- Details of the Traffic Incident Management.

Prior to the commencement of construction on site and following completion of the construction phase, the contractor shall carry out condition surveys of all haul routes and shall, at their own expense, carry out and provide a DVD detailing the condition of the existing roads being considered as haul routes.

The traffic management mechanisms described above will ensure that the works will be co-ordinated and controlled. Furthermore, a detailed CTMP will be agreed with the local authority post consent and after the appointment of the main works Contractor/s.

6.5.3 Operational Phase

6.5.3.1 Traffic

Since the operational impact of the proposed scheme will be minimal, dedicated mitigation measures are not deemed necessary.

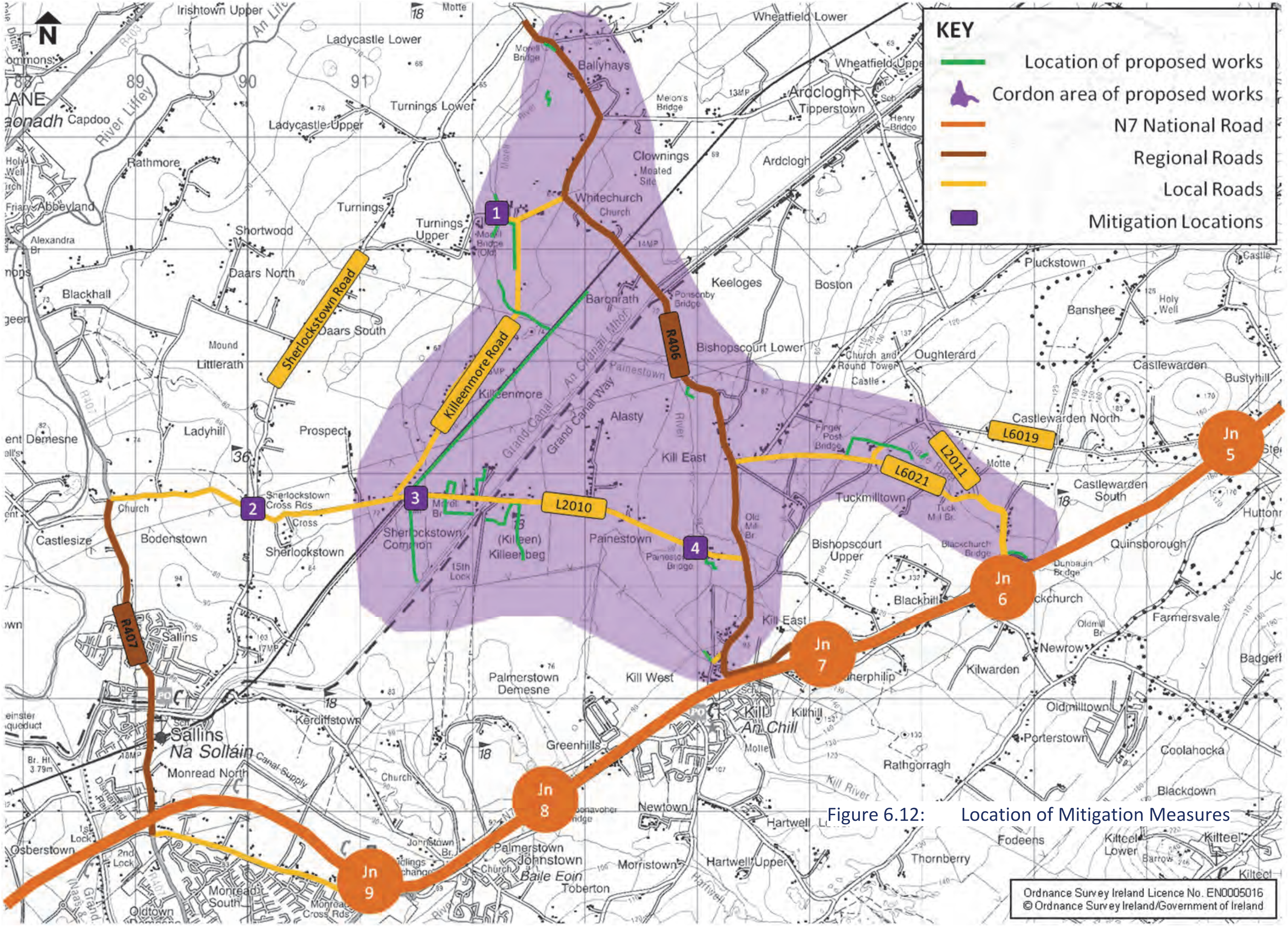


Figure 6.12: Location of Mitigation Measures

6.6 RESIDUAL IMPACTS

6.6.1 Construction Phase

Once the mitigation measures are implemented, the HGV movements associated with the construction phase are not predicted to cause a significant residual impact on the surrounding road network.

6.6.2 Operational Phase

Only minor traffic requirements will be associated with maintenance requirements. Therefore, there are no predicted residual impacts for the operational phase of the development.

6.7 EXISTING BUILT SERVICES

Underground services within the area of the proposed scheme are outlined below:

- Aurora Telecom has a fibre network cable running along the canal bank, between Sallins and the Killeen golf course, which lies within the area for construction of Morr 20. It is not expected that works will require interference with these services.

- Gas Networks Ireland has distribution networks within the Morell Catchment and specifically within the vicinity of Straffan (west of the Morell Bridge), Kill (on the south side of the N7 only) and Palmerstown Desmene. The nearest working area to the gas network is Morr 1, approximately 280m from the gas network at Straffan. It is not expected that construction works will impact on gas networks.

- Water supply and water sewerage pipes also exist within the area of the proposed scheme, but are largely confined to the road network. It is not expected that works will require interference with these services.

Overground services within the area of the proposed scheme are outlined below:

- Electricity Cables, the majority of which are above ground, cross over a number of the proposed defences. These are summarised in the Table below:

Type	Feature
LV (230V/400V)	▪ Morr 22 ▪ Morr 23 ▪ Slane 1 ▪ Slane 2
MV (10kV/20kV)	▪ Morr 23 ▪ Morr 2, (also HV 38kv crosses approx. 20m beyond its northern end) ▪ Morr 10 ▪ Morr 17 ▪ Morr 19 (3 places) ▪ Morr 21 ▪ Paines 3 ▪ parallel with part of Paines 4 ▪ Paines 5 ▪ Slane 6 ▪ Slane 8 (2 places) ▪ parallel with Slane 9 ▪ crossing compound B (at Morr 19) ▪ crossing compound C (at Morr 23)
HV 110kv	▪ Morr 4 (near Culvert 4)
HV 220kv	▪ 220kv crossing Morr 9 ▪ 220kv Paines 2 and 3

- Telecommunication Cables exist along the L6016, L82553 and L6014.

There is no BT Ireland network, Vodafone, Verizone or UPC network adjacent to the proposed scheme.

Maps of all the above services are available to the design & construction team. Precautions will be necessary during construction of the works in order to ensure there is no damage to any of this infrastructure. These precautions will be determined at detailed design stage in consultation with the Service Providers.

Any potential disruption to services in the vicinity of the works will be of a temporary nature and limited to the construction stage of the scheme. Good design, incorporating appropriate precautionary measures agreed at detailed design stages and the implementation of appropriate site management measures during the construction phase will reduce disturbances to utilities.

7 AIR QUALITY & CLIMATE

This Section of the EIAR assesses the impacts to air quality and climate associated with the Morell Flood Management Scheme. It should be read in conjunction with the Project Description in Chapter 4.

Impacts to air quality will arise during the construction phase, such as from the generation of construction dusts. The construction activities have been examined to identify those that have the potential for air emissions. Where applicable, a series of suitable mitigation measures have been listed.

Activities during the construction phase of the development have the potential to generate greenhouse gases. These emissions are produced by the use of construction materials, materials transport, construction machinery, etc. Greenhouse gas emissions from these sources have been quantified using standard procedures.

The operational stage will require minimal traffic movements and upkeep for maintenance purposes, therefore potential impacts on air quality and climate will be minimal.

7.1 METHODOLOGY

A desktop assessment was carried out to determine the potential impacts of the proposed scheme on the local and regional air quality and on the environment. The following describes the methodology used for the assessment of air quality and climate during the construction and operational phases of the proposed scheme:

- Residential receptors were identified from OSI mapping and from a site visit carried out on the on the 14th of April 2015.

- Prediction of ground level concentrations of traffic derived pollutants due to the additional traffic due to construction was carried out using the procedures outlined in the local model of UK Highways Agency Design Manual for Roads and Bridges (UK DMRB 2007), Volume 11, Section 3, Air Quality Assessment (referred to hereafter as the UK DMRB).

- Construction phase climate assessment identifying sources and quantifying total greenhouse gas (GHG) emissions from the construction activities was carried out using the carbon calculator for construction activities developed by the Environment Agency (EA) in the UK[1].

The air quality and climate assessment for the proposed scheme was undertaken with reference to the following Guidance Documents, as applicable:

- '*Guidelines on the Information to be contained in Environmental Impact Statements*', EPA, 2002;
- *'Advice Notes on Current Practice in the preparation of Environmental Impact Statements',* EPA, 2003;

[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/571707/LIT_7067.pdf accessed 09/03/2017

- Environmental Protection Agency (EPA) '*Monitoring network assessment*'; and
- Environment Agency (EA) '*Carbon Calculator for Construction Sites*'.

7.1.1 Air Quality

Certain combustion products have the potential to affect health and European Union air quality standards are specified to ensure air emissions do not exceed levels that are designed to protect human health and ecosystems.

The relevant Irish ambient air standards have been adopted from the European Commission Directives 1996/62/EC, 1999/30/EC and 2000/69/EC and are cited as the Air Quality Standards Regulations, which came into force on 17th June 2002 (Irish Legislation S.I. No. 271 of 2002). In May 2008, these European Directives on air quality were replaced with a new Directive, known as Clean Air for Europe Directive (CAFE Directive) (2008/50/EC), which has been transposed into Irish Legislation through the revised Air Quality Standards Regulations (S.I. 180 of 2011).

The new Directive specifies limit values in ambient air for sulphur dioxide (SO_2), lead, benzene, particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO_2) and oxides of nitrogen (NO_x). These limits are mainly for the protection of human health and are largely based on review of epidemiological studies on the health impacts of these pollutants. In addition, there are limits that apply to the protection of the wider environment (ecosystems and vegetation).

Various international initiatives, protocols and Directives also exist to limit and reduce emissions at a national level.

The following criteria were considered in the assessment of impact on air quality:

- Air Quality Standards Regulations (S.I. No. 180 of 2011);

- Directive 2001/81/EC on National Emission Ceilings for certain pollutants (NECs) (S.I. No. 10 of 2004); and

- There are no statutory limits for deposition of dusts and industry guidelines are typically employed to determine any impact. The TA Luft (German Government *'Technical Instructions on Air Quality*') states a guideline of 350 mg/m^2/day for the deposition of non-hazardous dusts. This value was used to determine the impact of residual dust as an environmental nuisance.

Table 7.1 shows the National Statutory limit for all relevant air pollutants.

Table 7.1: Air Quality Standards Regulations (Source: S.I. 180 of 2011)

Pollutant	Criteria	Value
Nitrogen Dioxide	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m³ NO_2
	Annual limit for protection of human health	40 µg/m³ NO_2
	Annual limit for protection of vegetation	30 µg/m³ NO + NO_2
Benzene	Annual limit for protection of human health	5 µg/m³

Pollutant	Criteria	Value
Carbon Monoxide	Maximum daily 8-hour running mean	10 mg/m³
Lead	Annual limit for protection of human health	0.5 µg/m³
Sulphur Dioxide	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	350 µg/m³
	Daily limit for protection of human health - not to be exceeded more than 3 times/year	125 µg/m³
	Vegetation	20 µg/m³
Particulate Matter (PM_{10})	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m³ PM_{10}
	Annual limit for protection of human health	40 µg/m³
Particulate Matter ($PM_{2.5}$)	Annual target value for the protection of human health	25 µg/m³ $PM_{2.5}$

7.1.2 Climate

Reference is made to Ireland's commitment to reduce greenhouse gases nationally. In relation to international commitments, under the Kyoto Protocol, member states must achieve legally binding GHG limitation and emission reduction targets for the first and second commitment periods, 2008 to 2012 and 2013 to 2020 respectively. The EU has adopted a target to reduce GHG emissions by 20% from 1990 levels by 2020.

Under the Kyoto Protocol, Ireland's total emissions are limited to 314.18 million tonnes of CO_2 eq for the five-year commitment period 2008-2012, 13% above 1990 levels, equivalent to an average of 62.84 million tonnes of CO_2 eq per annum. The EPA has produced initial estimates of greenhouse gas emissions for the time period 1990 – 2013. For 2013, total national greenhouse gas emissions are estimated to be 57.81 million tonnes carbon dioxide equivalent (Mt CO_2 eq). This is 0.7% lower (0.41 Mt CO_2 eq) than emissions in 2012.

In terms of impacts on climate, the assessment aims to identify and assess the sources and describe the measures in place to minimise releases of compounds with global warming potential. Many natural and human activities generate releases that can contribute to global warming. Due to the diverse and diffusive nature of sources, the effect that the proposed scheme might have on global warming cannot be specifically quantified within this assessment.

Having completed the desktop review, potential impacts resulting from the proposed scheme on existing air quality and greenhouse gas emissions were assessed and where relevant, proposed mitigation measures have been recommended.

7.2 RECEIVING ENVIRONMENT

7.2.1 Baseline Data Collection

7.2.1.1 Air Quality

The EPA carries out ambient air monitoring throughout the Republic of Ireland. The EU Air Framework Directive deals with each EU Member State in terms of Zones and Agglomerations for Air Quality. For Ireland, four zones, A, B, C and D have been defined and are included in the Air Quality Standards (AQS) Regulations (S.I. No 180 of 2011) as can be seen in Figure 7.1. Each zone is detailed as follows:

1. Zone A, Dublin conurbation;
2. Zone B, Cork conurbation;
3. Zone C, Other cities and large towns including Galway, Limerick, Waterford, Clonmel, Kilkenny, Sligo, Drogheda, Wexford, Athlone, Ennis, Bray, Naas, Carlow, Tralee, Ennis, Waterford, Letterkenny, Newbridge, Navan, Celbridge, Balbriggan, Mullingar and Dundalk; and
4. Zone D, the remainder of the country.

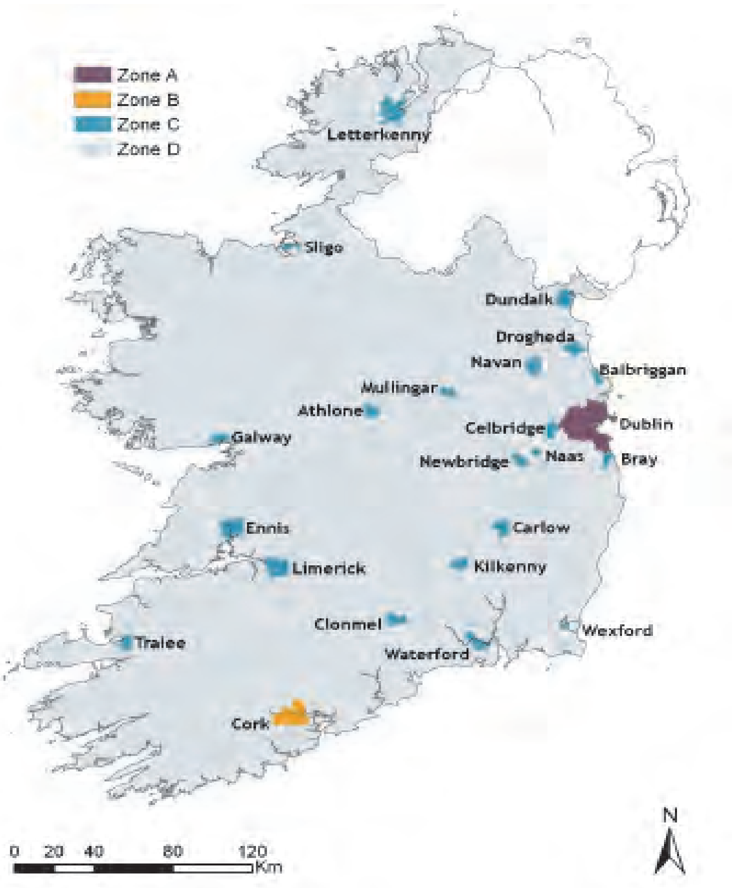


Figure 7.1: Air quality zones in Ireland 2013

The Morell River is located within Zone D and in February 2016 this air quality was recorded as being of good quality. Zone D is compliant with the air quality standards in relation to the following air pollutants: particulate matter (PM_{10}), Ozone, NO_X, SO_2, lead, CO, heavy metals, PAHs and benzene. The major source of air emissions in Ireland is road traffic. There are no major sources of potential air pollution in the study area. The towns of Sallins and Kill will generate concentrations of traffic derived pollution due to their status as commuting towns.

There is limited data available from the national air quality monitoring database for air quality specifically in this rural part of County Kildare. The nearest current air quality monitoring sites to the proposed scheme are located in County Dublin at Tallaght and Clonskeagh (Zone A) and in Emo Court, County Laois (Zone D). Despite being closer to the proposed scheme, the air quality data available from the Dublin monitoring stations are seen as not being representative of the air quality at the Morell River catchment area as they are located within Zone A.

The Emo site is located in the grounds of Emo Court, a stately home in County Laois. The site is heavily forested and was chosen to assess the levels of ozone in a forested area. Monitoring is done using a continuous monitor for ozone. Monitoring for oxides of nitrogen began in January 2013. This is a Zone D rural setting with little traffic or other influences on air quality and so is considered representative of air quality that would be encountered within the study area. Air quality at the Emo Court monitoring site is considered representative of the air quality in the study area due to its rural setting, its location relative to the Morell River and it's siting within Zone D. The following sub-sections provide details on the sources of these emissions and the background levels at Emo Court or where these are absent, the average background levels for Zone D.

The residential, working and visiting communities in the region, who would be considered sensitive air receptors, must be considered when completing all flood alleviation measures.

Nitrogen Dioxide

Nitrogen dioxide is classed as both a primary pollutant and a secondary pollutant. As a primary pollutant NO_2 is emitted in small concentrations of NO_X from all combustion processes (such as a gas/oil fired boiler or a car engine). As a secondary pollutant NO_2 is derived from the atmospheric oxidation of NO_X.

NO_2 and NO_x monitoring at Emo Court has been carried out since January 2013. The annual mean concentration for NO_2 at this location for 2015 was 3 µg/m³, which is below the limit value for the protection of human health of 40 µg/m³. The annual mean concentration for NO_x at this location for 2015 was 3 ug/m³, which is below the limit value for the protection of vegetation of 30 µg/m³.

Sulphur Dioxide

Sulphur dioxide is classed as a primary pollutant. It is principally emitted from the combustion of fossil fuels (diesel, coal, oil, etc.). As a traffic based pollutant, SO_2 is mainly emitted from vehicles running on diesel fuel, which will include most light goods vehicles (LGVs) and heavy goods vehicles (HGVs). However, since 2005 sulphur content in diesel fuel has been capped at 50ppm and this has been reduced further to 10ppm based on the latest EU Auto-Oil legislation. As such, sulphur dioxide emissions from traffic sources in future years are not considered significant. SO_2 emissions from burning of fossil fuels are the main cause of "sulphurous smog" in urban areas.

There is currently no SO_2 monitoring at Emo Court. The average Zone D annual mean concentration of SO_2 in 2015 was 2 µg/m³, which is below the limit value for the protection of ecosystems of 20 µg/m³.

Particulate Matter (PM_{10})

Particulate matter (PM_{10}) is considered a primary pollutant. It arises from road vehicle exhausts and other machinery. Point sources such as combustion, i.e. domestic fires, industrial boilers etc. are also primary sources of PM_{10}. In addition, natural sources of PM_{10} include re-suspended dusts and sea salts in coastal areas. PM_{10} may also be formed as secondary pollutants from the condensation or reaction of chemical vapours in the atmosphere.

There is currently no PM_{10} or $PM_{2.5}$ monitoring at Emo Court. The average Zone D annual mean concentrations of PM_{10} and $PM_{2.5}$ in 2015 were 15 µg/m³ and 8 µg/m³ respectively. These are below the respective annual mean limit values for the protection of human health of 40 µg/m³ and 25 µg/m³.

Total Suspended Particulates (Dust)

Health effects associated with dusts are typically associated with finer particulates such as PM_{10}, previously outlined. More commonly, dusts are associated with causing an environmental nuisance to residential, ecological and agricultural receptors. A guideline level for the prevention of dust nuisance is the TA Luft guideline of 350 mg/m^2/day as an annual average of monthly results. Background levels of dust in rural areas would typically demonstrate levels of 50-150 mg/m^2/day, dependent on the weather and agricultural practices in the area (e.g. ploughing, harvest time, etc.). Dust is not a pollutant regulated by national or European legislation and is therefore not included in the national monitoring network.

7.2.1.2 Climate

Meteorological Data

The nearest meteorological station to the proposed scheme is the Met Eireann Station in Casement Aerodrome, County Dublin. Casement Aerodrome is located at Baldonnel about 16 Km south of Dublin City. The 30-year averages from the station at Casement Aerodrome are presented in Table 7.2

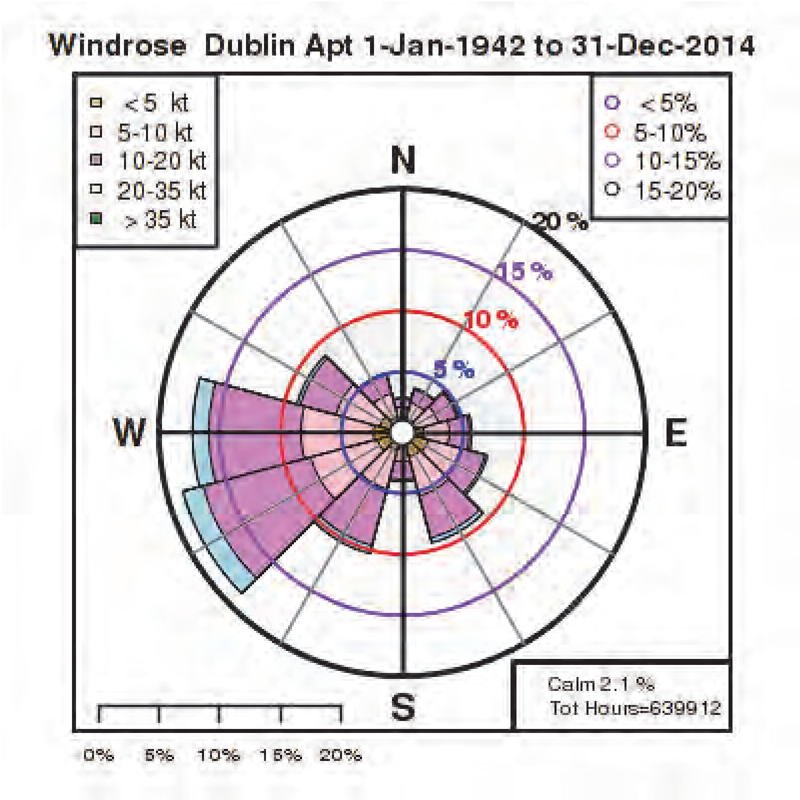
Table 7.2: 30-year Average Meteorological Data from Casement (Annual Values from 1981-2010, source: www.met.ie)

Parameter	30 Year Average
Mean Temperature (°C)	9.7
Mean Relative Humidity at 0900UTC (%)	83.6
Mean Daily Sunshine Duration (hours)	3.7
Mean Annual Total Rainfall (mm)	754.2
Mean Wind Speed (knots)	10.7

Wind

The prevailing wind direction for the area is between west and southwest as presented in the wind rose for Dublin Airport Met Station for 1942 to 2014 in Figure 7.2. Northerly winds tend to be very infrequent (less than 5%) with easterly winds marginally more frequently (5-10%). Wind characteristics are typically moderate with relatively infrequent gales (average only 8.2 days with gales per annum).

Figure 7.2: Windrose Data for Dublin Airport Met Station 1942 - 2014



Rainfall

Rainfall is an important factor to consider for the proposed scheme. In terms of dust generation, precipitation is a controlling factor i.e. during wet conditions dust generation is inhibited. The mean annual rainfall (in mm) for Ireland for 1981 to 2010 is presented in Figure 7.3. This illustrates that most of the eastern half of the country gets between 750 and 1000 (mm) of rainfall in the year. Rainfall in the west generally averages between 1000 and 1400 mm while in many mountainous districts rainfall exceeds 2000mm per year.

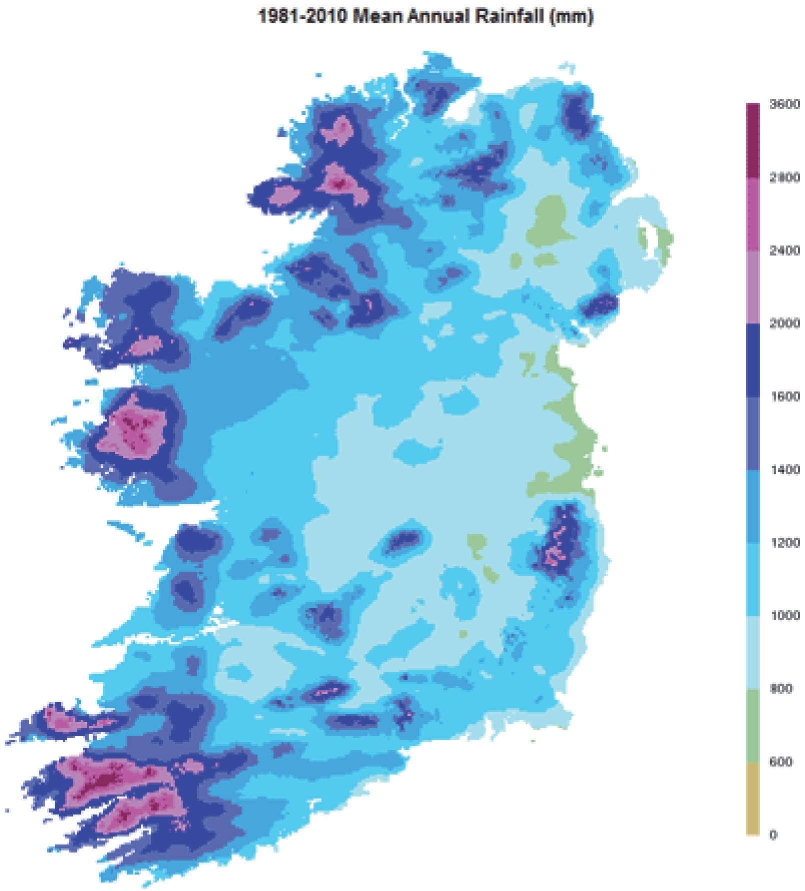


Figure 7.3: Rainfall in Ireland 1981 - 2010

The precipitation records for the Casement Aerodrome meteorological station are presented in Table 7.3. The table shows that daily rainfall greater than 1mm occurs for approximately 36% of an average year, while daily rainfall greater than 5mm occurs for approximately 12% of an average year.

Table 7.3: Mean precipitation (Casement Meteorological station 1981-2010)

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean Monthly Total	63.8	48.5	50.7	51.9	59.1	62.5	54.2	72.3	60.3	81.6	73.7	75.7	754.2
mean num. of days with >= 0.2mm	17	14	16	14	15	14	15	16	14	16	16	16	183
mean num. of days with >= 1.0mm	12	10	11	10	11	10	10	11	10	12	11	12	130
mean num. of days with >= 5.0mm	4	3	3	3	3	3	3	4	4	4	4	5	43

More specific to the study area, Chapter 12 has outlined the detailed hydrology for the proposed scheme.

7.2.2 Carbon Balance – Greenhouse Gas Emissions

In terms of release of greenhouse gases, the assessment aims to identify and assess the sources and describe the measures in place to minimise releases of compounds with global warming potential. Many natural and human activities generate releases that can contribute to global warming. Due to the diverse and diffusive nature of sources, the effect that the proposed scheme might have on global warming cannot be specifically quantified within this assessment. However, a conservative quantification of the carbon balance for proposed construction works have been estimated and presented using the carbon calculator for construction activities developed by the Environment Agency (EA) in the UK. Details of the results of this calculation are presented in Section 7.4.2.

7.3 POTENTIAL IMPACTS

This section of the report discusses the potential impact of the proposed scheme in relation to air quality and climate. The potential air quality and climate impacts on the surrounding environment must be considered for each of the two distinct stages: the short-term impact of the construction phase and the longer-term impact of the operational phase.

7.3.1 Do Nothing

If the proposed scheme does not proceed, the existing air quality in the vicinity of the study area would remain at ambient levels as are currently typical of the area.

7.3.2 Construction Phase Impacts

7.3.2.1 Air Quality

Due to the diverse nature of the scheme, and in particular, over 9,000 metres of embankments that will have to be constructed (approx. 7,423 metres of new embankments) or remediated in addition to the construction of up to 480m of flood walls, two stream realignments and up to 11 culvert alterations it is impossible to predict the amount of machinery that will be in operation at any one time.

The movement of machinery will generate exhaust fumes and subsequently contribute to potential emissions of the following compounds; oxides of nitrogen, carbon monoxide, sulphur dioxide, particulate matter (including PM_{10}/$PM_{2.5}$), volatile organic compounds (VOCs) and polyaromatic hydrocarbons (PAHs). While concentrations of these pollutants are expected to increase in the immediate vicinity of the machines during site works it is not anticipated that they will have any impact on the air quality of the region or in turn on the sensitive receptors in the area considering the size and nature of the proposed scheme and the number of machines proposed.

Construction activities are likely to generate some dust emissions. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive receptors locations and whether the wind can carry the dust to these locations. Dust can be managed effectively through good working practices and implements dust mitigation measures, which are outlined below.

Site investigations carried out (see Chapter 13) have also indicated that the made ground (in the vicinity of work areas Morr 2, 3 10 and 23, Paines 1, 2, 3 and 5, and Slane 5, 6, 7 and 11) totalling approximately 17,391m³ to be excavated is comprised of re-worked gravelly clays with rare inclusions of glass, concrete fragments, timber, brick and other potentially contaminated materials. The excavation, handling, processing and transport of this material therefore have the potential to give rise to contaminated dust. The contractor may employ a mobile screen on site to sift out the larger elements of the excavated made ground material and this could also give rise to construction dust.

All embankment works will be undertaken using tracked vehicles travelling along the temporary works area on the side of the embankment/wall furthest away from the rivers. The scheme will require approximately 61 weeks of construction in total, however the nature of the works dictate that they should be undertaken in settled weather.

The 'best case' scenario, based on completing all works within three years, considers the following groupings of works:

- **Group One**: The section from the confluence of the River Morell/River Liffey to Killeenmore (Morr 1 to 3 and Paines 1 to 3) which should hopefully be completed as a single phase;
- **Group Two:** The second group of works consists of the embankments, walls, culverts and stream diversions from Morr 4 to 23 and may be divided across two years, depending on construction delivery time. If this is the case Morr 4 to Morr 19 would most likely be completed as Phase 2A in year one and Morr 20 to 23 as Phase 2B in year two;
- **Group Three:** encompasses Paines 4 & 5, Kill 1 and Slane 1 to 11.

A number of haul routes were therefore identified for each phase, which would provide the most reasonable route options for deliveries to / from the proposed construction sites. The location and description of the haul routes are outlined in Chapter 6 'Traffic & Transport'. Three areas have been identified as potential locations for stockpiling / set down of materials; in the vicinity of Paines 1-3, Morr 19 and Morr 23. These three stockpiling locations are located off Killeenmore Road and the L2010 to the east and west of the Grand Canal. It is anticipated that the Contractor will use the best placed stockpiling site for each section, where possible, to minimise any unnecessary vehicular trips on the local road network.

It is anticipated that approximately 70,517m³ material will be required to construct and remediate the embankments, with an estimated 43,300m³ of fill import for engineered fill material and 27,217m³ of fill import for core material.

It is envisaged that different techniques will be adopted with regard to the reuse or recovery of excavated material. However, the overall intention will be to reuse the excavated material for side slope protection, the creation of embankments and/or the spreading of the material on the bank and adjacent lands where topsoil will be removed, excavated material will be spread and topsoil will be reinstated. These works will be undertaken with a view to minimising the transport of material off-site. Excavated material will be stockpiled on the land side of the works within the temporary working area. Additional fill material will be delivered only as required.

The air quality impact has also accounted for the road traffic impact associated with the construction works based on the traffic movements to/ from the various material handling areas. The number of HGV movements associated with the delivery of the earthworks is assumed to be constant throughout the duration of the construction period, with each section generating approximately 5 deliveries per hour, for eight hours a day. This equates to a total of 80 two-way HGV movements (40 inbound and 40 outbound) per day. There may however, on occasion, be the requirement of up to a maximum of 60 deliveries in any given day.

The traffic impact assessment, in Chapter 6, indicated that the overall impact of the construction traffic on the surrounding national and regional road network, in terms of absolute traffic volumes, is minimal. Since the number of daily HGV movements will remain relatively constant for the duration of the construction works, the impact of the construction traffic will only vary in duration, with certain sections of the local road network impacted for longer periods than others. The predicted construction traffic is outlined in Table 7.4.

Table 7.4: Predicted Construction Traffic

Road Route	2016 Background		Proposed Peak During Construction		Increase	
	AADT	% HGV	AADT	%HGV	AADT	%HGV
National Road Network						
N7 (between Jn.9 & 10)	57,052	8.3%	57,132	8.4%	80	0.1%
N7 (between Jn.7 & 8)	80,987	7.1%	81,067	7.2%	80	0.1%
N7 (between Jn.5 & 6)	84,831	10.7%	84,911	10.8%	80	0.1%
Regional Road Network						
R407	13,724	7.1%	13,804	7.7%	80	0.6%
R406 (off Jn.7)	7,440	2.0%	7,520	3.1%	80	1.1%
R406 (north)	5,638	2.2%	5,718	3.5%	80	1.4%
Regional Road Network						
L2010	2945	0.3%	3,025	2.9%	80	2.6%
L2011	1621	4.7%	1,701	6.9%	80	4.7%

A significant proportion of the proposed scheme works will be focused in close proximity to the R406, L2010, L6021 and Killeenmore Road. The traffic impact assessment, Chapter 6, indicated that the largest increase in HGV traffic (4.7%) can be seen on the L2011, adjacent to Junction 6 of the N7. This is evident based on Table 7.4 above, however it should be noted that only scheme section Slane 7 is proposed to be accessed at this location, with an approximate construction timescale of one week.

A prediction of ground level concentrations of traffic derived pollutants due to the additional traffic due to construction on the R406, R407, L2010 and L2011 was carried out using the procedures outlined in the local model of the *UK Highways Agency Design Manual for Roads and Bridges* (UK DMRB 2007), Volume 11, Section 3, Air Quality Assessment (referred to hereafter as the UK DMRB). The results of this assessment are outlined in Table 7.5 to Table 7.8.

The residential receptors are located at varying distances from the existing roads. For a worst-case scenario, the DMRB has assumed that the nearest receptors are located 10m from the roads.

Table 7.5: DMRB Assessment of Air Quality Impact for a Receptor 10m from the R407

Scenario	Nitrogen Oxides ($\mu g/m^3$)	Nitrogen Dioxide ($\mu g/m^3$)	Particulates (PM_{10}) ($\mu g/m^3$)
	Annual Average NO_x	Annual Average NO_2	Annual Average PM_{10}
Do Nothing	13.7	6.8	15.96
Do Something (Proposed Peak during Construction)	14.1	6.9	15.98
Air Quality Standard Limits	30	40	40

Table 7.6: DMRB Assessment of Air Quality Impact for a Receptor 10m from the R406 (north)

Scenario	Nitrogen Oxides ($\mu g/m^3$)	Nitrogen Dioxide ($\mu g/m^3$)	Particulates (PM_{10}) ($\mu g/m^3$)
	Annual Average NO_x	Annual Average NO_2	Annual Average PM_{10}
Do Nothing	6.3	4.3	15.36
Do Something (Proposed Peak during Construction)	6.6	4.4	15.37
Air Quality Standard Limits	30	40	40

Table 7.7 – DMRB Assessment of Air Quality Impact for a Receptor 10m from the L2010

Scenario	Nitrogen Oxides ($\mu g/m^3$)	Nitrogen Dioxide ($\mu g/m^3$)	Particulates (PM_{10}) ($\mu g/m^3$)
	Annual Average NO_x	Annual Average NO_2	Annual Average PM_{10}
Do Nothing	4.5	3.6	15.18
Do Something (Proposed Peak during Construction)	4.8	3.8	15.20
Air Quality Standard Limits	30	40	40

Table 7.8 – DMRB Assessment of Air Quality Impact for a Receptor 10m from the L2011

Scenario	Nitrogen Oxides ($\mu g/m^3$)	Nitrogen Dioxide ($\mu g/m^3$)	Particulates (PM_{10}) ($\mu g/m^3$)
	Annual Average NO_x	Annual Average NO_2	Annual Average PM_{10}
Do Nothing	4.1	3.5	15.11
Do Something (Proposed Peak during Construction)	4.3	3.6	15.12
Air Quality Standard Limits	30	40	40

The additional vehicular traffic on the R406, R407, L2010 and L2011 is not predicted to increase the concentrations of air quality parameters to any great extent. The overall impact of the construction traffic on the surrounding national and regional road network, in terms of absolute traffic volumes, is minimal and will result in a negligible impact on air quality.

7.3.2.2 Climate

No energy requirements will be associated with the proposed scheme post construction and as such there are no scheduled emissions planned for the scheme. Therefore it is not envisaged that the proposed scheme works will have any significant impacts on the climate.

Greenhouse Gas Emissions

The climate assessment for the construction phase was carried out to identify sources and quantify total GHG emissions generated from the construction activities associated with the proposed scheme. This assessment was carried out using the carbon calculator for construction activities developed by the Environment Agency (EA) in the UK. The carbon calculator calculates the embodied carbon dioxide (CO_2) of materials plus CO_2 associated with their transportation. It also considers personal travel, site energy use and waste management.

Emissions with the potential to cause climate change include carbon dioxide (the main greenhouse gas), which will arise from excavated materials as well as vehicles moving this material to the spreading or stockpiling areas. It is anticipated that approximately 70,517m^3 material will be required to construct and remediate the embankments, with an estimated 43,300m^3 of fill import for engineered fill material and 27,217m^3 of fill import for core material. The type of material expected to be required will consist of clean stone for construction fill with a capping layer of non-porous clay. It is assumed that the distance between the source of supply and the site is 100km and will be transported via the existing road network.

It is envisaged that different techniques will be adopted with regard to the reuse or recovery of excavated material. However, the overall intention will be to reuse the excavated material for side slope protection, the creation of embankments and/or the spreading of the material on the bank and adjacent lands where topsoil will be removed, excavated material will be spread and topsoil will be reinstated. These works will be undertaken with a view to minimising the transport of material off-site.

These emissions have been quantified as far as possible using the UK Environment Agency's *Carbon Calculator for Construction Sites* particularly related to the material to be excavated.

The total estimated greenhouse gas emissions associated with the scheme is calculated at 10,823 tonnes of CO_2eq compared to the National Kyoto Target of 63 million tonnes of CO_2eq. This increase is considered to be negligible (0.019%) in the context of the National Kyoto Target.

7.3.3 Operational Phase Impacts

Unless maintenance is required, due to damage to the embankments or walls, no further construction works will be necessary once the proposed scheme is completed. Regular maintenance of the river channel and in particular culverts will be required to ensure it retains its conveyance capacity. The maintenance activities will consists of clearing the overgrowth from the river banks and embankments in addition to removing debris from the rivers, embanked areas and culverts and will be completed as and when required.

Routine checks from local authority engineers will be carried out, however it is envisaged that there will be no other significant sources of nitrogen oxides, sulphur dioxide or vehicle particulates. Likewise there will not be any ozone depleting substances used or emitted during the operational phase of the project.

7.4 MITIGATION MEASURES

7.4.1 Construction Phase

7.4.1.1 Air Quality

In order to mitigate construction dust emissions during the construction phase, a dust minimisation plan will be prepared as part of the Construction Environmental Management Plan (CEMP). The dust minimisation plan will be based upon the industry guidelines in the Building Research Establishment document entitled *'Control of Dust from Construction and Demolition Activities*'. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The implementation of a dust minimisation plan during the construction phase of the project will include measures such as:

- Site roads shall be regularly cleaned and maintained as appropriate. Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads shall be restricted to essential site traffic only;
- Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions (also applies to vehicles delivering material with dust potential);
- All vehicles exiting the site shall make use of a wheel wash facility prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads. Wheel washes should be self-contained systems that do not require discharge of the wastewater to water bodies;

- Public roads outside the site shall be regularly inspected for cleanliness, and cleaned as necessary,
- Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind;
- Water misting or sprays shall be used as required if particularly dusty activities or activities generating potentially contaminated dust (associated with the excavation of made ground) are necessary during dry or windy periods;
- Vehicles delivering material with dust potential shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust;
- All vehicles which present a risk of spillage of materials, while either delivering or removing materials, will be loaded in such a way as to prevent spillage on to the public road;
- The contractor will be required to ensure that all vehicles are suitably maintained to ensure that emissions of engine generated pollutants is kept to a minimum;
- The contractor will be required to put a mobile screen on site in areas where made ground is to be excavated to sift out the larger elements of the spoil. This will minimise the generation of construction dust; and
- Due to the transient nature of the works, it is recommended that regular inspections are carried out by the construction contractor to monitor the potential for dust deposition. Where the duration of works are estimated to be longer than 4 weeks, it is recommended that the construction Contractor monitor monthly dust deposition levels for the duration of construction using the Bergerhoff method (German Standard VD 2119, 1972). Results should be compared to the TA Luft guidelines of 350mg/m^2/day (for non-hazardous dusts). This will be applicable for works at Paines 1, Morr 4, Morr 17 and Morr 23. The monitoring is only deemed necessary where residential receptors are located within 1km of the proposed works locations. In this instance, monitoring should take place along the boundary of the location of works or at the nearest residential location.

In order to ensure that any dust nuisance is minimised, a series of mitigation measures have been listed. If the construction contractor adheres to good working practices and dust mitigation measures the levels of dust generated are assessed to be minimal and are unlikely to cause an environmental nuisance.

7.4.1.2 Greenhouse Gas Emissions

Mitigation measures to minimise CO_2 emissions from transport include the following:-

- Implementation of a Traffic Management Plan which will be prepared in advance of the construction works and which will form part of the specification for the construction works. This will outline measures to minimise congestion and queuing, reduce distances of deliveries and eliminate unnecessary loads;
- Reducing the idle times by providing an efficient material handling plan that minimises the waiting time for loads and unloads. Reducing idle times could save up to 10% of total emissions during construction phase;
- Turning off vehicular engines when not in use for more than five minutes. This restriction will be enforced strictly unless the idle function is necessary for security or functionality reasons; and
- Regular maintenance of plant and equipment. Technical inspection of vehicles to ensure they will perform the most efficiently.

Materials with a reduced environmental impact may also be incorporated into the construction design through re-use of materials or incorporation of recycled materials in place of conventional building materials.

As part of the Construction Environmental Management Plan, the Contractor will be required to implement an Energy Management System for the duration of the works. This Energy Management system may include such measures as:-

- The use of thermostatic controls on all space heating systems in site buildings to maintain optimum comfort at minimum energy use;
- The use of sensors on light fittings in all site buildings and low energy lighting systems;
- The use of adequately insulated temporary building structures for the construction compound fitted with suitable vents;
- The use of low energy equipment and “power saving” functions on all PCs and monitors in the site offices;
- The use of low flow showers and tap fittings; and
- The use of solar/thermal power to heat water for the on-site welfare facilities and contamination unit (sinks and showers).

7.4.2 Operational Phase

There will be no operational phase impacts on air quality/climate as a result of the proposed scheme.

7.5 RESIDUAL IMPACTS

With the proposed mitigation in place there are no predicted residual impacts.

8 NOISE & VIBRATION

This Chapter of the EIAR assesses the impact of the proposed Morell Flood Management Scheme on the air environment in terms of Noise & Vibration. The assessment identifies potential noise sensitive receptors and the existing noise environment for these receptors. The extent of exposure of these receptors to noise generated in association with the construction of the proposed scheme has also been assessed. There will be no continuous noise or vibration generated by the proposed scheme upon completion of the construction works.

8.1 METHODOLOGY

The following describes the methodology used for the assessment of noise and vibration during the construction and operational phases of the proposed scheme:

- Review of the location of the proposed scheme including consideration of the location of sensitive receptors and topography.
- A baseline noise survey was conducted in accordance with ISO 1996-1:2003 "*Acoustics - Description, measurement and assessment of environmental noise".*
- Predicted construction noise impacts for the proposed scheme have been carried out in accordance with BS 5228-1:2009+A1:2014.

The noise and vibration assessment for the proposed scheme was undertaken with reference to the following Guidance Documents, as applicable:

- *'Guidelines on the Information to be contained in Environmental Impact Statements'*, EPA, 2002;
- *'Advice Notes on Current Practice in the preparation of Environmental Impact Statements'*, EPA, 2003;
- '*Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)'*, EPA, 2012;
- ISO 1996-1:2003 '*Acoustics - Description, measurement and assessment of environmental noise - Part 1: Basic quantities and assessment procedures';*
- ISO 1996-2:2007 '*Acoustics - Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise level'*;
- BS 5228-1:2009+A1:2014 **'***Code of practice for noise and vibration control on construction and open sites. Noise*';
- BS 5228-2:2009+A1:2014 **'***Code of practice for noise and vibration control on construction and open sites. Vibration*';
- *Calculation of Road Traffic Noise (CRTN)*, Department of Transport Welsh Office, HMSO, 1988;
- BS 6472-1:2008 '*Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting';*
- BS 6472-2:2008 *'Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration'; and*
- BS 7385-2:1993 '*Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration'.*

A baseline noise survey was carried out on the 14th April 2015 in accordance with ISO 1996-1:2003 at representative noise sensitive receptors located in close proximity to the proposed scheme, as shown in Figure 8.1. The baseline noise survey was carried out to establish the existing noise environment within the study area. The measured data from the baseline survey was used to compare the existing noise levels in the area with the predicted noise levels from construction works associated with the proposed scheme.

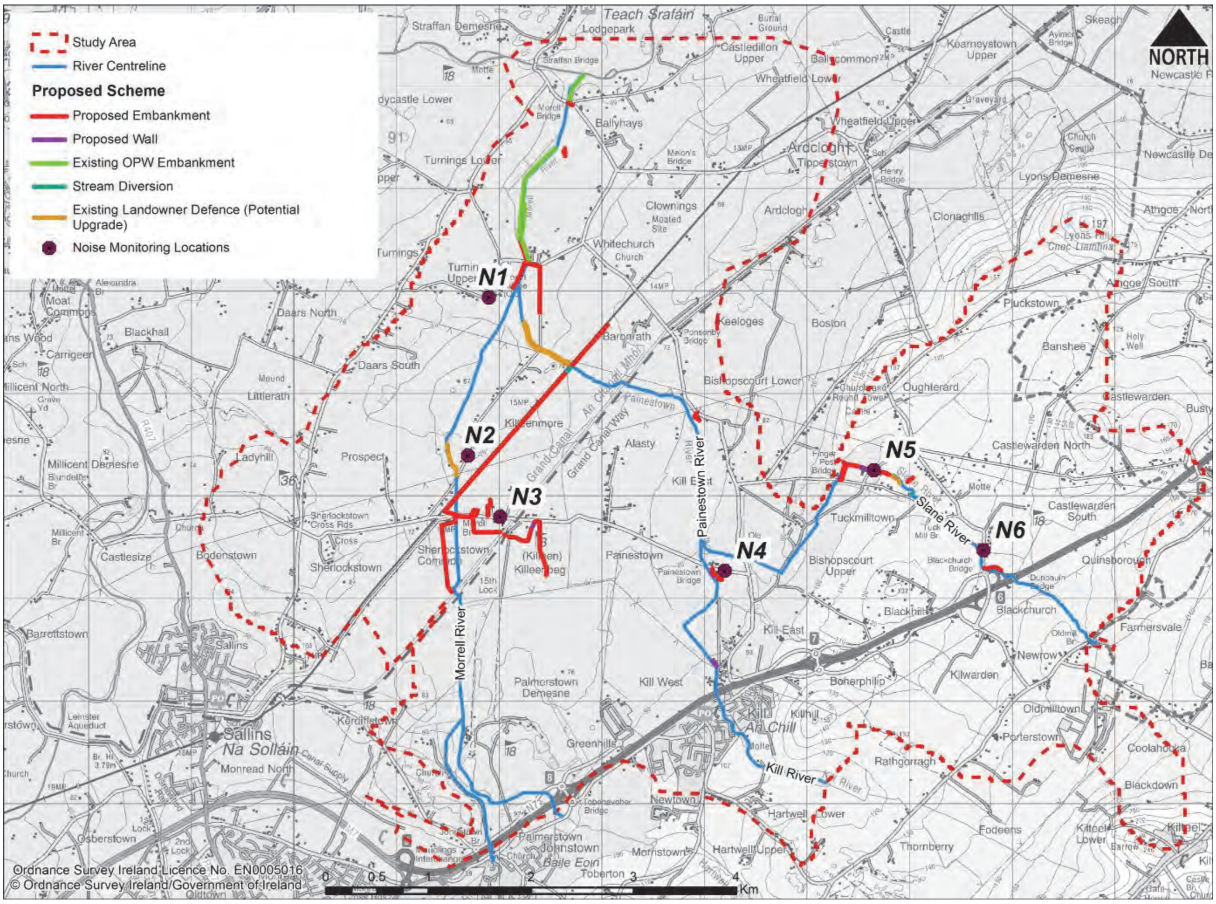


Figure 8.1: Baseline Noise Monitoring Locations

8.1.1 Construction Noise Assessment Criteria

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this type may be found in the National Roads Authority (NRA) publication Guidelines for the Treatment of Noise and Vibration in National Road Schemes which indicates the criteria and hours of operation outlined in Table 8.2. The majority of the construction activity is expected to occur during normal working hours.

Although the NRA's guidelines refer to road projects, they have been developed in line with typical construction noise limits on construction projects used previously in Ireland. The limits outlined represent a reasonable compromise between the practical limitations during a construction project and the need to ensure an acceptable ambient noise level for local residents. As a result, these limits have become the most acceptable standard for construction noise limits for EIA in Ireland to date.

Table 8.1 indicates the maximum permissible noise levels at the facade of dwellings during the construction period as recommended by the NRA.

Table 8.1: Maximum permissible noise levels at the façade of dwellings during construction

Days & Times	$L_{Aeq\ (1hr)}$ dB	$L_{pA(max)slow}$ dB
Monday to Friday 07:00 to 19:00hrs	70	80[1]
Monday to Friday 19:00 to 22:00hrs	60[1]	65[1]
Saturday 08:00 to 16:30hrs	65	75
Sundays and Bank Holidays 08:00 to 16:30hrs	60[1]	65[1]

Note 1: Construction activity at these times, other than that required in respect of emergency works, will normally require the explicit permission of the relevant local authority

The EPA guideline daytime noise limit for industrial noise is 55 dB(A), at the nearest noise sensitive location(s). The World Health Organisation guideline for outdoor areas is in the range 50 to 55 dB(A). The EPA guideline noise limit for industrial noise during the night-time (22:00 – 08:00) is 45 dB(A), at the nearest noise sensitive location(s).

Subjectively, the significance that can be attached to changes in noise levels (perceptible to human beings) can be described as follows in Table 8.2.

Table 8.2: Significance Scale for Changes in Noise Levels (Perceptible to Human Beings)

Change in Noise Level	Impact Rating	EPA Glossary of Impacts	Subjective Reaction
0 dB (A)	No change	n/a	n/a
<3 dB (A)	Not significant	Neutral, Imperceptible or Slight Impact	Barely perceptible
3 – 5 dB (A)	Minor	Significant Impact: Positive or Negative	Perceptible
6 – 10 dB (A)	Moderate		Up to a doubling of loudness
11 – 15 dB (A)	Major		Over a doubling of loudness
> 15 dB (A)	Severe	Profound Significant Impact: Negative only	-

It should be noted that the subjective description outlined in Table 8.2 applies to relatively continuous traffic noise. However, it can be used as likely indicative responses to changes in ambient noise levels.

It is considered unlikely that there will be any construction works associated with the proposed scheme undertaken during the night-time. However, in the event that any noise sources associated with the construction phase need to operate during the night-time, the EPA *"Guidance Note for*

Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)" night-time criteria of 45dB(A) at noise sensitive receptors will apply in order to prevent sleep disturbance.

Appropriate mitigation measures including suitable attenuation of any equipment in operation, will be employed in order to ensure this.

8.1.2 Operational Noise Assessment Criteria

Although operational noise limits are discussed there will be negligible noise during the operational phase of the scheme. Occasional maintenance/ inspection works would be the most likely noise generating activities associated with the operational phase.

The noise impact of the proposed scheme is assessed taking account of absolute noise criteria contained in the EPA "*Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)"* and World Health Organisation Guidelines "*Guidelines for Community Noise 1999*".

8.1.3 Construction Vibration Criteria

Measurements of vibration from construction sites have shown that, even from piling works, levels typically become imperceptible at relatively short distances from the vibration source.

However, higher levels of vibration are typically tolerated for single events or events of short duration. For example piling, one of the primary sources of vibration during construction works where competent rock is encountered, is typically tolerated at vibration levels up to 2.5 mm/s.

The National Roads Authority guidelines identify 2.5 mm/s as the vibration level that may be considered tolerable due to piling works. The potential vibration levels that could be generated by rock breaking works, if required would be expected to be comparable to the level of vibration that may be generated by piling works. The vibration level of 2.5 mm/s is substantially below the guideline values for protection of properties against cosmetic damage. The NRA limits for protection against cosmetic damage are given as a function of vibration frequency, and are outlined in Table 8.3.

Table 8.3: Allowable vibration in order to minimise the risk of building damage

Allowable vibration velocity (Peak Particle Velocity) at the closest part of any sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 – 50 Hz	50 – 100 Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

Source: NRA Guidelines for the Treatment of Noise & Vibration in National Road Schemes, 2004

The NRA 2.5mm/s limit is for piling, which is a continuous activity. This limit provides for protection against the vibration nuisance, and is comfortably within the limits for cosmetic damage.

8.1.4 Operational Vibration Criteria

In the case of nominally continuous sources of vibration, such as traffic, vibration is perceptible at around 0.5 mm/s and may become disturbing or annoying at higher magnitudes. However the operational phase of the proposed scheme will not generate perceptible vibrations.

8.2 RECEIVING ENVIRONMENT

8.2.1 Baseline Data Collection

Baseline Noise Survey

The survey was conducted in general accordance with ISO 1996-1: 2003: 'Acoustics - Description, measurement and assessment of environmental noise - Part 1: Basic quantities and assessment procedures' sets out requirements for conducting a baseline survey to establish prevailing noise levels. A noise survey was conducted on the 14th of April 2015 to meet with these requirements. During the survey, 6 attended monitoring locations were monitored simultaneously.

Procedure

Measurements were conducted over 15-minute periods on a cyclical basis between 10:00 to 17:00 hours. The measurement equipment used was a Bruel and Kjaer 2250 Type 1 Sound Level Meter with outdoor microphone protection. All measurements were free field, measured >2m from reflecting facades and the microphone was positioned at a height of 1.5m above ground level.

Weather conditions during the surveys were in line with the conditions described within ISO 1996, Acoustics '*Description and Measurements of Environmental Noise*'. All measurement equipment complies with the relevant Type 1 requirements of: IEC651 Specification for Sound Level Meters and IEC804 Specification for Integrating – Averaging Sound Level Meters, and were checked and calibrated before and after the survey using a Brüel and Kjaer 4231 piston phone calibrator to an accuracy of +/- 0.3dB.

The measurement results were noted onto survey record sheets immediately following each measurement and also stored in the instrument's internal memory for subsequent analysis. Notes were taken in relation to the primary contributors to noise build-up at each location.

Measurement Parameters

The noise parameters recorded during the baseline noise assessment were:

L_{Aeq} is the A-weighted equivalent continuous steady sound level during the measurement period and effectively represents an average ambient noise value. This is the equivalent continuous sound level.

L_{AFMax} is the maximum RMS A-weighted sound pressure level occurring within a specified time period. Measured using the "Fast" time weighting.

L_{AFMin} is the minimum RMS A-weighted sound pressure level occurring within a specified time period. Measured using the "Fast" time weighting.

L_{A10} refers to those A-weighted noise levels in the top 10 percentile of the sampling interval; it is the level which is exceeded for 10% of the measurement period. It is used to determine the intermittent high noise level features of locally generated noise and usually gives an indicator of the level of road traffic.

L_{A90} refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to describe a background level.

Measurement Locations

Measurements were carried out at the nearest noise sensitive locations to the proposed works. The EPA defines a noise sensitive location as "any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels".

Monitoring locations were comprised of 6 attended measurements locations, which are detailed in Table 8.4 and their locations shown in Figure 8.1.

Table 8.4: Noise Monitoring Locations

Position	Description
N1	Outside Residential Property at Turnings Upper along the Local Road (L6016) representing residential properties in the vicinity of the proposed Morr 3 works.
N2	Outside Residential Property at Killeenmore along the Local Road (L60161) representing residential properties in the vicinity of the proposed Morr 4, Morr 5, Morr 6 works.
N3	Outside Residential Property at Kileenbeg along the Local Road (L2010) representing residential properties in the vicinity of the proposed Morr 19 works.
N4	Within the boundary of Residential Property at Painestown along the Local Road (L2010) representing residential properties in the vicinity of the proposed Paines 5 works.
N5	Along the Local Road (L6019) at Tuckmilltown, adjacent to a residential garden with boundary adjacent to the River Slane representing residential properties in the vicinity of the proposed Slane 1 - 6 works.
N6	Adjacent to residential property along the Local Road (L6021) at Blackchurch representing residential properties in the vicinity of the proposed Slane 7 works.

Table 8.5 to Table 8.10 summarise the noise levels recorded during the attended baseline survey. All noise monitoring results are presented rounded to the nearest whole integer, with 0.5 being rounded up.

Overall the noise levels at all measurement positions were in the range of 51-64 dB LAeq, 15 minutes. The background noise measured was in the range of 39-56 dB L_{A90} and is considered representative of a rural area. The L_{A10} measurement, which is an indicator of the level of road traffic noise, ranged from 51 - 66 dB and indicates that some locations are influenced by road traffic noise. All results for each measurement location are discussed in further detail in the following tables.

Table 8.5: Results of Baseline Attended Noise Survey at N1

Position Number	Date	Measurement Period	Measured Noise Levels (dB re. 2x10-5 Pa)					Comments
			L_{Aeq}	L_{AFMax}	L_{AFMin}	L_{A10}	L_{A90}	
N1	14/04/2015	09:41 – 09:56	48	71	35	50	39	Background birdsong, rustling foliage, dog barking in distance, some infrequent passing traffic along the local road
		11:04 – 11:19	51	71	34	53	39	Background birdsong, rustling foliage, 6 vehicles passed along the local road, small aircraft passed overhead
		12:16 – 12:31	51	69	32	54	40	Background birdsong, rustling foliage, aircraft passed overhead, train audible in distance
		Arithmetic Average	**50**	**-**	**-**	**52**	**39**	

The measurement position was located outside a residential property at Turnings Upper along the Local Road (L6016). The location was chosen to represent residential properties in the vicinity of the proposed Morr 3 works.

The attended daytime noise measurements for N1 ranged between 48-51 dB L_{Aeq}, 15 minutes. The Arithmetic Average was 50 dB L_{Aeq}. The dominant noise source at this location was infrequent road traffic noise from the local road, the L6016. This is confirmed by analysis of the L_{A10} statistical noise parameter which had an arithmetic average of 52 dB.

The arithmetic average of the background noise at this location was measured as 39 dB L_{A90} and excludes the contribution from any intermittent noise sources such as road traffic noise and as such is more representative of the noise at this location. No significant sources of vibration were observed.

Table 8.6: Results of Baseline Attended Noise Survey at N2

Position Number	Date	Measurement Period	Measured Noise Levels (dB re. 2x10-5 Pa)					Comments
			L_{Aeq}	L_{AFMax}	L_{AFMin}	L_{A10}	L_{A90}	
N2	14/04/2015	10:14 – 10:29	55	79	38	53	40	Rustling foliage, background birdsong, three trains passed within the measurement period, aircraft movement audible overhead, infrequent passing traffic along the local road
		11:27 – 11:42	51	70	36	51	39	Background birdsong, rustling foliage, two aircraft movements passing overhead audible, two trains on the Dublin to Cork railway line passed and were audible within the measurement period
		12:40 – 12:55	57	79	38	55	43	Background birdsong, rustling foliage, lawn mower audible in distance, 2 trains passed by on the Dublin to Cork railway line, some passing traffic along the local road
		Arithmetic Average	**54**	-	-	**53**	**41**	

The measurement position for N2 was located outside a residential property at Killeenmore along the Local Road (L60161). This location was chosen to represent residential properties in the vicinity of the proposed Morr 4, Morr 5, and Morr 6 works.

The attended daytime noise measurements for N2 ranged between 51-57 dB L_{Aeq}, 15 minutes. The Arithmetic Average was 54 dB L_{Aeq}. The dominant noise source at this location was train movements on the Dublin to Cork railway line and infrequent passing traffic along the local road. This is confirmed by analysis of the L_{A10} statistical noise parameter which had an arithmetic average of 53 dB. The arithmetic average of the background noise at this location was measured as 41 dB L_{A90}.

Table 8.7: Results of Baseline Attended Noise Survey at N3

Position Number	Date	Measurement Period	Measured Noise Levels (dB re. 2x10-5 Pa)					Comments
			L_{Aeq}	L_{AFMax}	L_{AFMin}	L_{A10}	L_{A90}	
N3	14/04/2015	10:37 – 10:52	60	83	42	55	45	Background birdsong, rustling foliage, aircraft passing overhead, dog barking in distance, infrequent passing traffic along the local road, train passing in distance audible
		11:49 – 12:04	63	84	40	63	44	Background birdsong dominant in absence of local road traffic noise, train passing on the Dublin to Cork railway line audible, aircraft passing overhead audible
		13:01 – 13:16	64	83	37	66	42	Background birdsong, aircraft movement audible overhead, some road traffic noise from passing traffic along local road, some home construction noise audible at nearby residence
		Arithmetic Average	**62**	**-**	**-**	**61**	**44**	

The measurement position for N3 was located outside a residential property at Kileenbeg along the Local Road (L2010). This location was chosen to represent residential properties in the vicinity of the proposed Morr 19 works.

The attended daytime noise measurements for N3 ranged between 60-64 dB L_{Aeq}, 15 minutes. The Arithmetic Average was 62 dB L_{Aeq}. The dominant noise source at this location was road traffic noise from the local road, the L2010. This is confirmed by analysis of the L_{A10} statistical noise parameter which had an arithmetic average of 61 dB. The arithmetic average of the background noise at this location was measured as 44 dB L_{A90}.

Table 8.8: Results of Baseline Attended Noise Survey at N4

Position Number	Date	Measurement Period	Measured Noise Levels (dB re. 2x10-5 Pa)					Comments
			L_{Aeq}	L_{AFMax}	L_{AFMin}	L_{A10}	L_{A90}	
N4	14/04/2015	13:37 – 13:52	56	72	38	59	41	Background birdsong, rustling foliage, road traffic noise dominant source, intermittent passing traffic along the local Barberstown Rd (L2010) and distant road traffic noise audible from the Straffan Rd (R406)
		14:57 – 15:12	56	77	36	59	39	Background birdsong, rustling foliage, road traffic noise audible & dominant from local Barberstown Rd (L2010), distant road traffic noise from the Straffan Rd (R406) is the dominant source in the absence of local road traffic noise, light aircraft passed overhead
		15:48 – 14:03	55	75	36	59	41	Background birdsong, rustling foliage, light aircraft passed overhead, chainsaw audible in distance, some road traffic noise from the local road audible
		Arithmetic Average	**56**	**-**	**-**	**59**	**40**	

The measurement position for N4 was located within the boundary of a residential property at Painestown along the Local Road (L2010). This location was chosen to represent residential properties in the vicinity of the proposed Paines 5 works.

The attended daytime noise measurements for N4 ranged between 55-56 dB L_{Aeq}, 15 minutes. The Arithmetic Average was 56 dB L_{Aeq}. The dominant noise source at this location was intermittent road traffic noise from the local road, the L2010. This is confirmed by analysis of the L_{A10} statistical noise parameter which had an arithmetic average of 59 dB. The arithmetic average of the background noise at this location was measured as 40 dB L_{A90}.

Table 8.9: Results of Baseline Attended Noise Survey at N5

Position Number	Date	Measurement Period	Measured Noise Levels (dB re. 2x10-5 Pa)					Comments
			L_{Aeq}	L_{AFMax}	L_{AFMin}	L_{A10}	L_{A90}	
N5	14/04/2015	14:10 – 14:25	53	77	45	51	46	Background birdsong, rustling foliage, vehicle movements from automobile depot audible in distance, flowing water from River Slane audible
		15:20 – 15:35	58	82	46	51	47	Background birdsong, rustling foliage, flowing water from River Slane audible, some noise from the automobile depot audible in distance, infrequent passing traffic along the local road (L6019)
		16:34 – 16:49	57	85	46	51	47	Background birdsong, rustling foliage, distant road traffic noise is dominant noise source, flowing water from River Slane audible
		Arithmetic Average	**56**	-	-	**51**	**47**	

The measurement position for N5 was located along the Local Road (L6019) at Tuckmilltown, adjacent to a residential garden with boundary adjacent to the River Slane. This location was chosen to represent residential properties in the vicinity of the proposed Slane 5 works.

The attended daytime noise measurements for N5 ranged between 53-58 dB L_{Aeq}, 15 minutes. The Arithmetic Average was 56 dB L_{Aeq}. The dominant noise source at this location was distant road traffic noise and some infrequent passing traffic movements along the local road, the L6019. This is confirmed by analysis of the L_{A10} statistical noise parameter which had an arithmetic average of 51 dB. The arithmetic average of the background noise at this location was measured as 47 dB L_{A90}.

Table 8.10: Results of Baseline Attended Noise Survey at N6

Position Number	Date	Measurement Period	Measured Noise Levels (dB re. 2x10-5 Pa)					Comments
			L_{Aeq}	L_{AFMax}	L_{AFMin}	L_{A10}	L_{A90}	
N6	14/04/2015	14:33 – 14:48	64	81	48	64	51	Background birdsong, road traffic noise from the N7 dominant source of noise, some road traffic noise from local traffic, aircraft passing overhead
		16:13 – 16:28	59	77	47	60	51	Background birdsong, road traffic noise from the local road is dominant noise source
		16:56 – 17: 11	63	78	54	66	56	Background birdsong, in the absence of local traffic, road traffic noise from the N7 is audible dominant noise source
		Arithmetic Average	**62**	**-**	**-**	**63**	**53**	

The measurement position for N6 was located adjacent to a residential property along the Local Road (L6021) at Blackchurch. This location was chosen to represent residential properties in the vicinity of the proposed Slane 7 works.

The attended daytime noise measurements for N6 ranged between 59-64 dB L_{Aeq}, 15 minutes. The Arithmetic Average was 62 dB L_{Aeq}. The dominant noise source at this location was road traffic noise from the N7 which was audible at this location and some passing traffic along the local road, the L6021. This is confirmed by analysis of the L_{A10} statistical noise parameter which had an arithmetic average of 63 dB and had the highest arithmetic average of the L_{A10} of all the measurement positions. The arithmetic average of the background noise at this location was measured as 53 dB L_{A90}.

8.3 POTENTIAL IMPACTS

This section of the report discusses the potential impact of the proposed scheme in relation to noise and vibration. The potential noise impacts on the surrounding environment must be considered for each of the two distinct stages: the short-term impact of the construction phase and the longer-term impact of the operational phase.

8.3.1 Do Nothing

If the proposed scheme does not proceed, the existing noise environment in the vicinity of the study area would remain at ambient levels as are currently typical of the area. Traffic volumes on the surrounding road network are not likely to increase by any noticeable amount, therefore the existing noise environment is not expected to change in the Do Nothing scenario.

8.3.2 Construction Phase Impacts

The construction of the scheme will occur in distinct phases. The construction works will commence at the confluence between the River Morell and the River Liffey and from there the works will progress upstream, subject to the availability of suitable materials. Within the works, the main artery of the scheme will be prioritised from embankments and associated tie-ins and culverts.

During the construction phase the majority of works to be undertaken will comprise of site preparation works, involving use of earth moving and excavation equipment. Site investigations have indicated that the made ground present in the vicinity of work areas Morr 2, 3, 10 and 23, Paines 1, 2, 3 and 5 and Slane 5, 6, 7 and 11, totalling approximately 17,391m^3 to be excavated is mainly comprised of re-worked gravelly clays with rare inclusions of glass, concrete fragments, timber, brick, and other potentially contaminated material. For this reason, the contractor may employ a mobile screen on site to sift out the larger elements of the spoil.

There will also be additional traffic noise generated by construction site traffic, which will include HGV movements associated with the delivery of the earthworks, which would have potential for a noise impact along the haul routes to the site.

Although the construction phase of the proposed scheme has the greatest potential for impact, it should be noted that these works will be temporary in duration as it is anticipated that construction works will be sequential, the daily HGV trips will be travelling to different sites in the catchment area as the work progress from embankment to embankment.

8.3.2.1 Noise

The most noticeable noise impact will occur during general construction activities associated with the proposed scheme. There are a number of noise sensitive receptors located adjacent to the proposed work areas where embankments and new walls will be constructed. The majority of works will be earth works that are required for topsoil stripping, construction of the new embankments, construction of remediated embankments and construction of the new walls.

Noise predictions were undertaken in accordance with BS 5228-1: 2009: *Code of Practice for Noise and Vibration Control on Construction and Open Sites: Noise to predict noise levels at nearby noise sensitive receptors*. Details regarding the nature and numbers of plant and machinery to be utilised on-site during the construction works have not been finalised at this stage. Table 8.11 provides an overview of the type of plant and machinery which will be required as part of the works.

Table 8.11: List of Construction Plant/Machinery and Associated Sound Power Levels

Item and BS5228-1: 2009 Reference	No. Required	Sound Pressure Level L_{Aeq} at 10m
Dump Trucks (Ref C.2.30)	2	79
Articulated Dump Trucks (Ref C.2.33)	2	81
Lorry 4 axle (Ref C.2.34)	3	80
40t Tracked Excavators (Ref C.2.14)	2	79
25t Tracked Excavators (Ref C.2.19)	2	77
Tracked Mobile Crane (Ref C.4.52)	1	75
Truck mounted concrete pump + boom arm (Ref C.4.29)	1	80

All embankment works will be undertaken using tracked vehicles travelling along the temporary works area along the bank of the Morell catchment Rivers. Construction noise sources will result in a temporary impact on the noise climate in the area. Given the transient nature of a construction site and the proposed layout of the site compound, activities will be at varying distances from the nearest sensitive receptors depending on the location of works.

For the majority of the time, plant and equipment will be a greater distance from the nearest noise sensitive locations than that used for the calculations and consequently will have lesser impact. The assessment is therefore representative of a “worst-case” scenario and the following assumptions have been made in predicting construction noise levels:

- The nearest noise sensitive locations are located approximately 10m from proposed work areas;
- All items listed in Table 8.11 are operating for a proportional periods of 1 hour; and
- All items are operating simultaneously for 80% of the time.

Table 8.12 summarises the construction noise prediction calculations at varying distances from the proposed works area.

Table 8.12: Predicted Noise Levels at Varying Distances

Item & BS5228-1: 2009 Reference	No. Required	Sound Pressure Level L_{Aeq} at 10m	Predicted Noise Levels at Varying Distances		
			10m	20m	40m
Dump Trucks (Ref C.2.30)	2	79	54	48	42
Articulated Dump Trucks (Ref C.2.33)	2	81	56	50	44
4-axle Lorry (Ref C.2.34)	3	80	57	51	45
40t Tracked Excavators (Ref C.2.14)	2	79	54	48	42
25t Tracked Excavators (Ref C.2.19)	2	77	52	46	40
Tracked Mobile Crane (Ref C.4.52)	1	75	47	41	35

Truck mounted concrete pump + boom arm (Ref C.4.29)	1	80	52	46	40
Combined Level dB $_{LAeq,1hour}$			62	56	50

Predictions are based on a $L_{Aeq,1hour}$ value with all machinery operating for proportional periods of 1 hour. This may be considered a worst case scenario as this machinery will not all operate simultaneously and will be used at varying stages as the works progress.

The results of the assessment indicate that construction noise levels at varying distances from the proposed works areas are within the NRA guidelines for construction noise levels as outlined in Table 8.1. The predicted noise levels are below the maximum permissible noise level of 70 dB $L_{Aeq,1hour}$ for Monday – Friday (07:00 – 19:00 hrs).

Baronrath Stud is located to the east of Morr 9, which is estimated to have a construction timeframe of 3.3 weeks. It is assumed that the plant and machinery listed in Table 8.11 will be utilised at this location. Given the transient nature of works, activities will be at varying distances from this sensitive receptor. Table 8.13 summarises the construction noise prediction calculations for this location assuming a worst-case distance of 10m from the proposed work area of Morr 9.

Table 8.13: Predicted Noise Levels at Morr 9

Item & BS5228-1: 2009 Reference	No. Required	Sound Pressure Level L_{Aeq} at 10m	Predicted Noise Levels
			10m
Dump Trucks (Ref C.2.30)	2	79	54
Articulated Dump Trucks (Ref C.2.33)	2	81	56
4-axle Lorry (Ref C.2.34)	3	80	57
40t Tracked Excavators (Ref C.2.14)	2	79	54
25t Tracked Excavators (Ref C.2.19)	2	77	52
Tracked Mobile Crane (Ref C.4.52)	1	75	47
Truck mounted concrete pump + boom arm (Ref C.4.29)	1	80	52
Combined Level dB $_{LAeq,1hour}$			62

The results of the assessment indicate that construction noise levels at Baronrath Stud at a distance of 10m from the proposed works areas are within the NRA guidelines for construction noise levels as outlined in Table 8.1. The predicted noise levels are below the maximum permissible noise level of 70 dB $L_{Aeq,1hour}$ for Monday – Friday (07:00 – 19:00 hrs).

Traffic Noise

The road traffic impact has been undertaken in accordance with the UK's Highway Agency, Design Manual for Roads and Bridges (DMRB) HD 213/11 Volume 11, Section 3, Part 7 Revision 1. The DMRB states that noise should only be assessed when changes in traffic flow are greater than 25% or a 20% decrease in traffic flow. The road traffic impact associated with the construction works has built in the traffic movements to/ from the various material handling areas.

The traffic impact assessment, outlined in Chapter 6 indicated that the overall impact of the construction traffic on the surrounding national and regional road network, in terms of absolute traffic volumes, is minimal. Since the number of daily HGV movements will remain relatively constant for the duration of the construction works, the impact of the construction traffic will only vary in duration, with certain sections of the local road network impacted for longer periods than others. The predicted construction traffic is outlined in Table 8.14.

Table 8.14: Predicted Construction Traffic

Road Route	2016 Background		Proposed Peak During Construction		Increase	
	AADT	% HGV	AADT	%HGV	AADT	%HGV
National Road Network						
N7 (between Jn.9 & 10)	57,052	8.3%	57,132	8.4%	80	0.1%
N7 (between Jn.7 & 8)	80,987	7.1%	81,067	7.2%	80	0.1%
N7 (between Jn.5 & 6)	84,831	10.7%	84,911	10.8%	80	0.1%
Regional Road Network						
R407	13,724	7.1%	13,804	7.7%	80	0.6%
R406 (off Jn.7)	7,440	2.0%	7,520	3.1%	80	1.1%
R406 (north)	5,638	2.2%	5,718	3.5%	80	1.4%
Regional Road Network						
L2010	2945	0.3%	3,025	2.9%	80	2.6%
L2011	1621	4.7%	1,701	6.9%	80	4.7%

A number of haul routes were therefore identified for each grouped area of works, which would provide the most reasonable route options for deliveries to / from the proposed construction sites. The location and description of the haul routes are outlined in Chapter 6 ‘Traffic & Transport’. Three areas have been identified as potential locations for stockpiling / set down of materials; in the vicinity of Paines 1-3, Morr 19 and Morr 23. These three stockpiling locations are located off Killeenmore Road and the L2010 to the east and west of the Grand Canal. It is anticipated that the Contractor will use the best placed stockpiling site for each section, where possible, to minimise any unnecessary vehicular trips on the local road network.

The number of HGV movements associated with the delivery of the earthworks is assumed to be constant throughout the duration of the construction period, with each section generating approximately 5 deliveries per hour, for eight hours a day. This equates to a total of 80 two-way HGV movements (40 inbound and 40 outbound) per day. There may however, on occasion, be the requirement of up to a maximum of 60 deliveries in any given day.

The impact of the predicted construction traffic on the surrounding road network is summarised in Table 8.15.

Table 8.15: Noise Impact of Predicted Construction Traffic

Road Route	2016 Background		Proposed Peak During Construction		Increase		Predicted Change in Noise Level
	AADT	% HGV	AADT	%HGV	AADT	%HGV	
National Road Network							
N7 (between Jn.9 & 10)	57,052	8.3%	57,132	8.4%	80	0.1%	0.0
N7 (between Jn.7 & 8)	80,987	7.1%	81,067	7.2%	80	0.1%	0.0
N7 (between Jn.5 & 6)	84,831	10.7%	84,911	10.8%	80	0.1%	0.0
Regional Road Network							
R407	13,724	7.1%	13,804	7.7%	80	0.6%	0.0
R406 (off Jn.7)	7,440	2.0%	7,520	3.1%	80	1.1%	0.0
R406 (north)	5,638	2.2%	5,718	3.5%	80	1.4%	+0.1
Regional Road Network							
L2010	2945	0.3%	3,025	2.9%	80	2.6%	+0.1
L2011	1621	4.7%	1,701	6.9%	80	4.7%	+0.2

The predicted change in noise level due to additional vehicular traffic on the assessed roads for the construction phase are less than 1dB and would therefore be imperceptible. Considering that in order to increase traffic noise levels by 1dB traffic volumes would need to increase by the order of 25% it is concluded that these additional traffic movements introduced onto the local road network during the construction phase would not result in a significant noise impact.

For mobile items of plant that pass at intervals (such as earth-moving machinery passing along a haul road), it is possible to predict an equivalent continuous sound level using the method F.2.5. outlined in BS 5228 - 1: 2009.

The general expression for predicting the L_{Aeq} alongside a haul road used by single engine items of mobile plant is:

$$L_{Aeq} = L_{WA} - 33 + 10\log10Q - 10\log10V - 10\log10d$$

where:
L_{WA} is the sound power level of the plant, in decibels (dB);
Q is the number of vehicles per hour;
V is the average vehicle speed, in kilometres per hour (km/h);
d is the distance of receiving position from the centre of haul road, in metres (m).

Using the traffic data providing which assumes that there will be ten deliveries per hour (5 inbound and 5 outbound) with the item of plant being a Dumper Truck (Ref: C.4.3 of BS5228-1: 2009) with a sound power level of 76 dB, travelling an average speed of 25 km/hr and at a distance of 10m from the nearest noise sensitive receptor. There is a correction of 3dB for reflections, however no correction for screening, as it is assumed that there is a direct line of sight. As such, the predicted noise level at a residential property 10m from the haul road will result in a noise level of 29dB.

The cumulative noise impacts are 50 dB L_{Aeq} at N1, 54 dB L_{Aeq} at N2, 62 dB L_{Aeq} at N3, 56 dB L_{Aeq} at N4, 56 dB L_{Aeq} at N5 and 62 dB L_{Aeq} at N6. As such the increase in traffic noise levels along the proposed haul routes will not result in cumulative noise impact greater than 1 dB in all instances and confirms that this increase is negligible and the resultant impact is typically imperceptible.

8.3.2.2 Vibration

Potential sources of vibration during typical construction projects include rock-breaking equipment, sheet piling machinery, excavators, dump trucks and HGV's. There are internationally recognised criteria for vibration levels, for vibration which would be likely to lead to complaints, and vibration levels which would be likely to lead to structural damage (BS6472-1: 2008 *Guide to evaluation of human exposure to vibration in buildings, Vibration sources other than blasting*, BS6472-2: 2008 *Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration* and BS7385-2: 1993 *Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration).*

It is anticipated that the levels of vibration generated by construction works associated with the proposed scheme and haulage of material to the site compounds and subsequent movement to construction sites/area of works would be below the criteria specified in aforementioned standards, as the level of vibration from these activities would not be significant.

It has been identified that sheet-piling will not be used during the construction works. If this changes and sheet piling is undertaken of the flood defence walls as part of the proposed scheme, vibration measurements will need to be carried out at any requisite monitoring points in the vicinity of residential properties. This will ensure that vibrations generated by any of the construction activities at the proposed scheme would not give rise to nuisance in the vicinity of proposed works.

8.3.3 Operational Phase Impacts

There is no significant noise impact predicted to be emitted from the operational phase of the proposed scheme. Regular maintenance of the river channel and in particular culverts will be required to ensure it retains its conveyance capacity. The maintenance activities will consist of clearing the overgrowth from the river banks and embankments in addition to removing debris from the rivers, embanked areas and culverts and will be completed as and when required.

8.4 MITIGATION MEASURES

As outlined above, the main potential impacts will be in relation to the construction phase of the proposed scheme. In order to sufficiently ameliorate the likely noise and vibration impacts, a schedule of control measures has been formulated for the construction phase.

8.4.1 Construction Phase

8.4.1.1 Noise

Reference will be made to BS 5228-1: 2009: Code of Practice for Noise and Vibration Control on Construction and Open Sites: Noise, which offers detailed guidance on the control of noise and vibration from demolition and construction activities. The following proposed practices will be adopted during construction and will be developed in the CEMP, including:

- The normal working hours for the construction of this scheme will be 7.30am – 4:30pm Monday to Friday. Working hours may be extended to 7.00am - 7.00pm Monday to Friday; and 9.00am and 4.00pm on Saturdays on occasion. There will be no activity on Sundays or Bank Holidays.
- Where additional or alternative working hours outside those stated above are required, these will require notification to Kildare County Council and to be agreed in advance;
- All construction related traffic should only use the designated and approved haul routes;
- Provision of a 2.4m high hoarding should be provided around contractor's compound;
- A mobile system of screens or temporary hoarding should be placed close to the noisy construction works within embankment areas to provide acoustic screening in locations with residential properties in close proximity to construction works;
- The contractor will be required to put a mobile screen on site in areas where made ground is to be excavated to sift out the larger elements of the spoil. This will minimise the generation of construction dust and noise.
- Establishing channels of communication between the client/ contractor, Kildare County Council and residents through implementation of a communications procedure for noise and vibration related issues;
- Appointing a site representative responsible for matters relating to noise and vibration; and
- Monitoring typical levels of noise and vibration during critical periods and at sensitive locations.

Furthermore, it is envisaged that a variety of practicable noise control measures will be employed. These may include:

- Selection of plant with low inherent potential for generation of noise and/ or vibration;
- Erection of enclosures as necessary around noisy processes and items such as generators, heavy mechanical plant or high duty compressors; and
- Placing of noisy/ vibratory plant as far away from sensitive properties as permitted by site constraints and the use of vibration isolated support structures where necessary.

It is also recommended that periodic noise monitoring be undertaken during the initial construction phase to determine noise levels at noise sensitive receptors, in particular during 'noisy' activities. If the recommended noise exposure levels are exceeded further mitigation measures will be employed including temporary enclosures or screens around particularly ‘noisy’ plant.

8.4.1.2 Vibration

It is anticipated that the levels of vibration generated by construction activities will be below the criteria specified in the standards.

It has been identified that sheet-piling will not be used during the construction works. If this changes during detailed design and sheet piling is undertaken of the flood defence walls as part of the proposed scheme, vibration measurements will need to be carried out at any requisite monitoring points in the vicinity of residential properties. The chosen locations will be agreed in advance with Kildare County Council. This would help to ensure that any vibration generated by the construction of the proposed scheme would not give rise to nuisance in the vicinity of the proposed scheme. If vibration-monitoring results were to indicate that levels were approaching the standard limits, appropriate mitigation measures will need to be put in place to ensure that vibration levels were reduced to acceptable levels.

It is proposed that vibration monitoring will be carried out for all properties in close proximity to construction works and haul routes. Precondition surveys will be carried out at residential properties in close proximity to the construction works and haul routes. Survey and monitoring locations will be identified during detailed design and agreed with residents/owners as part of the CEMP in advance of the construction works. The vibration limits for the duration of the construction works are set out in Table 8.3 and represent the allowable vibration in order to minimise the risk of building damage. Specifically, Noise & Vibration levels shall be kept below those levels specified in Table 8.3, or if further limits are imposed by the Local Authority.

A programme of noise monitoring and vibration (if required) at sensitive receptors will be detailed by the Contractor prior to works beginning. This will allow for a constant review of noise and vibration (if required) levels generated by the construction of the proposed scheme and will highlight the need for further mitigation measures should they be required.

8.4.2 Operational Phase

There will be no operational noise or vibration sources on-site once the proposed works are completed and therefore no mitigation measures have been prescribed for the operational phase of the scheme.

8.5 RESIDUAL IMPACTS

There will be no significant residual noise and vibration impacts associated with the construction or operation stage of the proposed scheme.

9 LANDSCAPE AND VISUAL IMPACT ASSESSMENT

9.1 INTRODUCTION

This chapter examines the potential landscape and visual impact of the Morell Flood Management Scheme on the landscape and visual resources within the catchment area.

The chapter seeks to:

a) Establish the baseline conditions -
Record and analyse the existing character, quality and sensitivity of the landscape and visual resource. This should include elements of the landscape such as;

- Landform;
- Land cover including the vegetation, the slopes, drainage, etc;
- Landscape character;
- Current landscape designations and planning policies; and
- Site visibility, comprising short, medium and long distance views.

b) Analyse baseline conditions -
Comment on the scale, character, condition and the importance of the baseline landscape, its sensitivity to change and the enhancement potential where possible.

A visual analysis (illustrated by photographic material) describing characteristics which may be of relevance to the impact of the design and to the method of mitigation.

c) Describe the proposed scheme relevant to the landscape and visual impact assessment.

d) Identify the Impacts of the proposed scheme on the Landscape and Visual Resource (see Section 9.4):
Identify the landscape and visual impacts of the proposed scheme at different stages of its life cycle, including:

- Direct and indirect *landscape impacts* of the proposed scheme on the landscape of the site and the surrounding area; and
- *Visual impacts* including: the extent of potential visibility; the view and viewers affected; the degree of visual intrusion; the distance of views; and resultant impacts upon the character and quality of views.

e) Assess the significance of the landscape and visual impacts in terms of the sensitivity of the landscape and visual resource, including the nature and magnitude of the impact.

f) Detail measures proposed to mitigate significant residual detrimental landscape and visual impacts and assess their effectiveness (see Section 9.5).

g) Assess the ability of the landscape and visual resource to absorb the proposed scheme.

9.2 METHODOLOGY

The methodology for the Landscape and Visual Impact Assessment (LVIA) has been derived from *Guidelines for Landscape and Visual Impact Assessment, Third Edition* (The Landscape Institute and Institute of Environmental Management & Assessment, 2013) (GLVIA3).

The landscape has been appraised to allow it to be described and classified into landscape character areas that in turn enable the classification of landscape quality. The capacity of the landscape to accept change of the type proposed is assessed by determining the sensitivity of each landscape character area. Overall key landscape components are normally landform, vegetation and historical and cultural components. Landform relates to topography, drainage characteristics and geology. Historical and cultural components include historic landscapes, listed buildings, conservation areas and historic designed landscapes. Vegetation plays an important role in how the landscape and visual resources of an area are viewed and is an integral component of a landscape character.

This assessment has been undertaken through analysis of;

- Up to date digital copies of OSI vector maps;
- Aerial photography;
- Establish baseline conditions by survey and analysis;
- Kildare County Development Plan 2011 -2017
- Draft Kildare County Development Plan 2017 - 2023; and
- Detailed drawings of the proposed scheme.

Site visits were undertaken to establish the existing baseline environment, to establish the existing visual resource and to identify sensitive receptors, i.e. residential properties, scenic viewpoints. Site visits were also used to establish the perceived extent of landscape and visual impacts that may be associated with the proposed scheme.

The proposed scheme is then applied to this landscape and visual baseline and potential impacts predicted.

9.2.1 Identifying Effects

Assessing the significance of an effect is a key component of the LVIA and is an evidenced based process combining professional judgments on the nature of a landscape or visual receptor's sensitivity, their susceptibility to change and the value attached to the receptor. It is important to note that judgments in this LVIA are impartial and based on professional experience and opinion informed by best practise guidance.

The effects of development are of variable duration and are assessed as being temporary, short-term or long-term, and permanent or reversible. Effects are considered to be long-term during the operational phase of the development, whilst other operations and infrastructure such as temporary construction compounds and access tracks, apparent only during the construction and initial operating period are considered to be short-term effects.

The reversibility of effects is also variable. The effects on the landscape and visual resource that result from the proposed scheme are long term and permanent. The effects that will occur during the construction period of the proposed scheme, such as the use of heavy machinery, are temporary.

To avoid repetition, the duration and permanence of effects are not reiterated throughout the assessment outlined in this chapter.

9.2.2 Assessment Criteria

The objective of the assessment process is to identify and evaluate the predicted significant effects arising from the proposed scheme. Significance is a function of the:

- Sensitivity of the affected landscape and visual receptors; and
- Scale or Magnitude of Impact that they will experience.

These definitions recognise that landscapes vary in their capacity to accommodate different forms of development according to the nature of the receiving landscape and the type of change being proposed.

Significance is not graded in bands, and a degree of informed judgement is required. Even with the application of pre-defined criteria, interpretation may differ between individuals, but this allows the process of reaching these conclusions to be transparent.

9.2.3 Landscape Impact Assessment

The LVIA firstly assesses how the proposed scheme would impact directly on any landscape features and resources. This category of effect relates to specific landscape elements and features (e.g. woods, trees, walls, hedgerows, watercourses) within the site that are components of the landscape that may be physically affected by the proposal. Physical effects are restricted to the area within the site boundary, and are the direct effects on the fabric of the site, such as the removal or addition of trees and alteration to ground cover.

The LVIA then considers impacts on landscape character at two levels. Firstly, consideration is given to how the landscape character is affected by the removal or alteration of existing features and the introduction of new features. This is considered to be a direct impact on landscape character. Secondly, the indirect impacts of the proposed scheme on the wider landscape are considered. The assessment of impacts on the wider landscape is discussed using the surrounding character areas identified in the relevant regional landscape character assessments. It is acknowledged there is an overlap between perception of change to landscape character and visual amenity, but it should be remembered that landscape character in its own right is generally derived from the combination and pattern of landscape elements within the view.

The significance of effects on landscape features and character is determined by cross referencing the sensitivity of the feature or landscape character with the magnitude of impact.

Consideration of the sensitivity of the landscape resource against the magnitude of impact caused by the revised development is fundamental to landscape and visual assessment and these two criteria are defined in more detail in the following sections.

9.2.4 Landscape Sensitivity

The determination of the sensitivity of the landscape resource is based upon an evaluation of each key element or characteristic of the landscape likely to be effected. The evaluation reflects such factors as its quality, value, contribution to landscape character and the degree to which the particular element or characteristic can be replaced or substituted.

For the purpose of this assessment, landscape quality is categorised as:

- Very High: Areas of especially high quality acknowledged through designation as Areas of Outstanding Natural Beauty (AONB) or other landscape based sensitive areas. These are of landscape significance within the wider region or nationally;
- High Quality: Areas that have a very strong positive character with valued and consistent distinctive features that gives the landscape unity, richness and harmony. These are of landscape significance within the district;
- Medium Quality: Areas that exhibit positive character but which may have evidence of alteration/degradation or erosion of features resulting in a less distinctive landscape. These may be of some local landscape significance with some positive recognisable structure; and
- Low Quality: Areas that are generally negative in character, degraded and in poor condition. No distinctive positive characteristics and with little or no structure. Scope for positive enhancement.

As previously discussed, landscape sensitivity is influenced by a number of factors including value, condition and the type of change brought about by the proposed scheme. In order to assist with bringing these factors together the following five point scale has been used. Table 9.1 defines the criteria that have guided the judgement as to the Sensitivity of the Landscape Resource.

Table 9.1 – Landscape Sensitivity

Definition		Sensitivity
Landscape resource sensitivity	**Landscape resource value**	
Exceptional landscape quality, no or limited potential for substitution. Key elements / features well known to the wider public. *Little or no tolerance to change.*	*Nationally / internationally designated/ valued landscape, or key elements or features of national / internationally designated landscapes.* *Little or no tolerance to change*	*Very High*
Strong / distinctive landscape character; absence of landscape detractors. *Low tolerance to change.*	*Regionally / nationally designated / valued countryside and landscape features.* *Low tolerance to change.*	*High*
Some distinctive landscape characteristics; few landscape detractors. *Medium tolerance to change*	*Locally / regionally designated / valued countryside and landscape features.* *Medium tolerance to change*	*Medium*
Absence of distinctive landscape characteristics; presence of landscape	*Undesignated countryside and landscape features.*	*Low*

Definition		Sensitivity
Landscape resource sensitivity	**Landscape resource value**	
detractors. *High tolerance to change*	*High tolerance to change*	
Absence of positive landscape characteristics. Significant presence of landscape detractors. *High tolerance to change*	*Undesignated countryside and landscape features.* *High tolerance to change*	*Negligible*

9.2.5 Magnitude of Landscape Impacts

Direct resource changes on the landscape character in the study area are brought about by the introduction of the proposed scheme and its impact on the key landscape characteristics. The categories and criteria used are given in Table 9.2.

Table 9.2 – Magnitude of Landscape Impact

Definition	Magnitude
Total loss or addition or/ very substantial loss or addition of key elements / features / patterns of the baseline, i.e., pre-development landscape and/ or introduction of dominant, uncharacteristic elements with the attributes of the receiving landscape	*Large*
Partial loss or addition of or moderate alteration to one or more key elements / features / patterns of the baseline, i.e., pre-development landscape and / or introduction of elements that may be prominent, but may not necessarily be substantially uncharacteristic with the attributes of the receiving landscape.	*Medium*
Minor loss or addition of or alteration to one or more key elements / features / patterns of the baseline, i.e., pre-development landscape and or introduction of elements that may not be uncharacteristic with the surrounding landscape.	*Small*
Very minor loss or addition of or alteration to one or more key elements / features / patterns of the baseline, i.e., pre-development landscape and/or introduction of elements that are not uncharacteristic with the surrounding landscape approximating to a 'no-change' situation.	*Negligible*
No loss, alteration or addition to the receiving landscape resource	*No change*

9.2.6 Zone of Visual Influence (ZVI)

The ZVI is the area within which views of the site and/or the proposed scheme can be obtained. The extent of the ZVI is determined primarily by the topography of the area. The ZVI is then refined by field studies to indicate where relevant forestry, woodlands, hedges or other local features obscure visibility from the main roads, local viewpoints/landmarks and/or significant settlements. The ZVI is illustrated in Figure 9.1. As the proposed scheme is located within a predominantly flat lowland landscape the ZVI is predominantly defined by trees and vegetation.

Using terrain-modelling techniques combined with the proposed scheme specification, a map is created to show areas from where the proposed scheme would theoretically be seen. A worst case scenario is taken in line with Landscape Institute guidelines. The actual visual impacts within the ZVI have been described in later sections of this chapter.

9.2.7 Visual Impact Assessment

The assessment of effects on views is an assessment of how the introduction of the proposed scheme will affect views throughout the study area. Assessment of visual effects therefore needs to consider:

- Direct impacts of the proposal upon views of the landscape through intrusion or obstruction;
- The reaction of viewers who may be affected, e. g. residents, walkers, road users; and
- The overall impact on visual amenity.

Viewpoints have been selected to meet the following criteria, with locations illustrated on Figure 9.2;

- A balance of viewpoints from where main directions of view are towards the revised development;
- A range of views of the revised development covering the extent of the study area;
- A proportion representing areas known to be available to the community where people may frequent or congregate; and
- Locations of interest e.g. settlements and local residents houses.

9.2.8 Photographs

Photographs have been prepared for selected representative viewpoints throughout the study area as indicated in Figure 9.2 and illustrated in the following sections.

Viewpoints are chosen to give a typical representative sample of views of the proposal within the landscape using the parameters of distance and direction of view. Viewpoints frequented by members of the public such as public rights of way, car parks and popular viewpoints are usually chosen, along with views from nearby settlements.

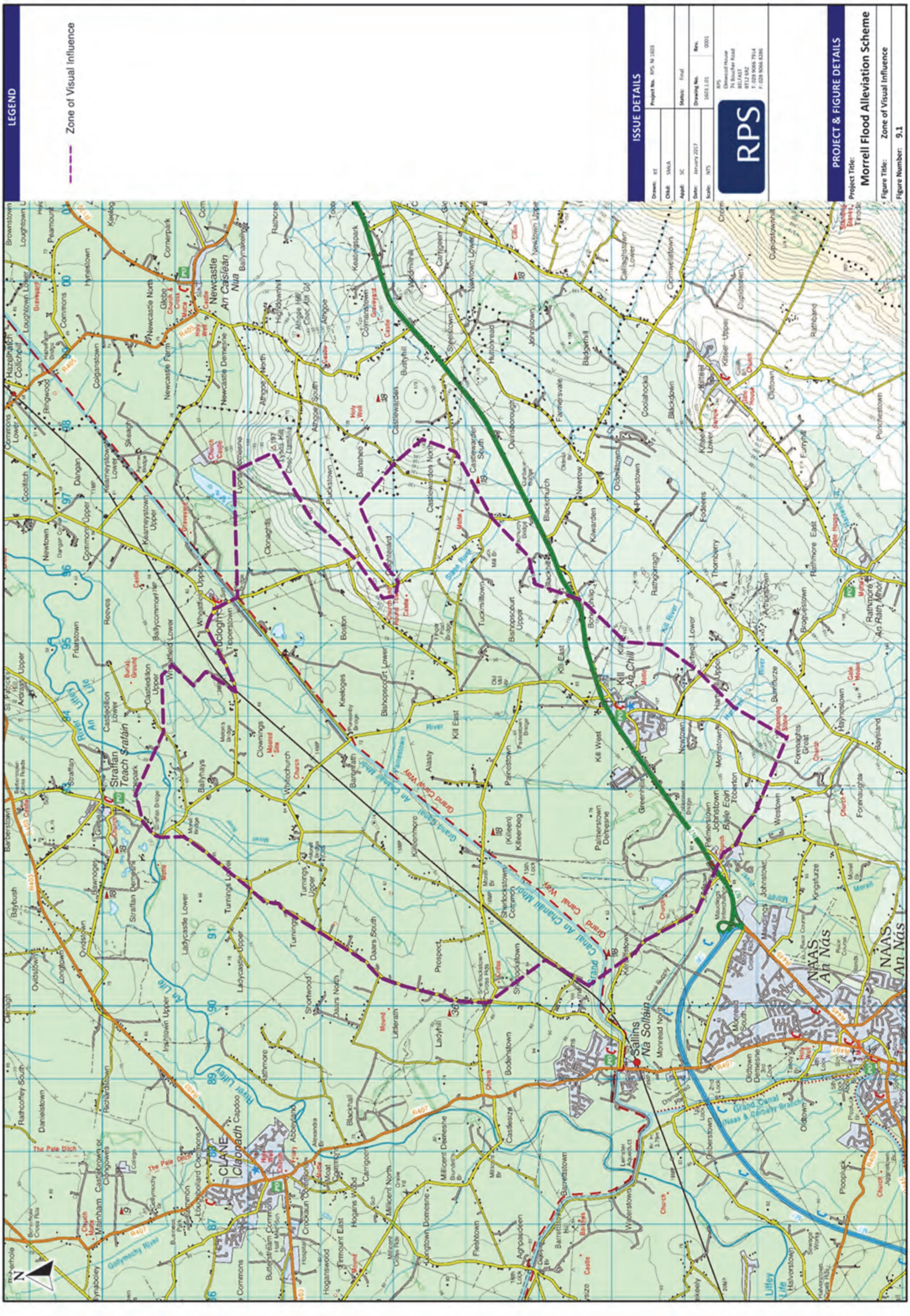
Photographs from each viewpoint location are taken covering an arc of view matching that of the visual extent of the development.

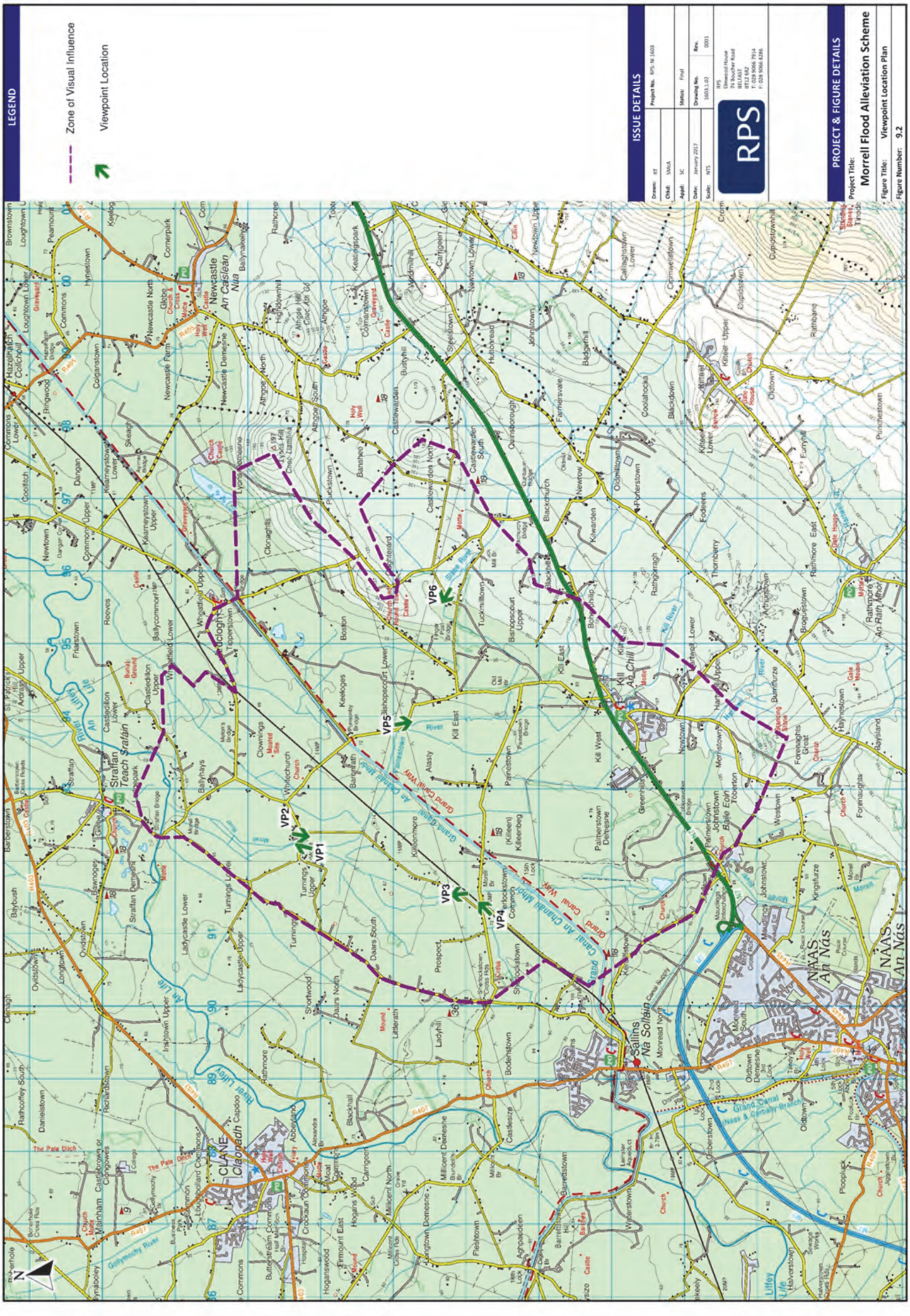
9.2.9 Visual Sensitivity

Visual sensitivity is defined with reference to the landscape sensitivity of the viewpoint location and the view. Other factors affecting visual sensitivity include:

- The location and context of the viewpoint;
- The expectations and occupation or activity of the receptor; and
- The importance of the view.

Although the interpretation of viewers' experience can have preferential and subjective components, there is generally clear public agreement that the visual resources of certain landscapes have high visual quality.


LEGEND
Zone of Visual Influence
ISSUE DETAILS
RPS
PROJECT & FIGURE DETAILS
Project Title: Morell Flood Alleviation Scheme
Figure Title: Zone of Visual Influence
Figure Number: 9.1
CLANE
Clóanadh
Sallins
Na Solláin
NAAS
An Nás
Kill
An Chill
Straffan
Teach Srafáin
Newcastle
An Caisleán Nua
Grand Canal
River Liffey
Morell River


LEGEND
Zone of Visual Influence
Viewpoint Location
ISSUE DETAILS
PROJECT & FIGURE DETAILS
Project Title: Morell Flood Alleviation Scheme
Figure Title: Viewpoint Location Plan
Figure Number: 9.2
VP1
VP2
VP3
VP4
VP5
VP6

Viewer sensitivity, as set out in Table 9.3, is a combination of the sensitivity of the human receptor (for example resident, commuter, tourist, walker, recreationist or worker, and the numbers of viewers affected) and viewpoint type or location (for example house, workplace, leisure venue, local beauty spot, scenic viewpoint, commuter route, tourist route or walkers' route).

Table 9.3 – Viewer Sensitivity

Definition		Sensitivity
Visual resource sensitivity	Visual resource value	
Views of remarkable scenic quality, of and within internationally designated landscapes or key features or elements of nationally designated landscapes that are well known to the wider public. Little or no tolerance to change.	*Observers, drawn to a particular view, including those who have travelled from around Ireland and overseas to experience the views. Little or no tolerance to change*	*Very High*
Views from residential property. Public rights of way, National Trails, Long distance walking routes and nationally designated countryside/ landscape features with public access. Low tolerance to change.	*Observers enjoying the countryside from their homes or pursuing quiet outdoor recreation are more sensitive to visual change. Little tolerance to change*	*High*
Views from local roads and routes crossing designated countryside / landscape features and 'access land' as well as promoted paths. *Medium Tolerance to change.*	*Observers enjoying the countryside from vehicles on quiet/ promoted routes are moderately sensitive to visual change.* *Medium tolerance to change*	*Medium*
Views from work places, main roads and undesignated countryside / landscape features. *High tolerance to change.*	*Observers in vehicles or people involved in frequent or infrequent repeated activities are less sensitive to visual change.* *High tolerance to change*	*Low*
Views from within and of undesignated landscapes with significant presence of landscape detractors. *High tolerance to change.*	*Observers in vehicles or people involved in frequent or frequently repeated activities are less sensitive to visual change.* *High tolerance to change*	*Negligible*

9.2.10 Magnitude of Visual Impacts

The magnitude of impact on the visual resource results from the scale of change in the view, with respect to the loss or addition of features in the view, and changes in the view composition. Important factors to be considered include: proportion of the view occupied by the proposed scheme, distance and duration of the view. Other vertical features in the landscape and the backdrop to the proposal will all influence resource change. Magnitude of visual impact is defined in Table 9.4.

Table 9.4 – Magnitude of Visual Impact

Definition	Magnitude
Complete or very substantial change in view dominant involving complete or very substantial obstruction of existing view or complete change in character and composition of baseline, e.g., through removal of key elements	*Large*
Moderate change in view: which may involve partial obstruction of existing view or partial change in character and composition of baseline, i.e., pre-development view through the	*Medium*

Definition	Magnitude
introduction of new elements or removal of existing elements. Change may be prominent, but would not substantially alter scale and character of the surroundings and the wider setting. Composition of the view would alter. View character may be partially changed through the introduction of features which, though uncharacteristic, may not necessarily be visually discordant	
Minor change in baseline, i.e. pre-development view - change would be distinguishable from the surroundings whilst composition and character would be similar to the pre change circumstances.	*Small*
Very slight change in baseline, i.e. pre-development view - change barely distinguishable from the surroundings. Composition and character of view substantially unaltered.	*Negligible*
No alteration to the existing view	*No change*

9.2.11 Significance of Effects

The purpose of an LVIA is to determine, in a transparent way, the likely significant landscape and visual effects of the proposed scheme. It is accepted that, due to the nature and scale of proposed scheme, the proposal could potentially give rise to some notable visual and landscape effects. Furthermore, a significant effect would not necessarily mean that the effect is unacceptable in planning terms. What is important is that the likely effects on the landscape and visibility are transparently assessed and understood in order that the determining authority can bring a balanced, well-informed judgement to bear when making the planning decision.

The significance of the landscape and visual effects are assessed through a combination of the sensitivity of the receptor with the magnitude of impact.

The significance of effects on landscape, views and visual amenity are evaluated according to a six-point scale: Substantial Major, Moderate, Minor, Negligible or None.

For the purposes of this assessment those effects indicated as being of Substantial, Major to Substantial are considered significant as per Table 9.5. Effects of 'Moderate' and lesser significance have been identified in the assessment, but are not considered significant upon the character and quality of the landscape and on views although they remain worthy of consideration throughout the decision making process.

For those effects indicated as being Moderate to Major the assessor will exercise professional judgement in determining if the effect is considered significant.

Table 9.5 – Significance of Effects Matrix

Magnitude of impact	Sensitivity				
	Negligible	Low	Medium	High	Very High
No Change	None	None	None	None	None
Negligible	Negligible	Negligible to Minor	Negligible to Minor	Minor	Minor
Small	Negligible to Minor	Negligible to Minor	Minor	Minor to Moderate	Moderate to Major
Medium	Negligible to Minor	Minor	Moderate	Moderate to Major	Major to Substantial
Large	Minor	Minor to Moderate	Moderate to Major	Major to Substantial	Substantial

A conclusion that an effect is 'significant' should not be taken to imply that the proposed scheme is unacceptable. Significance of effect needs to be considered with regard to the scale over which it is experienced.

9.2.12 Landscape Visual Definitions

The following provides a list of landscape and visual definitions for the terms used within this assessment:

- Landscape Capacity: the capacity of a particular type of landscape to absorb change without unacceptable adverse effects on its character;
- Landscape Character Type: distinct types of landscape which are generic in character in that they may occur in different parts of the country, but wherever they are they share broadly similar combinations of geology, topography, drainage patterns, vegetation and historical land use and settlement pattern. Landscape character type (LCT) names are generic, for example 'Upland Hills', 'river valley' and 'urban landscape';
- Landscape Fabric: is the physical pattern of elements and features such as vegetation, landform and land use that combine to create landscape character. The effects of a development on landscape fabric are those that alter the physical pattern of elements. These effects are restricted to the landscape within which the proposal is located as it is within this area that the physical pattern will alter, for instance through loss of vegetation, re-contouring or changes to land use;
- Landscape Quality (or condition): is based on judgements about the physical state of the landscape, and about its intactness, from visual, functional, and ecological perspectives. It also reflects the state of repair of individual features and elements which make up the character in any one place;
- Landscape Resource: the combination of elements that contribute to landscape context, character and value;
- Landscape Value: the importance attached to a landscape (often as a basis for designation or recognition) that expresses national or local consensus, because of its quality, cultural associations, scenic or aesthetic characteristics;
- Sensitivity: vulnerability of a sensitive receptor to change;

- Sensitive receptor: physical or natural resource, special interest or viewer group that will experience an impact;
- Magnitude: size, extent and duration of an impact;
- Visual Amenity: the value of a particular area or view in terms of what is seen;
- Visual Character: when a viewer experiences the visual environment, it is not observed as one aspect at a time, but rather as an integrated whole. The viewer's visual understanding of an area is based on the visual character of visible features and aspects and the relationships between them. The visual character is descriptive and not evaluative;
- Visual Effect: is a change to an existing view as a result of development or the loss of particular landscape elements or features already present in the view;
- Visual Resources: The visual resources of the landscape are the stimuli upon which actual visual experience is based. They are a combination of visual character and visual quality; and
- Visual Quality: Although the interpretation of viewers' experience can have preferential and subjective components, there is generally clear public agreement that the visual resources of certain landscapes have high visual quality. The visual quality of a landscape will reflect the physical state of individual features or elements. Due to the subjective value of the evaluation there is no comprehensive official process for identifying visual quality. The visual quality of this evaluation has been carried out by one Chartered Landscape Architect and verified by another.

9.3 RECEIVING ENVIRONMENT

9.3.1 Baseline Data Collection

9.3.1.1 Scale and Character

Landscape character is generally determined by physical factors such as landform and land cover including topography, water, vegetation and settlements.

The Morell River and its tributaries flow in a generally northerly direction towards the River Liffey across a generally flat topography. The proposed scheme is located north of the M7/N7, northeast of Naas/Sallins and east of Clane. There are further small settlements scattered across the landscape in close proximity to the propose scheme.

The landscape land use is dominated by agricultural use primarily pasture and arable with frequent golf courses. There is an absence of significant tree cover and the landscape has in most areas an open character. Taller hedgerows do interrupt views but from slightly elevated locations (i.e. bridges and low hills) longer distance views are available.

The area has historically been used as a transport corridor out of Dublin and has the Grand Canal, railway line and the N7/M7 extending northeast to southwest across the area of the proposed scheme. The Grand Canal has well treed banks that prevent direct views of the canal but identify the canal as a feature of significance in this otherwise open landscape.

There are extensive rural residential properties scattered throughout the area due to the close proximity to numerous large and small settlements. The residential properties where densely located do bring an urban character to the area.

Numerous golf courses add to this urban character namely; Killeen Golf Club; Naas Golf Club; Millicent Golf and Country Club; and The K Club/Ryder Cup Village. The golf courses are frequently located in the grounds of former estates and demesnes such as at Palmerstown and Millicent.

Frequently local roads cross the Grand Canal and local rivers and at these locations elevated views are available across the generally flat and open landscape character.

9.3.1.2 Landscape Character

The landscape character of the study area can be described by use of the following distinctive landscape character area namely *River Morell Lowland Landscape Character Area (LCA)* as defined by this Landscape & Visual Impact Assessment.

This LCA is comprised of predominantly of very low lying and flat agricultural landscape through which the Morell River flows. The landscape does undulate very gently but has a level character that is illustrated by very straight roads and transport corridors that have resulted from the lack of topographical constraints. The agricultural fields are used for both pasture and arable uses and are generally large in size with well maintained hedgerows at boundaries. Trees are limited to hedgerows but there are areas of denser tree cover at some locations normally associated with former estates and demesnes. Numerous golf courses are found in this LCA and they are also most frequently found at the location of former estates and demesnes. The River Liffey meanders eastwards through this LCA with good tree cover on its banks and is an attractive feature. Similarly the Grand Canal extends along a straight northeast to southwest axis with good tree cover and is a notable feature in this LCA with its bridges and tow path used for local access and community use.

Rural residential properties are frequent and scattered throughout this LCA with higher densities with proximity to the fringes of Clane, Sallins/Naas and Kill.

The River Morell LCA has been classed as being of medium sensitivity.

9.3.1.3 Planning Designations

The proposed scheme lies within the Kildare County Council area, covered by the County Development Plan 2011 – 2017. A review has taken place of the Development Plan, the Draft Kildare County Development Plan 2017 – 2023 and other relevant statutory documents to establish if there are any relevant landscape related designations that may influence the assessment within the study area.

The Kildare County Development Plan 2011-2017, adopted on 4th April 2011, states the following objectives regarding scenic amenity views and prospects:

SR 1: It is a general objective to protect views from designated scenic routes by avoiding any development that could disrupt the vistas or disproportionately impact on the landscape character of the area thereby affecting the scenic and amenity value of the views.

WV 1: It is the policy of the Council to curtail any further development along the canal and river banks that could cumulatively affect the quality of a designated view.

WV 2: Preserve and enhance the scenic amenity of the river valleys and canal corridors and the quality of the vistas available from designated views.

WV 3: To restrict development on floodplains of the rivers in the county.

HV 1: The Councils aim is to protect the upland Landscape Character Areas as identified in the Landscape Character Assessment and to ensure that development on or in the vicinity of the upland areas does not disproportionately affect views to and from the hills, or impact on the landscape character of the area as a whole.

Designations relevant to the Landscape and Visual Impact Assessment are indicated in Volume 4 of the County Development Plan and itemised in Table 9.6.

The Draft Kildare County Development Plan 2017 – 2023 contains similar objectives with regard to scenic amenity views and prospects as the County Development Plan 2011 – 2017. Objectives listed below relate to those contained within the Draft Kildare County Development Plan 2017 – 2023:

SR 1: To Protect Views from designated scenic routes by avoiding any development that could disrupt the vistas or disproportionately impact on the landscape character of the area thereby affecting the scenic and amenity value of the views

WV 1: To curtail any further development along the canal and river bank that could cumulatively affect the quality of a designated View

WV 2: To preserve the enhance the scenic amenity of the river valleys and canal corridors and the quality of the vistas available from designated views

WV 3: To prevent inappropriate development along canal and the river banks and o preserve these areas in the interests of biodiversity, built and natural heritage and amenity by creating or maintaining buffer zones, where development should be avoided

HV 1: To protect the upland Landscape Character Areas as identified in the landscape assessment and to ensure that development on or in the vicinity of the upland area does not disproportionately affect views to and from the hills, or impact on the landscape character of the area as a whole.

Table 9.6 – Designated Scenic Landscapes and Scenic Routes in Study Area (Maps in Chapter 14 of the Development Plan 2011-2017).

Designation	Location
High Value Landscape	The Development Plan designates areas according to landscape sensitivity (see Map 14.2 Chapter 14). The proposed scheme lies across low and medium sensitive areas.
Scenic Route 10	Scenic Route 10 is located in Bishopscourt Lower, Boston and has views of the West Plains on the Oughterard Road (L2009). The elevated nature of the lands in the area allows open and long-distance vistas of the lowlands to the west. An existing powerline significantly affects the quality of the views. Nevertheless, and despite the scattered housing that occurs throughout the plains, the extensive character of the views provides highly scenic vistas.
Scenic Route 11	Scenic Route 11 extends along Pluckerstown, Oughterard, Castlewarden North

Designation	Location
	and has views of the Upland Areas on the Oughterard Road (L6018). The L6018 local road that runs through Oughterard provides scenic vistas of the undulating lands at the County Boundary, as well as views of the Wicklow Mountains in the distance. The elevated nature of the road and the existing low vegetation of the agricultural lands allow long-distance visibility. The generally smooth terrain is interrupted by hedgerows and conifer forests. Although scattered housing occurs throughout the area, these are partially screened by existing vegetation.
View Point GC3	Located at the Ponsonby Bridge, Barrowrath, this view is protected for its views of the Grand Canal.
View Point GC4	Located at the Devonshire Bridge, Sherlockstown Common, this view is protected for its views of the Grand Canal.
View Point RL4	This view is located on the Straffan Bridge, Lodgepark Straffan and has views of River Liffey from the Bridge.
View Point RL5	This view is located on the Alexandra Bridge, Abbeyland and has views of River Liffey from the Bridge.
View Point RL6	This view is located on the Millicent Bridge, Castlesize and has views of River Liffey from the Bridge.

Volume 2 Appendix 3 of the County Development Plan sets out the Landscape Character Areas identified in the County Plan. The proposal is located in one landscape character area namely *Northern lowlands Landscape Character Area (LCA).* The County Plan states that this LCA is comprised of principally fertile lands with relatively high levels of local population and intensive land management. The slope and topography of areas occur in a shallow / gradual transition and the area is generally characterised by flat terrain and low vegetation. Concentrations of tillage lands in this lowland area tend to be characterised by extensive views across large fields with low, maintained hedges. The area is suitable to moderately suitable for tillage, pasture and meadow and suitable for forestry. Gently undulating topography is presented at certain areas of this character unit, providing the potential for local visual enclosure thereby absorbing development where it does not break the skyline. River valleys and canal corridors are generally visually enclosed and highly localised areas of very distinctive character with a high degree of visual consistency. This character unit includes sections of the River Liffey and the Grand and Royal Canals. Due to the low lying nature of this area, many views of the river valley and the canal corridors are available from the local roads and from the viewing points located on bridges.

9.4 POTENTIAL IMPACTS

9.4.1 Do Nothing

The do-nothing scenario would result in no landscape or visual alteration to the existing landscape and visual context of the area.

9.4.2 Construction Phase Impacts

Potential construction stage impacts relate to the following:

(i) Obstruction of views;

(ii) Change in landscape character;

(iii) Machinery for site preparation/enabling works and operations;

(iv) Storage of topsoil, imported materials, site office facilities and parking within potential temporary compound areas;

(iv) Site access and vehicular and plant movements.

The particular aspects of the proposed scheme that are most relevant to the LVIA are as follows:

- The proposed scheme has lengths of both flood walls and embankments extending to approximately 2.00m in height.
- The construction of flood walls will be required at certain locations particularly in proximity to properties. The proposed scheme will result in loss of riverside vegetation at some locations.
- The stockpiling of soil and infill material and temporary site office facilities and car parking within potential temporary compound areas illustrated in EIAR Chapter 4; Figure 4.1.

Full details of the location of all works and locations of vegetation loss are provided in Chapter 4 Project Description.

9.4.2.1 Landscape Character Area Impacts

An assessment of the significance of the impact of the proposed scheme during construction on the landscape character area described previously has been completed and summarised below. The proposed scheme is located directly within the River Morell Lowland Landscape Character Area. The key potential direct impact on this landscape is from construction traffic movements through the lowland landscape and the physical works at the flood walls and embankments and loss of any vegetation. The increase in construction traffic travelling to and from the construction sites will blend with this existing use along the local road network without significant change in landscape resource. The construction of embankments and flood walls will require construction equipment that will be noticeable while in operation within this lowland landscape. Such activities will be localised in their effect as the lowland landscape quickly absorbs features that are not particularly tall.

The potential stockpile areas identified in EIAR Chapter 4; Figure 4.1 will be temporary in duration and only utilised during the phased construction periods outlined in EIAR Chapter 4; Table 4.4 and Table 4.5. The identified areas will be utilised for storage of imported material, site office facilities and car parking with site office facilities and parking being fenced. The identified stockpile areas are generally well screened by field boundary vegetation, which will be retained, with current agricultural usage being returned following construction of scheme embankments and flood walls.

The landscape construction impacts are considered to be temporary in duration. This landscape character area has a medium sensitivity to change. The magnitude of landscape effects will be medium. When landscape impacts are assessed during the construction phase the significance of effect will be Moderate and temporary due to the medium levels of landscape resource change that will result.

9.4.2.2 Planning Policy Designation Impacts

Construction stage impacts on relevant designations contained within the Kildare County Development Plan 2017 -2023 are assessed below.

Landscape Sensitivity

The proposed scheme lies within areas identified as being of low and medium sensitive. No impacts are predicted for areas within the Plan identified as High Sensitivity, Special or Unique.

Scenic Routes

The physical construction works will not be located in close proximity to any Scenic Route and the designated Scenic Routes identified in the Development Plan will not be significantly affected during the construction stage.

Protected Views

The nearest protected view to the proposed scheme is RL4 that is located Straffan Bridge. Due to distance and intervening vegetation it will not be possible to view the proposed scheme from RL4 or any other protected view.

9.4.2.3 Visual Impacts on Residential Properties

The physical construction works at the flood walls and embankments will result in significant localised visual impact due to proximity to some residential properties in particular at Morr 1 to 4; Morr 16 – 16a; Morr 20-23; Paines 1 to 5; Slane 1 to 6; Slane 7; and Kill 1. The viewer sensitivity at locations in proximity to the proposed scheme is high. The magnitude of change in visual resource will be large. The predicted significance of visual impact will be Major to Substantial and significant due to the close proximity of the construction works to houses. The visual impacts will however be temporary in duration.

Temporary Storage Compounds:

Storage Compound at Paines 1 – 3:

It is proposed that this potential, temporary stockpile area will be utilised for a period of approximately 9 weeks during the construction of Morr 1, Morr 1a, Morr 2, Morr 3 and Paines 1 and 3.

A number of dwellings will have a direct view of this proposed storage compound that extends along a local road. The viewer sensitivity is high. The change in visual resource will be large, though limited in duration. The predicted significance of visual impact will be Major to Substantial negative and significant though considered to be temporary as the site will be returned to current agricultural use.

Storage Compound at Morr 23:

It is proposed that this potential, temporary stockpile area will be utilised for a period of up to approximately 30 weeks during the construction phase of the scheme.

There are limited properties with potential visibility of this proposed storage compound area. There are properties on a local road to the north which may have partial views through roadside vegetation.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major negative and significant though considered to be temporary as the site will be returned to current agricultural use.

Storage Compound at Morr 19:

It is proposed that this potential, temporary stockpile area will be utilised for a period of up to approximately 30 weeks during the construction phase of the scheme.

This proposed compound area is located to the south and west of a group of properties. The compound will be a new, temporary feature in views from a limited number of these properties immediately to the north.

The viewer sensitivity is high. The change in visual resource will be medium, temporary. The predicted significance of visual impact will be Moderate to Major negative and significant though considered to be temporary as the site will be returned to current agricultural use.

9.4.3 Operational Phase Impacts

9.4.3.1 Landscape Character Area Impacts

An assessment of the significance of the impact of the proposed scheme during operation on the landscape character area described previously has been completed and summarised below. The proposed scheme is located directly within the River Morell Lowland Landscape Character Area. The key potential direct impact on this landscape is from the positioning of new vertical flood walls and embankments and loss of any vegetation as permanent features in this landscape. There are existing flood embankments at locations within the wider Morell floodplain and therefore such features are not uncharacteristic of this landscape. The permanent loss of vegetation will have localised but significant impacts at locations particularly at Morr 2; Morr 4, Morr 16 – 16a, Morr 17; Morr 20-23; and Slane 1-6.

The new flood walls and embankments will read as part of the wider landscape from most locations. Embankments in particular that are the predominant treatment will be green and read as part of local fields in most views.

This landscape character area has a medium sensitivity to change. The magnitude of landscape effects will be small. When landscape impacts are assessed during the operation phase the significance of effect will be Minor negative.

9.4.3.2 Planning Policy Designation Impacts

Operation stage impacts on relevant designations contained within the Kildare County Development Plan 2017 - 2023 are assessed below:

High Value Landscapes

The proposed scheme lies within areas identified as low and medium sensitive. No operation stage impacts are predicted for areas within the Plan identified as High Sensitivity, Special or Unique.

Areas of High Amenity

The proposed scheme lies adjacent to the Grand Canal Area of High Amenity. No operational stage impacts are predicted for areas within the Plan identified as being of High Amenity Value.

Scenic Routes

The operational scheme will not be located in close proximity to any Scenic Route and the designated Scenic Routes identified in the Plan will not be significantly affected during the operation stage.

Protected Views

The nearest protected view to the proposed scheme is RL4 that is located Straffan Bridge. Due to distance and intervening vegetation it will not be possible to view the proposed scheme from RL4 or any other protected view.

Visual Impacts on Residential Properties

An assessment has been completed within the ZVI to determine the magnitude of visual impact of the proposed scheme during the operational phase on potential views from sensitive visual receptors including residential properties. The visual impact has focused on locations where a potential significant visual impact could occur through the proposal to the construct flood walls and embankments and not on minor proposals such as land drains which will not interrupt views from properties.

Morr 1: 50 metres of embankment max height 1.1m

There are very limited properties with potential visibility of this embankment. There are properties on a local road to the immediate north of Morr 1 and to the west that will have partial views through vegetation. The proposals will not be prominent.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Morr 1a: 100 meters of embankment max height 0.84m

There are very limited properties with potential visibility of this embankment. There are properties on a local road to the east of Morr 1a that will have partial views through vegetation. The proposals will not be prominent.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Morr 2: 217 metres of embankment max height 1.25m

There is a single property located to the east of the proposed embankment where potentially significant numbers of trees will be lost. There are numerous large agricultural buildings between the dwelling and the proposed embankment.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Morr 3: 293 metres of embankment max height 1.40 m

There is a single dwelling to the immediate west of this proposed embankment that will have a direct view from the rear elevation. At 1.40m high the embankment will not be prominent.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Morr 4: 1613 metres of embankment max height 1.6m

This embankment is located to the immediate east of the railway and will be visually screened from properties to the west. A small number of properties lying to the east which will have partial views through vegetation. At 1.6m the proposed embankment will not be prominent and existing railway side vegetation will aid screening.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Morr 7: 76 metres of wall max height 1.70m;

The proposed wall is located on the eastern side of the railway line and away from dwellings with limited potential visibility from dwellings to the west.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Morr 9: 532 metres of embankment max height 1.50m;

This embankment is located to the immediate east of the railway and will be visually screened from properties to the west. A single property to the north-east will have partial views through vegetation. At 1.5m the proposed embankment will not be prominent and intervening farm buildings and field boundary vegetation will aid screening.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Morr 10: 374 metres of embankment

This proposed riverbank improvement will run along the side of a single property and be directly visible.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major and not significant.

Morr 15: 290 metres of embankment max height 1.47m

The proposed embankment is located on the eastern side of the railway line and away from dwellings with limited potential visibility from dwellings to the west.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Morr 16 : 143 metres of embankment max height 0.75m

This embankment is located at the boundary of a dwelling and will be directly visible with effects limited by the low height.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major negative, assessed as not significant.

Morr 16a: 187 metres of embankment max height 0.82m

This embankment is located along the boundary of agricultural fields with properties to the immediate east and west which will have partial views of the development through vegetation.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major negative, assessed as not significant.

Morr 17: 867 metres of embankment max height 1.70m

This embankment extends to the south and is located the east of several properties. Retention of hedgerow vegetation will limit visibility from dwellings.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major negative and significant.

Morr 19: 555 metres of embankment max height 1.73m

This embankment is located to the south and west of a group of properties. The embankment will be a new feature in views from these properties.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major negative and significant.

Morr 20: 11 metres of embankment (& culvert) max height 1.05m

This part of the proposed scheme will not be visible from any dwelling.

The viewer sensitivity is high. The change in visual resource will be no change. The predicted significance of visual impact will be None and not significant.

Morr 21: 314 metres of embankment max height 1.73m

This section of the proposed scheme passes through a golf course and in proximity to a group of agricultural buildings adjoining the canal.

The viewer sensitivity is high. The change in visual resource will be large. The predicted significance of visual impact will be Major to Substantial negative and significant.

Morr 22: 76 metres of wall max height 1.90m

This section is located on the opposite side of a local road from where a line of properties have potential views that are broken by vegetation.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Morr 23: 578 metres of embankment max height 2.06m

This section of the proposed scheme is not located in the vicinity of a dwelling.

The viewer sensitivity is high. The change in visual resource will be no change. The predicted significance of visual impact will be None and not significant.

Paines 1: 569 metres of embankment max height 2.06m

A number of dwellings will have a direct view of this embankment that extends along a local road.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major negative and significant.

Paines 2: 649 metres of embankment max height 2.00m

This section along the Painestown River is located at the site of an existing embankment and in close proximity to three dwellings that will have direct views.

The viewer sensitivity is high. The change in visual resource will be high. The predicted significance of visual impact will be Major to Substantial negative and significant.

Paines 3: 665 metres of embankment max height 1.80m

This section is located at the site of an existing embankment and to the east and north of single dwellings that will have direct views.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major negative and not significant.

Paines 4: 107 metres of embankment max height 0.5m

This embankment is located at the boundary of a single dwelling with direct views. Effects will be limited by the low overall height.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Paines 5: 186 metres of embankment max height 1.20m

This embankment is located at the boundary of a single dwelling with direct views. Effects will be limited by the low overall height.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Minor to Moderate negative and not significant.

Slane 1: 90 metres of wall max height 1.40m;

Slane 2: 121 metres of embankment max height 1.40m;

Slane 3: 302 metres of embankment max height 1.40m;

Slane 4: 131 metres of wall max height 1.40m; and

Slane 5: 144 metres of embankment max height 1.30m

This section of the proposed scheme consists of various works that are all closely linked. The proposals are located along the boundary of dwellings and will be directly visible.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major negative and not significant.

Slane 6: 155 metres of embankment max height 2.00m

This embankment is located to the north of a dwelling that will have views partly screened by trees.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major negative assessed as not significant.

Slane 7: 177 metres of embankment max height 1.50m

This roadside embankment will not be visible from properties.

The viewer sensitivity is high. The change in visual resource will be no change. The predicted significance of visual impact will be None and not significant.

Slane 8: Stream realignment

This section of the proposed scheme will not be visible from properties.

The viewer sensitivity is high. The change in visual resource will be no change. The predicted significance of visual impact will be None and not significant.

Slane 9: 67 metres of embankment max height 0.75m

This embankment is located north-east of the Slane River, west of properties. The embankment runs along an existing field boundary, with views from adjacent properties restricted by vegetation. Effects will be limited by the low overall height.

The viewer sensitivity is high. The change in visual resource will be small. The predicted significance of visual impact will be Moderate to Major negative and significant.

Kill 1: 101 metres of wall max height 1.50m

This wall is located on the property boundary of a dwelling with direct views.

The viewer sensitivity is high. The change in visual resource will be medium. The predicted significance of visual impact will be Moderate to Major negative and significant.

Viewpoint Assessment

A series of representative viewpoints have been selected from locations throughout the study area and subjected to specific assessment below. The location of all viewpoints can be found on Figure 9.1.

Viewpoint 1: View from Morell Bridge at local road looking south to Morr 3

Viewer sensitivity: this view is from a local road that is predominantly used by the local community and visitors driving by to the K Club. The viewer sensitivity is medium.

Existing visual resource: the existing view is from a bridge that offers a glimpse view south along the river channel. The view is framed by trees on both sides of the river. There is a partial view to a pasture field on the right. Hedgerows on the eastern bank of the river provide screening in the centre part of the view.

Predicted view: the proposals will be directly visible from this location. Approximately 292 m of flood embankment will be constructed on the eastern bank of the river to a maximum height of 1.40m. There will be no requirement to remove any bank side vegetation but localised tree clearance may be required at either end of the embankment and a worst case scenario has been assumed. The new embankment will not obscure views to south and will blend with the existing pasture field. The views along the river will be maintained.

Magnitude of change: the magnitude of change in visual resource is medium.

Significance of Visual Impact: the predicted significance of visual impact will be Moderate negative.

Viewpoint 2: View from Morell Bridge at local road looking north to Morr 2

Viewer sensitivity: this view is from a local road that is predominantly used by the local community and visitors driving by to the K Club. The viewer sensitivity is medium.

Existing visual resource: the existing view is from a bridge that offers an open view north across pasture fields to the left and light industrial/agricultural units to the right of the river. Hedgerows on the western bank of the river provide screening in the centre part of the view.

Predicted view: the proposals will be directly visible from this location. Approximately 217 m of flood embankment will be constructed on the western bank of the river to a maximum height of 1.25m. There may be a requirement to remove the hedgerow on the river bank to construct the embankment and a worst case scenario has been assumed. The new embankment will not obscure views to north. The views along the river will be maintained.

Magnitude of change: the magnitude of change in visual resource is medium.

Significance of Visual Impact: the predicted significance of visual impact will be Moderate negative.

Viewpoint 3: View north from local road at bridge of the Morell River

Viewer sensitivity: this view is from a local road that is predominantly used by the local community. The viewer sensitivity is medium.

Existing visual resource: the existing view is from a local road where it rises to cross the river. There is limited roadside vegetation that permits medium distance views across a level landscape. Views to the north are interrupted by vegetation on the banks of the river and a rural dwelling to the left of the view. Tall electricity lines cross the view.

Predicted view: the proposals will be located in the view direction but difficult to discern. Approximately 373m of flood embankment will be constructed on the eastern bank of the river to a maximum height of 0.5m. There will be no requirement to remove vegetation to construct the embankment. The new embankment will be low and will not obscure views and will be well screened by existing vegetation.

Magnitude of change: the magnitude of change in visual resource is negligible.

Significance of Visual Impact: the predicted significance of visual impact will be Negligible to Minor negative.

Viewpoint 4: View from local road North to Morr 4

Viewer sensitivity: this view is from a local road that is predominantly used by the local community. The viewer sensitivity is medium.

Existing visual resource: the existing view is from an elevated location as it crosses the rail link, with views generally limited by roadside vegetation at lower elevations. The available view from this location is partially restricted by roadside vegetation, with remaining portions of the view interrupted by field boundary hedgerows, garden boundary vegetation and trees. Residential properties are visible to the left of the view.

Predicted view: the proposals will be directly visible from this location. Approximately 400m of flood embankment will be constructed on the eastern side of the railway to a maximum height of 1.6m. There may be a requirement to remove existing areas of vegetation to construct the embankment and a worst case scenario has been assumed. The new embankment will be relatively low and will not obscure views to east from properties within close proximity to the west and will broadly blend with the existing landscape.

Magnitude of change: the magnitude of change in visual resource is medium.

Significance of Visual Impact: the predicted significance of visual impact will be Moderate negative.

Viewpoint 5: View from a local road looking south to Paines 4

Viewer sensitivity: this view is from a local road that is predominantly used by the local community and in close proximity to a dwelling. The viewer sensitivity is high.

Existing visual resource: the existing view is from a local road towards the garden/yard of a dwelling. Farm buildings and machinery define the view to the left and a line of trees define the visual boundary to the right. There are existing walls in the foreground.

Predicted view: the proposals will be directly visible from this location. Approximately 107m of flood embankment will be constructed to a maximum height of 0.5m at the boundary of the dwelling. There will be no requirement to remove any vegetation to construct the embankment. The new embankment will be low and will not obscure views and will blend with the existing pasturelands to the rear of the dwelling.

Magnitude of change: the magnitude of change in visual resource is small.

Significance of Visual Impact: the predicted significance of visual impact will be Minor to Moderate negative.

Viewpoint 6: View from local road crossing the Slane River

Viewer sensitivity: this view is from a local road that is predominantly used by the local community and in close proximity to dwellings. The viewer sensitivity is high.

Existing visual resource: the existing view is from a local road with strong roadside vegetation. There is a break in vegetation at the river crossing that permits short distance views across a level landscape. Views are interrupted by field boundary hedgerows and trees to the boundary of pasture fields.

Predicted view: the proposals will be directly visible from this location albeit partially screened by vegetation at the roadside. Approximately 144m of flood embankment will be constructed on the eastern bank of the river to a maximum height of 1.30m. There may be a requirement to remove a small area of vegetation to construct the embankment in the foreground of the view and a worst case scenario has been assumed. At other locations the embankment will be built around trees to avoid their removal. The new embankment will be low and will not obscure views.

Magnitude of change: the magnitude of change in visual resource is small.

Significance of Visual Impact: the predicted significance of visual impact will be Minor to Moderate negative.

9.5 MITIGATION MEASURES

Mitigation measures are those taken to help reduce the impacts arising from any visually intrusive or insensitive elements within the proposed scheme. These can be undertaken as part of the scheme design or as remedial works undertaken as the proposed scheme construction is completed. The impact of the proposed scheme should be ameliorated through a landscape rehabilitation plan, prepared in conjunction with the engineering design which would, in time, go some way to insuring integration of the proposals into the broader environment. Given the nature of the proposals, particular mitigation measures shall be incorporated as part of the proposed scheme. A list of objectives in terms of mitigation for visual quality and landscape character shall include the following for the construction and operational stage.

9.5.1 Construction Phase

- Materials chosen for flood wall construction to be of similar colour, size and scale to existing flood walls within the locality. Walls where visible at roadsides will be masonry stone faced and where appropriate stone capped;
- Temporary storage heaps associated with infill materials and soil not to exceed 1m height;
- Storage compound areas will be reinstated to former agricultural use upon completion of the works.
- Vehicles exiting compound areas will be subject to wheel wash facilities or road sweepers shall be used in order to maintain clean roads;
- Any lighting used will be kept to a minimum, providing for site safety only and shall be directed into the compound and away from adjacent residential properties. Lighting shall be shielded to avoid light spill onto adjacent properties and roads.
- Fencing used around site offices, welfare units and parking within the compound areas shall be painted green in order to merge with surrounding landscape.
- Construction of Embankments. The embankments will be planted with grass;
- Protection of existing trees. The services of a qualified aboriculturist will be sought to perform a tree survey of the proposed scheme. The trees should be assessed to quantify their age, condition and amenity value and tagged with metal tags. Prior to commencement of construction, existing trees which are to be retained will be protected by erection of timber post and wire fence to ensure no works are carried out under reach of their canopies. Unstable trees should be removed under direction of the aboriculturist;
- Ensuring landscape framework remains dominant by cleaning up of debris on river banks and providing a landscape management programme to protect and reinforce bank side vegetation.

9.5.2 Operational Phase

- Ensuring the landscape management programme identified previously is implemented during the lifetime of the proposed scheme to protect and reinforce bank side vegetation with the aim of ensuring landscape framework remains dominant; and
- Ongoing landscape maintenance and debris cleaning from river channel.

9.6 RESIDUAL IMPACTS

9.6.1 Construction Phase

9.6.1.1 Residual Landscape Impacts

The residual impacts (are those remaining after mitigation measures are employed) on the landscape will remain as Moderate negative. The retention of the existing vegetation and the use of stone walls will help to integrate the proposed scheme within the existing environment but the use of machinery will remain a medium impact on the local landscape character of the area. Elsewhere the proposed scheme will be read as part of the wider landscape where similar embankments and walls are an existing feature.

9.6.1.2 Residual Visual Impacts

Following implementation of mitigation measures the significant impacts predicted for properties at; Morr 14; Morr 17; Morr 19; Morr 21; Paines 1 and2; Slane 1 to 5; Slane 9; and Kill 1 will remain due to the close proximity of the properties to construction of the proposed scheme. Elsewhere the proposed scheme will be read as part of the wider landscape where similar embankments and walls are an existing feature.

9.6.2 Operational Phase

9.6.2.1 Residual Landscape Impacts

The residual impacts on the landscape will reduce to Minor, negative and not significant. The retention of the existing vegetation and the use of stone walls will help to integrate the proposed scheme within the existing environment and the proposed scheme will be read as part of the wider landscape where similar embankments and walls are an existing feature.

9.6.2.2 Residual Visual Impacts

Following implementation of mitigation measures the significant impacts predicted for properties will be slightly reduced once the scheme has been landscaped. Elsewhere the proposed scheme will be read as part of the wider landscape where similar embankments and walls are an existing feature.

9.7 CONCLUSION

The proposed Morell River Flood Management Scheme is located within a landscape character area identified as River Morell Lowland Landscape Character Area. During construction of the proposed scheme the predicted magnitude of landscape resource change will be medium and the significance of landscape impact will be Moderate, negative and temporary in duration. On completion of the proposed Specific Landscape Mitigation measures the predicted landscape effects will be reduced during the operation stage.

A Zone of Visual Influence (ZVI) has been established for the proposed scheme to allow any potential areas of significant visual impact to be identified. Actual visual impacts from within the ZVI have been predicted by site survey and assessment.

A total of 4 viewpoints have been assessed, none of which have been predicted to experience significant visual impacts. Following implementation of the Specific Landscape Mitigation measures the predicted visual effects on viewpoints will be reduced for all viewpoints assessed.

10 BIODIVERSITY- TERRESTRIAL ECOLOGY

This Chapter of the EIA Report (EIAR) examines the impact of the proposed scheme on the natural environment in terms of terrestrial ecology. Potential impacts to aquatic ecology are addressed in Chapter 11.

An Appropriate Assessment Screening Report (RPS, 2017) has been prepared for the proposed scheme in line with the requirements of Article 6(3) of the EU Habitats Directive (EC 92/43/EEC) on the Conservation of Natural Habitats and of Wild Fauna and Flora; European Union (Birds and Natural Habitats) Regulations 2011 as amended and the Planning and Development Act 2000 as amended. The screening report is included as **Appendix D** in **Volume 3** of the EIAR. Please note that all figures referred to in this Chapter are located at the end of the Chapter on pages 10-35 – 10-42.

10.1 METHODOLOGY

The assessment was carried out in accordance with the following guidelines and documents:

- *Best Practice Guidance for Habitat Survey and Mapping* (Smith *et al*., 2011);
- *A Guide to Habitats in Ireland* (Fossitt, 2000);
- *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes* (NRA, 2009a);
- *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, Second Edition*. (CIEEM, 2016);
- *Guidelines for the Assessment of Ecological Impacts of National Road Schemes Rev. 2.* (NRA, 2009b);
- *Guidelines For Ecological Impact Assessment in the UK and Ireland Terrestrial, Freshwater and Coastal*, 2nd Edition CIEEM (2016);;
- *Bat Surveys for Professional Ecologists: Good Practice Guidelines* (3rd edn.) (Collins, 2016);
- *Bat Surveys: Good Practice Guidelines* (Hundt, 2012);
- *Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes* (NRA, 2006a);
- *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (NRA, 2006b); and
- *Guidelines for the Treatment of Bats during the Construction of National Road Schemes*. (NRA, 2006c).

The assessment was carried out in two stages, initially through a desktop study, followed by field survey work in order to identify, describe and map areas of known or potential ecological value.

10.1.1 Consultation

As the statutory bodies responsible for Fisheries and Ecology respectively, both the IFI (Inland Fisheries Ireland) and NPWS (National Parks and Wildlife Service) were consulted at the Constraints Stage and during the EIAR Stage. The results of consultation with IFI are detailed in Chapter 11 Biodiversity- Aquatic Ecology, which assesses impacts on aquatic flora and fauna, including water quality and fisheries. Consultation with the NPWS was sought on 23rd June 2015 and they responded on 28th July 2015. A summary of the correspondence is contained in **Chapter 2** of this EIAR, along with further details of the consultations undertaken for the proposed scheme.

10.1.2 Desk Study

A desktop study was undertaken in order to collate available information on the existing local ecological environment. The following resources and databases were consulted in the production of this report:

- The National Parks and Wildlife Service (NPWS) online database (www.npws.ie), consulted for designated sites of nature conservation interest in the study area, accessed online January 2017;
- The National Parks and Wildlife Service (NPWS) online database (www.npws.ie), consulted for data on rare/protected/threatened species for Irish National Grid 10km square N92, accessed online January 2017;
- The National Biodiversity Data Centre (NBDC) database (www.biodiversityireland.ie), consulted for records of rare, protected and invasive species for Irish National Grid 10km square N92, accessed online 17th January 2017;
- GeoHive online mapping http://map.geohive.ie/mapviewer.html;
- Environmental Protection Agency – Watercourse and water quality www.epa.ie;
- ESRI Ireland - Mapping Themes www.esri-ireland.ie;
- Geological Survey of Ireland – Geology, soils and hydrogeology www.gsi.ie;
- Information on the conservation status of birds in Ireland (Colhoun & Cummins, 2013)[1];
- Information on the Eastern River Basin District www.erbd.ie; and
- A review of Ordnance Survey maps and ortho-photography www.osi.ie.

10.1.3 Zone of Influence

Following the guidance set out by the NRA (2009), the proposed scheme has been evaluated based on an identified zone of influence (ZoI) with regard to the potential impact pathways to ecological feature (habitats, flora and fauna).

The ZoI for terrestrial habitats is limited to the footprint of the proposed scheme and flood zone.

Hydrological linkages between a proposed scheme and aquatic habitats/species can occur over significant distances; however the significance of the impact will be site specific depending on the receiving water environment and nature of the potential impact. This is assessed in Chapter 11 *Aquatic Ecology.*

The ZoI for significant impacts to breeding birds is considered to extend no more than 100m from the proposed development to take account of disturbance during construction.

The ZoI for mammals such as bats, badgers and otters may extend over larger distances due to the fact that they can commute and forage many kilometers from their breeding sites.

10.1.4 Field Survey

[1] Colhoun, K. & Cummins, S. (2013) Birds of Conservation Concern in Ireland 2014-2019. Irish Birds, 9, pp. 523-544.

The principal aim of the field survey was to identify and map the habitats present at the proposed scheme measure areas, to note the occurrence of protected species and to identify associated ecological constraints and any potential impacts of the proposed works.

Flora

Field survey of the entire scheme was originally carried out on 18th and 19th August 2014 and 4th June 2015. Further surveys were undertaken on January 24th, 25th and 26th 2017 in light of further design modifications. Areas of ecological interest highlighted during the desktop assessment were investigated further during the walkover survey. Habitats on site were classified in accordance with the Heritage Council publication '*A Guide to Habitats in Ireland'* (Fossitt, 2000) and mapped in accordance with the '*Best Practice Guidance for Habitat Survey and Mapping*' (Smith *et al.*, 2011). The classification is a standard scheme for identifying, describing and classifying wildlife habitats in Ireland. The classification is hierarchical and operates at three levels, using codes to differentiate habitats based on the plant species present. Species recorded in this report are given both their Latin and common names, following the nomenclature as given in the '*New flora of the British Isles'* (Stace, 2010).

Invasive species listed on Schedule 3 of the Birds and Natural Habitats Regulations 2011 (as amended) were also recorded.

Fauna

The site walkovers included an assessment of the presence, or likely presence, of a range of rare or protected fauna and bird species. Habitats were assessed for field signs and/or usage by fauna, such as well-used pathways, droppings, places of shelter, other habitation features or areas likely to be of particular value as foraging resources.

10.1.5 Survey Constraints

Surveys carried out in January 2017 were conducted in the sub-optimal botanical survey season (optimal season: April to September). Bird surveys were not undertaken during the breeding season and therefore actual occurrence of breeding birds and their nesting sites in the proposed scheme area could not be identified. As a precautionary measure, it was assumed that all significant woody vegetation cover, rank grassland and buildings within the study area have the potential to support breeding birds during the breeding bird season. Some areas could not be accessed and searched for evidence of mammals due to dense scrub. In these instances, the assessment relied on observations of secondary evidence e.g. mammal runs into scrub.

10.1.6 Impact Assessment Criteria

The methodology for the assessment of impacts is derived from CIEEM guidance (2016) and *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (NRA, 2009b).

When describing changes/activities and impacts on ecosystem structure and function, reference was made to the parameters as discussed below.

Positive or Negative: Is the impact likely to be positive or negative? Positive impacts merit just as much consideration as negative ones, as international, national and local policies increasingly press for projects to deliver positive biodiversity outcomes.

Extent: 'Extent' should also be predicted in a quantified manner and relates to the area over which the impact occurs. Where the receptor is in an area of a particular plant community for example, Extent=Magnitude.

Magnitude: 'Magnitude' should be predicted in a quantified manner wherever possible and relates to the quantum of an impact, for example the number of individuals of a species affected by an activity or amount of habitat loss.

Duration: 'Duration' is intended to refer to the time during which the impact is predicted to continue, until recovery or re-instatement (which may be longer than the impact-causing activity). This should be quantified wherever possible, and interpreted in relation to the ecological processes involved rather than on a human timescale.

Timing and frequency: The timing of impacts in relation to important seasonal and/or life-cycle constraints should be evaluated. Similarly, the frequency with which activities take place can be an important determinant of the impact on receptors and should also be assessed and described.

Reversibility: 'Reversibility' should be addressed by identifying whether an impact is ecologically reversible (either spontaneously or through specific action) and whether such an outcome is likely.

Integration of Impact Characteristics

An informed integration of each of these impact characteristics, for each potentially significant impact, is necessary in order to underpin the determination of impact significance. A significant effect can be a positive or negative ecological effect and is "an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' or for biodiversity in general" as defined in CIEEM (2016). In each case, it is important to assess the likelihood that the change will occur as anticipated and that the impact on ecological structure and function will manifest as predicted.

In accordance with NRA guidelines (2009b), ecological features valued as "Local Importance (Higher Value)" or higher as per the NRA evaluation criteria (see **Appendix H,** in **Volume 3**) were considered in the impact assessment. Features of lower ecological value are excluded from the impact assessment.

10.2 DESKTOP STUDY RESULTS

10.2.1 Designated Sites

SACs and SPAs

There are twelve Special Areas of Conservation (SACs) and nine Special Protection Areas (SPAs), collectively referred to as European Sites, located within or adjoining the Liffey catchment, the catchment within which the proposed scheme is located. This is illustrated in Figure 10.1 and listed in the Appropriate Assessment Screening Report (see **Appendix D** in Volume 3 of the EIAR).

SACs are sites of international importance due to the presence of Annex I habitats and/or Annex II species listed under the EU Habitats Directive (92/43/EEC). SPAs are designated for the protection of bird species listed on Annex I of the Bird Directive (2009/147/EC), regularly occurring populations of migratory species and areas of international importance for migratory birds.

An Appropriate Assessment Screening Report (see **Appendix D** in Volume 3 of the EIAR) has been prepared for the proposed scheme, which considered SACs and SPAs within the Liffey catchment, especially those located downstream of the proposed scheme, and concluded that there is no likelihood of significant effects as a result of the proposed scheme, either alone or in combination with other plans or projects.

NHAs and pNHAs

There are no Natural Heritage Areas (NHAs) and 29 proposed Natural Heritage Areas (pNHAs) located within or adjoining the Liffey catchment, the catchment within which the proposed scheme is located. This is illustrated in Figure 10.2 and listed in Table 10.1. Many of these overlap at least partially with European Site boundaries.

NHAs are sites deemed to be of national ecological importance and are afforded protection under the Wildlife (Amendment) Act 2000, with many NHA boundaries overlapping with European sites. The pNHAs have not been statutorily proposed or designated under the Wildlife Act (as amended), however they do have some protection under schemes such as Agri-Environmental Schemes, Licensing Authorities and County Development Plans. This is the case for the Kildare County Development Plan 2011-2017 (Policy DS 3).

Table 10.1: Proposed Natural Heritage Areas (pNHAs) within the Liffey Catchment

Site Name and Code	Qualifying Interest Habitats and Species	Approximate Distance from the Proposed Scheme[2]	Connectivity
Red Bog, Kildare pNHA (000397)	Wetland complex of lake, fen and bog	*ca.* 4km south	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Rye Water Valley/Carton pNHA (001398)	River and woodland habitat and species	*ca.* 8km north	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them. The Rye Water joins the Liffey near Leixlip, with the designated site immediately upstream of the confluence.
Glenasmole Valley pNHA (001209)	Woodland, herb and orchid rich grasslands, calcareous fens and flushes, rare and protected plant species.	*ca.* 10km east	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological/hydrogeological connectivity between them. The site is lcoated in the Kilcullen groundwater body.
Mouds Bog pNHA (000395)	Bog habitat	*ca.* 10 km west	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Poulaphouca Reservoir pNHA (000731)	Reservoir, wet grassland, mosses, ferns, inland waterfowl and birds	*ca.* 6km south	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Kilteel Wood pNHA (001394)	Grazed, deciduous woodland habitat with heath type plant species.	Partially occurs within Morell Catchment	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Grand Canal pNHA (002104)	Man-made waterway. A number of different habitats are found within the canal boundaries - hedgerow, tall herbs, calcareous grassland, reed fringe, open water, scrub and woodland. Presence of rare species.	Occurs within Morell catchment	No. There is no obvious connectivity between the proposed works and the site. Although as the Grand Canal flows through the scheme area it is likely that field drains/wet ditches drain to the canal.
Slade of Saggart and Crooksling Glen pNHA (000211)	Wooded river valley and a small wetland system. Well-developed ground flora with mostly planted tree species. More natural vegetation higher up in the valley. Rare species present.	*ca.* 4km east	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Royal Canal pNHA (002103)	Freshwater habitat, hedgerow, calcareous grassland, reed fringe, scrub and woodland.	*ca.* 7km north	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.

[2] Closest approximate distance as measured from the boundary of the Morell catchment area to the boundary of the designated site.

Site Name and Code	Qualifying Interest Habitats and Species	Approximate Distance from the Proposed Scheme[2]	Connectivity
Donadea Woodland pNHA (001391)	Mixed woodland with deciduous and conifer trees. Species poor ground flora. Rare species present.	*ca.* 7.5km north-west	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Lugmore Glen pNHA (001212)	Wooded glen habitat with good representation of woodland plants and rare Red Data Book plant.	*ca.* 7km east	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Dodder Valley pNHA (000991)	River habitat and associated bank side vegetation.	*ca.* 11km east	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Liffey Valley Meander Belt pNHA (000393)	Broad floodplain with Ash woodland and marshy areas.	*ca.* 11km to the south	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Curragh (Kildare) pNHA (000392)	Lowland acid grassland dominant, with small areas of wet heath and dry heath. Red Data Book species present.	*ca.* 15km south-west	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Newtown Marshes pNHA (001759)	A series of freshwater marshes and ponds within an area of calcareous eskers. Grassland habitats also present.	*ca.* 14.5km south	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Liffey Valley pNHA (000128)	River and woodland habitats, and a number of rare and/or protected plant species	*ca.* 8.5km north east	Yes. Located downstream of the proposed works along the River Liffey.
Liffey Bank Above Athgarvan pNHA (001396)	Grassland, scarce plants, unstable habitats	*ca.* 13km south west	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Hollywood Glen pNHA (002053)	A complex of steep-sided channels, mosaic of upland grassland with substantial rocky outcrops in the upper slopes, established diverse flora, broadleaved woodland, mosses, birds, geology typifying a glacial meltwater channel cut in rock	*ca.* 18km south	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Ballinagee Wood pNHA (001750)	Oak woodland, bryophytes and lichens are particularly notable, oligotrophic river habitat, semi-natural remnant of deciduous forest	*ca.* 20km south	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.

Site Name and Code	Qualifying Interest Habitats and Species	Approximate Distance from the Proposed Scheme[2]	Connectivity
Liffey at Osberstown pNHA (001395)	Wet boulder-clay surface, moss, willow, scrub, scarce plants	*ca.* 4km south west	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Fitzsimon's Wood pNHA (001753)	Birch *Betula* spp. Woodland	*ca.* 21km east	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Dalkey Coastal Zone and Killiney Hill pNHA (001206)	Coastal habitats and breeding waterbirds and terns	*ca.* 26km east	No. There is no connectivity between the proposed works and the site due to the distance, marine open water buffer between them.
North Dublin Bay pNHA (000206)	Coastal and estuarine habitats and wintering waterbirds	*ca.* 21km north east	Yes. Located downstream of the proposed works in Dublin Bay.
South Dublin Bay pNHA (000210)	Estuarine habitats and wintering waterbirds	*ca.* 24.5km east	Yes. Located downstream of the proposed works in Dublin Bay.
Howth Head pNHA (000202)	Sea cliff and heath habitats and breeding Kittiwake	*ca.* 30km north east	Yes. Located downstream of the proposed works in Dublin Bay.
Santry Demesne pNHA (000178)	Woodland habitat and protected plant species (Hairy St. John's wort *Hypericum hirsutum*)	*ca.* 22km north east	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Baldoyle Bay pNHA [000199]	Coastal and estuarine habitats, and wintering waterbirds	*ca.* 29km north east	No. There is no connectivity between the proposed works and the site due to the distance, marine open water buffer between them.
Feltrim Hill pNHA [001208]	The site is of geological interest with two rare plant species present.	*ca.* 28km north east	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Sluice River Marsh pNHA [001763]	Freshwater marsh habitats	*ca.* 29km north east	No. There is no connectivity between the proposed works and the site due to the distance and the lack of hydrological connectivity between them.
Malahide Estuary pNHA [000205]	Coastal and estuarine habitats, and wintering waterbirds	*ca.* 32km north east	No. There is no connectivity between the proposed works and the site due to the distance, marine open water buffer between them.

10.2.2 Protected Flora and Fauna and Invasive Species

The Morell River catchment area lies within or adjacent to Ordnance Survey 10km Grid Square N92. Records of rare and protected species from this grid square are detailed in Table 10.2 and records of invasive species from this grid square are detailed in Table 10.3.

Table 10.2: Records of Rare and Protected Species of Flora and Fauna

Scientific Name	Common Name	Date of Last Record	Location / Grid Square Ref	Designation
Plants				
Groenlandia densa	Opposite-leaved Pondweed	31/12/1999	N92I	Flora Protection Order
Other Fauna				
Rana temporaria	Common Frog	12/09/2003	N92	Annex V, Wildlife Acts
Martes martes	Pine Marten	22/04/2016	N944238	Annex V, Wildlife Acts
Meles meles	Badger	05/05/2013	N92	Wildlife Acts
Lutra lutra	European Otter	28/12/2014	N92	Annex II, Annex IV, Wildlife Acts
Vertigo moulinsiana	Desmoulin's Whorl Snail	02/04/1971	N92	Annex II, Wildlife Acts
Austropotamobius pallipes	Freshwater White-clawed Crayfish	17/04/2007	N92	Annex II, Annex V, Wildlife Acts
Erinaceus europaeus	Western European Hedgehog	27/06/2012	N92	Wildlife Acts
Myotis daubentonii	Daubenton's Bat	31/08/2014	N92	Annex IV, Wildlife Acts
Nyctalus leisleri	Lesser Noctule / Leisler's Bat	25/08/2013	N92	Annex IV, Wildlife Acts
Pipistrellus pipistrellus sensu lato	Pipistrelle	10/05/2010	N92	Annex IV, Wildlife Acts
Pipistrellus pygmaeus	Soprano Pipistrelle	10/05/2010	N92	Annex IV, Wildlife Acts
Plecotus auritus	Brown Long-eared Bat	30/06/2007	N92	Annex IV, Wildlife Acts
Scientific Name	**Common Name**	**Date of Last Record**	**Location/ Grid Square Ref**	**Conservation Status[3]**
Aythya ferina	Common Pochard	29/02/1984	N92	Red List
Aythya fuligula	Tufted Duck	31/07/1991	N92	Red List
Alcedo atthis	Common Kingfisher	15/11/2014	N92	Annex I, Amber List
Circus cyaneus	Hen Harrier	29/02/1984	N92	Annex I, Amber List
Falco columbarius	Merlin	09/03/2014	N92	Annex I, Amber List
Crex crex	Corncrake	31/07/1991	N92	Annex I, Red List
Fulica atra	Common Coot	31/12/2011	N92	Amber List
Pluvialis apricaria	European Golden Plover	31/12/2011	N92	Annex I, Red List
Anas crecca	Eurasian Teal	29/02/1984	N92	Amber List

[3] Colhoun, K. & Cummins, S. (2013): Birds of Conservation Concern in Ireland 2014-2019. Irish Birds 9: 523-544

Scientific Name	Common Name	Date of Last Record	Location / Grid Square Ref	Designation
Egretta garzetta	Little Egret	31/12/2011	N92	Annex I
Falco peregrinus	Peregrine Falcon	31/12/2011	N92	Annex I
Gallinago gallinago	Common Snipe	31/12/2011	N92	Amber List
Scolopax rusticola	Eurasian Woodcock	31/07/1991	N92	Red List
Vanellus vanellus	Northern Lapwing	21/12/2016	N92	Red List
Alauda arvensis	Skylark	31/12/2011	N92	Amber List
Apus apus	Common Swift	31/12/2011	N92	Amber List
Carduelis cannabina	Common Linnet	31/12/2011	N92	Amber List
Charadrius hiaticula	Ringed Plover	31/07/1991	N92	Amber List
Columba oenas	Stock Dove	31/12/2011	N92	Amber List
Cygnus olor	Mute Swan	31/12/2011	N92	Amber List
Delichon urbicum	House Martin	31/12/2011	N92	Amber List
Falco tinnunculus	Common Kestrel	22/04/2015	N92	Amber List
Hirundo rustica	Barn Swallow	16/05/2013	N92	Amber List
Larus fuscus	Lesser Black-backed Gull	31/12/2011	N92	Amber List
Larus marinus	Great Black-backed Gull	29/02/1984	N92	Amber List
Locustella naevia	Common Grasshopper Warbler	31/12/2011	N92	Amber List
Muscicapa striata	Spotted Flycatcher	31/12/2011	N92	Amber List
Oenanthe oenanthe	Northern Wheatear	04/05/2014	N92	Amber List
Passer domesticus	House Sparrow	31/12/2011	N92	Amber List
Passer montanus	Eurasian Tree Sparrow	31/12/2011	N92	Amber List
Phalacrocorax carbo	Great Cormorant	31/12/2011	N92	Amber List
Rallus aquaticus	Water Rail	31/07/1972	N92	Amber List
Riparia riparia	Sand Martin	31/12/2011	N92	Amber List
Sturnus vulgaris	Common Starling	31/12/2011	N92	Amber List
Tachybaptus ruficollis	Little Grebe	31/12/2011	N92	Amber List
Emberiza citrinella	Yellowhammer	31/12/2011	N92	Red List
Larus argentatus	Herring Gull	31/12/2011	N92	Red List
Larus ridibundus	Black-headed Gull	31/12/2011	N92	Red List
Tyto alba	Barn Owl	31/07/1991	N92	Red List
Anthus pratensis	Meadow Pipit	2011	N92	Red list
Motacilla cinerea	Grey Wagtail	2011	N92	Red list

Table 10.3: Records of Invasive Species

Scientific Name	Common Name	Date of Last Record	Location/ Grid Square Ref	Status
Plants				
Fallopia japonica	Japanese Knotweed	30/09/2011	N92	High Impact Invasive Species. Third Schedule of the Birds and Natural Habitats Regulations
Heracleum mantegazzianum	Giant Hogweed	31/12/1974	N92	High Impact Invasive Species. Third Schedule of the Birds and Natural Habitats Regulations
Mammals				
Muntiacus reevesi	Chinese Muntjac	31/12/2008	N92	High Impact Invasive Species. Third Schedule of the Birds and Natural Habitats Regulations
Mustela vison	American Mink	04/03/1992	N92	High Impact Invasive Species. Third Schedule of the Birds and Natural Habitats Regulations
Rattus norvegicus	Brown Rat	06/09/2015	N92	High Impact Invasive Species. Third Schedule of the Birds and Natural Habitats Regulations
Sciurus carolinensis	Eastern Grey Squirrel	01/12/2014	N92	High Impact Invasive Species. Third Schedule of the Birds and Natural Habitats Regulations
Cervus nippon	Sika Deer	06/07/2012	N92	High Impact Invasive Species. Third Schedule of the Birds and Natural Habitats Regulations

10.3 FIELD SURVEY RESULTS

10.3.1 Habitats

A habitat map was prepared to illustrate the habitats encountered during the field surveys for the proposed scheme, see Figures 10.3, 10.4 and 10.5.

The following provides an overview of the habitats identified in the survey. None of the habitats surveyed in the study area correspond to Annex I habitats.

Other Artificial Lakes and Ponds (FL8)

A number of artificial ponds are situated in a golf course within the study area.

Depositing/Lowland River (FW2)

The Morell River and its tributaries are classified as depositing lowland rivers. The Morell River itself is a salmonid river.

Improved Agricultural Grassland (GA1)

The catchment is predominantly characterised by fields of improved agricultural grassland bound by hedgerows or treelines. Some areas reflect species-poor (4-5 consistently occurring species) that is typical of intensive management. But the level of intensity varies with the result that additional herbaceous species are common. The improved grassland sward is generally dominated by Perennial Rye-grass (*Lolium perenne*), with herbs commonly comprising White Clover (*Trifolium repens*), Red Clover (*Trifolium pratense*), Dandelion (*Taraxacum officinale* agg.) and Creeping Buttercup (*Ranunculus repens*). However, considerable variation was encountered in the condition and status of the habitat reflecting edaphic conditions - soil geology, soil saturation and the management regime that occur across individual land parcels condition. Depending on the soil conditions, transitions to either neutral grasslands or wet grasslands were noted. These mosaics are often intricate in nature and have not been mapped.

Amenity Grassland (GA2)

This habitat related to sports grounds such as golf courses and football pitches. Gardens of private residential dwellings would also be classified as GA2, however, these have not been mapped in this instance due to the resolution of the mapping, and instead house/garden complex has been mapped as BL3.

Dry Calcareous and Neutral Grassland (GS1)

Although the proposed scheme area was predominantly characterised as GA1, some of the field were less improved and maintained, although still subject to grazing by livestock suck as horses, sheep and cattle.

Dry Meadows and Grassy Verges (GS2)

This habitat relates to a small area near Blackchurch Bridge. A species list was not taken due to access difficulties, but appeared to be species poor and grass dominated.

Wet Grassland (GS4)

This habitat often occurred alongside improved agricultural grasslands where reflecting edaphic conditions - soil geology, soil saturation and management regime. The habitat varied in species composition, with graminoids present including False Oat-grass (*Arrhenatherum elatius*), Creeping Bent (*Agrostis stolonifera*), Cock's-foot (*Dactylis glomerata*), Yorkshire Fog (*Holcus lanatus*), Hard Rush (*Juncus inflexus*), Sharp-flowered Rush and Hairy Sedge (*Carex hirta*). Herbs present included Meadowsweet (*Filipendula ulmaria*), Purple-loosestrife (*Lythrum salicaria*), Square-stemmed Willowherb (*Epilobium tetragonum*), Hoary Willowherb (*E. parviflorum*), Common Knapweed (*Centaurea nigra*), Bush Vetch (*Vicia sepium*) and Common Bird's-foot-trefoil (*Lotus corniculatus*).

In more water-logged areas, wet grassland graded into a marsh habitat (GM1). Species here included Reed Canary-grass (*Phalaris arundinacea*), Common Reedmace (*Typha latifolia*), Branched Bur-reed (*Sparganium erectum*), Soft Rush (*Juncus effusus*) and Hard Rush; and with Field Horsetail (*Equisetum arvense*), Water Mint (*Mentha aquatica*), Lesser Spearwort (*Ranunculus flammula*), Meadowsweet and Yellow Iris (*Iris pseudacorus*).

Riparian Woodland (WN5)

This habitat was recorded along the north eastern bank of the Slane River that was gently sloped and subject to periodic flooding. It was dominated by Willows (*Salix* spp.) with Nettle (*Urtica dioica*) and Bramble (*Rubus fruticosus* agg.) frequent in the understory.

Mixed Broadleaved Woodland (WD1)

This habitat was generally recorded as small belts of woodland in the proposed scheme area. Species present included Sycamore (*Acer pseudoplatanus*), Beech (*Fagus sylvatica*), Ash (*Fraxinus excelsior*), Horse Chestnut (*Aesculus hippocastanum*), Pine (*Pinus* spp.) and Oak (*Quercus robur*); with Alder (*Alnus glutinosa*) and Willow (*Salix* spp.) in wet areas. The understorey comprised of Hawthorn (*Crataegus monogyna*), Elder (*Sambucus nigra*), Blackthorn (*Prunus spinosa*) and Hazel (*Corylus avellana*). Many of these areas of woodland were inaccessible so a full list of ground flora species was not taken.

Mixed Conifer Woodland (WD3)

A small block of woodland at Killeenmore comprised of Scot's Pine (*Pinus sylvestris*), with a scrub layer of Elder and Hawthorn. The ground flora was dominated by Nettle (*Urtica dioica*), with occasional Cleavers (*Galium aparine*), Bramble (*Rubus fruticosus* agg.) and Hogweed (*Heracleum sphondylium*).

Scrub (WS1)

Small areas of scrub were present, mainly in abandoned areas of damp grassland or woodland and along banks of watercourses. Species included Willow, Alder, Hawthorn, Blackthorn and Bramble.

Immature Woodland (WS2)

Located on the motorway shoulder embankments, the area was characterised by immature conifer and broadleaf species.

Hedgerows (WL1)

As noted previously, the study area is characterised mainly by agricultural fields bounded by hedgerows. These hedges are in various stages of management, and, with the exception of garden hedges, are comprised of native species including Hawthorn, Blackthorn, Elder, Willow, Sycamore and Ash, with Crab Apple (*Malus sylvestris*).

Treelines (WL2)

There are a number of treelines across the catchment. These vary from planted conifer shelterbelts around properties to lines of mature broadleaved trees and grown out hedgerows. Species mainly include Ash, Beech and Sycamore, with some Hawthorn and Willow also present.

Arable Crops (BC1)

A number of fields of arable crops are situated in the study area.

Table 10.4: Habitat Types Recorded and their Ecological Valuation

Habitat Type	Fossitt Category	Ecological Valuation	Rationale
Depositing/ lowland rivers	FW2	National	Rivers and streams provide potential salmonid spawning, habitat for other fish species and otter habitat. The Morell is an important salmonid system holding significant populations of Atlantic salmon, (Annex II and V of the Habitats Directive) Sea trout, Brown trout, Lamprey and Crayfish (both Annex II species).
Other artificial lakes and ponds	FL8	Local (lower)	Provides some potential habitat for amphibians, although none recorded during site survey.
Improved agricultural grassland	GA1	Local (lower)	The habitat is of low botanical importance; however it does provide a foraging habitat for some species of fauna e.g. badgers and passerine birds.
Amenity grassland (improved)	GA2	Local (lower)	The habitat is of low botanical importance. It may provide foraging habitat for some fauna e.g. passerine birds.
Dry calcareous and neutral grassland	GS1	Local (lower)	This habitat within the study area was associated with less intensively managed agricultural grassland and is generally of low botanical importance. It may provide a foraging habitat for some species of fauna e.g. badgers and passerine birds.
Dry meadows and grassy verges	GS2	Local (lower)	The grassy verges in the study area are species poor, dominated by tussocky grasses. It does provide a habitat for some species of fauna e.g. mammals and passerine birds.
Wet grassland	GS4	Local (higher)	This habitat generally tends to be more botanically diverse than improved grassland, however this habitat was limited in extent. The habitat can provide habitat for a range of species including mammals, birds and amphibians.

Habitat Type	Fossitt Category	Ecological Valuation	Rationale
Marsh	GM1	Local (higher)	Occurs in more waterlogged areas of wet grassland. These areas contain a greater diversity of forbs than wet grassland. The habitat can provide habitat for a range of species including mammals, birds and amphibians.
Riparian woodland	WN5	Local (higher)	This habitat is of limited botanical value, however does potentially provide habitat for fauna e.g. otter.
Mixed broadleaved woodland	WD1	Local (higher)	Cannot be classified as semi-natural habitat but does have potential to support a range of species including mammals and birds.
(Mixed) conifer woodland	WD3	Local (higher)	The habitat has the potential to support a range of species including mammals and birds.
Scrub	WS1	Local (higher)	Scrub occurs in small parcels in the study area and occasionally along watercourses. Scrub can provide habitat for birds and refuge for fauna.
Immature woodland	WS2	Local (lower)	This habitat is of limited botanical value as the stand was immature and located on the motorway embankment. It has potential to provide habitat for mammals and birds.
Hedgerows	WL1	Local (higher)	The hedgerows in the study area are largely comprised of native species and provide habitat for birds and mammals in additional to providing connectivity in the landscape.
Treelines	WL2	Local (higher)	Treelines provide habitat for birds and mammals (including potential roost sites for bats) in additional to providing connectivity in the landscape.
Arable crops	BC1	Local (lower)	This habitat is of limited botanical importance although it may provide habitat for fauna e.g. birds and mammals.
Buildings and artificial surfaces	BL3	Local (lower)	This habitat is of limited botanical importance although buildings may provide habitat for fauna e.g. bats.

10.3.2 Invasive Species

Giant Rhubarb (*Gunnera tinctoria*) was observed in several locations along the Slane River at Tuckmilltown, see Figure 10.4.

10.3.3 Protected Species

Badgers

Badgers (*Melees males*) are legally protected under the Wildlife Act 1976 (as amended). A number of mammal burrows were recorded throughout the proposed scheme area which could potentially be used by badger, due to size and shape, although they did not appear active at the time of survey and there was no evidence of badger usage. Mammal trails were also observed throughout the study area, potentially badger, however could also be as a result of rabbit, fox or otter. It is likely that badgers are active across the proposed scheme area, making use of grassland, hedgerows, treelines and forestry for foraging and shelter. Mammal runs are shown Figures 10.6 to 10.8, however potential badger setts have been excluded from the mapping in the interest of nature conservation.

Otters

An otter survey was conducted as part of the aquatic ecology survey, as detailed in Chapter 11.

Bats

All bats and their roosting sites are legally protected under the EU Habitats Directive as transposed by the Habitats Regulations, as well as under the Wildlife Act (as amended). Across Europe, bats are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982), which, in relation to bats, exists to conserve all species and their habitats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries. The Irish government has ratified both of these conventions.

No bat activity surveys were undertaken for this EIAR. However, bridges, buildings and trees in the proposed scheme area have the potential to act as bat roosting sites. A number of trees and treelines were identified as having low to moderate bat roost potential as per the classification scheme outlined in Collins (2016). One abandoned cottage with outhouses in Killeenmore was identified as having low potential for roosting bats. These are illustrated in Figures 10.6 to 10.8. Bat species are likely to utilise the Morell, Painestown, Slane and Kill rivers, other smaller streams/watercourses, the Grand Canal, hedgerows and treelines as commuting corridors as they provide connectivity in the landscape and also act as a foraging habitat.

Other mammals

No other signs of mammals were recorded during the walkover survey. Other species likely to occur in the area include pygmy shrew (*Sorex minutus*), hedgehog (*Erinaceus europaeus*) and Irish hare (*Lepus timidus hibernicus*).

Amphibians and Reptiles

There were no observations or evidence of common frog (*Rana temporaria*), smooth newt (*Lissotriton vulgaris*) or viviparous lizard (*Zootoca vivipara*) encountered during the site walkover survey.

It is likely that common frog is present in areas of standing water, damp areas and vegetation in the proposed scheme area. Viviparous lizard are known to occupy damp or wet areas with abundant grass tussocks in high densities and can be found on grassland, hedgerows and road embankments (Edgar *et al.*, 2010). Therefore, it is likely that they are present along the proposed route.

Avifauna

All birds and their nests are protected under the Wildlife Act 1976 (as amended). There is substantial suitable habitat for breeding birds in the proposed scheme area including hedgerows, trees, woodland, scrub, rank grassland, wetland and buildings.

Bird species identified during the course of the site walkover surveys are presented in Table 10.5. The conservation status of these birds is also provided according to Colhoun and Cummins (2013), on which birds are classified into three separate lists (Red, Amber and Green), based on the conservation status of the bird and hence conservation priority. The Red List birds are of high conservation concern, the Amber List birds are of medium conservation concern and the Green List birds are not considered threatened.

No Annex I species were recorded during the site visits.

Table 10.5: Bird Species Observed During the Site Surveys

Common Name	Species Name	Conservation Status
Blackbird	*Turdus merula*	Green
Blue Tit	*Cyanistes caeruleus*	Green
Buzzard	*Buteo buteo*	Green
Chaffinch	*Fringilla coelebs*	Green
Dipper	*Cinclus cinclus*	Green
Dunnock	*Prunella modularis*	Green
Goldfinch	*Carduelis carduelis*	Green
Great Tit	*Parus major*	Green
Grey Heron	*Ardea cinerea*	Green
Hooded Crow	*Corvus cornix*	Green
House Sparrow	*Passer domesticus*	Amber
Jackdaw	*Corvus monedula*	Green
Magpie	*Pica pica*	Green
Moorhen	*Gallinula chloropus*	Green
Mute Swan	*Cygnus olor*	Amber
Pied Wagtail	*Motacilla alba*	Green
Robin	*Erithacus rubecula*	Amber
Rook	*Corvus frugilegus*	Green
Snipe	*Gallinago gallinago*	Amber
Song thrush	*Turdus philomelos*	Green

Common Name	Species Name	Conservation Status
Starling	*Sturnus vulgaris*	Amber
Swallow	*Hirundo rustica*	Amber
Woodpigeon	*Columba palumbus*	Green
Wren	*Troglodytes troglodytes*	Green

10.4 POTENTIAL IMPACTS OF THE PROPOSED SCHEME

All impacts are described in the absence of mitigation measures.

10.4.1 Construction Impacts

10.4.1.1 Designated Sites

SACs and SPAs

An AA Screening has been carried out to determine the potential for likely significant effects as a result of the proposed scheme. It has been concluded in the Appropriate Assessment Screening Report (see **Appendix D** in Volume 3), that there is no likelihood of significant effects on any European Sites either alone or in combination with other plans or projects.

NHAs and pNHAs

Construction works for the proposed scheme located in the vicinity of the Grand Canal may be hydrologically connected to the Grand Canal via wet field drains and/or wet ditches. There is potential for indirect impacts as a result of run-off from construction areas, eutrophication and sedimentation decreasing water quality in the Grand Canal pNHA, pNHAs located downstream of the proposed scheme and within Dublin Bay (Liffey Valley pNHA, Dolphins Dublin Docks pNHA, North Dublin Bay pNHA, South Dublin Bay pNHA, Howth Head pNHA and Booterstown Marsh pNHA). This may in turn impact on the aquatic habitats and species therein. In the absence of mitigation this could result in a temporary, reversible negative impact. This ecological receptor is considered to be of National Importance. Any potential indirect effects on the water quality in pNHAs would be considered likely to be significant at a National level. Also see Chapter 11 Biodiversity- Aquatic Ecology.

Habitats

The proposed scheme will involve the construction of *c.* 7423m of new embankments, potential restoration works to *c.* 1842m of existing embankments, construction of *c.*474m of new flood walls, *c.* 100m of stream alignment (over two areas) and a number of culvert alterations (please refer to Chapter 4 for further details). Construction works will also require the establishment of temporary central base construction compounds for drop-off and storage of materials including fuel, site offices and other staff facilities including canteen, toilets and parking, as well as three temporary bridge crossings. Construction activities and site clearance could lead to direct loss of habitats and disturbance through trampling or damage by machinery. There will be a permanent loss of habitat in the footprint of any new flood alleviation measures or if vegetation removal is required for site compounds or access tracks. Although impacts arising from disturbance to habitats would last longer than the construction period, it is likely to be reversible in time once construction ceases allowing the habitat to re-establish in the vicinity of the proposed scheme.

Wet grassland and marsh habitat

Scheme measures Morr 4, Morr 7, Morr 8, Morr 15 and Morr 17 will involve *c.* 400m of walls and embankment to be built on this habitat, and a stream diversion adjoining the habitat, constituting direct habitat removal. In the absence of mitigation, this will result in a permanent, irreversible negative impact. The implementation of the proposed scheme will not result in the drying out of wet grassland and marsh habitat. Therefore, no indirect impacts are anticipated. Overall, this ecological receptor is considered to be of local (higher) importance. However, the embankments will be positioned in relatively species poor areas of wet grassland. Therefore the loss of wet grassland habitat is not deemed to be significant.

The temporary bridge crossings near scheme measures Morr 7 – Morr 9 and Slane 8 are likely to temporarily disturb the habitat upon installation. The footprint of the temporary bridges will be relatively small scale and any impact is likely to be reversible in time once construction ceases and the temporary bridges are removed allowing the habitat to re-establish.

Riparian Woodland

Scheme measures Slane 8 will involve the realignment of a small section of the stream to remove a sharp bend. Although this will largely involve the direct removal of improved agricultural grassland to dig the realignment channel, there may be a very small portion of riparian woodland removed at either end of the new channel. Slane 9 will involve the construction of an embankment along a field boundary leading down to the Slane River. It is unlikely that any riparian woodland will be lost as result of this. However, at most *c.* 10m in length of riparian woodland in the footprint of the embankment would be lost.

Any removal of this habitat would result in the direct loss of the habitat on a permanent basis, resulting in an irreversible negative impact. However, it is likely that in time, the stream realignment at Slane 8 will encourage the establishment of riparian woodland within in the old stream alignment lands. Therefore the loss of a very small section of riparian woodland is not deemed to be significant.

Mixed Broadleaved Woodland

Scheme measure Morr 3 will likely involve the removal of a small area of this habitat *c.* <30m in length, immediately adjoining the south side of Turnings Upper road on western bank of River Morell. This will result in the direct loss of a small section of this woodland habitat on a permanent basis, resulting in an irreversible negative impact. The habitat was not classified as semi-natural habitat and the loss of a very small portion is not deemed to be significant.

Scheme measures Morr 1 is located on the opposite side of the L2007 to the woodland habitat. Therefore no impact is envisaged.

Mixed Conifer Woodland

There are no impacts envisaged as none of the scheme measures are being constructed on this habitat.

Scrub, Hedgerows, Treelines

Scheme measures Morr 1-6, Morr 8 - 10, Morr 15-23, Paines 1, 2, 4 & 5, Kill 1, Slane 1-6 and Slane 9 will necessitate removal of small sections of treelines, hedgerows and scrub where the proposed scheme embankments, walls, stream realignments and temporary bridge crossings will cross field boundaries. Some scrub/ tree removal may also be required at the junction of Killeenmore Road and the L2010 for haulage routes accessibility (see Chapter 6 Traffic and Transportation). The establishment of central base compounds and any access track required for these or for site access may require the removal of sections of scrub, hedgerows and treelines. The proposed works will result in the direct loss of sections of these habitats. In the absence of mitigation this will result in a permanent, irreversible negative impact significant at the local level.

Treelines, hedgerows and scrub act as ‘ecological corridors’ for faunal species to aid dispersal and have the potential to support fauna species such as badger, bat and passerine birds. In the absence of mitigation, the loss of these habitats could result in a permanent, irreversible, negative impact significant at the local level.

Invasive Species

Giant Rhubarb (*Gunnera tinctoria*) was observed in several locations along the Slane River at Tuckmilltown. No scheme measures are proposed in this area, therefore no significant impacts are envisaged in relation to the presence of the species in this location.

Invasive species can be introduced into a location or spread from a location by contaminated vehicles and equipment, in particular tracked vehicles which have been used previously in locations that contained invasive alien plant species. They can also be spread to a location via vector materials such as soil. Therefore, construction works for the scheme measures, including the setting up of central base compounds and importation of fill material, has the potential to introduce invasive alien plant species into the proposed scheme area. In the absence of mitigation this could result in a long term reversible negative impact significant at the local level.

10.4.1.2 Protected Species

Badger

Potential badger activity including a number of potential setts, mammal runs and tracks were recorded throughout the proposed scheme area, however no active setts were confirmed. Rabbit activity was also noted throughout the area. Exact locations of potential setts have not been presented in the EIAR due to the sensitivity of this information and in the interests of nature conservation.

Potential badger setts/mammal burrows were identified in the vicinity of scheme measures Morr 1a, Morr 3, Morr 4, Morr 6, Morr 18 and Slane 9. The construction of the proposed scheme could result in direct destruction of setts via excavation for embankment/wall construction or via machinery driving over setts en route to the construction area. Construction works could also lead to disturbance to the species at critical times in its lifecycle e.g. breeding season (December to June inclusive). Any storage or stockpiling of materials also has the potential to negatively affect badger setts within the footprint via direct destruction/disturbance.

In the absence of mitigation there could be a negative impact through direct destruction or disturbance to badger setts. The installation of flood alleviation measures will involve excavation works. The flood alleviation infrastructure is generally all located on agricultural lands where machinery would currently be used. If active badger setts were located in these areas at the time of construction then the impact would be permanent in terms of having to exclude a badger sett under licence from NPWS, however it is considered likely that badgers would move back into the area and re-establish setts once construction works cease reducing this impact to short term. It is considered likely that this short term impact could negatively affect the conservation status of badger locally. Therefore a significant negative effect at the local level is concluded.

The removal of treelines and hedgerows in the scheme area may also impact on dispersal routes for badgers, however, this is not deemed to be significant.

Bats

No bat roosts were confirmed within the proposed scheme area. However, usage of trees, buildings and bridges by individual or small numbers of bats cannot be ruled out on an annual cycle. There were a number of trees and treelines identified as having low to moderate bat roost potential which could be affected by scheme measures Morr 1, Morr 1a, Morr 16, Morr 16a, Morr 17, Morr 18, Morr 20-23, Paines 1, Paines 5, Kill 1 and Slane 9 and the proposed central base compound locations at Morr 19 and Morr 23. There was one building near Killeenmore identified as having low bat roost potential, located near Morr 16-16a. In the absence of mitigation, if any of these trees/treelines and buildings supported bat roosts and had to be removed as a result of the construction works, there would be potential for bat mortality. This could result in a short term negative impact, significant at a local level.

Hedgerows, treelines and rivers act as commuting corridors for bats in the landscape. The proposed scheme does require the removal of some hedgerows and treelines for creation of the scheme measures. In most cases hedgerows/treelines will not be removed in their entirety, just smaller sections required for removal. Removal of this commuting/foraging habitat is unlikely to impact on the conservation status of any bat species. Scheme measures such as embankments and walls are likely to act as commuting corridors in time. Therefore an impact is likely to be temporary negative but not significant at a local level.

Other mammals

It is likely that Pygmy shrew and Hedgehog occur in hedgerows, woodlands and grasslands. The proposed scheme will involve the removal of sections of these habitats in a number of locations, see assessment under 'Habitats' in this section, and construction activity in the vicinity of these habitats. In the absence of mitigation, if the species were present then negative impacts could arise via direct mortality or disturbance. It is considered that removal of habitat would be permanent and irreversible, with disturbance from construction being short term and reversible once construction was complete. As a relatively widespread mobile species, it is considered likely that both Pygmy shrew and Hedgehog could re-establish in adjacent habitats and that the proposed scheme is extremely unlikely to negatively affect the conservation status of the species locally. Therefore it is unlikely that a significant impact would arise.

Amphibians and reptiles

No amphibians or reptiles were observed in the proposed scheme area during the site survey. While it is possible that species in these groups utilise the area, they are mobile species and the proposed scheme does not involve the removal of any prime habitat for amphibians, such as ponds. It is unlikely that significant impacts to amphibians and reptiles will arise as a result of the works.

In the absence of mitigation, there could be a negative impact on amphibians through direct mortality during construction works. Wheeled vehicles would most likely be required for any construction works. These will utilise the local public road network and lands adjacent to the proposed scheme measures, which are generally all located on agricultural lands which could contain wet areas that host frogs and frog spawn. These could be directly trampled by machinery. Removal of vegetation also has the potential to result in direct mortality of frogs that utilise this habitat to shelter/hibernate. However, as frogs are generally widespread it is considered likely that they would move back into the area once construction works cease reducing this impact to short term negative. It is considered likely that this short term impact could negatively affect the conservation status of frogs locally. Therefore a significant negative effect at the local level is concluded.

Birds

All birds and nests are protected under the Wildlife Acts 1976 (as amended). If vegetation clearance and/or building demolition is carried out during the breeding bird season (i.e. from the 1st March to the 31st August), there is the potential for significant negative impacts to local breeding bird populations. During the breeding season noise, vibration, increased human presence and movement of construction vehicles associated with the construction phase of the proposed scheme has the potential to result in a disturbance to local breeding bird populations. This could result in reduced breeding success of birds in habitats adjacent to the construction zone and could potentially impact on the conservation status of bird species locally. Therefore a significant effect at a local level is concluded.

The construction of the proposed scheme, including establishment of central base compounds and access tracks, will require the removal of hedgerows, trees, treelines, scrub and some woodland. It may also involve the removal of some buildings/structures. These habitats have the potential to provide breeding habitat for birds. Removal of these areas of habitat during the breeding bird season could potentially impact on the conservation status of bird species locally. Therefore a significant effect at a local level is concluded.

10.4.2 Operational Phase Impacts

During the operational phase of the proposed scheme there will be considerably less site activity than during the construction phase. Kildare County Council will be required to maintain the completed flood relief schemes in proper repair and effective condition. This may mean, *inter alia*:

- Clearing obstructions to flows from time to time e.g., fallen trees, significant weed growth, build-up of materials likely to impact on the performance of the scheme;
- Repairing and rebuilding structures (walls and embankments); and
- Prevention of erosion/undermining of the completed works of the proposed scheme.

While the maintenance requirements of the proposed scheme will be monitored and reviewed on an annual basis, it is envisaged that maintenance works would only be undertaken as and when required, e.g. on a six to ten year cycle. Maintenance works to be carried out will be subject to the relevant environmental assessment requirements, including Screening for Appropriate Assessment, to consider the environmental sensitivities around the maintenance required, and will be required to be carried out in line with current best practice at the time of maintenance e.g. OPW's Standard Operating Procedures for Arterial Drainage Maintenance Service (OPW, 2011).

10.4.2.1 Designated Sites

SACs and SPAs

An AA Screening has been carried out to determine the potential for likely significant effects as a result of the proposed scheme. It has been concluded in the Appropriate Assessment Screening Report (see **Appendix D**), that there is no likelihood of significant effects on any European Sites either alone or in combination with other plans or projects.

NHAs and pNHAs

Maintenance works for the proposed scheme located in the vicinity of the Grand Canal may be hydrologically connected to the Grand Canal via wet field drains and/or wet ditches. There is potential for indirect impacts as a result of run-off from construction areas, eutrophication and sedimentation decreasing water quality in the Grand Canal pNHA, pNHAs located downstream of the proposed scheme and within Dublin Bay (Liffey Valley pNHA, Dolphins Dublin Docks pNHA, North Dublin Bay pNHA, South Dublin Bay pNHA, Howth Head pNHA and Booterstown Marsh pNHA). This may in turn impact on the aquatic habitats and species therein. In the absence of mitigation this could result in a temporary, reversible negative impact. This ecological receptor is considered to be of National Importance. Any potential indirect effects on the water quality in pNHAs would be considered likely to be significant at a National level. Also see Chapter 11 Aquatic Ecology.

Habitats

Once completed, areas from which vegetation was removed will gradually re-vegetate through succession. Mapping of the predicted post scheme flood plains is shown in Figure 12.2. Reduced flooding is anticipated mainly in areas of agricultural grasslands (and associated hedgerows and treelines) and buildings and artificial surfaces (mainly associated with residential dwellings). Some smaller areas of arable land, amenity grassland and broadleaved woodland will also be subject to reduced flooding. This is unlikely to result in any significant changes in species composition as these areas will still be subject to periodic flooding, albeit reduced.

New flooding areas and the 1% AEP floodplain are also mainly located in areas of agricultural grasslands (and associated hedgerows and treelines) and buildings and artificial surfaces (mainly associated with residential dwellings). Some smaller areas of habitat located within the flood area include arable land, amenity grassland, wet grassland, scrub, broadleaved and riparian woodland will also be subject to reduced flooding. This is unlikely to result in any significant changes in species composition as much of these areas will only be subject to periodic flooding.

Invasive Species

As per the impact outlined for invasive species under Section 10.4.1.

10.4.2.2 Protected Species

Badger

In the absence of mitigation, there could be a negative impact on badger through direct destruction or disturbance to badger setts during maintenance works. Wheeled vehicles would most likely be required for any maintenance works. These will utilise the local public road network and lands adjacent to the flood alleviation infrastructure, which are generally all located on agricultural lands where machinery would currently be used. If active badger setts were located along these routes then the maintenance works could have a permanent impact in terms of in terms of having to exclude a badger sett under licence from NPWS, however it is considered likely that badgers would move back into the area and re-establish setts once construction works cease reducing this impact to short term. It is considered likely that this short term impact could negatively affect the conservation status of badger locally. Therefore a significant negative effect at the local level is concluded.

Passage of mammals through the Morell River catchment will not be impeded by the embankments, therefore foraging and commuting through the catchment area will not be interrupted. The walls proposed as part of the scheme will only be positioned where necessary adjacent to properties, and as such it is not anticipated that these structures will interrupt passage of mammals through the catchment.

Figure 1.2 (in Chapter 1) illustrates the present day flood extent in the absence of the proposed scheme. When compared to the mammal evidence identified during field surveys, mammal evidence occurs throughout the scheme area including within areas currently subject to periodic flooding. Areas of additional flooding are relatively limited, adjoining those areas already subject to flooding. It is considered unlikely that the operational phase will result in any significant negative impacts to mammals locally.

Bats

In the absence of mitigation, there could be a negative impact on bats through direct destruction or disturbance to bat roosts in trees or works to bridges during maintenance works. Felling of trees may be required during maintenance works for clearance and access. If these trees had bat roost potential, removal could result in direct mortality of individual or small numbers of bats. Any works including upgrade or maintenance works to bridges could result in bats becoming entombed in crevices in bridges or being disturbed in the roost. These roosts are generally transient in nature, but maintenance works could result in a short term negative impact on the conservation status of bats locally. Therefore a significant negative effect at the local level is concluded.

Passage of mammals through the Morell River catchment will not be impeded by the embankments, therefore foraging and commuting through the catchment area will not be interrupted. The walls proposed as part of the scheme will only be positioned where necessary adjacent to properties, and as such it is not anticipated that these structures will interrupt passage of mammals through the catchment. Scheme measures such as embankments and walls are likely to act as commuting corridors for bats in time, which is a slight positive impact.

Other Mammals

It is not considered likely that during operation of the proposed scheme that there would be any significant negative impact on any other mammals.

Amphibians and reptiles

In the absence of mitigation, there could be a negative impact on amphibians through direct mortality during maintenance works. Wheeled vehicles would most likely be required for any maintenance works. These will utilise the local public road network and lands adjacent to the flood alleviation infrastructure, which are generally all located on agricultural lands which could contain wet areas that hosts frogs and frog spawn. These could be directly trampled by machinery. Removal of bank side vegetation also has the potential to result in direct mortality of frogs that utilise this habitat. However, as frogs are generally widespread it is considered likely that they would move back into the area once maintenance works cease reducing this impact to short term negative. It is considered likely that this short term impact could negatively affect the conservation status of frogs locally. Therefore a significant negative effect at the local level is concluded.

Birds

Maintenance works requiring the removal of vegetation such as scrub and trees during the breeding bird season (i.e. from the 1st March to the 31st August), have the potential for significant negative impacts to local breeding bird populations. During the breeding season noise, vibration, increased human presence and movement of vehicles associated with the maintenance of the proposed scheme has the potential to result in a disturbance to local breeding bird populations. This could result in reduced breeding success of birds in habitats adjacent to the maintenance area and could potentially impact on the conservation status of bird species locally. Therefore a significant effect at a local level is concluded.

10.4.3 Do Nothing Scenario

The likely do nothing scenario for the proposed flood relief works is that there would be no change to the existing situation. The continued use of the lands in their current state with ongoing flooding would remain. This would benefit the terrestrial ecology both habitats and species. There would be no direct loss or change of habitat. Similarly species confirmed or likely to use the site (even if only to traverse it) would not be impacted.

The level of flooding that has been experienced in the area is however predicted to continue and it could be argued that as a result of predicted climate change might negatively impact upon elements of terrestrial ecology particularly during winter storm events. It is possible that alterations to some managed and semi-natural habitats could occur, particularly as a result of winter flooding. It is not possible to quantify the impact on species that might reside or forage in flooded lands.

10.5 MITIGATION MEASURES

10.5.1 Construction Phase

10.5.1.1 Environmental Supervision

It is recommended that a Construction Manager with appropriate experience and expertise be employed for the duration of the construction phase to ensure that all the mitigation measures outlined in relation to the environment are implemented. This manager will be awarded a level of authority and will be allowed to stop construction activity if there is potential for adverse environmental effects other that those predicted in the EIAR. In addition a Project Ecologist will be appointed to assist with potential ecology queries as they may arise during the course of the project.

10.5.1.2 Protection of Waterbodies

The proposed scheme has been identified as potentially giving rise to adverse effects on water quality in the Grand Canal pNHA, pNHAs located downstream of the proposed scheme and within Dublin Bay (Liffey Valley pNHA, Dolphins Dublin Docks pNHA, North Dublin Bay pNHA, South Dublin Bay pNHA, Howth Head pNHA and Booterstown Marsh pNHA). The effective protection of water quality within the proposed scheme during the construction and operation phases will minimise the risk to the ecological interests of this site and other water bodies within the Morell catchment. The measures outlined in Chapter 11 Biodiversity- Aquatic Ecology to ensure avoidance reduction and remediation of impacts and ensure protection of water quality during construction, along with the outline Construction Environmental Management Plan for the proposed scheme that outlines best practice construction methodology to be adhered to will ensure the protection of waterbodies.

10.5.1.3 Habitats

General mitigation will involve implementation of best practice, such as the OPW's Standard Operating Procedures for Arterial Drainage Maintenance Service (OPW, 2011).

Works shall be carried out ideally during a period of settled weather with no flood risk which will allow sufficient time for construction materials to settle. A sediment barrier, such as a continuous geo-textile silt curtain, at the foot of the embankment heap will be in place surrounding the structure as it develops and for a settling period following completion.

Habitats identified as sensitive ecological receptors in Section 10.3.1 include depositing/lowland rivers, wet grassland, marsh, riparian woodland, mixed conifer woodland, scrub, hedgerows and treelines. Where construction activity takes place in these habitat types it is important that activity is restricted to the footprint required for development of the proposed scheme measures. Therefore, the proposed works area must be clearly demarcated with temporary fencing or another suitable method to restrict access to areas adjacent to the works area. When establishing central base compounds and access tracks, vegetation should only be removed where absolutely essential.

Trees, hedgerows, treelines, woodland and scrub shall be retained intact where possible. Trees located adjoining/adjacent to the construction/compound area shall be protected from root damage by machinery by an exclusion zone of at least seven metres or equivalent to canopy height. Such protected trees shall be fenced off by adequate temporary fencing prior to other works commencing. NRA guidelines on the protection of trees and hedges prior to and during construction should be followed (NRA, 2006d). No soil, spoil, construction materials or rubbish will be stored or tipped and no construction plant or vehicles will be parked within the spread of existing trees, shrubs or hedges.

Where possible, vegetation will be reinstated following completion of the project. Embankments will be seeded with grass. Where treeline, hedgerow or scrub removal as part of the proposed scheme was unavoidable, a new native planting scheme should be implemented to function as replacement habitat for that removed.

It is recommended that tree lines or lines of shrubs are planted to enhance the potential of the site to provide feeding areas for bats. Tree lines are of far greater benefit to bats than single, free-standing trees or shrubs as they provide corridors for movement, avoidance of light and predators, a better shelter belt for the clustering of insects and provide greater substrate for insect breeding and feeding (bats food source). Native species of broadleaved trees are generally more beneficial to bats.

Invasive Species

Prior to undertaking any construction works of the various scheme measures, or establishing central base compounds and access tracks, the OPW shall engage a suitably qualified ecologist to carry out an invasive plant species survey in the appropriate botanical season (April through to September). This should entail a walkover of each location of the proposed scheme measures due for construction in that phase, to identify any stands of invasive plants species that may have become established in the intervening period between the EIA surveys and construction. Particular attention should be given to identifying those invasive plant species listed on the Third Schedule of the Birds and Natural Habitats Regulations 2011 (as amended). If any invasive alien plant species are identified then the suitably qualified ecologist shall outline the appropriate course of action to be taken with regard to treatment during construction works.

The introduction of invasive alien plant species (including Japanese Knotweed (*Fallopia japonica*)) will be avoided during the construction and operation phase of the proposed scheme by ensuring that appropriate precautionary measures are in place.

- All plant and equipment employed on the construction/compound site (e.g. excavator, footwear, etc.) must be thoroughly cleaned down using a power washer unit and washed into a dedicated and contained area prior to arrival on site to prevent the spread of invasive aquatic / riparian species such as Japanese Knotweed (*Fallopia japonica*) and Himalayan Balsam (I*mpatiens glandulifera*). A sign off sheet must be maintained by the contractor to confirm cleaning.
- The treatment and control of invasive alien species will follow Guidelines for the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (NRA 2010), and any other best practice guidance which may become available in the interim.
- For any material entering the site, including all fill material, the supplier must provide an assurance that it is free of non-native invasive species.
- Should any invasive plant species be encountered, the infested areas will be clearly demarcated accounting for potential underground rhizome spread, creating an exclusion zone.

- Ensure all site users are aware of invasive species management plan and treatment methodologies. This can be achieved through "toolbox talks "before works begin on the site.
- Adequate site hygiene signage should be erected in relation to the management of non-native invasive material.

10.5.1.4 Fauna

Badger

Badgers could establish setts and the activity and breeding status of setts/burrows could change in the intervening period between site survey and commencement of construction of each phase of the proposed scheme. Precise mitigation measures for badger will be informed by a badger survey prior to construction works commencing on each phase of the development (including establishing central base compounds, satellite sites and access tracks) to identify setts and confirm the level of activity and breeding status of setts/mammal burrows at that time. The following measure is proposed:

- Prior to construction works commencing on each phase of the development (including establishing central base compounds, satellite sites and access tracks) the Contractor will engage the services of a suitably qualified ecologist to conduct a badger survey of the proposed scheme measure area, compound area and all access routes. This shall be undertaken to NRA (2006a) specifications, and no more than 10 months in advance of construction;
- If an active sett is encountered, mitigation measures as outlined in national guidelines *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (NRA, 2006a) will apply. In brief these are, but are not limited to:
  - During the breeding season (December to June inclusive) a clearly marked exclusion zone of 50m should be established around the active sett and no works should take place within this exclusion zone;
  - Outside of the breeding season (July – November inclusive) a clearly marked exclusion zone of 30m should be established around the active sett and no heavy machinery used within this exclusion zone. Lighter machinery (wheeled vehicles) should not be used within 20m of a sett entrance and light work such as digging by hand should not take place within 10m of a sett entrance;
  - Any works in and around setts must be supervised/carried out by a suitably qualified and experienced ecologist;
  - If the above detailed exclusion zones cannot be adhered to and disturbance to setts is deemed likely during construction works then the local NPWS Ranger will be contacted. This may require an application for a derogation licence from the NPWS to exclude the sett. If required, any further mitigation measures required will follow those outlined in NRA (2006a) and will be agreed with the NPWS at the time of licence application.

Bats

As no bats have so far been identified as roosting within the study area no specific mitigation in relation to roost loss is recommended.

As a general protective measure, the following is recommended:

- In the unlikely event that bats are found on the site during construction works, works will immediately cease in that area and the local NPWS Conservation Ranger will be contacted. The bats will be removed by hand by a suitably qualified and licenced bat surveyor.

A number of trees/treelines, buildings and bridges in the proposed scheme area were identified as potential bat roots and for these, the following mitigation applies.

Removal of trees/tree lines deciduous trees

Where possible, trees, treelines and woodland shall be retained. Any existing trees adjacent to the works, construction sites and compounds to be retained shall be protected from root damage by machinery by an exclusion zone of at least seven metres or equivalent to canopy height. Such protected trees shall be fenced off by adequate temporary fencing prior to other works commencing.

Any trees requiring removal to facilitate construction works, establishment of compounds or access tracks must be subject to a visual inspection by a suitably qualified and licenced bat surveyor to identify potential bat roosts and advise on additional surveys required. If potential bat roosts are identified then bat activity surveys at such trees will be required. If bats are found, the suitably qualified and licenced bat surveyor will advise on the appropriate course of action, including the need for application for a derogation licence from the NPWS.

All trees requiring removal in the proposed scheme area should be felled and left in place on the ground for 24 hours prior to removal/disposal to allow any bats beneath foliage to escape overnight.

Should the removal of mature broadleaved trees be unavoidable, it is recommended that two bat boxes, of Schwegler Type 1FF flat box, for each felled mature broadleaved tree shall be attached to suitable alternative trees in order to compensate for the loss of potential roosting space. The bat box locations and supervision of installation of same shall be carried out by a suitably qualified ecologist in line with best practice measures.

Removal of buildings

One abandoned cottage and associated outhouses was identified in Killeenmore adjacent to scheme measures Morr 16 and Morr 16a. Although not identified as requiring removal for construction for the proposed scheme, adopting a precautionary approach, mitigation has been specific in the event that demolition or other construction works on the abandoned cottage and associated outhouses are required.

The buildings must be subject to a visual inspection by a suitably qualified and licenced bat surveyor to identify bat roost potential and advise on additional surveys required. If potential bat roosts are identified then bat activity surveys will be required. If bats are found, the suitably qualified and licenced bat surveyor will advise on the appropriate course of action, including the need for application for a derogation licence from the NPWS.

Works to bridges

No construction or upgrade works to bridges have been identified for the proposed scheme, rather the works identified are either in relation to culverts but that may be associated with bridges, or embankment/wall tie ins to bridges which will not affect the underside of the bridge structure. However, adopting a precautionary approach, mitigation has been specified for any works to culverts or bridges adjoining or adjacent to culverts to ensure that any potential disturbance to potential roosting bats is considered prior to construction activities commencing and in the event that any works to bridges becomes apparent during construction.

The bridge must be subject to a visual inspection by a suitably qualified and licenced bat surveyor to identify bat roost potential and advise on additional surveys required. If potential bat roosts are identified then bat activity surveys will be required. If bats are found, the suitably qualified and licenced bat surveyor will advise on the appropriate course of action, including the need for application for a derogation licence from the NPWS.

Compensation for loss of commuting routes

Linear features such as hedgerows and treelines act as commuting corridors for bats (and other wildlife). Mitigation measures are recommended to compensate for the loss of these features that are used by bats as commuting routes. These measures will also compensate for habitat loss and provide continuity and connectivity in the landscape.

Existing hedgerows and treelines, semi-natural scrub or semi-natural grasslands should be retained where possible and incorporated into the landscaping programme. Where hedgerow or treeline removal is unavoidable, the severed linear features should, where possible, be reconnected using native hedgerow or tree species to compensate for the loss of hedgerows that are currently used by bats. The exact locations of such planting will be designed at detailed landscaping stage. Treelines are of far greater benefit to bats than single, free-standing trees or shrubs as they provide corridors for movement, avoidance of light and predators, a better shelter belt for the clustering of insects and provide greater substrate for insect breeding and feeding (bats food source). Native species of broadleaved trees are generally more beneficial to bats.

Lighting Restrictions

In general, artificial light creates a barrier for commuting bats so lighting should be avoided where possible. If any external lighting is required to facilitate night time working, security lighting in the proposed works areas or within the central base compounds, it must be sensitive to the presence of bats in the area. Directional lighting (i.e. lighting which only shines on work areas and not nearby countryside) shall be used to prevent overspill. This can be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvers and shields to direct the light to the intended area only. Lighting levels should be the minimum required for health and safety requirements, and vertical light spill at light sources should be below 3m to avoid potential bat flight paths.

Amphibians and Reptiles

The Construction Manager and Project Ecologist shall maintain a watching brief for frog spawn and frogs throughout construction works. If frog spawn is identified, this should be translocated to an alternative suitable habitat under derogation licence from the NPWS.

Birds

To limit the potential impact of construction on breeding birds, vegetation removal/trimming (including trees, treelines, hedgerow, woodland and) will not be permitted during the breeding bird season (1st March to 31st August inclusive). If this seasonal restriction cannot be accommodated, a suitably qualified ecologist with experience in nest-finding will be required to check all vegetation for nests (under licence from NPWS to permit potential disturbance to nesting birds) prior to removal/trimming.

10.5.2 Operational Phase

10.5.2.1 Protection of Waterbodies

Maintenance works for the proposed scheme have been identified as potentially giving rise to adverse effects on water quality in the Grand Canal pNHA, pNHAs located downstream of the proposed scheme and within Dublin Bay (Liffey Valley pNHA, Dolphins Dublin Docks pNHA, North Dublin Bay pNHA, South Dublin Bay pNHA, Howth Head pNHA and Booterstown Marsh pNHA). The effective protection of water quality within the proposed scheme during operational (maintenance) phase will minimise the risk to the ecological interests of this site and other water bodies within the Morell catchment. The measures outlined in Chapter 11 Biodiversity- Aquatic Ecology to ensure protection of water quality during operation, along with the requirement to implement current best practice for works at the time of maintenance will ensure the protection of waterbodies.

10.5.2.2 Habitats

General mitigation will involve implementation of current best practice for riparian works at the time of maintenance e.g. the OPW's Standard Operating Procedures for Arterial Drainage Maintenance Service (OPW, 2011) or any subsequent updates. No additional mitigation measures are required.

Invasive Species

Prior to undertaking any maintenance works along the scheme measures, the maintenance Contractor shall engage a suitable qualified ecologist to carry out an invasive plant species survey, in the appropriate botanical season (April through to September) and in advance of any maintenance works. This should entail a walkover of the scheme measures due for maintenance works to identify any stands of invasive plants species that may have become established in the intervening period between construction and maintenance. Particular attention should be given to identifying those invasive plant species listed on the Third Schedule of the Birds and Natural Habitats Regulations 2011 (as amended). If any invasive alien plant species are identified then the suitably qualified ecologist shall outline the appropriate course of action to be taken with regard to treatment during maintenance works.

During maintenance works, the introduction of invasive alien plant species (including Japanese Knotweed (*Fallopia japonica*)) will be avoided by ensuring that appropriate precautionary measures are in place.

- All plant and equipment employed on the site (e.g. excavator, footwear, etc.) must be thoroughly cleaned down using a power washer unit and washed into a dedicated and contained area prior to arrival on site to prevent the spread of invasive aquatic / riparian species such as Japanese Knotweed (*Fallopia japonica*) and Himalayan Balsam (*Impatiens glandulifera*). A sign off sheet must be maintained by the contractor to confirm cleaning.

- The treatment and control of invasive alien species will follow Guidelines for the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (NRA 2010), and any other best practice guidance which may become available in the interim.
- For any material entering the site, the supplier must provide an assurance that it is free of non-native invasive species.
- Should any invasive plant species be encountered, the infested areas will be clearly demarcated accounting for potential underground rhizome spread, creating an exclusion zone.
- Ensure all site users are aware of invasive species management plan and treatment methodologies. This can be achieved through “toolbox talks “before works begin on the site.
- Adequate site hygiene signage should be erected in relation to the management of non-native invasive material.

10.5.2.3 Fauna

Prior to undertaking any maintenance works along the scheme measures, the maintenance Contractor shall engage a suitably qualified ecologist to assess the potential ecological impact of the maintenance works (including but not limited to badgers, bats, otters, bird, water quality and invasive species) and identify potential constraints. Dependent on the extent of the works, this may require a survey of the scheme measures due for maintenance works to confirm presence/absence of species and to identify potential impact pathways that may exist between the maintenance works, access routes and flora and fauna.

The ecologist should be engaged in advance of works to allow adequate time for survey, monitoring if required, and developing measures to avoid ecological impacts where possible, and to propose mitigation measures for those impacts that cannot be avoided. Where appropriate, construction methodology for maintenance works should detail how water quality will be maintained throughout the maintenance works. All mitigation measures outlined should be in line with current best practice and national guidelines

10.6 CUMULATIVE IMPACTS

Cumulative effects can result from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location[4]. The analysis of cumulative effects presented in this report considers projects and landuses affecting or potentially affecting ecological receptors in the zone of influence of the proposed flood management scheme and whether the construction and operation of the proposed flood management scheme is likely to add to an overall significant effect upon them. A search of Kildare County Council Planning enquiry system (http://webgis.kildarecoco.ie/PlanningEnquiry/) was conducted in July 2017 for developments that may have a cumulative impact with the proposed flood management scheme. Projects, Plans and activities or landuses within the wider area that may act cumulatively with the proposed scheme and result in impacts on flora and fauna include:

[4] CIEEM (2016). Chartered Institute of Ecology and Environmental Management Guidelines for Ecological Impact Assessment in the UK and Ireland

- Kildare County Development Plan 2017-2023;
- Sallins Local Area Plan 2016-2022;
- Draft Clane Local Area Plan 2017-2023;
- M7 Naas Newbridge Upgrade and Sallins bypass scheme;
- Irish Water Proposed Capital Investment Plan for 2014 to 2016;
- Catchment Flood Risk Management Plans;
- Eastern RBD Management Plan;
- Waste water discharges or other IPC licenced discharges;
- Other planning applications within the proposed scheme area, mainly in relation to residential dwellings, many with site foul effluent treatment systems associated with them and some agricultural related applications.

There is a potential linkage for cumulative impacts with the plans/projects and activities listed above. This is would be mainly via changes to surface water quality e.g. through silt release, and some impacts in relation to habitat loss, if both the proposed scheme and the plans/projects and activities resulted in the aforementioned effects. However, it is not anticipated that the proposed scheme will result in any cumulative impacts, and this conclusion is based on the following:

- The measures incorporated into the construction methodology for the proposed scheme to ensure protection of all waterbodies and water quality (as outlined in Chapter 4 and Chapter 11);
- The requirement to adhere to current best practice for any works at the time of maintenance, e.g. the OPW's Standard Operating Procedures for Arterial Drainage Maintenance Service (OPW, 2011);
- The measures incorporated to protect habitats and species and to compensate for hedgerow and tree loss.

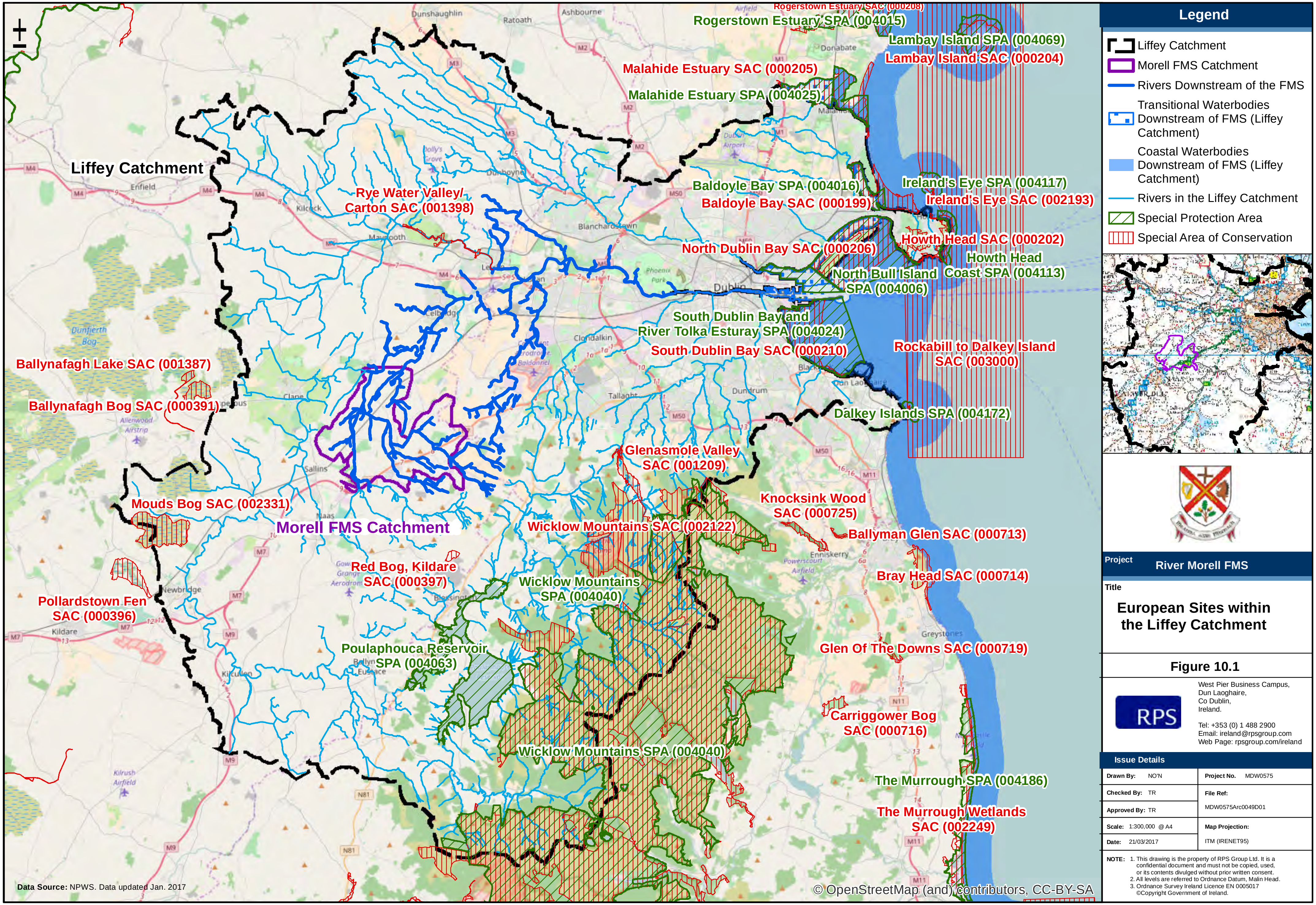
10.7 MONITORING

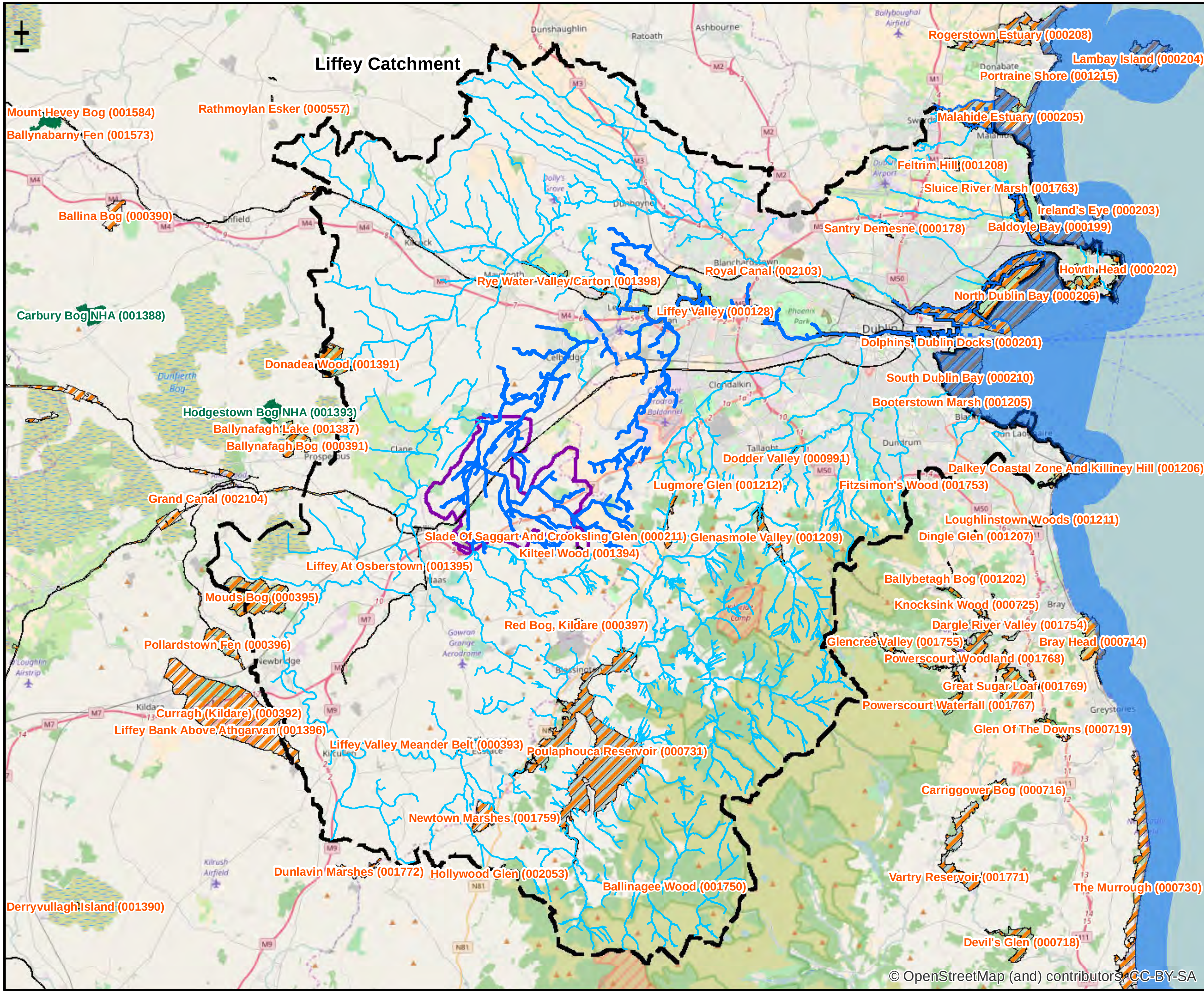
The mitigation measures provided in Section 10.5 are routinely applied in the construction and operational phases of development projects. Therefore, no monitoring to test the efficacy of the terrestrial ecology mitigation measures provided for the Morell River Flood Management Scheme is required. Separate water quality monitoring proposals have been recommended as part of Chapter 11.

10.8 RESIDUAL IMPACTS

Provided that the mitigation measures described in Section 10.5 are implemented in full then it is not anticipated that there will be any residual significant negative impacts on terrestrial habitats, flora or fauna as a result of the proposed scheme.

This page has been left intentionally blank.

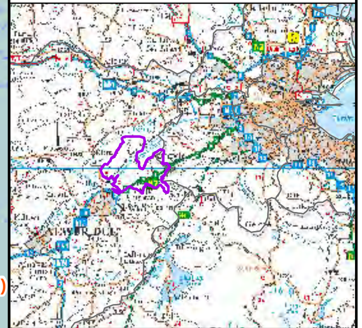

Liffey Catchment
Morell FMS Catchment
Rogerstown Estuary SAC (000208)
Rogerstown Estuary SPA (004015)
Lambay Island SPA (004069)
Lambay Island SAC (000204)
Malahide Estuary SAC (000205)
Malahide Estuary SPA (004025)
Baldoyle Bay SPA (004016)
Baldoyle Bay SAC (000199)
Ireland's Eye SPA (004117)
Ireland's Eye SAC (002193)
Rye Water Valley/
Carton SAC (001398)
North Dublin Bay SAC (000206)
Howth Head SAC (000202)
Howth Head
Coast SPA (004113)
North Bull Island
SPA (004006)
South Dublin Bay and
River Tolka Esturay SPA (004024)
South Dublin Bay SAC (000210)
Rockabill to Dalkey Island
SAC (003000)
Ballynafagh Lake SAC (001387)
Ballynafagh Bog SAC (000391)
Dalkey Islands SPA (004172)
Glenasmole Valley
SAC (001209)
Knocksink Wood
SAC (000725)
Mouds Bog SAC (002331)
Wicklow Mountains SAC (002122)
Ballyman Glen SAC (000713)
Red Bog, Kildare
SAC (000397)
Bray Head SAC (000714)
Wicklow Mountains
SPA (004040)
Pollardstown Fen
SAC (000396)
Poulaphouca Reservoir
SPA (004063)
Glen Of The Downs SAC (000719)
Carriggower Bog
SAC (000716)
Wicklow Mountains SPA (004040)
The Murrough SPA (004186)
The Murrough Wetlands
SAC (002249)
Data Source: NPWS. Data updated Jan. 2017
© OpenStreetMap (and) contributors, CC-BY-SA
Legend
Liffey Catchment
Morell FMS Catchment
Rivers Downstream of the FMS
Transitional Waterbodies Downstream of FMS (Liffey Catchment)
Coastal Waterbodies Downstream of FMS (Liffey Catchment)
Rivers in the Liffey Catchment
Special Protection Area
Special Area of Conservation
Project
River Morell FMS
Title
European Sites within the Liffey Catchment
Figure 10.1
RPS
West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.
Tel: +353 (0) 1 488 2900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland
Issue Details
Drawn By: NO'N
Project No. MDW0575
Checked By: TR
File Ref:
Approved By: TR
MDW0575Arc0049D01
Scale: 1:300,000 @ A4
Map Projection:
Date: 21/03/2017
ITM (IRENET95)
NOTE: 1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. Ordnance Survey Ireland Licence EN 0005017 ©Copyright Government of Ireland.



Legend

- Liffey Catchment
- Morell FMS Catchment
- Rivers Downstream of the FMS
- Transitional Waterbodies Downstream of FMS (Liffey Catchment)
- Coastal Waterbodies Downstream of FMS (Liffey Catchment)
- Rivers in the Liffey Catchment
- Natural Heritage Area (NHA)
- Proposed Natural Heritage Area (pNHA)

Data Source: NPWS. Data updated Nov. 2015



Project
River Morell FMS

Title
National Sites within the Liffey Catchment

Figure 10.2

RPS
West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 488 2900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

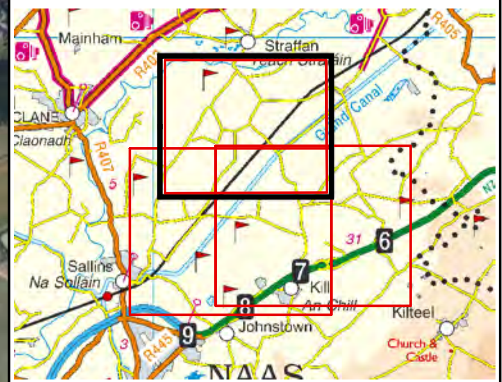
Drawn By:	NO'N	Project No.	MDW0575
Checked By:	TR	File Ref:	
Approved By:	TR		MDW0575Arc0048D01
Scale:	1:300,000 @ A4	Map Projection:	
Date:	21/03/2017		ITM (IRENET95)

NOTE: 1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. Ordnance Survey Ireland Licence EN 0005017 ©Copyright Government of Ireland.

Legend

Fossitt Code

- FW2
- WL1
- WL2
- BC1
- BL3
- FL8
- FW2
- GA1
- GA1, GS4
- GA2
- GM1, WN6
- GS1
- GS1, GS4
- GS2
- GS4
- GS4, GM1
- WD1
- WD3
- WN5
- WS1
- WS2
- Gunnera tinctoria Locations



Client
Kildare County Council

Project
River Morell FMS

Title
Habitat Map (Map 1 of 3)

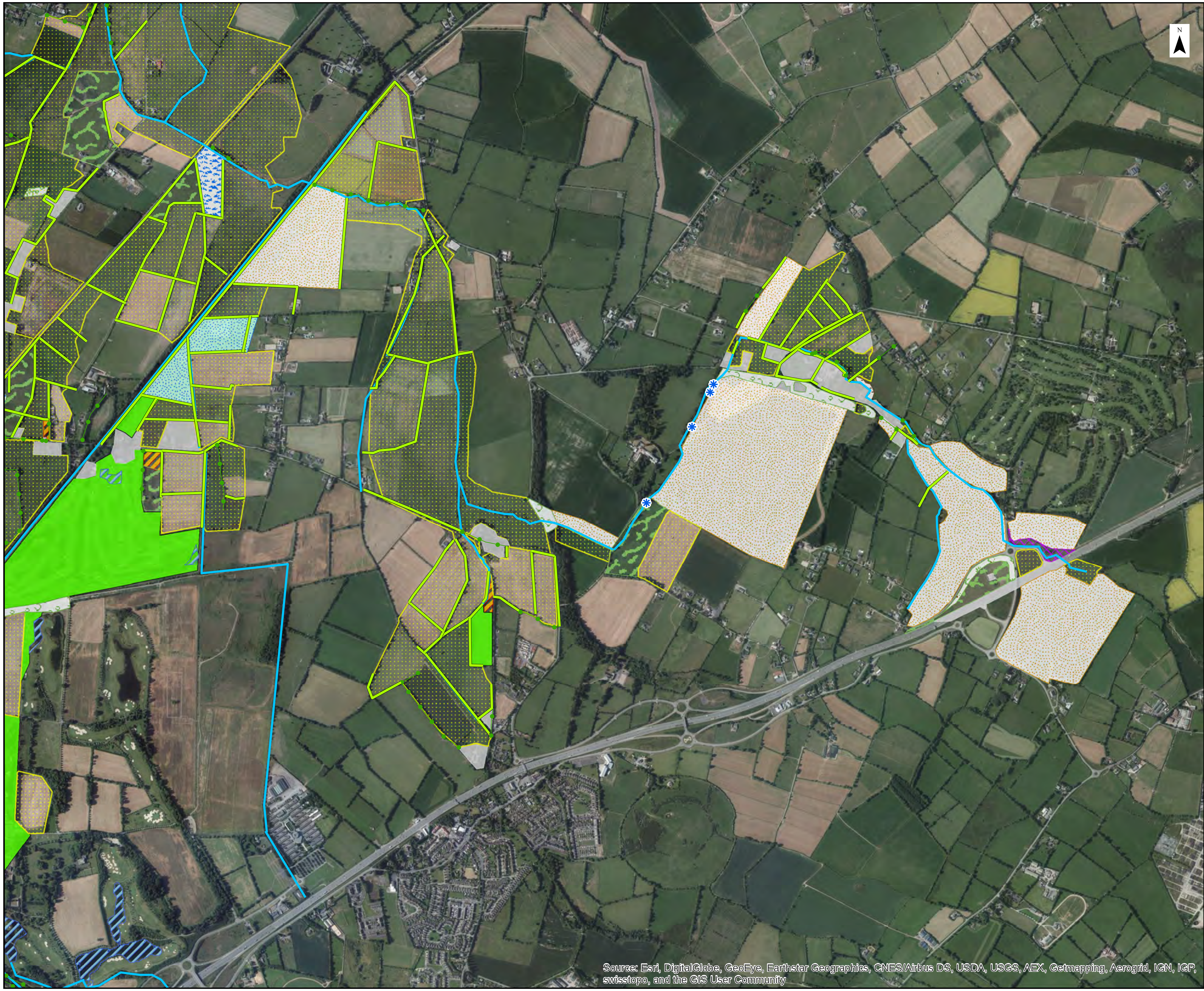
Figure 10.3

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 488 2900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

Drawn By: NO'N	Project No. MDW0575
Checked By: ACr	File Ref: MDW0575Arc0046A01
Approved By: CD	
Scale: 1:15,000 @ A3	Map Projection: ITM (IRENET95)
Date: 10/03/2017	

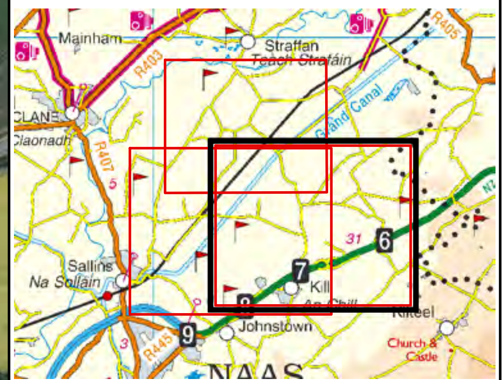


Legend

Fossitt Code

- FW2
- WL1
- WL2
- BC1
- BL3
- FL8
- FW2
- GA1
- GA1, GS4
- GA2
- GM1, WN6
- GS1
- GS1, GS4
- GS2
- GS4
- GS4, GM1
- WD1
- WD3
- WN5
- WS1
- WS2

Gunnera tinctoria Locations



Client
Kildare County Council

Project
River Morell FMS

Title
Habitat Map (Map 2 of 3)

Figure 10.4

RPS

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 488 2900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

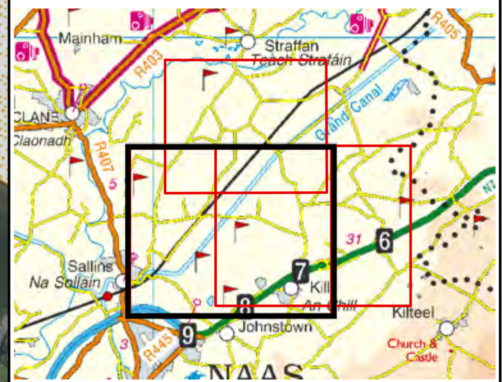
Drawn By: NO'N	Project No. MDW0575
Checked By: ACr	File Ref:
Approved By: CD	MDW0575Arc0046A01
Scale: 1:18,000 @ A3	Map Projection:
Date: 10/03/2017	ITM (IRENET95)

NOTE: 1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. Ordnance Survey Ireland Licence EN 0005017 ©Copyright Government of Ireland.

Legend

Fossitt Code

- FW2
- WL1
- WL2
- BC1
- BL3
- FL8
- FW2
- GA1
- GA1, GS4
- GA2
- GM1, WN6
- GS1
- GS1, GS4
- GS2
- GS4
- GS4, GM1
- WD1
- WD3
- WN5
- WS1
- WS2
- Gunnera tinctoria Locations



Client
Kildare County Council

Project
River Morell FMS

Title
Habitat Map (Map 3 of 3)

Figure 10.5

RPS
West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 488 2900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

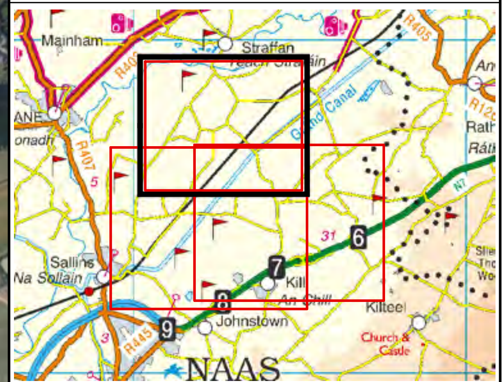
Issue Details

Drawn By: NO'N	Project No. MDW0575
Checked By: ACr	File Ref: MDW0575Arc0046A01
Approved By: CD	
Scale: 1:18,000 @ A3	Map Projection: ITM (IRENET95)
Date: 10/03/2017	

NOTE:
1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. Ordnance Survey Ireland Licence EN 0005017 ©Copyright Government of Ireland.

Legend

- Badger print
- Otter spraint
- Potential otter slide
- Building with bat roost features
- Tree with bat roost features
- Trees with bat roost features
- Mammal run



Client
Kildare County Council

Project
River Morell FMS

Title
Fauna Observations (Map 1 of 3)

Figure 10.6

RPS
West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 488 2900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

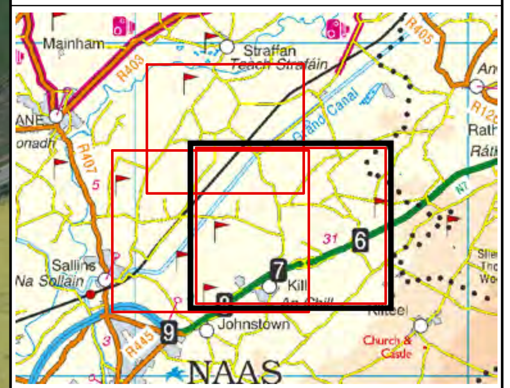
Issue Details

Drawn By:	NO'N	Project No.	MDW0575
Checked By:	ACr	File Ref:	MDW0575Arc0044A01
Approved By:	CD		
Scale:	1:15,000 @ A3	Map Projection:	ITM (IRENET95)
Date:	10/03/2017		

NOTE: 1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. Ordnance Survey Ireland Licence EN 0005017

Legend

- Badger print
- Otter spraint
- Potential otter slide
- Building with bat roost features
- Tree with bat roost features
- Trees with bat roost features
- Mammal run



Client
Kildare County Council

Project
River Morell FMS

Title
Fauna Observations (Map 2 of 3)

Figure 10.7

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

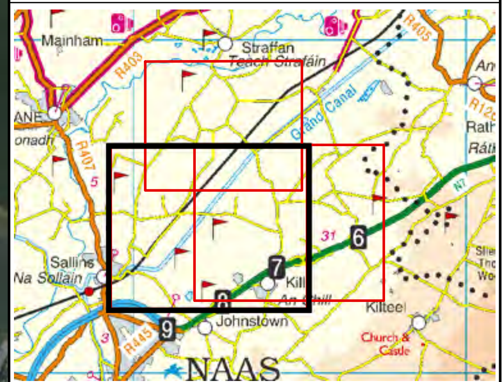
Tel: +353 (0) 1 488 2900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

Drawn By: NO'N	Project No. MDW0575
Checked By: ACr	File Ref: MDW0575Arc0044A01
Approved By: CD	
Scale: 1:18,000 @ A3	Map Projection: ITM (IRENET95)
Date: 10/03/2017	

Legend

- Badger print
- Otter spraint
- Potential otter slide
- Building with bat roost features
- Tree with bat roost features
- Trees with bat roost features
- Mammal run



Client
Kildare County Council

Project
River Morell FMS

Title
Fauna Observations (Map 3 of 3)

Figure 10.8

West Pier Business Campus,
Dun Laoghaire,
Co Dublin,
Ireland.

Tel: +353 (0) 1 488 2900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Issue Details

Drawn By: NO'N	**Project No.** MDW0575
Checked By: ACr	**File Ref:** MDW0575Arc0044A01
Approved By: CD	
Scale: 1:18,000 @ A3	**Map Projection:** ITM (IRENET95)
Date: 10/03/2017	

NOTE:
1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. Ordnance Survey Ireland Licence EN 0005017 ©Copyright Government of Ireland.

11 BIODIVERSITY - AQUATIC ECOLOGY

This Chapter of the EIAR assesses the impact of the proposed scheme on the natural environment in terms of biodiversity with a particular focus on Aquatic Ecology.

An Appropriate Assessment screening exercise has also been undertaken (RPS, 2017) in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011). The screening report is included as Appendix D, in Volume 3 of the EIAR.

The proposed scheme encompasses sections of the Liffey catchment along the Morell River (Upper and Lower) and the Morell tributaries Painestown, Kill and Slane Rivers (see Figure 1.1 in Chapter 1, 'Introduction' and Figure 4.1 in Chapter 4, 'Project Description').

11.1 METHODOLOGY

11.1.1 Desk Study

As part of the assessment the following data was accessed to understand the existing environment:

- Design descriptions and drawings of proposed scheme (See Chapter 4 'Project Description');
- Maps and aerial photography of the study area and relevant associated watercourses;
- Site synopses and qualifying interests for all of the water dependent protected areas within or adjoining the proposed development (source NPWS);
- EIA Scoping comments by Inland Fisheries Ireland
- A wide range of guidelines and best practice published by the OPW regarding the potential environmental impacts of drainage on the aquatic environment with particular reference to:
    - Environmental Management Protocols April 2011
    - Environmental Drainage Maintenance Guidance Notes (10 Steps to Environmentally Friendly Maintenance) April 2011; and
- Various online resources were used to assist the desktop study including:
    - National Biodiversity Data Centre Live Maps:
    - http://www.biodiversityireland.ie/biodiversitydata/access-biodiversity-data/
    - EPA ENVision Mapping: http://maps.epa.ie/InternetMapViewer/mapviewer.aspx
    - NPWS Maps and Data: http://www.npws.ie/mapsanddata/
    - WFD and River Basin Management site: http://www.wfdireland.ie/
    - OSI Mapviewer: http://maps.osi.ie/publicviewer/#V1,591271,743300,0,10
    - Geological Survey of Ireland online mapping: http://www.gsi.ie/mapping.htm

11.1.2 Consultation

As the statutory body responsible for the protection, management and conservation of Ireland's inland fisheries, Inland Fisheries Ireland (IFI), were consulted by RPS. Consultation between IFI and RPS took place in March and July 2015 to discuss the proposed scheme and appropriate mitigation measures along potentially impacted areas of the Morell Catchment.

IFI noted the following:

- The Morell River is an important fishery for Atlantic Salmon (listed on Annex II of the Habitats Directive) and that significant impacts on this species in particular should be avoided.
- IFI will require detailed design on proposals to alter culverts to increase flood capacity and also for proposals for stream realignment. Any alteration to culvert capacity must ensure the unimpeded passage of fish at all times. Permanent diversions are not encouraged, in limited circumstances they are permitted, the new channel must display hydraulic and morphological characteristics fulfilling the requirements of salmonid habitats.

The IFI also provided the results of electrofishing assessments conducted along the Morell Catchment from 2008 – 2012 (see Section 11.2.4).

Correspondence to the NPWS, as the statutory body responsible for protecting our natural heritage, was also issued on 23rd June 2015 and a response received on 28th July 2015. A summary of the response is contained in Chapter 2 of this EIAR, along with further details of Stage 1 consultation undertaken for the proposed scheme. Further discussions took place with IFI in October 2015 after additional design updates were proposed. Drawings of the Slane River diversion and also culvert upgrades along the Painestown and lower Morell River are included in Chapter 4.

11.1.3 Field Surveys

Surveys were carried out at each of the watercourses within the study area. Field surveys and walkovers undertaken on the 29th and 30th September, 2014, though slightly outside of the optimum survey period, provided satisfactory indication of the biodiversity of the site in the context of aquatic habitats and species present. Ideally, the more optimum period to conduct macroinvertebrate assessments is from May - August as invertebrate nymphs are more physically developed and easier to identify. Repeat surveys were conducted on 5th June 2015, within the optimum survey period, to validate September results. In January 2017, Otter signs were recorded during surveys carried out for terrestrial habitats (see Chapter 10.1.4) and these have been included within the assessment.

Select habitats and biological sampling points within the study area were investigated. Potential impact sites where natural resources, in particular soil, land, water and biodiversity could be directly impacted, i.e. near proposed embankments, culvert upgrades and walled areas were selected for survey using Arc GIS with OS 1:50,000 discovery series mapping. Detailed notes and photographs for fisheries assessments and targeted biological surveys to inform the biodiversity baseline were taken at these selected sites. Figure 11.1 presents a map showing locations of the aquatic survey sites.

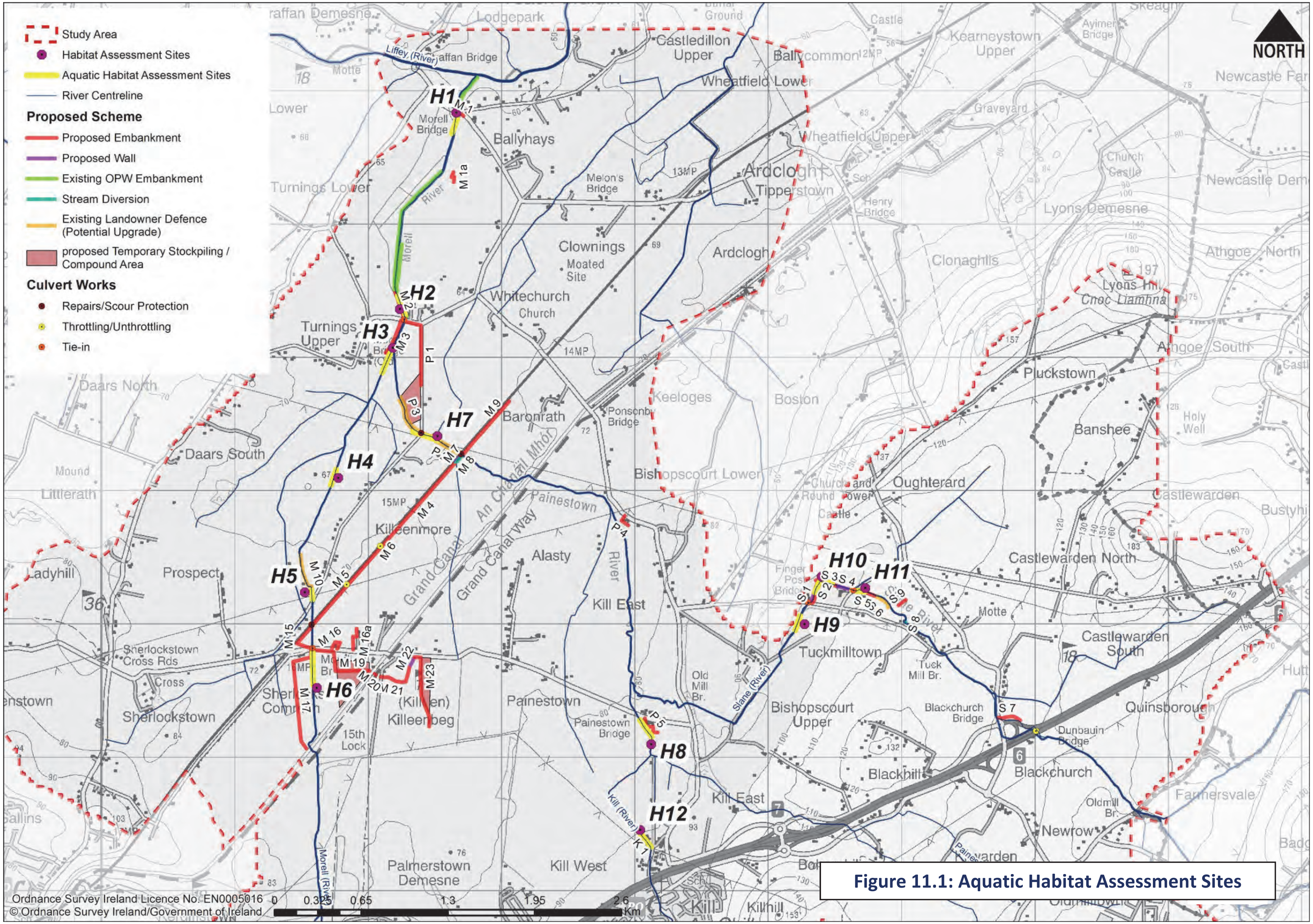


Figure 11.1: Aquatic Habitat Assessment Sites

11.1.4 Habitat Assessments

General physical characteristics and hydromorphological features were recorded including substrate, flow types and aquatic vegetation. These sites were assessed in terms of:

i. Stream width and depth;
ii. Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, silt, clays etc.;
iii. Flow type, listing sampling area type e.g. riffle, glide and pool;
iv. In-stream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site;
v. Dominant bankside vegetation, listing the main species overhanging the stream;
vi. Estimated cover by bankside vegetation, and estimated shading of the sampling site;
vii. The degree of siltation was recorded on a scale of clean, slight, moderate and heavy, prior to kick sampling;
viii. Grid references were recorded at all sites using a GPS: and
ix. Site photographs were taken using a digital camera.

11.1.4.1 Criteria Used For Assessment of Salmonid Quality

Each stream habitat section was rated for the different life stages of salmonid fish based on features listed in Section 11.1.4 above, points i-v.

The more diverse the stream habitat in terms of substrate, flow rate, depth, riparian vegetation, light conditions etc., the richer the biological community is likely to be, and the more suitable it is likely to be for salmonid fish (trout and salmon).

Assessment of the quality of salmonid spawning habitat, nursery habitat and adult habitat is based on personal expertise and on published information from Bjorn and Reiser 1991 such as the following:

- Favourable locations for salmon spawning are likely to occur where the gradient of a river is 3% or less;
- Typical spawning sites are the transitional areas between pool and riffle where flow is accelerating and depth decreasing, where gravel of suitable coarseness is present and interstices are kept clean by up-welling flow;
- Salmon fry and parr occupy shallow, fast-flowing water with a moderately coarse substrate with cover;
- Deep or slow-moving water, particularly when associated with a sand or silt substrate, does not support resident juvenile salmonids;
- Suitable cover for juveniles includes areas of deep water, surface turbulence, loose substrate, large rocks and other submerged obstructions, undercut banks, overhanging vegetation, woody debris lodged in the channel, and aquatic vegetation; and
- The juxtaposition of habitat types is also important. The proximity of juvenile habitat to spawning gravels may be significant to their utilisation. In addition, adults require holding pools immediately downstream of spawning gravels in which they can congregate prior to

spawning. Cover for adult salmon waiting to migrate or spawn can be provided by overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water and surface turbulence (Bjorn and Reiser 1991).

11.1.4.2 Criteria Used For Assessment of Lamprey and Crayfish Habitat Quality

Each stream habitat section was also rated as habitat for lamprey and crayfish based on features listed in Section 11.1.4, points 1-5.

Lamprey habitat preferences change with the stages of their life cycle. They show a preference for gravel-dominated substratum for spawning. After hatching, the larvae swim, or are washed downstream by the current, to areas of sandy silt in still or slow flowing water where they burrow and spend the next few years in tunnels. Lampreys therefore require mainly silt and sand dominated substratum for nursery habitat. Other important environmental characteristics for optimal ammocoete habitat are shallow waters with low water velocity, and the presence of organic detritus and/or plant material. Suboptimal habitat supporting only a few individuals may consist of a few square centimetres of suitable silt in an open, comparatively high-velocity, boulder-strewn streambed. Spate rivers with high flow velocities tend to support fewer ammocoetes because they contain smaller areas of stable sediment (Maitland, 2003).

11.1.5 Benthic Macroinvertebrate Sampling

Samples were taken using a 2-minute ‘kick’ sampling method in the fast flowing (riffle) areas of the streams/rivers using a standard hand net (250 mm width, mesh size 1 mm). Survey technique adhered to the ISO Standard for kick sampling and utilised EPA protocol and recording sheet. Stone washing was undertaken to ensure that species that cling to stone surfaces – e.g. leeches and gastropods were adequately collected. Macroinvertebrates were identified at the stream bank and returned to the stream on completion of analysis.

The Biotic Index of Water Quality (BIWQ) was developed in Ireland by the Environmental Protection Agency (EPA). Q-values and water quality classes are assigned using a combination of habitat characteristics and structure of the macroinvertebrate community within the waterbody. Individual macroinvertebrate species are ranked for their sensitivity to organic pollution and the Q-value is assessed based, primarily, on their relative abundance within a biological sample. EPA indices, EPA water quality status and WFD status are interpreted in Table 11.1.

Table 11.1: EPA Q-Rating and equivalent WFD Water Quality Status Classes

Biotic Index	EQR[1]	EPA Quality Status	Water Quality	WFD[2] Status
Q5	1.0	Unpolluted	Good	High
Q4-5	0.9	Unpolluted	Fair-to-Good	High
Q4	0.8	Unpolluted	Fair	Good
Q3-4	0.7	Slightly Polluted	Doubtful-to- Fair	Moderate
Q3	0.6	Moderately Polluted	Doubtful	Poor
Q2-3	0.5	Moderately Polluted	Poor-to-Doubtful	Poor
Q2	0.4	Seriously Polluted	Poor	Bad
Q1-2	0.3	Seriously Polluted	Bad-to-Poor	Bad
Q1	0.2	Seriously Polluted	Bad	Bad

(Colour coding as employed under the WFD as specified in Schedule 3 of S.I. No 272 of 2009: High – blue, Good – green, Moderate – yellow, Poor – orange, and Bad – red)

The Environmental Quality Ratio or EQR represents the relationship between the values of the biological parameters observed for a given body of surface water and the values for these parameters in the reference conditions applicable to that body. The ratio is expressed as a numerical value between zero and one, with high ecological status represented by values close to one and bad ecological status by values close to zero. In Ireland it is calculated as Observed Q-value/Reference Q-value (i.e., Q5). The EQR allows comparison of water quality status across the European Union as each member state has an EQR value for 'High'; 'Good' etc., based on an intercalibration of boundaries between water quality categories e.g., 'High-Good'; 'Good–Moderate'.

11.1.6 Otter (*Lutra lutra*) Observations

During habitat assessments, observations were carried out along river banksides for Otter signs. Observations for spraints (and other signs, such as footprints, fish remains, slides, etc.) were recorded over select study habitats. Further detail on Otter is given in Section 11.2.5.

11.1.7 Biodiversity and Ecological Valuation for Aquatic Resources

Values were assigned to the receiving watercourses on the basis of their known (or perceived) rarity, status and distribution. This involved consideration of contextual information for the resource at a geographic level (NRA, 2009).

Observations and biological sample results were assessed in the context of national trends, guidelines and standards and EU (WFD) standards as appropriate. In the absence of any standards or guidelines, scientific literature was consulted. Table 11.2 shows the Ecological valuation of Aquatic Resources (adapted from NRA, 2009), which details criteria used to classify sites in these assessments.

[1] EQR = Environmental Quality Ratio (Observed/Reference)
[2] WFD = Water Framework Directive (EPA, 2006)

Table 11.2: Biodiversity/Ecological Valuation Criteria for Aquatic Resources (adapted from NRA, 2009)

Relevant Criteria	Classification
International Importance: 'European Site' including Special Area of Conservation (cSAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation. Features essential to maintaining the coherence of the Natura 2000 Network. Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. Resident or regularly occurring populations (assessed to be important at the national level) of species of animal and plants listed in Annex II and/or IV of the Habitats Directive. Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988). Major salmon river fisheries.	**A**
National Importance: Site designated or proposed as a Natural Heritage Area (NHA). Statutory Nature Reserve. Refuge for Fauna and Flora protected under the Wildlife Acts. National Park Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. Resident or regularly occurring populations (assessed to be important at the national level) of species protected under the Wildlife Acts; and/or; species listed on the relevant Red Data list. Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive. Major trout river fisheries. Commercially important coarse fisheries. Sites of 'High' water quality status (Q4-5, Q5). Waterbodies with high amenity value.	**B**
County Importance: Area of Special Amenity. Area of High Amenity, or equivalent, designated under the County Development Plan. Resident or regularly occurring populations (assessed to be important at the County level) of species of animal and plants listed in Annex II and/or IV of the Habitats Directive, and/or; species protected under the Wildlife Acts; and/or; species listed on the relevant Red Data list. Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance.	**C**
Local Importance (higher value): Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of species of animal and plants listed in Annex II and/or IV of the Habitats Directive, and/or; species protected under the Wildlife Acts; and/or; species listed on the relevant Red Data list. Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality. Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value. Water body with some fisheries values and potential salmonid habitat.	**D**
Local Importance (lower value): Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; Sites or features containing non-native species that are of some importance in maintaining habitat links. Waterbody with no fisheries value and poor fisheries habitat.	**E**

11.1.8 Impacts Assessment and Level of Significance

Each of the proposed scheme elements have the potential to impact on the freshwater aquatic environment and therefore biodiversity and in turn the downstream environments of the River Liffey. This concurs with most recent NRA Guidelines which state: "*Whilst the EcIA process should focus only on likely significant impacts, any effects on a European site may need to be the subject of further investigations and actions*"(p.15, NRA, 2009).

All impacts that could arise from the proposed scheme elements were assessed. Assessments were carried out in line with International and National Guidelines for EcIA including CIEEM 2006 and NRA (2009). The magnitude, extent, timing and duration of potential impacts have been considered as well as their likelihood of occurring using the following scale (CIEEM, 2006):
C

- **Certain/near-Certain**: probability estimated at 95% chance or higher;
- **Probable:** probability estimated above 50% but below 95%;
- **Unlikely:** probability estimated above 5% but less than 50%, or
- **Extremely Unlikely**: probability estimated at less than 5%.

Special consideration was given to the prediction of how the proposed scheme elements may affect the *integrity* of the downstream SPA and SAC and the *conservation status* of Annex I habitats and Annex II species. Overall, impact types and levels of significance were assigned according to the terminology of EPA (2002).

11.1.9 Characterising Impacts

The methodology for the assessment of impacts is derived from the Guidelines for Ecological Impact Assessment (CIEEM, 2006). When describing changes/activities and impacts on ecosystem structure and function, reference should be made to the following parameters.

Positive or negative: Is the impact likely to be positive or negative? Positive impacts merit just as much consideration as negative ones, as international, national and local policies increasingly press for projects to deliver positive biodiversity outcomes.

Magnitude: 'Magnitude' should be predicted in a quantified manner wherever possible and relates to the quantum of an impact, for example the number of individuals affected by an activity.

Extent: 'Extent' should also be predicted in a quantified manner and relates to the area over which the impact occurs. Where the receptor is an area of a particular plant community for example, Extent=Magnitude.

Duration: 'Duration' is intended to refer to the time during which the impact is predicted to continue, until recovery or re-instatement (which may be longer than the impact-causing activity). This should be quantified wherever possible, and interpreted in relation to the ecological processes involved rather than on a human timescale.

Reversibility: 'Reversibility' should be addressed by identifying whether an impact is ecologically reversible (either spontaneously or through specific action) and whether such an outcome is likely.

Timing and frequency: The timing of impacts in relation to important seasonal and/or life-cycle constraints should be evaluated. Similarly, the frequency with which activities (and concomitant impacts) would take place can be an important determinant of the impact on receptors and should also be assessed and described.

11.2 RECEIVING ENVIRONMENT

11.2.1 Desktop Study

The Morell catchment in County Kildare is situated within the Eastern River Basin District (ERBD), Hydrometric Area (HA)/Unit of Management (UoM) 09. The main rivers in the catchment are the Morell River (itself a tributary of the River Liffey) and its tributaries the Painestown, Slane and Kill rivers. The Grand Canal flows through the catchment from northeast to southwest. The catchment has been subject to flooding for many years, with both properties and agricultural lands affected.

The upper extent of the works are at culverts under the N7 where the Kill River and Slane River intersect the N7. The lower extent of the works is at the Morell Bridge at Ballyhays. The length of channel between these two points is 7.6 kilometres via the Kill River and 10.4 kilometres via the Slane River. The contributing catchment in relation to this stretch of channel is approximately 40 km^2 in area (including the tributaries).

The focus, in terms of field studies to inform the aquatic ecology biodiversity baseline, was on the Morell River and its tributaries that are subject to works under the proposed scheme. The aquatic element of the Morell catchment has been separated into five components for the purpose of this assessment, they include:

- Morell River (Lower)
- Morell River (Upper)
- Kill River
- Painestown River; and
- Slane River.

Each of the five study areas listed above have each been assigned habitat sites, twelve in total across all of the study areas, as shown in Figure 11.1. Each habitat site was assessed in terms of potential fishery value and ecological characteristics. Results of habitat assessments are described in detail in Section 11.2.7 and presented in Appendix E of this EIAR.

11.2.2 Designated Sites

Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) are designated under the EU Habitats Directive (92/43/EEC) and the EU Birds Directive (79/409/EEC), respectively, and as such form part of the Natura 2000 network of sites. Natural Heritage Areas (NHAs) are legally protected from damage from the date they are formally proposed for designation under the Wildlife (Amendment) Act 2000, while proposed Natural Heritage Areas (pNHAs) have not been statutorily proposed or designated, but do receive some protection under the Rural Environment Protection Scheme (REPS), Coillte and Planning and Licensing Authorities.

Table 10.1 in Chapter 10 'Terrestrial Ecology' lists all of the European sites and pNHAs within 15km of the proposed scheme.

There are no Special Areas of Conservation (SACs) within or near the study site. The nearest SAC to the proposed scheme is Red Bog, Kildare SAC (NPWS Site Code: 000397), located more than 5km to the south and upstream of the boundary of the proposed scheme. There are no Special Protection Areas (SPAs), designated for internationally important populations of birds, within or near the study site. The nearest designated SPA to the proposed scheme is Poulaphouca Reservoir SPA (NPWS Site Code: 004063) located *c*. 9km south-east and upstream of the boundary of the proposed scheme.

There is no hydraulic connectivity between any of the European sites listed in Chapter 10 and the study area. However the nearest pNHA to the proposed scheme is the Grand Canal pNHA (NPWS Site Code: 002104) which transects the Morell River at Sherlockstown Common. All aquatic designated sites, with direct hydraulic connectivity to the scheme, are presented in Table 11.3 and illustrated in Figure 11.2.

Table 11.3: Aquatic Designated Sites within 15km of the Proposed Scheme

Designated Area	Designation and Site Code	Site Description	Approximate Distance from Boundary of Proposed Scheme
Grand Canal	pNHA (002104)	NPWS Site Synopsis unavailable	Transects Morell catchment at Sherlockstown Common
Liffey Valley	pNHA (000128)	NPWS Site Synopsis unavailable	10.4km north-east (downstream)

11.2.3 Morell River Water Quality

11.2.3.1 Water Framework Directive Risk Assessment

A Pressures and Impacts assessment of human activity on surface waters (and groundwater) was conducted under Article V of the WFD to identify those water bodies that may be at risk of failing to meet the Directive's environmental objectives. The risk categories employed in the first cycle of the WFD (2009 – 2015) in Ireland were revised by EPA for the second WFD cycle (2015 – 2021). A new approach was taken in an attempt to attribute more specific measures to waterbodies which are either not currently meeting their required WFD objectives, or are at risk of such. This approach involved an in-depth analysis of existing biological and chemical monitoring data to determine current ecological status, the distance to relevant quality thresholds (Environmental Quality Standards (EQS) as set out in the Surface Water Regulations (S.I. No. 272 of 2009)) and any significant trends apparent in the data. Input was then sought from Local Authorities and other relevant stakeholders to identify the key pressures acting upon individual waterbodies and throughout catchments as a whole in order to assign the most appropriate further measures required to meet WFD Objectives. A summary of the risk status categories is presented in Table 11.4 below and the risk for the water bodies affected by the scheme is included in Table 11.5.

Table 11.4: WFD Risk Categories

Risk Category	WFD Classification
At Risk	At risk of not achieving Good Status
Not At Risk	Currently achieving Good Status
Review	Expected to achieve Good Status
Unassigned	Monitoring data or donor waterbody required

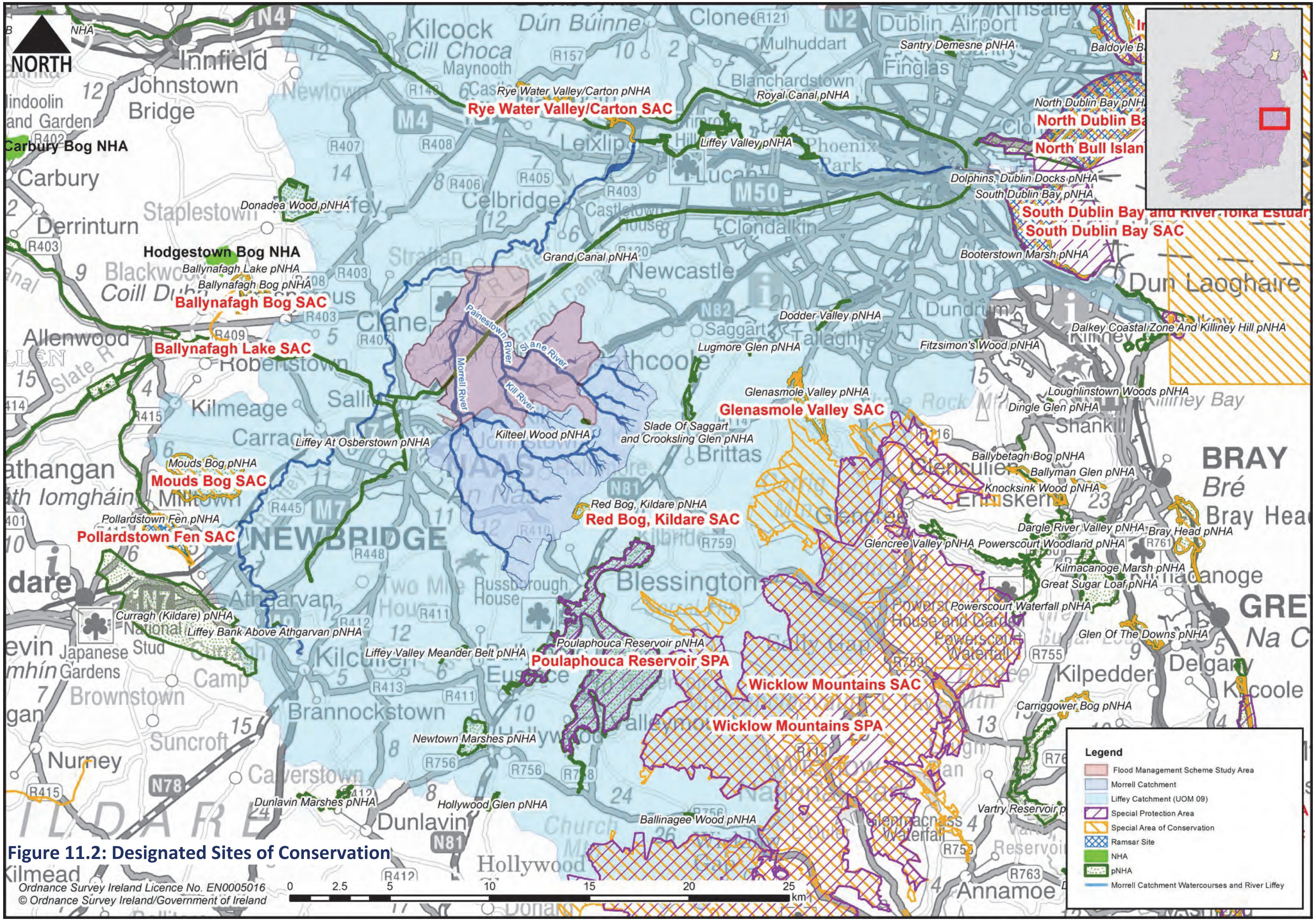


Figure 11.2: Designated Sites of Conservation

11.2.3.2 Surface Water Quality

Surface water body (river, lakes, transitional and coastal waters) monitoring is conducted by the EPA as part of WFD national surface water quality monitoring programme. Water bodies are classified, in accordance with the WFD, on the basis of a combination of ecological status (a combination of biological status, and the supporting elements of hydromorphology and physico-chemical parameters) and chemical status. The overall status of a water body is classified into one of five classes, as per Schedule 3 of the Surface Water Regulations 2009 (S.I. No. 272) (see Table 11.5). The first three year cycle of WFD monitoring was undertaken between 2007 and 2009, the second three year cycle between 2010 and 2012 and the most recent cycle completed between 2013 and 2015. Available results are documented on the EPA website http://gis.epa.ie/Envision. The 2013 - 2015 results for the Morell catchment are presented in Table 11.5.

Table 11.5: EPA Q-Rating and Equivalent WFD Water Quality Status Classes Morell River Catchment 2013-2015 (*Source: EPA ENVision online map viewer*)

River Stretch	WFD Waterbody	WFD Risk	WFD Status (2010 -2015)	Biological Water Quality (Q-Value)	EQR Rating
Morell (Upper)	Morell_030	At Risk	Moderate	Q3-4	0.7
Morell (Lower)	Morell_040	Not At Risk	Good	Q4	0.8
Slane	Morell_040	Not At risk	Good	N/A	0.7
Painestown	Morell_040	Not At risk	Good	N/A	0.7
Kill	Painestown_010	At Risk	Moderate	Q3-4	0.7

As presented in Table 11.5, EPA 2010- 2015 Q-Value results classify the Morell River(Lower) at a value of Q4: Unpolluted Quality Status with the remaining Morell River tributaries classified at a slightly lower value of Q3-4: Moderate Quality Status. Biological quality values, as a measure of biodiversity, are based on assemblage and diversity of macroinvertebrates. The higher quality value at Morell River (Lower) would indicate a less polluted habitat with slightly reduced pollutant influences surrounding this section of the Morell River. The increased numbers and diversity of more pollutant sensitive macroinvertebrates would clearly indicate this section of the Morell to be a cleaner habitat and more likely to support greater salmonid and lamprey activity as well as better conditions for Otter foraging.

A WFD Assessment, based on the methodology employed by the Northern Ireland Environment Agency (NIEA) (NIEA, 2012) has been included in Appendix I. This assessment looks at the potential impacts of the different components of the proposed works with specific regard to compliance with objectives outlined under WFD. The assessment indicates that compliance with WFD objectives will be attainable provided suitable mitigation (as outlined in Schedule B of the Assessment) is undertaken.

11.2.4 Morell River Fisheries

The rivers in the catchment are not designated under national or European legislation for fisheries protection. However, the Morell River is an extremely productive tributary of the Liffey and is a nationally highly important salmonid system which should be protected (*Pers. Comm.* Paddy Gargan IFI Officer). Salmon spawn within the river annually and it supports a resident population of Brown trout and migratory populations of Sea trout (*Salmo trutta*) and Atlantic salmon (*Salmo salar*), the latter listed under Annex II and V of the EU Habitats Directive. Thus it is important to note that salmonid waters constraints apply to any development in this area. Fishery habitat is regarded as particularly good for all salmonid life stages throughout much of the Morell system. Similary, the tributaries of the Morell River (the Painstown, Kill and Slane rivers) are important salmonid rivers. Consideration of these sensitive species is important when considering any development within the catchment.

The importance of the Morell to the overall fisheries productivity and biodiversity in the Liffey Catchment cannot be overstated. This tributary also supports populations of the Freshwater Crayfish (*Austropofamobius pallipes*) and Lamprey (*Lampetra sp.*) species, listed under Annex II of the EU Habitats Directive (*Pers. Comm* Paddy Gargan IFI Officer). In terms of natural resources only clean, uncontaminated water should leave the site and drain to the river network. Preventing any polluting matter from entering this important river system must be a key component of the proposed scheme.

The most recent published data for the Morell River and its tributaries is that undertaken by Inland Fisheries Ireland as part of the WFD fisheries surveys between 2008 and 2012. IFI quantitative fish data was provided to RPS and is summarised in the following sections.

Fish stocks were counted after a five minute electrofishing assessment along collective stretches of the Morell Catchment. Table 11.6, Table 11.7 and Table 11.8 present results obtained along the Morell River (Lower), Morell River (Upper) and the Painestown River, respectively.

Table 11.6 present collective results obtained across four separate stations along the Morell River (Lower), Morell Bridge at Ballyhays, Turnings Lower, and two stations at Morell Bridge (Old). Table 11.7 presents collective results obtained from one station along the Morell River (Upper) at the Morell Bridge downstream of Sherlockstown Common and Table 11.8 presents collective results obtained from four stations along the Painestown River.

Table 11.6: IFI stock survey results for Morell River (Lower)

Morell River (Lower)	2008	2009	2010	2011	2012
Trout (Fry)	8	20	42	21	1
Salmon (Fry)	64	10	25	26	11
Crayfish	0	0	0	0	0
Minnow	0	0	2	0	0
Stone Loach	0	0	0	0	0
3-Spined Stickleback	0	0	0	1	0

Table 11.7: IFI stock survey results for the Morell River (Upper) (N/S - Not Sampled)

Morell River (Upper)	2008	2009	2010	2011	2012
Trout (Fry)	4	13	N/S	16	N/S
Salmon (Fry)	15	0	N/S	0	N/S
Crayfish	0	0	N/S	0	N/S
Minnow	0	0	N/S	0	N/S
Stone Loach	0	0	N/S	0	N/S
3-Spined Stickleback	0	0	N/S	0	N/S

Table 11.8: IFI Stock Survey Results for the Painestown River (N/S - Not Sampled)

Painestown River	2008	2009	2010	2011	2012
Trout (Fry)	N/S	8	14	38	10
Salmon (Fry)	N/S	3	38	0	16
Crayfish	N/S	1	0	0	0
Minnow	N/S	0	1	0	0
Stone Loach	N/S	1	0	0	0
3-Spined Stickleback	N/S	0	0	0	0

As presented in the previous tables, fish stock counts for all three areas sampled did not appear to vary considerably. It is difficult to make accurate comparisons based on the above results given that 2010 and 2012 surveys for Morell River (Upper) were not carried out. Also 2008 surveys were not conducted along the Painestown River.

2009 and 2011 surveys across all three sites show that Morell River (Lower) as a natural resource supports slightly greater numbers of Trout and Salmon compared to Morell River (Upper) and Painestown River indicating a marginally cleaner habitat. For 2010-2015 EPA Q-Value Surveys, the Morell River (Lower) was calculated at Q-Value 4: Unpolluted Class compared with a value of Q-3-4: Moderate Class for the remaining Morell tributaries. This classification is in line with IFI results which show Morell River (Lower) to provide a slightly cleaner and unpolluted habitat for salmonid populations.

11.2.5 Morell River Mammals

Otter are listed on Annex II and Annex IV of the EU Habitats Directive and are also protected by the Wildlife Act (1976 and 2000 as amended). Annex II species under the Habitats Directive; require the designation of protected areas by Member States (Special Areas of Conservation) as set out in Article 3, 4 and 6 of the Directive. Annex IV species require strict protection measures by Member States in accordance with Article 12 of the Directive, the Eurasian Otter is also listed on Appendix 1 of CITES and Appendix II of the Bern Convention. The Irish population is also listed in the 'Irish Red Data Book 2: Vertebrates' as being of international importance.

They require suitable bankside vegetation as cover for their burrows or rest sites. Their underground shelters are called holts and above ground sites are called *couches*. Otters may dig their own holts but they very often make use of other structures ranging from enlarged rabbit holes and cavities amongst tree roots to rock piles and man-made structures.

Otters mark their home ranges by depositing their droppings termed "spraints", at distinct landmarks such as grassy mounds, large rocks or ledges under bridges. These favoured sites are known as seats and are usually found at important locations, i.e. access points to the water, good fishing grounds. Other signs, such as footprints, fish remains, slides, etc. are also recorded to establish how this important species contributes to the biodiversity of the site.

Although there are no seasonal requirements for Otter surveying, dense vegetation in areas along the riverbanks of the Morell Catchment may reduce success in the identification of Otter holts and couches. In addition spraints may also have been washed away following a period of heavy rain fall or flooding.

Signs were searched for on the banks of rivers and streams during aquatic ecology surveys September 2014, June 2015 and during terrestrial habitat surveys in January 2017. Holts and signs of otter activity were searched for in the banks of the rivers and islands within the watercourses during aquatic surveys.

There were a number of records of Otter activity on the Morell and Painestown rivers and with the exception of H4 all aquatic habitat survey areas H1 – H8 on the Morell and Painestown rivers noted that the habitat was suitable for foraging and potential holt sites. Sites H9-H12 on the Slane and Kill Rivers also noted moderate potential for foraging and potential holt sites. The evidence suggests that otters commute/forage in the area, and it is possible, given the potential of at least 3 holts, that they breed in the area. The observations of Otter activity within the study area are provided in Table 11.10 - Table 11.14.

11.2.6 Habitat Classification of Study Area (Fossitt)

Aquatic Habitats within the study area were classified according to the Guidelines set out in *'A Guide to Habitats in Ireland*' (Fossitt, 2000). The aquatic habitats found within the study area, their corresponding habitat codes (in accordance with Fossitt Level 3) and their ecological value is detailed in Table 11.9.

Table 11.9: Habitat Types within the Proposed Scheme Catchment

Habitat Type	Fossitt Code	Ecological Interest	Rationale
Depositing/ lowland rivers (**See Image 11.1**)	FW2	National Importance	Rivers, or sections of these, which deposit fine sediments on the river bed, are classified as 'Lowland Depositing Rivers' (FW2). These watercourses are generally found in lowland areas with low gradients where water flow is sluggish. Morell is an important salmonid system holding significant populations of Atlantic salmon, (Annex II and V of the Habitats Directive) Sea trout, Brown trout, Lamprey and Crayfish (both Annex II species). The Morell is hugely important in terms of its valuable salmonid spawning and nursery habitat contribution to the Liffey main channel.
Canals (**See Image 11.2**)	FW3	National Importance	A number of different habitats are found within the canal boundaries - hedgerow, tall herbs, calcareous grassland, reed fringe, open water, scrub and woodland. The ecological value of the canal lies more in the diversity of species it supports along its linear habitats than in the presence of rare species.

Image 11.1: FW2 Habitat - Morell River (Lower)

Image 11.2: FW3 Habitat- Upstream view of Grand Canal between Killeenbeg and Sherlockstown Common

11.2.7 Field Habitat Survey Results

Habitat and biological water quality assessments were carried out in September 2014 and June 2015, along with further observations for Otter activity carried out between 24th to 26th January 2017. A total of twelve aquatic habitat sites were assessed for fishery value. Biological Q-Value assessments were also carried at each of the twelve sites to classify the existing biodiversity conditions in the context of aquatic ecology.

Appendix E contains the species lists and species abundance recorded for each habitat site. Table 11.10 to Table 11.14 presents the Q-Value rating for each habitat site sampled. The results showed little difference between all twelve locations. Q-Values varied between:

- Q4, or 'unpolluted' quality rating, with an EQR of 0.8 equating to potential 'Good' WFD status to:
- Q3-4, or 'slightly polluted' quality rating, with an EQR of 0.7 equating to potential ' Moderate' Status

These results concur with the most recent EPA monitoring data from this stretch of the Morell Catchment as summarised in Table 11.5.

The sections within the catchment were further divided into habitat sections and assessed for:

- Biological Quality (Q-Value) Assessment;
- Salmonid, Lamprey and Crayfish Potential; and
- Otter Observations

11.2.7.1 Morell River (Lower)

This section of the Morell Catchment is potentially impacted by the proposed measures Morr 1 - Morr 4, Morr 10 and Culvert 5. Morell River (Lower) runs from the townland of Killeenmore in a northerly direction downstream flowing east of Turnings Upper and meandering North West of Ballyhays towards the Morell Bridge just at the start of Morr 1.

Five sites were selected for aquatic ecology and biodiversity assessment along this section of the route. They are:

- Habitat Site 1 (H1) - Located at Morell Bridge - Ballyhays;
- Habitat Site 2 (H2) - Located at Morell Bridge (Old) - East of Turnings Upper;
- Habitat Site 3 (H3) - Located approximately 300m upstream of Morell Bridge (Old) at Painestown River confluence point;
- Habitat Site 4 (H4) - Located 1km upstream of H3. West of Killeenmore; and
- Habitat Site 5 (H5) - Located 1km upstream of H4. Southwest of Killeenmore.

A corresponding biological Q-Value measurement was taken within each habitat assessed. Figure 11.1 illustrates the location of each habitat site along this section of the proposed scheme Catchment. Table 11.10 presents aquatic ecology assessments for Morell River (Lower) habitat sites.

Table 11.10: Aquatic Ecology Assessment along the Morell River (Lower) Habitat Sites

Habitat Code	Habitat Characteristics	Potential Annex II Species / Supporting Habitat	Fishery Value	Q-Rating	Evaluation (see Table 11.2)
H1	-Shallow, clear river stretch with a moderate to fast flow over a riffle type habitat and a compacted substratum comprised of predominantly cobble, boulder, gravel, sand and silt. -Depth varies from 0.2- 1m. -No in-stream vegetation present. -Filamentous algae coverage: ca.30%. -Riverbanks are well-vegetated, forming a near-continuous riparian corridor comprising a dense mix of mainly Ash (*Fraxinus* excelsior) and Willow (*Salix* spp) (See Appendix E – Photo 1 &2)	None Observed, aside from old Otter spraint identified on embankment. However there is potential for Otter (*Lutra lutra*) activity as habitat is suitable for foraging and potential holt sites. White-clawed crayfish are also possible at low density.	-Possibility of patchy spawning for salmon and lamprey. - Migration routes of adult salmon.	Q4 Unpolluted Good Status (See Appendix E)	***National Importance***
H2	-Shallow with a moderate to fast flow over a riffle/glide type habitat and a compacted substratum comprised of predominantly cobble, boulder and coarse gravel -Depth varies from 0. 2m-1m -No in-stream vegetation or macrophyte beds present -Filamentous algae coverage was extensive -Significant bank erosion on east bank at Morell Bridge (Old) -Riverbanks are well-vegetated, forming a near-continuous riparian corridor comprising a dense mix of mainly Alder, Willow & Hazel extending north along this habitat section. (See Appendix E – Photo 3 & 4)	None Observed. However there is potential for Otter (*Lutra lutra*) activity as habitat is suitable for foraging and potential holt sites. Optimum habitat for White-clawed crayfish due to overhanging banks, shallow stretches and good boulder/cobble mix.	-Potential spawning for salmon and lamprey. - Migration routes of adult salmon. -Potential Patchy habitat for Lamprey ammocoetes utilising marginal soft sediments	Q3-4 Slightly Polluted Moderate Status (See Appendix E)	***National Importance***

Habitat Code	Habitat Characteristics	Potential Annex II Species / Supporting Habitat	Fishery Value	Q-Rating	Evaluation (see Table 11.2)
H3	-Moderate to fast flow over a riffle/glide type habitat and a compacted substratum comprised of predominantly cobble, boulder and some coarse gravel with overlying silt -Depth varies from 0. 3 - 1.2m -No in-stream vegetation or macrophyte beds present -Filamentous algae coverage was extensive with silty plumes observed after bed disturbance -Significant bank erosion on either bank mainly at midway area of the habitat section due to cattle access (See Appendix E – Photo 5 & 6)	Otter holt observed along west bank. Optimum habitat for White-clawed crayfish due to overhanging banks, shallow stretches and good boulder/cobble mix.	-Some patchy potential spawning habitat for Salmon and Lamprey however excessive silt pockets my inhibit successful spawning activity -Migratory routes for Salmon -Some deep pools downstream are potential holding areas for coarse fish and larger trout	Q3-4 Slightly Polluted Moderate Status (See Appendix E)	***National Importance***
H4	Slow to moderate flow over a shallow glide type habitat and a compacted substratum comprised of predominantly bedrock with some cobble and boulder. Silt deposits line undercut bankside edges -Depth varies from 0. 1 - 1m -No in-stream vegetation or macrophyte beds present -Filamentous algae coverage was not extensive -No cattle access -Significant shading along the length of the habitat with overhanging Hazel and Hawthorn trees lining bankside intertwined with excessive Bramble (*Rubus*) growth (See Appendix E – Photo 7 & 8)	No Otter (*Lutra lutra*) observed. Good for White clawed crayfish as silty marginal sections and undercut banks provide good habitat.	-Limited spawning potential for Salmon due to lack of clean, coarse gravel -Migratory routes for Salmon -Some deep pools downstream are potential holding areas for coarse fish and larger trout	Q4 Unpolluted Good Status (See Appendix E)	***National Importance***

Habitat Code	Habitat Characteristics	Potential Annex II Species / Supporting Habitat	Fishery Value	Q-Rating	Evaluation (see Table 11.2)
H5	Narrow channel. Slow to moderate flow over a shallow type habitat comprised predominantly of coarse gravel, cobble and boulder. Silt deposits line undercut bankside edges -Depth varies from 0. 1 – 0.6m -No in-stream vegetation or macrophyte beds present -Filamentous algae coverage was slight -No cattle access -Moderate shading along the length of the habitat due to grassy verges and excessive Bramble and Fern growth (See Appendix E – Photo 7 & 8)	No Otter (*Lutra lutra*) observed. However there is potential for Otter (*Lutra lutra*) activity as habitat is suitable for foraging and potential holt sites. Moderate for White clawed crayfish as some silty deposits observed along sections and undercut banks provide good habitat	-Salmonid Spawning potential due to clean, cobble and coarse gravel - Potential Patchy habitat for Lamprey ammocoetes utilising marginal soft sediments	Q3-4 Slightly Polluted Moderate Status (See Appendix E)	***National Importance***

11.2.7.2 Morell River (Upper)

This section of the Morell Catchment is potentially impacted by the proposed measures Morr 15 - Morr 23. Morell River (Upper) travels upstream from the townland of Killeenmore in a southerly direction towards Sherlockstown Common.

One site was selected and deemed accessible for aquatic ecology assessment along this section of Morell:

- Habitat Site 6 (H6) - This habitat section is located south of the Morell Bridge at Sherlockstown Common just 300m downstream of its intersection with the Grand Canal

A corresponding biological Q-Value measurement was taken within each habitat assessed. Figure 11.1 illustrates location of habitat sites. Table 11.11 presents aquatic ecology assessments for the Morell River (Upper) habitat site.

Table 11.11: Aquatic Ecology Assessment along the Morell River (Upper) Habitat Sites

Habitat Code	Habitat Characteristics	Annex II Species / Supporting Habitat	Fishery Value	Q-Rating	Evaluation (see Table 11.2)
H6	-Moderate flow over a riffle/glide type habitat and a compacted substratum comprised of predominantly cobble, boulder and coarse gravel with some silty margins upstream -Depth varies from 0. 2m-1.2m -No in-stream vegetation or macrophyte beds present -Filamentous algae coverage was extensive presumably due to direct nutrient input at cattle access points upstream -Silty plumes observed upon disturbance of substrate -Bank erosion was observed -Riverbanks are well-vegetated upstream forming a near-continuous riparian corridor comprising a dense mix of mainly Alder, Willow & Hazel extending north along this habitat section. (See Appendix E – Photo 11 & 12)	None Observed apart from old Otter spraint on a bankside tree. There is potential for Otter (*Lutra lutra*) activity as habitat is suitable for foraging and potential holt sites. Optimum habitat for White-clawed crayfish due to overhanging banks, shallow stretches and good boulder/cobble mix. Two White Clawed Crayfish juveniles observed within macroinvertebrate sample on upstream section where overhanging banks and shading was extensive A single brown trout juvenile was observed swimming upstream	-Potential spawning for salmon and lamprey however poor in places due to excessive silt and algae formation - Migration routes of adult Salmon and Trout -Potential Patchy habitat for Lamprey ammocoetes utilising marginal soft sediments *Algae coverage was extensive potentially depleting the river system of oxygen reserves for fish and invertebrates.	Q3-4 Slightly Polluted Moderate Status (See Appendix E)	***National Importance***

11.2.7.3 Painestown River

This section of the Morell Catchment is potentially impacted by the proposed measures Paines 1 - Paines 5, Morr 7 – 9 and Culverts 9 & 10.

The Painestown River, a tributary of the Morell River, confluences with the Kill and Slane Rivers 200m downstream at Painestown Bridge south of Kill East. Two sites were selected for aquatic ecology assessment along this section of the Painestown River. They are:

- Habitat Site 7 (H7) : This habitat section runs in a southeast to northwest downstream direction and includes its intersection with the L6016;
- Habitat Site 8 (H8): This habitat section is located just south of Painestown Bridge.

A corresponding biological Q-Value measurement was taken within each habitat assessed. Figure 11.1 illustrates the location of the habitat sites. Table 11.12 presents aquatic ecology assessments for Painestown habitat sites.

Table 11.12: Aquatic Ecology Assessment along the Painestown River Habitat Sites

Habitat Code	Habitat Characteristics	Annex II Species / Supporting Habitat	Fishery Value	Q-Rating	Evaluation (see Table 11.2
H7	-Moderate flow over a riffle/glide type habitat and a compacted substratum comprised of predominantly cobble , coarse and fine gravel with some sandy interstitial deposits -Depth varies from 0. 2m-0.8m -No in-stream vegetation or macrophyte beds present -Riverbanks comprised undercut banks, grassy verges and low embankments along with patchy Bramble and Fern coverage. (See Appendix E – Photo 13)	None Observed. However there is potential for Otter (*Lutra lutra*) activity as habitat is suitable for foraging and potential holt sites. Optimum habitat for White-clawed crayfish due to undercut banks, shallow stretches and good boulder/cobble mix.	-Potential spawning for salmonids. - Migration routes of adult Salmon and Trout	Q3-4 Slightly Polluted Moderate Status (See Appendix E)	***National Importance***
H8	-Moderate flow over a riffle/glide type habitat and a compacted substratum comprised of predominantly cobble , coarse and fine gravel with some sandy interstitial deposits -Depth varies from 0.1m-0.6m -Cattle access -Filamentous Algae coverage excessive in patches -No in-stream vegetation or macrophyte beds present -Riverbanks comprised undercut banks, grassy verges and low embankments along with patchy bramble coverage as well as occasional Hawthorn stands. (See Appendix E – Photo 14)	None Observed. A large, wide hole was found with Otter potential, but no evidence of any current animal use was found and no Otter spraint was found nearby. However there is potential for Otter (*Lutra lutra*) activity as habitat is suitable for foraging and potential holt sites. Optimum habitat for White-clawed crayfish due to undercut banks, shallow stretches and good boulder/cobble mix.	-Potential spawning for salmonids. - Migration routes of adult Salmon and Trout -Poor for Lamprey ammocoetes due to lack of marginal soft sediments	Q3 Moderately Polluted Poor Status (See Appendix E)	***National Importance***

11.2.7.4 Slane River

This section of the Morell Catchment is potentially impacted by the proposed measures Slane 1-Slane 9.

The Slane River is a tributary of the Morell River and drains the Northern side of Kilteel traversing Blackchurch and flowing North of Tuckmilltown before confluencing with the Painestown River north of Painestown Bridge.

Three sites were selected for aquatic ecology assessment along this section of Slane River. They are:

- Habitat Site 9 (H9) - This habitat section runs is located 50m downstream of the L6021 Finger Post Bridge crossing;
- Habitat Site 10 (H10) - This habitat section is located approximately 100m upstream of H9; and
- Habitat Site 11 (H11) - This habitat section is located approximately 100m upstream of H10;

A corresponding biological Q-Value measurement was taken within each habitat assessed. Figure 11.1 illustrates location of habitat sites. Table 11.13 presents aquatic ecology assessments for Slane River habitat sites.

Table 11.13: Aquatic Ecology Assessment along the Slane River Habitat Sites

Habitat Code	Habitat Characteristics	Annex II Species / Supporting Habitat	Fishery Value	Q-Rating	Evaluation (see Table 11.2)
H9	Wide channel. Moderate to fast flow over a shallow, riffle type habitat comprised predominantly of coarse gravel, cobble and boulder. Silt deposits line undercut bankside edges -Depth varies from 0.1 -1.2m -No in-stream vegetation or macrophyte beds present -Filamentous algae coverage was slight -No cattle access -Excessive bank erosion -Excessive shading along the habitat including Sycamore, Alder and Bramble. (See Appendix E – Photo 9)	No Otter (*Lutra lutra*) observed. However there is potential for Otter activity as habitat is suitable for foraging and potential holt sites. Good for White clawed crayfish as some silty deposits observed along sections and undercut banks provide good habitat. A singe White Clawed Crayfish was observed within the macroinvertebrate sample at this habitat	-Salmonid Spawning potential due to clean, cobble and coarse gravel - Potential Patchy habitat for Lamprey ammocoetes utilising marginal soft sediments -Potential Migratory route for Salmon and Trout	Q3-4 (See Appendix E)	***National Importance***
H10	Moderate to fast flow over a shallow glide /riffle type habitat and a compacted substratum comprised of predominantly of coarse gravel and cobble -Depth varies from 0.1 - 1m -No in-stream vegetation or macrophyte beds present -Filamentous algae coverage was minimal -No cattle access observed -Bank undercuts -Significant sheltered shading along the length of the habitat with high embankments and excessive Bramble and Cow Parsley growth (See Appendix E – Photo 16)	No Otter (*Lutra lutra*) observed but this habitat does provide support for Otter due to excessive shelter cover and clean foraging material. Good for White clawed crayfish as silty marginal sections and undercut banks provide good habitat	-Potential spawning potential for Salmonid due to clean, coarse gravel -Migratory routes for Salmon and Trout -Limited for Lamprey ammocoetes due to lack of marginal soft sediments	Q4 Unpolluted Good Status (See Appendix E)	***National Importance***

Habitat Code	Habitat Characteristics	Annex II Species / Supporting Habitat	Fishery Value	Q-Rating	Evaluation (see Table 11.2)
H11	Slow to moderate flow over a glide type habitat and a compacted substratum comprised of predominantly boulder and cobble with excessive silt coverage -Depth varies from 0.5 – 1.2 m -Silt margins -No in-stream vegetation or macrophyte beds present -Large boulder embankments observed on the west bank -Bank undercuts -Significant sheltered shading along the length of the habitat with grassy verges and Bramble growth (See Appendix II – Photo 17)	No Otter (*Lutra lutra*) observed. This habitat provides moderate potential to support Otter. It provides good cover for holts and protection but clean foraging material could be quite limited Good for White clawed crayfish as silty marginal sections and undercut banks provide good habitat	**-** Poor spawning potential for Salmonid due to lack of clean coarse gravels and cobbles -Patchy potential for Lamprey ammocoetes due to marginal soft sediments	Q3 Moderately Polluted Poor Status (See Appendix E)	***National Importance***

11.2.7.5 Kill River

This section of the Morell Catchment is potentially impacted by the proposed measure, Kill 1.

The Kill River, a tributary of the Morell River, transects the N7 at the most southerly end of the proposed scheme where it runs downstream in a northerly direction eventually confluencing with the Painestown River approximately 250m south of the Painestown Bridge.

One site was selected for aquatic ecology assessment along this section of Kill River:

- Habitat Section 12 (H12) - This habitat section is located in Kill East, approximately 300m downstream (north) from where the Kill River passes beneath the N7.

A corresponding biological Q-Value measurement was taken within each habitat assessed. Figure 11.1 illustrates the location of the habitat site. Table 11.14 presents aquatic ecology assessments for Kill River habitat site

Table 11.14: Aquatic Ecology Assessment along the Kill River Habitat Site

Habitat Code	Habitat Characteristics	Annex II Species / Supporting Habitat	Fishery Value	Q-Rating	Evaluation (see Table 11.2)
H12	-Moderate to fast flow over a shallow glide /riffle type habitat and a compacted substratum comprised of predominantly of coarse gravel and cobble -Depth varies from 0. 1 - 1m -No in-stream vegetation or macrophyte beds present -Filamentous algae coverage was slight -No cattle access observed -Bank undercuts -Significant shading along the length of the habitat with Hawthorn and Holly stands observed along with patchy Bramble and Cow Parsley growth (See Appendix E – Photo 18)	No Otter (*Lutra lutra*) observed but this habitat does provide support for Otter due to excessive shelter cover and clean foraging material. Good potential for White clawed crayfish due to undercut banks providing good refuge	**-**Potential spawning potential for Salmonid due to clean, coarse gravel -Migratory routes for Salmon and Trout -Limited for Lamprey ammocoetes due to lack of marginal soft sediments	Q4 Unpolluted Good Status (See Appendix E)	***National Importance***

11.3 POTENTIAL IMPACTS

The nature of the works dictate that they should be undertaken in settled weather, without flood risk to ensure the impact on natural resources that sustain the biodiversity of the catchment are reduced as much as possible . As such, the construction of the scheme may take 61 weeks, phased over three years (but potentially taking up to four years dependent on weather conditions). Full details of the construction methodology are included in Chapter 4, '*Project Description'*.

The proposed scheme has the potential for impacts on aquatic ecology and other natural resources such as water quality and substrate condition of the Morell River catchment and therefore the overall biodiversity of the area. The following sections examine the potential impacts of the proposed scheme.

11.3.1 Potential Impacts to Designated Sites

The proposed scheme is within 15km of eight SACs and two SPAs however the Zone of Influence for Screening for Appropriate Assessment was extended to the entire Liffey catchment and coastal sites within Dublin Bay, as detailed in Chapter 10 'Terrestrial Ecology'. Twelve SACs and nine SPAs were therefore included in the AA screening. Potential impacts associated with the proposed scheme on European Sites are considered in greater detail in the accompanying AA Screening Statement (See Appendix D, in Volume 3 of this EIAR).

The AA screening found that there is no hydrological or hydrogeological connectivity between the catchment and any of the upland / inland sites within the catchment and therefore no scope for the works to impact on the hydromorphology or water quality at the sites. The AA screening also determined that although there is hydrological connectivity between the scheme and fourteen European sites within the greater Dublin coastal area, via the River Liffey, the potential effects are not considered to be significant. The habitats at the sites and their biodiversity would therefore not be affected by the works in the Morell catchment. Likewise, the AA screening found that implementation of the proposed scheme will not result in impacts on qualifying species of these European Sites.

The AA screening concluded that implementation of the proposed scheme is not likely to have significant effects, alone or in combination with other plans and projects, on the qualifying interests of European Sites.

All aquatic National (pNHA) and European (SAC, SPA) designated sites, within 15km of the proposed scheme, are presented in Table 11.3 and illustrated in Figure 11.2. The Grand Canal pNHA transects the Morell catchment at Sherlockstown Common. Potential impacts associated with the Grand Canal arising from the proposed scheme are provided in Table 11.16.

Liffey Valley pNHA is located 10.4km northeast of the boundary of the proposed scheme. The Morell River is part of the River Liffey Catchment and potentially the proposed scheme could extend **slight adverse impacts** over the **short term** to the River Liffey in the absence of mitigation measures.

11.3.2 Construction Phase Impacts

Potential impacts on natural resources that could potentially arise during the construction, impacting on the abiotic and biotic environment and therefore biodiversity are provided in this section.

11.3.2.1 Release of Sediment

There is potential for the release of sediment during the construction phase. The potential for sediment loss would primarily arise as a result of earth movement and excavation associated with the placement of embankments and defence walls, particularly those proposed along riverbanks. Such an impact would be more likely during very heavy rain giving to slumping of the bank edges or run-off of silt-laden water.

There also exists the risk of sediment loss from stockpiled construction materials held within the temporary working areas associated with each of the various measures and also stored at the larger stockpiling/compound areas that will be established for the project beside Paines 3, Morr 19 and Morr 23 as illustrated in Figure 11.1. Haul routes, access roads and parking areas can generate significant quantities of water polluted with sediment. Being temporary in nature, they are often formed by simply stripping topsoil and grading the subsoil to suit. This means that during heavy rainfall surface run-off can erode the surface. The tracking of plant and machinery across wet or saturated soil can also loosen and mobilise additional sediment.

Sediment loss to watercourses may also result from other instream works as part of the scheme including stream alignment works on the Slane River and Painestown tributary (EIAR ref: Slane 8 and Morr 8) and culvert alterations along the Morell River (Lower), Painestown River and Slane River. Sediment loss can give rise to increased bottom sedimentation, which, in turn, can adversely impact macroinvertebrates and aquatic habitat quality.

Elevated suspended solids levels within the water column can impact on the gills of salmonid fish, white-clawed crayfish and benthic macroinvertebrates and can smother fish spawning areas when deposited. The habitat of the Morell catchment is such that juvenile salmon and trout will be present in varying densities depending on specific habitat type. Riffles, runs and shallow glides are likely to be important nursery areas for salmonids with some pockets of localised spawning present, whist pools and deeper glides will hold older fish. Juvenile fish are likely to be more susceptible to gill damage than older fish as a result of temporary increases in suspended solids. Lamprey ammocoetes would not be expected to be adversely impacted by sediment release as a result of works since they inhabit areas of silt deposition during their nursery stage.

Plumes of silt could result in a reduced food supply for otters- i.e. where reductions in water quality affect macro-invertebrate diversity and abundance and fisheries production or temporarily displace fish from sections of channel.

The magnitude and severity of this impact on natural resources in terms of water quality, substrate condition and the biology is highlighted in relation to proposed measures at different locations in Table 11.15 to Table 11.20.

11.3.2.2 Loss of Cement and Hydrocarbons

There is a potential for the loss of cement or hydrocarbons such as diesel and hydraulic fluids during the construction phase particularly at locations proposed for defence walls along select riverbanks of the Slane and Kill (EIAR ref: Slane 1, Slane 4 & Kill 1) as well as construction of head walls within the Morell River Lower and Painestown River (EIAR ref: Cul 5 & Cul 10) respectively and culvert refurbishment at Cul 9, also on the Painestown River. Cement is highly alkaline and can give rise to very serious fish kills with similar effects on invertebrates, including white-clawed crayfish. Wash-off from poorly cured cement can also be highly alkaline and potentially dangerous to fish. Careful supervision of cement handling, curing times, and general good engineering practice can greatly reduce the risk from concrete-related impacts so that the likelihood of impacts is best described as low. Hydrocarbon spills from poorly secured or non-bunded fuel storage areas, leaks from vehicles or plant or spills during re-fuelling can all give rise to the escape of hydrocarbons from construction sites to water courses. These spills can give rise to tainting of fish or, if large enough, fish kills and invertebrate kills. The likelihood of their occurrence in a well-equipped, maintained and managed construction site is low, however the magnitude of the impact on water quality, deterioration in substrate condition and biodiversity is considered to be **large adverse** in the absence of mitigation.

The magnitude and severity of this impact is applicable across all proposed measures at the different locations as plant and machinery will be used for the construction of all measures. It is therefore assumed that this impact is applicable to all sections of the works and has not been included in Table 11.15 to Table 11.20.

11.3.2.3 Physical modifications to riparian zone

Loss of bank riparian cover as a result of installation of walls and embankments will result in increased light incidence to the channel and may encourage greater in-stream productivity, i.e. increased algal growth and benthic macroinvertebrate density. A decrease in channel shading can also impact negatively on fish and crayfish distribution. Riparian tree cover plays an important role in regulating stream ecology, e.g. stream temperature, carbon inputs, and in-stream vegetation cover. Recent IFI research, for example, shows the importance of channel shading in avoiding lethal stream temperatures for salmonids in Irish rivers (Gretta Hannigan, IFI, *pers. comm.*). Lack of shade has been shown to be correlated with absence of crayfish in habitat that would otherwise be optimal for the species (Besson et al., 2007). Whilst it is not proposed for any removal of canopy cover along the riparian zone for operational purposes, there may be some incidental requirement for removal of individual canopy stands during proposed construction works.

While no breeding or resting sites were found within the immediate vicinity of any of the proposed measures for the scheme, three potential holts were found during the ecological surveys and evidence shows that they are utilising the streams, rivers, drainage ditches and wetland habitats across the Morell River Catchment. Given that the construction of the scheme will result in the temporary loss of some riparian habitat, which may provide suitable foraging, sheltering and breeding opportunities for otters. Loss of habitat/vegetation cover (scrub clearance) could result in reduced habitat quality and cover for Otter utilising the various rivers throughout the catchment. The impact of habitat loss is reversible (temporary) as, due to the long timescales associated with maintenance activities, substantial vegetation cover will be able to re-grow prior maintenance works. This regenerated habitat may provide suitable cover and foraging opportunities for otters, particularly as prey species re-colonise these areas.

In this event and for the reasons stated above, the impacts on biodiversity along the affected riparian section could be **long term, moderate negative** in the absence of mitigation measures.

11.3.2.4 Made Ground Excavations

As discussed in Chapter 13, section 13.3.2.3, construction of new embankments and the restoration of existing embankments will require excavations at locations of made ground. Based on the results from the site investigations (Causeway Geotech, 2015) it is estimated that approximately 17,391m³ of made ground will be encountered as part of the works. Intrusive site investigations carried out to date have indicated that the made ground is mainly comprised of re-worked gravelly clays with rare inclusions of glass, concrete fragments, timber and brick. No evidence of contamination was observed during any of the site investigations.

The excavation and handling of potentially contaminated made ground could result in the increased mobilisation of contaminants which could increase the potential impacts on the surrounding areas. Dependant on the contaminant of concern; these impacts could include:

- Surface run off from exposed contaminated made ground; and
- Migration of contaminants through the subsurface could result in the impacting of groundwater (and surface water).

In the absence of mitigation, the excavation of potentially contaminated made ground would have a **temporary negative** effect on the water quality with associated impacts on aquatic ecology and therefore biodiversity within the study area. These may be **slight** to **significant** negative impacts depending on the nature of the contamination and the sensitivity of the receiving environment.

11.3.3 Operational Phase Impacts

11.3.3.1 Physical modifications to river channel and riparian zone

- **Culvert Alterations** can result in potential impacts on aquatic ecology during the operation of the proposed scheme. Culvert works, particularly if incorrectly designed, may prevent fish from migrating through them due to the flow pattern in the culvert or behavioural changes resulting from the imposition of a new structure i.e. increased shade, etc. if not appropriately designed. This can lead to a net loss of large areas of habitat and a reduction in biodiversity as fish are unable to colonise or spawn within aquatic habitats upstream of an inappropriately designed culvert.

- **Instream structures** may change flow patterns resulting in loss of gravel substrate, increased siltation and may remove meanders and natural riffle-pool sequences, which are important for fish populations during different stages of their life cycle.

- **Stream diversions -** Certain proposed works at the Slane River (Slane 8) will involve realigning the stream channel to alleviate bank erosion (See Section 4.3.4 in Chapter 4 for complete description of works). At Morr 8, a short section (70 metres) of a small tributary of the Painestown River running adjacent to the railway embankment will be diverted to allow construction of the flood defence at this location. If poorly designed, stream diversions can result in changes to the hydraulic and morphological characteristics of the channel, making them less desirable for fish populations. Permanent diversions of watercourses can result in permanent loss of aquatic and established riparian habitat and therefore biodiversity if the new channel is significantly shorter than the original or if it is not reinstated to a standard at least equivalent to the original in terms of fish habitat type and quality.

- **Loss of Riparian Tree Cover** - Retention of full riparian cover by the existing canopy on the west bank, as proposed under this measure, will be critical to reducing the impact on in-stream fauna and otter foraging and protection thereby maintaining the green corridor and biodiversity. In this event, the impacts along the affected riparian section during the operational stage are considered to be **negligible**.

11.3.3.2 Maintenance

During the operational phase of the proposed scheme there will be considerably less site activity than during the construction phase. Maintenance will be carried out to maintain the completed flood relief scheme in proper repair and effective condition. This may mean, inter alia:

- Clearing obstructions to flows from time to time, e.g., fallen trees, significant weed growth, build-up of materials likely to impact on the performance of the scheme;
- Repairing and rebuilding structures (walls and embankments); and
- Prevention of erosion/undermining of the completed works of the scheme.

While the maintenance requirements of the proposed scheme will be monitored and reviewed on an annual basis, it is envisaged that maintenance works would only be undertaken as and when required, e.g., on a six to ten year cycle. Maintenance works to be carried out will be subject to the relevant environmental assessment requirements, including Screening for Appropriate Assessment, to consider the environmental sensitivities around the maintenance required, and will be required to be carried out in line with current best practice at the time of maintenance e.g. OPW's Standard Operating Procedures for Arterial Drainage Maintenance Service (OPW, 2011). Provided these protocols are in place the impact of the maintenance regime is considered to be **negligible**.

11.3.4 Potential Impacts of Proposed Scheme

Tables 11.15 to 11.20 below provide details of the proposed scheme along each of the following sections of the Morell River within the proposed scheme catchment:

- Morell River (Lower)
- Morell River (Upper)
- Painestown River
- Slane River
- Kill River

Impact significance, duration and type follows definitions set out in EPA (2002).

Table 11.15: Proposed Scheme Measures and Potential Impacts on Morell River (Lower)

Proposed Scheme	Potential Impact	Cumulative Impact	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Morr 1	**Silt Runoff** – This embankment will tie in with Culvert 1. The potential exists for silt to wash off from fresh, pre-vegetated embankments and spoil heap excavations and flow into the river, particularly during periods of wet weather. Suspended solids can have negative effects on fish, macroinvertebrate and crayfish respiratory functions and on their respective habitats. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. In addition the temporary working area will consist of a 15m wide temporary work zone on the land side of the works. Working materials and all excavated material will be stockpiled on the land side of the works within this temporary working area. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Lower) as a result of this measure in the absence of mitigation measures.	Cumulative impacts would be primarily in association with other measures as part of the proposed scheme. Walls or embankments running directly along the riverbank pose more of a direct potential impact on the Morell River. Therefore the following measures are likely to contribute the greatest cumulative impact within the Morell River (Lower) as these will occur during the same phase of works: Morr 1, 1a, 2 and 3, and Paines 1, 2 and 3, which are upstream on the Painestown River along with Cul 9. Cumulative impacts may also occur with the construction of measures Morr 4-10, Culvert 10 and Morr 15, 16, 16a, 17 and 19 if Group 2, Phase 2a works commence being constructed in the same season as Group 1. Works will be completed during favourable weather only, so if adverse/extreme weather conditions are encountered the phasing of works for construction may span up to a total of 61 weeks over 3-4 years. In this case it is considered that there will be sufficient time between proposed flood relief measures which would greater reduce the cumulative impact during the construction phase (See Chapter 4).	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morr 1a	**Silt Runoff** – Morr 1a is being constructed to cut off an overland flow path during a flood event and is located *c.* 75m from the river channel. However there is some potential for runoff via drainage ditches. See Morr 1 impact description. There is potential for **temporary**, **slight, negative** impacts on the aquatic ecology of the Morell River (Lower) as a result of this measure in the absence of mitigation measures.	See Morr 1 Cumulative Impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Proposed Scheme	Potential Impact	Cumulative Impact	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Morr 2	**Silt Runoff** - See Morr 1 impact description. This embankment will tie in with Culvert 2. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Lower) as a result of this measure in the absence of mitigation measures.	See Morr 1 Cumulative Impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morr 3	**Silt Runoff** - See Morr 1 impact description. This embankment will tie in with culvert 2. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Lower) as a result of this measure in the absence of mitigation measures._ A potential Otter holt was found as part of the habitat surveys for H3, on the lower reaches of the Painestown River. Morr 3 is located downstream on the Morell river, approximately 70 metres from the potential holt at its nearest point. There exists the potential for disturbance of otters during the construction of the embankment and potential disruption of foraging areas. In the absence of mitigation there is potential for **moderate, significant negative** impacts on otter as a result of this measure.	See Morr 1 Cumulative Impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morr 4	**Silt Runoff** - See Morr 1 impact description. Morr 4 is *c.* 1.6km in length and much of the embankment is located well away from watercourses. However the embankment will tie in with Culverts 4, 4a and 5. The construction of Morr 4 will require temporary crossings of at least two minor watercourses, (passing through culverts 4 and 4a) which are tributaries of the Morell River (Lower). There is some potential for runoff via drainage ditches. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Lower) as a result of this measure in the absence of mitigation measures.	Cumulative Impacts with Morr 4 would be primarily associated with measures in close proximity that will be constructed during the same Phase, i.e. alterations of Culverts 4, 4a and 5, and measures Morr 4, Morr 7-10, 15 16, 16a, 17 and 19. Cumulative impacts may also occur with Morr 1, 1a, 2 and 3, and Paines 1, 2 and 3, along with the repairs to Cul 9, if Group 2, Phase 2a works are able to commence being constructed in the same season as Group 1. Cumulative effects may also occur with measures Morr 20-23, if Group 2, Phase 2b works occur in the same season as Phase 2a. Works will be completed during favourable weather only so if adverse/extreme weather conditions are encountered the phasing of works for construction may span up to a total of 61 weeks over 3-4 years. In this case it is considered there will be sufficient time spacing between proposed flood relief	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Proposed Scheme	Potential Impact	Cumulative Impact	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
		measures which would greater reduce the cumulative impact during the construction phase (See Chapter 4.4).	
Morr 5	Also referred to as Culvert 4 – please see impact description in Table 11.20 in the Culvert Alterations section 11.3.5 below.	See Morr 4 cumulative impacts	See Table 11.20
Morr 6	Also referred to as Culvert 4a – please see impact description in Table 11.20 in the Culvert Alterations section 11.3.5 below.	See Morr 4 cumulative impacts	See Table 11.20
Morr 10	**Silt Runoff** - See Morr 1 impact description. This is an existing embankment which may require improvements. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Lower) as a result of this measure in the absence of mitigation measures.	See Morr 4 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Table 11.16: Proposed Scheme Measures and Potential Impacts on Morell River (Upper)

Proposed Scheme	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
Morr 15	**Silt Runoff –** This embankment will tie in with Culverts 5 and 7. The potential exists for silt from excavations during embankment construction to flow into the river, particularly during periods of wet weather. Suspended solids can have negative effects on fish, macroinvertebrate and crayfish respiratory functions and on their respective habitats. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. The temporary working area will consist of a 15m wide area alongside the embankment. Where the embankment is in proximity to the river, working materials and all excavated material will be stockpiled on the land side of the works within this temporary working area. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Upper) (and Lower) as a result of this measure in the absence of	Cumulative Impacts with Morr 15 would be primarily associated with measures in close proximity that will be constructed during the same phase i.e. alterations of Culverts 4, 4a and 5, and the embankments at Morr 4, 10, 15, 16, 16a, 17 and 19. This may also include measures Morr 20-23, if Group 2, Phase 2b works are able to occur in the same season as 2a. Works will be completed during favourable weather only so if adverse/extreme weather conditions are encountered the phasing of works for construction may span up to a	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Proposed Scheme	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
	mitigation measures.	total of 61 weeks over 3-4 years. In this case it is considered there will be sufficient time spacing between proposed flood relief measures which would greater reduce the cumulative impact during the construction phase (See Chapter 4.4).	
Morr 16	**Silt Runoff:** See Morr 15 impact description. This embankment is located 150m from the Morell River channel, though is adjacent to local drains which are hydraulically linked to it. There is potential for **temporary**, **slight, negative** impacts on the aquatic ecology of the Morell River (Upper) as a result of this measure in the absence of mitigation measures.	See Morr 15 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morr 16a	**Silt Runoff:** See Morr 15 impact description. This embankment is located >300m from the Morell River channel, though is adjacent to local drains which are hydraulically linked to it. There is potential for **temporary**, **slight, negative** impacts on the aquatic ecology of the Morell River (Upper) as a result of this measure in the absence of mitigation measures.	See Morr 15 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morr 17	**Silt Runoff:** See Morr 15 impact description. The majority of the length of this embankment will be more than 100m from the river channel. Where the embankment ties in with Culvert 7 there is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Upper) as a result of this measure in the absence of mitigation measures.	See Morr 15 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morr 19	**Silt Runoff:** See Morr 15 impact description. The majority of Morr 19 will be constructed away from the river bank; however it will include a tie-in with Culvert 7. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Upper) as a result of this measure in the absence of mitigation measures.	See Morr 15 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morr 20	This upgrade is very slight and located a considerable distance west (>500m) of the Morell River (Upper). However as the embankment is proposed for a ditch adjacent to the Grand Canal, The Grand Canal provides a linear habitat with the potential to support fish species particularly Brown Trout. It also provides sufficient cover and foraging habitat for Otter along its length. There is a **temporary, slight negative** impact associated with silt runoff into the channel of the canal in the absence of mitigation measures.	Cumulative Impacts with Morr 20 would be primarily associated with measures in close proximity that will be constructed during the same Phase i.e. Morr 20-23 which are all within the vicinity of the golf course. Cumulative impacts may also occur with the construction of Group2, Phase 2a measures (Morr 4, 5, 6, 10, 15, 16, 16a, 17, 19 and Culvert 5) if Phase 2a works are constructed	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Proposed Scheme	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
		in the same season as Phase 2b. Works will be completed during favourable weather only so if adverse/extreme weather conditions are encountered the phasing of works for construction may span up to a total of 61 weeks over 3-4 years. In this case it is considered there will be sufficient time spacing between proposed measures which would greater reduce the cumulative impact during the construction phase (See Chapter 4.4).	
Morr 21	**Silt Runoff:** See Morr 15 impact description. Morr 21 is approx. 750m east of the Morell River at its nearest point. Some potential for runoff via drainage ditches or via groundwater. There is potential for **temporary**, **slight, negative** impacts on the aquatic ecology of the Morell River (Upper) as a result of this measure in the absence of mitigation measures.	See Morr 20 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morr 22	**Cement Runoff –** Mor 22 is located >800m from the Morell River at its nearest point. The potential exists, as with any construction, that concrete or mortar, may enter the river channel via drainage ditches from the golf course grounds. Cement is highly alkaline and can give rise to fish kills with similar effects on invertebrates, including white-clawed crayfish. Wash off from poorly cured cement can also be highly alkaline and potentially dangerous to fish. There is potential for **temporary**, **slight**, **negative** impact given the toxicity of concrete to aquatic life within the Morell River (Upper) in the absence of mitigation measures.	See Morr 20 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morr 23	**Silt Runoff:** See Morr 15 impact description. Morr 23 is located >850m from the Morell river at its nearest point. Some potential for runoff via drainage ditches or via groundwater. There is potential for **temporary**, **slight, negative** impacts on the aquatic ecology of the Morell River (Upper) as a result of this measure in the absence of mitigation measures.	See Morr 20 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Table 11.17: Proposed Scheme Measures and Potential Impacts on Painestown River

Proposed Scheme	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
Paines 1	**Silt Runoff** – Paines 1 will tie in with Culvert 2. The potential exists for silt from excavation during embankment construction to flow into the river, particularly during periods of wet weather. Suspended solids can have negative effects on fish, macroinvertebrate and crayfish respiratory functions and on their respective habitats. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. The temporary working area will consist of a 15m wide area alongside the embankment. Where the embankment is in proximity to the river, working materials and all excavated material will be stockpiled on the land side of the works within this temporary working area. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Painestown River as a result of this measure in the absence of mitigation measures.	Cumulative impacts on the Painestown River would be primarily in association with other measures constructed on or adjacent to the river during the same phase as part of the proposed scheme.. They are Paines 1- 3 and Culvert 9 in Group 1. Cumulative impacts may also occur with the construction of Group 2, Phase 2a measures in the Painestown catchment (Morr 4, Morr 7 -10 and Culvert 10) if Phase 2a works are constructed in the same season as Group 1. Works will be completed during favourable weather only so if adverse/extreme weather conditions are encountered the phasing of works for construction may span up to a total of 61 weeks over 3-4 years. In this case it is considered there will be sufficient time spacing between proposed flood relief measures which would greater reduce the cumulative impact during the construction phase (See Chapter 4.4).	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Paines 2 & 3	**Silt Runoff:** See Paines 1 impact description. Paines 2 & 3 will tie in with Culvert 9 and Culvert 10. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Painestown River as a result of this measure in the absence of mitigation measures.	See Paines 1 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Paines 4	**Silt Runoff**: See Paines 1 impact description. There is potential for **temporary**, **slight, negative** impacts on the aquatic ecology of the Painestown River as a result of this measure in the absence of mitigation measures.	Cumulative impacts on the Painestown River would be primarily in association with other measures constructed on or adjacent to the river during the same phase as part of the proposed scheme.. These are Paines 4 and 5 in Group 3. Upstream measures Kill 1 and Slane 1-11, also proposed in Group 3 also present a risk of cumulative impacts. Cumulative impacts may also occur with the construction of Group 2, Phase 2a measures	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Proposed Scheme	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
		in the Painestown catchment (Morr 4, Morr 7 -10 and Culvert 10) if Phase 2a works are constructed in the same season as Group 3. Group 3 construction works are expected to occur 2-3 years after Group 1 and so cumulative impacts with Paines 1-3 are unlikely. Works will be completed during favourable weather only so if adverse/extreme weather conditions are encountered the phasing of works for construction may span up to a total of 61 weeks over 3-4 years. In this case it is considered there will be sufficient time spacing between proposed flood relief measures which would greater reduce the cumulative impact during the construction phase (See Chapter 4.4).	
Paines 5	**Silt Runoff:** See Paines 1 impact description. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Painestown River as a result of this measure in the absence of mitigation measures.	See Paines 4 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morr 7	**Silt Runoff:** The potential exists for silt from excavations during wall construction to flow into the river, particularly during periods of wet weather. Suspended solids can have negative effects on fish, macroinvertebrate and crayfish respiratory functions and on their respective habitats. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Painestown River as a result of this measure in the absence of mitigation measures. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. The temporary working area will consist of a 15m wide area alongside the flood wall. All working materials and all excavated material will be stockpiled a minimum distance of 15m from the river. **Cement Runoff –** Morr 7 will tie in with Culvert 10. The potential exists, as with any construction, that concrete or mortar, may enter the river channel. Cement is highly alkaline and can give rise to fish kills with similar effects on invertebrates, including white-clawed crayfish. Wash off from poorly cured cement can also be highly alkaline and potentially dangerous to fish. There is potential for **temporary, moderate,**	Cumulative Impacts on the Painestown River with Morr 7 would be primarily associated with those measures in the Painestown catchment that will be constructed during the same Phase i.e. measures Morr 4 and Morr 7-10. Cumulative impacts may also occur with Paines 1, 2 and 3, along with the repairs to Cul 9, if Group 2, Phase 2a works are able to commence being constructed in the same season as Group 1. It is unlikely that upstream measures in Group 3 (these include Paines 4 & 5) will occur in the same season as Phase 2a. Works will be completed during favourable weather only so if adverse/extreme weather conditions are encountered the phasing of	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Proposed Scheme	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
	negative impact given the toxicity of concrete to aquatic life within the Painestown River in the absence of mitigation measures. ***<u>Otters</u>*** Surveys in January 2017 found evidence of otter activity on the Painestown tributary stream which runs alongside the proposed flood wall. There exists the potential for disturbance to otters during the construction of the flood wall and potential disruption of foraging areas. Otters are likely to avoid areas where construction activities are ongoing due to noise, light and visual disturbance. Construction of new embankments and walls may result in temporary severance of connectivity between otter habitats. In the absence of mitigation there is potential for **temporary moderate, significant** impacts on otter as a result of this measure.	works for construction may span up to a total of 61 weeks over 3-4 years. In this case it is considered there will be sufficient time spacing between proposed measures which would greater reduce the cumulative impact during the construction phase (See Chapter 4.4).	
Morr 8	**<u>Release of sediment</u>** ***Potential Impacts on Juvenile salmonids, Lamprey and other fish*** An increase in suspended sediment associated with stream diversion works is likely to force fish away from the works and move downstream from where the works is being undertaken at a particular time. Short-term exposure to very high suspended solids loads is unlikely to be an issue because fish will avoid such areas, but has the potential to affect crayfish more significantly (See below). Any unhealthy or stressed fish may become more susceptible to disease if exposed over an extended period to lower levels of solids. This would therefore be considered a **moderate negative** impact affecting salmon and trout, within the first few hundred meters downstream from the works. ***Potential Impacts on White Clawed Crayfish and Macroinvertebrates*** The release of sediment and cutting of banks can result in the exposure and death of large numbers of white-clawed crayfish and macroinvertebrates, for which optimum habitat was identified in the Painestown River at H7 during field surveys. The impact, without mitigations, would be considered as a **major negative impact**. **<u>Otter</u>:** Surveys in January 2017 found evidence of otter activity on the Painestown tributary stream which is proposed to be diverted. There exists the potential for disturbance to otters during the construction of the diversion and potential disruption of foraging areas. Otters are likely to avoid areas where construction activities are ongoing due to noise, light and visual disturbance. Construction of new embankments and walls may result in temporary severance of connectivity between otter habitats.	See Morr 7 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Proposed Scheme	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
	<u>Impact from Morphological changes</u> Permanent diversions of watercourses can result in permanent loss of habitat if the new channel is significantly shorter than the original or if it is not reinstated to a standard at least equivalent to the original in terms of fish habitat type and quality. In the absence of mitigation there is potential for **temporary moderate, significant** impacts on otter as a result of this measure.		
Morr 9	**<u>Silt Runoff:</u>** See Paines 1 impact description. Morr 9 will tie in with Culvert 10. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Painestown River as a result of this measure in the absence of mitigation measures.	See Morr 7 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Table 11.18: Proposed Scheme Measures and Potential Impacts on Slane River

Proposed Scheme	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
Slane 1	**Silt Runoff:** The potential exists for silt from excavations during wall construction to flow into the river, particularly during periods of wet weather. Suspended solids can have negative effects on fish, macroinvertebrate and crayfish respiratory functions and on their respective habitats. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. The temporary working area will consist of a 15m wide area alongside the flood wall. As the flood wall is in proximity to the river, the temporary working area will be on the land side of the wall. Working materials and all excavated material will be stockpiled within the temporary working area, away from the river. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Slane River as a result of this measure in the absence of mitigation measures. **Cement Runoff –** Slane 1 will tie in with Culvert 18. The potential exists, as with any construction, that concrete or mortar, may enter the river channel. Cement is highly alkaline and can give rise to fish kills with similar effects on invertebrates, including white-clawed crayfish. Wash off from poorly cured cement can also be highly alkaline and potentially dangerous to fish. There is potential for **temporary, moderate, negative** impact given the toxicity of concrete to aquatic life within the Slane River in the absence of mitigation measures.	Cumulative impacts would be primarily in association with other measures as part of the proposed scheme. Measures Slane 1 - Slane 11 proposed along the Slane River can potentially pose in-combination impacts with each other due to their proximity. Slane Works will be completed during favourable weather only so if adverse/extreme weather conditions are encountered the phasing of works for construction may span up to a total of 61 weeks over 3-4 years. In this case it is considered there will be sufficient time spacing between proposed measures which would greater reduce the cumulative impact during the construction phase (See Chapter 4.4).	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Proposed Scheme	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
Slane 2	**Silt Runoff:** Slane 2 will tie in with Culvert 18. The potential exists for silt to wash off from fresh, pre-vegetated embankments, excavations and stockpiles and flow into the river, particularly during periods of wet weather. Suspended solids can have negative effects on fish, macroinvertebrate and crayfish respiratory functions and on their respective habitats. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. The temporary working area will consist of a 15m wide area alongside the embankment. As the embankment is in proximity to the river, the temporary working area will be on the land side of the embankment. Working materials and all excavated material will be stockpiled within this temporary working area, away from the river. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Slane River as a result of this measure in the absence of mitigation measures. **Loss of Bramble/Scrub Cover:** See section 11.3.2.3 Physical modifications to riparian zone. The impact of loss of riparian cover could be **long term, moderate negative**.	See Slane 1 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Slane 3	**Silt Runoff** - See Slane 2 impact description. Slane 3 will tie in with Culvert 19. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Slane River as a result of this measure in the absence of mitigation measures.	See Slane 1 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Slane 4	**Silt Runoff –** See Slane 1 impact description. Slane 4 will tie in with Culvert 19. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Slane River as a result of this measure in the absence of mitigation measures. **Cement runoff -** See Slane 1 impact description. There is potential for **temporary**, **moderate**, **negative** impact given the toxicity of concrete to aquatic life within the Slane River in the absence of mitigation measures.	See Slane 1 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Slane 5	**Silt Runoff –** See Slane 2 impact description. Slane 5 will tie in with Culvert 19. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Slane River as a result of this measure in the absence of mitigation measures.	See Slane 1 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Proposed Scheme	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
Slane 6	**Silt Runoff –** See Slane 1 impact description. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Slane River as a result of this measure in the absence of mitigation measures. **Concrete Runoff**- Potential to arise from excavations within commercial yard. See Slane 1 impact description for **Cement runoff**. There is potential for **temporary**, **moderate**, **negative** impact given the toxicity of concrete to aquatic life within the Slane River in the absence of mitigation measures.	See Slane 1 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Slane 7	**Silt Runoff –** See Slane 1 impact description. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Slane River as a result of this measure in the absence of mitigation measures.	Limited cumulative impact anticipated between Slane 7 and other measures within the Slane River due to considerable distance between Slane 7 at Blackchurch and the remaining Slane measures at Tuckmilltown.	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Slane 8	**Release of sediment** ***Potential Impacts on Juvenile salmonids, Lamprey and other fish*** An increase in suspended sediment associated with the works is likely to force fish away from the works and move downstream from where the works is being undertaken at a particular time. Short-term exposure to very high suspended solids loads is unlikely to be an issue because fish will avoid such areas, but has the potential to affect crayfish more significantly (See below). Any unhealthy or stressed fish may become more susceptible to disease if exposed over an extended period to lower levels of solids. This would therefore be considered a **moderate negative** impact affecting salmon and trout, within the first few hundred meters downstream from the works. ***Potential Impacts on White Clawed Crayfish and Macroinvertebrates*** The release of sediment and cutting of banks can result in the exposure and death of large numbers of white-clawed crayfish and macroinvertebrates, which have been recorded in the Slane River during September surveys. The impact, without mitigations, would be **significantly negative**.	See Slane 1 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Slane 9	**Silt Runoff** - See Slane 2 impact description. Slane 9 is located *c.* 60m from the Slane River at its nearest point. Some potential for runoff via drainage ditches or via groundwater. There is potential for **temporary**, **slight, negative** impacts on the aquatic ecology of the Slane River as a result of this measure in the absence of mitigation measures.	See Slane 1 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

Table 11.19: Proposed Scheme Measures and Potential Impacts on Kill River

Proposed Scheme	Potential Impact	Cumulative Impact	Operational & Maintenance Phase
Kill 1	**Silt Runoff:** The potential exists for silt from excavations during wall construction to flow into the river, particularly during periods of wet weather. Suspended solids can have negative effects on fish, macroinvertebrate and crayfish respiratory functions and on their respective habitats. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. The temporary working area will consist of a 15m wide area alongside the flood wall. As the wall is in proximity to the river, the temporary working area will be on the land side of the wall. Working materials and all excavated material will be stockpiled within this temporary working area, away from the river. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Kill River as a result of this measure in the absence of mitigation measures. **Cement Runoff** - The potential exists, as with any construction, that concrete or mortar, may enter the river channel. Cement is highly alkaline and can give rise to fish kills with similar effects on invertebrates, including white-clawed crayfish. Wash off from poorly cured cement can also be highly alkaline and potentially dangerous to fish. There is potential for **temporary**, **negative** impact given the toxicity of concrete to aquatic life within the Slane River in the absence of mitigation measures	Kill 1 is the only measure proposed on the Kill river. Cumulative impacts with other measures on downstream watercourses are discussed under Paines 4; however there is limited potential for a cumulative impact from this measure in association with other scheme measures due to the considerable distance between the Kill tributary to the Slane, Painestown and Morell stretches. In addition the dimensions of this proposed measure are relatively slight compared to other scheme measures and unlikely to pose a significant impact in combination with other measures.	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

11.3.5 Potential Impacts from Culvert Alterations

As previously stated Chapter 4 of this EIAR provides detail into the proposed culvert alterations along the Morell Catchment for the proposed scheme - Table 11.20

Table 11.20: Proposed Culvert Measures and Potential Impacts along the Morell River Catchment

River Section Potentially Impacted	River Section Potentially Impacted	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
Morell River Lower	Cul 1 – embankment tie-in	**Silt Runoff –** The potential exists for silt to wash off from fresh, pre-vegetated embankments, excavations and stockpiles and flow into the river, particularly during periods of wet weather. Suspended solids can have negative effects on fish, macroinvertebrate and crayfish respiratory functions and on their respective habitats. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. The temporary working area will consist of a 15m wide area alongside the embankment. As the embankment is in proximity to the river, the temporary working area will be on the land side of the embankment. Working materials and all excavated material will be stockpiled within this temporary working area, away from the river. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Lower) as a result of this measure in the absence of mitigation measures.	Cumulative impacts are as per those described for Morr 1 in Table 11.19 above.	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Morell River Lower	Cul 2 – embankment tie-in	**Silt Runoff –** See Cul 1 impact description. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Lower) as a result of this measure in the absence of mitigation measures.	Cumulative impacts are as per those described for Morr 1 in Table 11.19 above.	
Morell River Lower	Cul 4 & Culvert 4a Throttling Culvert.	Provided proposed measures are carried out outside of the Salmonid spawning period (May - September), and to appropriate guidance standards for culvert design, the potential impacts would be minimal as the proposed works will not pose siltation impacts or much disturbance to the river substrate. In addition, clearance of obvious blockages, e.g., woody debris, extraneous material etc. would provide a passage for fish migration. In the absence of mitigation measures, impacts would be considered **temporary, slight, negative,** locally.	There is potential for cumulative impacts in association with other Group 2, Phase 2a measures.	**Likely to be significantly positive on a local level**
Morell River Upper	Cul 5 Head wall to be	In-Stream works have the potential to generate silt and suspended solids during the works. The substrate material on	Cumulative impacts are as per those described for Morr 4 in Table 11.19 above.	**Unlikely to be significant on a**

River Section Potentially Impacted	River Section Potentially Impacted	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
	constructed in front of the pillar at the railway bridge to redirect the impact of the water and its increased flow velocity. Embankment tie ins	this particular stretch is generally coarse with cobbles, gravels and coarse sands very prevalent and is considered significant for salmonid and lamprey spawning as well as a supporting habitat for Otter. The proposed measure will increase flow velocity (See Chapter 12- Hydrology & Drainage). Changes to fisheries habitat associated with these hydraulic changes can potentially reduce the attractiveness of this stretch for spawning salmon. Indeed the higher velocity of this stretch during floods will reduce its attractiveness to juvenile salmon at such times and they will require to seek slower velocities closer to the substrate, at the margins or farther downstream. Construction of headwalls will either be from precast material placed in-situ or from the pouring of concrete material. Extensive excavation and runoff of silt and potentially cement can pose significant adverse effects to aquatic species. Cement is highly alkaline and can give rise to fish kills with similar effects on invertebrates, including white-clawed crayfish. Siltation poses an adverse impact on respiratory functions of fish and invertebrates. In the absence of mitigation measures, impacts would be considered **long term, significantly negative** locally. **Silt Runoff –** See Cul 1 impact description. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Upper & Lower) as a result of this measure in the absence of mitigation measures.		**national level,** but is considered **likely to be significant on a local level**
Morell River Upper	Cul 7 – embankment tie-in	**Silt Runoff –** The potential exists for silt to wash off from fresh, pre-vegetated embankments, excavations and stockpiles and flow into the river, particularly during periods of wet weather. Suspended solids can have negative effects on fish, macroinvertebrate and crayfish respiratory functions and on their respective habitats. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. The	Cumulative impacts are as per those described for Morr 15 in Table 11.19 above.	

River Section Potentially Impacted	River Section Potentially Impacted	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
		temporary working area will consist of a 15m wide area alongside the embankment. Where the embankment is in proximity to the river, the temporary working area will be on the land side of the embankment. Working materials and all excavated material will be stockpiled within this temporary working area, away from the river. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Morell River (Lower) as a result of this measure in the absence of mitigation measures.		
Painestown	Cul 9 Upgrading/repairs to Culvert.	In stream works associated with culvert upgrades have the capacity to give rise to significant amounts of silt especially if there is heavy rain and increased flows during culvert upgrade. The latter will result in deposition in the channel downstream, potentially impacting on trout and lamprey (river/brook) spawning gravel, crayfish habitat and macroinvertebrates and without mitigation could, therefore, be **long-term**, **significantly negative**, locally.	Each of the maintenance measures have cumulative impacts in association with other measures proposed in relation to the scheme. Culvert upgrades could be phased with other measures within the scheme to minimise release of silt to the Morell River Lower. Cumulative Impacts with Cul 9 would be primarily associated with embankment measures that tie into this culvert i.e. Paines 2 & 3 potentially causing an in-combination impact during the construction phase as well as upstream works associated with Group 2, Phase 2a in the Painestown Catchment, i.e. Morr 4 and Morr 7-10 and Culvert 10.	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**
Painestown (Painestown Bridge)	Cul 10 Head wall to be constructed in front of the pillar at the railway bridge to redirect the impact of the water and its increased flow velocity Embankment and wall tie-ins	See Cul 5. In-Stream habitat is similar, so same potential impacts will apply	See Culvert 9 cumulative impacts	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

River Section Potentially Impacted	River Section Potentially Impacted	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
Slane	Cul 18 embankment and wall tie-in	**Silt Runoff –** The potential exists for silt to wash off from fresh, pre-vegetated embankments, excavations and stockpiles and flow into the river, particularly during periods of wet weather. Suspended solids can have negative effects on fish, macroinvertebrate and crayfish respiratory functions and on their respective habitats. As works are intended to take place only in settled weather, the likelihood of silt runoff during wet weather is reduced. The temporary working area will consist of a 15m wide area alongside the embankment. As the embankment is in proximity to the river, the temporary working area will be on the land side of the embankment. Working materials and all excavated material will be stockpiled within this temporary working area, away from the river. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Slane river as a result of this measure in the absence of mitigation measures. **<u>Cement Runoff</u>** **–**The potential exists, as with any construction, that concrete or mortar, may enter the river channel. Cement is highly alkaline and can give rise to fish kills with similar effects on invertebrates, including white-clawed crayfish. Wash off from poorly cured cement can also be highly alkaline and potentially dangerous to fish. There is potential for **temporary, moderate, negative** impact given the toxicity of concrete to aquatic life within the Slane River in the absence of mitigation measures	Cumulative impacts are as per those described for Slane 1 in Table 11.19 above.	
Slane	Cul 19 embankment and wall tie-in	**<u>Silt Runoff</u> –** See Cul 18 impact description. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Slane as a result of these measures in the absence of mitigation measures. **<u>Cement Runoff</u> –** See Cul 18 impact description. There is potential for **temporary**, **moderate, negative** impacts on the aquatic ecology of the Slane River as a result of this measure in the absence of mitigation measures.	Cumulative impacts are as per those described for Slane 1 in Table 11.19 above.	

River Section Potentially Impacted	River Section Potentially Impacted	Potential Impact	Cumulative Impact	Impact Assessment and Level of Significance
Slane	Cul 22 Opening Culvert, the existing culvert is partially sealed. The ends of the culvert will be opened to accommodate scheme.	In stream works associated with culvert openings have the capacity to give rise to significant amounts of silt and concrete especially if there is heavy rain and increased flows during culvert openings. The latter will result in deposition in the channel downstream, potentially impacting on trout and lamprey (river/brook) spawning gravel, crayfish habitat and macroinvertebrates and without mitigation could, therefore, be **significantly negative**, locally.	Cumulative impacts are as per those described for Slane 1 in Table 11.19 above.	**Unlikely to be significant on a national level,** but is considered **likely to be significant on a local level**

11.3.6 Do Nothing

If the proposed scheme does not proceed then the current situation in relation to biodiversity will continue, i.e. the habitats and species currently inhabiting the main channel of the Morell River Catchment will persist with the normal interannual variation associated with discharge and temperature. Taking climate change scenarios into account, shorter return periods have been predicted for large flood events which would mean the Morell River Catchment may be subject to greater frequency of elevated and peak channel velocities. It is difficult to say what the likely ecological response to increased frequency of elevated channel velocity would be. Certainly additional flushing would ensure that the channel remained self-cleaning and without maintenance requirements, which is a positive impact in terms of salmonids and sensitive macroinvertebrates in faster flowing areas with fine and coarse substrates, however increased velocities could also result in additional scour of the channel bed and banks resulting in increased erosion. Increased frequency of elevated channel velocity would be unlikely to have further negative impacts on adult crayfish or their habitat, since any crayfish resident in the Morell Catchment would have access to stable refuges and would normally seek refuge during high flows under the present flow regime. Generally, it would be expected that salmonid spawning potential would remain somewhat patchy as a result of the present hydromorphological characteristics of the reach. Overall the **do nothing impact** would be neutral or in terms of aquatic ecology.

11.4 MITIGATION MEASURES

Mitigation measures are proposed to address the potentially adverse effects of the proposed scheme on biodiversity and in particular the aquatic ecological elements of the Morell River Catchment. These measures will allow any potential impacts affecting the ecological status of the Morell River Catchment to be minimised and avoided where possible.

An over-arching mitigation measure will be for the contractor to draw up a Construction Environmental management Plan (CEMP) and associated Method Statements that incorporate detailed mitigation measures as outlined in the following sections in relation to the implementation of all measures proposed. These documents will be strictly adhered to by staff and contractors involved in the works and will be overseen by the contractor’s site representative/foreman. The Environmental Management Protocols and Standard Operating Procedures (SOPs) will form the backbone of the Method Statements, supplemented by specific additional measures proposed below. The Method Statements will detail how these mitigation measures will be monitored for effectiveness by both the OPW themselves and independently, such as through proposed water quality monitoring. There will be ongoing consultation by Kildare County Council and the OPW with IFI and NPWS throughout all phases of the works which will include attendance at progress meetings at stages agreed in advance by Kildare County Council, the OPW and designated IFI and NPWS representatives. A mechanism for reporting of pollution incidents will be agreed in advance between the contractor(s) and the IFI (See Appendix B, in Volume 3 of this EIAR for an outline CEMP).

11.4.1 Construction Phase

In response to concerns raised by IFI, the following mitigation measures should be adopted during construction works:

As with any development, all measures necessary should be taken to ensure comprehensive protection of local aquatic ecological integrity, in the first place by complete impact avoidance and as a secondary approach through mitigation by reduction and remedy. Fisheries-specific constraints which will apply to this works programme are listed in the IFI's guidance document "*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*" (ERFB, 2003). This document should be consulted by the Local Authority and associated Contractors when preparing the Method Statement to undertake these works. The maintenance of habitat integrity (both in-stream and riparian) is essential in safeguarding the ecological value of these important systems. Any works directly affecting watercourses or riparian habitats must first be submitted for assessment and approval in the form of a detailed Method Statement. The measures below, and outlined in the draft CEMP, should be adhered to.

11.4.1.1 Mitigation Measures for Protection of Water bodies

The proposed scheme has been identified as potentially giving rise to adverse effects on natural resources, particularly water quality within the Morell River Catchment. The effective protection of water quality within the proposed scheme during construction will minimise the risk to fish and aquatic features of the Morell that rely on good water quality to sustain their condition. Water quality mitigation measures for avoidance, reduction and remediation of impacts are prescribed in the following sections.

Standard pollution control and mitigation measures, as outlined in Table 11.21, will be employed where relevant when working in and near the watercourses affected by the proposed works, to prevent the transport of deleterious substances to the Morell River Catchment and its associated water-dependent habitats and species. The CEMP and Method Statements will include how these mitigation measures will be monitored for effectiveness. An outline water quality management plan has been included in the draft CEMP but this will be developed by the contractor and a detailed programme of water quality monitoring, will be agreed with the IFI.

11.4.1.2 Mitigation Measures for the Protection of Otter

Loss of habitat/vegetation cover (scrub clearance) could result in reduced habitat quality and cover for otter utilising the various rivers throughout the catchment. Where possible, flood measures will be set back from the river bank, leaving a buffer zone of natural riparian vegetation. The removal of natural riparian vegetation should be minimised.

Prior to construction works commencing, the Contractor will engage the services of a suitably qualified ecologist to resurvey the proposed scheme measures, construction compounds and all access routes to identify whether otter occurs or not at the site of the proposed measure to be constructed and whether there is a breeding or resting place present.

Site specific avoidance and mitigation measures are required in respect of identified Otter habitat. The OPW Environmental Management Protocols and SOPs (for Otter) should be followed. In accordance with the OPW's Otter SOP, Operational Staff will walkover the works area one week in advance in conjunction with the Health & Safety assessment noting dense cover with access directly to the water that is to be avoided where feasible.

In addition, any recognisable signs of Otter presence observed such as spraints, footprints or suspected holts, will be recorded on the weekly record cards.

While holts are usually well concealed, where Operational Staff observe a suspected holt such as a burrow opening, in consultation with Management Staff, subject to flood risk management functions, no works are to occur within a 50m buffer each side.

It is important that any otter holts identified during survey work are dealt with appropriately, to stay within the obligations of relevant legislation. Where a holt is identified by a suitably trained ground staff member, work should not commence until NPWS have been consulted for advice and on the requirement for a licence to proceed. Where construction activities are required within 150m of a breeding Otter holt, a derogation licence will be required from NPWS. In relation to nonbreeding holts, no wheeled or tracked vehicles should be permitted within 20m of active holts or scrub clearance by hand within 15m (NRA, 2008).

Where possible, bank slopes should be protected - minimise scraping of bank slope on working bank. This will ensure that riparian habitat is permanently available for otters, thus providing potential breeding and sheltering opportunities;

Where possible, mature trees within the river corridor should be retained. Similarly, large in-stream boulders and substrate should be retained where possible. Where in-stream works are required, the replacement of in-stream boulders will also ensure that features are available for otters to use as territorial sign posts, and substrate is available for fish spawning/hiding places. Steps to enhance fisheries (loosen bed gravels and if channel bed is composed of suitable material, excavate pools and create riffles) should also be undertaken. This will ensure that fisheries habitat, fish populations and food availability for otters are improved (Envirocentre, 2006).

Table 11.21: Standard Pollution Prevention Control Measures

Potential Impact	Mitigation Measure
General	▪ Prior to any works, all construction personnel will receive an on-site induction relating to operations within and adjacent to watercourses and the environmentally sensitive nature of working within and in proximity to the Morell River Catchment and re-emphasise the precautions that are required as well as the mitigation to be implemented. ▪ The contractor will ensure that their engineer setting out the works is fully aware of the ecological constraints and mitigation requirements. The OPW will ensure that a Corrective Action procedure is put in place in the event of an incident onsite. ▪ The amount of bare ground created by excavation and vegetation removal will be minimised to prevent run-off. ▪ In-stream works will be carried out outside of the salmonid spawning season and the times that early life stages of salmonid fish will be present. In-stream work within the period 1st October to 1st May (inclusive) will only be undertaken with the advanced approval of Inland Fisheries Ireland.
Pollution of Watercourses	**General** ▪ To prevent the spread of invasive aquatic / riparian species, all plant and equipment employed on the construction site (e.g. excavator, footwear, etc.) must be thoroughly cleaned down using a power washer unit and washed into a dedicated and contained area, prior to arrival on site. A sign off sheet must be maintained by the contractor to confirm cleaning. ▪ Tools and equipment are not to be cleaned in rivers. ▪ Chemicals/fuels used shall be stored in sealed containers in the site lockup prior to use. ▪ The chemicals shall be applied in such a way as to avoid any spillage or leakage. Any and all excavated material is not to be temporarily stored adjacent to watercourses.

Potential Impact	Mitigation Measure
	Fuelling and lubrication ▪ The Contractor shall provide designated areas for fuel transfer away from any watercourses or drainage channels. The refuelling of mobile plant in the working area will be undertaken well away from any drains or water bodies. ▪ Spill kits will be made available close to the river and all staff will be properly trained on correct use. ▪ All fuels, lubricants and hydraulic fluids will be kept in secure bunded areas at a minimum of 10m from the river. ▪ The bunded area will accommodate 110% of the total capacity of the containers within it. Containers will be properly secured to prevent unauthorised access and misuse. An effective spillage procedure will be put in place with all staff properly briefed. Any waste oils or hydraulic fluids will be collected, stored in appropriate containers and disposed of offsite in an appropriate manner. ▪ All plant shall be well maintained with any fuel or oil drips attended to on an ongoing basis. ▪ Any minor spillage during this process will be cleaned up immediately. Should any incident occur, the situation will be dealt with and coordinated by the nearest supervisor who will be responsible for instructions by the OPW. **Cement/Concrete Runoff** Measures relating to concrete/cement management will mostly apply to the construction of the defence walls along select areas throughout the Morell Catchment. See 11.4.1.5.2 for mitigation measures. **Silt Runoff** Measures relating to management of silt runoff will mostly apply to the construction of the embankments along select areas throughout the Morell Catchment. See Section 11.4.1.5.3 for mitigation measures.

11.4.1.3 Timing of works

Direct instream works such as stream alignment, culvert upgrades or proposed measures along the riverbank have the greatest potential for negative impacts during spawning / breeding and early nursery periods for aquatic protected species in the study area. No instream or potentially significantly damaging out of river works should occur during restricted periods for relevant species in relation to individual measures (Table 11.22).

11.4.1.4 Location of Stockpiling/Compound Areas

Three areas have been identified as potential locations for stockpiling / set down of materials; in the vicinity of Paines 3, Morr 19 and Morr 23, shown on Figure 4.1. In addition to other logistical requirements such as their proximity to the proposed works areas, suitable haul routes and accessibility for HGVs, consideration was also given in the selection of the proposed locations of these compound areas in terms of the surrounding water environment. The compounds have been selected to be located away from vulnerable watercourses (or, in the case of Paines 3, separated from them by existing embankments) and outside the flood plain to reduce the risk of sediment mobilisation.

Diversion drains should be implemented on the upstream/upslope side of the stockpile area. Drains should be lined with a non-erodible material such as turf/geotextiles.

Bunds should be placed around exposed soils. This will prevent clean water entering the area and dirty water from leaving the area. Bunds should be made of non-erodible material such as straw bales/geotextiles.

Water polluted by sediment should not be allowed to leave the site untreated; polluted runoff should be routed for treatment by filtration, settlement or specialist techniques.

Table 11.22: In-Stream Works Restriction Periods for Aquatic Protected Species of the Morell Catchment

Species	Period of no instream disturbance (inclusive)	Likelihood of presence in the affected areas and comments	Period instream works allowed (inclusive)
Salmon (*Salmo salar*)	October to April - spawning, nursery (IFI).	Distributed throughout study area.	May to September
Brook (*Lampetra planeri*) and River Lamprey (*Lampetra fluviatilis*)	March to May - spawning / hatching	Distributed throughout study area, depending on localised habitat, i.e. spawning in riffles, nursery in silty deposits.	June to February.
Sea Lamprey (*Petromyzon marinus*)	Mid June – July	Distributed throughout study area, depending on localised habitat i.e. Spawning and juvenile nursery habitat abundant throughout the study area, depending on localised habitat, i.e. spawning in riffles, nursery in silty deposits.	August to April.
White Clawed Crayfish (*Austropotamobius pallipes*)	November to late June (breeding / berried females + hatching).	Distributed throughout study area but populations particularly abundant on Slane River.	July - October
Trout (*Salmo Trutta*)	October to May - spawning, nursery (IFI).	Distributed throughout study area.	June to September
Combined/ overall timing restrictions.	No instream works allowed between October and July.	-	Instream works allowed August to September.

11.4.1.5 Scheme-Specific Mitigation Measures

11.4.1.5.1 Haul Routes

Surface water should be directed away from haul routes to prevent uncontaminated run-off flowing onto the road. Excess water should be prevented from running along haul routes by installing small earth bunds (like speed bumps) or cut-off ditches at regular spacing to direct water into roadside ditches.

Where haul routes cross watercourses, adopt measures to prevent sediment-laden run-off from entering them, e.g. ensuring crossing structures have edge upstands or bunds e.g. straw bales, sandbags or earth; and making sure bridge decks are sealed.

Water polluted by sediment should not be allowed to leave the site untreated; polluted run-off should be routed for treatment by filtration, settlement or specialist techniques.

Where inlets to existing surface water drainage are present on- site (e.g. road gullies or yard drains), they should be protected from run-off polluted with sediment. Water should be diverted away from the inlet to treatment facilities. Where this is not possible, a bund should be created around the surface water drain to prevent contaminated water entering.

11.4.1.5.2 Stream Realignment

Certain proposed works at the Slane River (Slane 8) will involve realigning the stream channel to alleviate bank erosion (See Section 4.3.4 in Chapter 4 for complete description of works). At Morr 8, a short section (70 metres) of a small tributary of the Painestown River running adjacent to the railway embankment will be diverted to allow construction of the flood defence at this location.

The following measures will be put in place during proposed works:

- Operation of machinery instream should be kept to an absolute minimum.
- All construction machinery operating instream should be mechanically sound to avoid leaks of oils, hydraulic fluid, etc;
- Machinery should be steam-cleaned and checked prior to commencement of instream works;
- At Slane 8 in-stream works will be carried out outside of the salmonid spawning season and the times that early life stages of salmonid fish will be present. In-stream work within the period 1st October to 1st May (inclusive) will only be undertaken with the advanced approval of Inland Fisheries Ireland;
- During realignment works on the Slane River, contractor SOPs will be applied to respond in the case white-clawed crayfish are present and emerge from refuges at the times of stream realignment. In the event that significant populations of white clawed crayfish emerge, advice will be sought from IFI and NPWS to facilitate any necessary rescue and relocation;
- The permanent diversion will be excavated in the dry to an agreed specification;
- The banks and bed of the new channel will be lined with a biodegradable geotextile;
- The stream diversions will have a natural stream bed and will replicate insofar as practicable the stream bed material characteristics of the watercourse.

- Fish will need to be removed from the impacted section of the existing channel in advance. The fish removal must be completed by IFI or persons authorised under Section 14 of the Fisheries Consolidation Acts 1959 (as amended);
- Bungs should be fixed at both ends of the existing channel and removed in a controlled manner at IFI's direction ensuring the river flow remains uninterrupted from above to below the works.

The new channels will be open cut through the existing bends, the streams will be diverted through this new channel and the old channel will be filled in. The opening of the new channels will be completed from the field, it will start at the centre point and move progressively in both directions until it reaches the stream banks. Once it reaches the banks, both banks will be opened and the upstream section of the stream diverted in a controlled manner by restricting flow down the old channel, the downstream section will also have flow restriction to minimise backflow, this will allow the old section to drain slowly. The old channel will be backfilled from the upstream side starting with the new upstream bank around the bend to the downstream section where the second new bank will be created.

The filling in of the old channels will be from the temporary island that the new channel will have created. During re-alignment the temporary work areas will be set up in the field, this is where the excavated material will be stock piled for use when backfilling the old channel. The machinery will traverse the stream twice, once to access the island to fill in the old channel and the second time to exit the works area upon completion.

Triple silt curtains derived from Terram or other similar material should be placed in stages downstream of the confluence with the new channel, to first filter out the heaviest of materials and subsequently the finer material. These would need to be checked on a regular basis with the heavy material removed from the first silt curtain thereby keeping it functional. A procedure will need to be included for the removal of the silt fences on a staged basis, as even these preventative measures will lead to a build up behind the curtain. The curtain nearest to the point of works should be removed first followed by the others.

A plan and section drawing of the proposed channel is included in Chapter 4 and further information on the diversion method is included in the outline CEMP in Appendix B. The design takes into account the recommendations within '*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*' (ERFB, 2003) to assist with providing appropriate hydraulic and morphological characteristics fulfilling the requirements of salmonid habitats as advised by IFI.

11.4.1.5.3 Flood Defence Walls

Table 4.1 in Chapter 4 provides details of where flood defence walls are proposed. The following measures should be set in place during proposed works:

- Disposal of raw or uncured waste concrete will be controlled to ensure that the watercourse will not be impacted;
- Best practice will be adopted in bulk-liquid concrete management, addressing pouring and handling, secure shuttering / form-work, adequate curing times;
- Where shuttering is used, measures should be put in place to prevent against shutter failure and to control storage, handling and disposal of shutter oils;

- All working materials and excavated material should be stockpiled on the land side of the works within the assigned 15m temporary working area;
- Where excavations are proposed which are within 10 metres of a river, a sediment barrier should be used on the river side to minimise the potential for sediment transport. Once the wall is complete the sediment barrier should be left in-situ to allow the reinstated ground around the wall to settle in. The sediment barrier should only be removed after inspection of the reinstated ground confirms that it is stable;
- Wash water from cleaning ready mix concrete lorries and mixers may be contaminated with cement and is therefore highly alkaline. Due to the size of the site and the proximity of sensitive watercourses, it is recommended that lorries and mixers are washed out offsite.

The following activities associated with the construction of flood defence walls should be noted:

- ***Bank Protection*** – Refer to OPW's Environmental Management Protocols and Standard Operating Procedures.
- ***Bush Cutting / Branch Trimming*** - Refer to OPW's Environmental Management Protocols and Standard Operating Procedures.

In addition to the above a detailed Method Statement for each works area will be drawn up by the contractor, indicating what measures will be taken to avoid sediment or soil loss associated with all aspects of the construction and how these will be monitored for effectiveness. These mitigation measures in combination with the inclusion, where possible, of a buffer area between the works and the river will reduce the likelihood of silt mobilisation and cement runoff.

11.4.1.5.4 Embankments

Table 4.1 in Chapter 4 provides details of where embankments are proposed. The following measures should be employed during proposed works:

- Works should be carried out ideally during a period of settled weather with no flood risk which will allow sufficient time for construction materials to settle;
- Embankment material should be selected that has low silt content;
- All working materials and excavated material should be stockpiled on the land side of the works within the assigned 15m temporary working area; and
- Where embankments which are within 10 metres of a river, sediment barriers, e.g. silt fencing, should be used on the river side to minimise the potential for sediment transport. Once the embankment is complete the sediment should be left in-situ to allow the reinstated ground around the wall to settle in. The sediment barriers should only be removed after inspection of the reinstated ground confirms that it is stable.

The following activities associated with the construction of embankments should be noted:

- ***Bank Protection*** – Refer to OPW's Environmental Management Protocols and Standard Operating Procedures.
- ***Bush Cutting / Branch Trimming*** - Refer to OPW's Environmental Management Protocols and Standard Operating Procedures.

In addition to the above a detailed Method Statement for each works area will be drawn up by the contractor indicating what measures will be taken to avoid sediment or soil loss associated with all aspects of the construction and how these will be monitored for effectiveness. These mitigation measures in combination with the inclusion of, where possible, a considerable buffer area between the works and the river will to reduce the likelihood of silt mobilisation.

11.4.1.5.5 Upgrade of Existing walls

This is proposed for existing boundary wall in Killeen Golf Club - Morr 22 (see Table 4.1 in Chapter 4):

- Address Best Practice OPW standards available for liquid and/or mortar management addressing batching on site pouring and handling, secure shuttering / form-work, adequate curing times and management of spills;
- No washings should be allowed to enter nearby drains; and
- Works should occur in the dry.

11.4.1.5.6 Culvert Alterations

Upgrades are proposed for the following three culverts:

- Cul 5 - (Morell River Upper) Head wall to be constructed in front of the pillar at the railway bridge to redirect the impact of the water and its increased flow velocity, scour protection measures will also be incorporated - (See Section 4.3.4 in Chapter 4 for description of proposed measure);
- Cul 9 – Painestown River at the L60161 – remediation of existing culvert which is in poor structural condition;
- Cul 10 – Painestown River at railway bridge- as per description above for Cul 5.

Throttling/unthrottling of culverts is proposed at three locations:

- Cul 4 - Culvert to be cleared of debris and throttled by reduction of inlet size at upstream end;
- Cul 4a – Culvert to be cleared of debris and throttled by reduction of inlet size at upstream end;
- Cul 22 - The existing culvert is partially sealed, the ends of the culvert will be opened to accommodate scheme.

Tie-ins with new walls and embankments will occur at five locations:

- Cul 1 - Culvert to be inspected and remediated if necessary to accommodate interactions with embankment Morr 1;
- Cul 2 - Culvert to be inspected and remediated if necessary to accommodate interactions with embankment Morr 2 & 3 and Paines 1;
- Cul 7 - Culvert to be inspected and remediated if necessary to accommodate interactions with embankment Morr 15, 17 & 19;
- Cul 18 - Culvert to be inspected and remediated if necessary to accommodate interactions with wall Slane 1 and embankment Slane 3;
- Cul 19 - Culvert to be inspected and remediated if necessary to accommodate interactions with wall Slane 4 and embankment Slane 5.

All instream works should adhere to timing restrictions for aquatic protected species of the Morell Catchment (Table 11.22).

- Any alteration to culverts must ensure the unimpeded passage of fish at all times;
- Morell River (Cul 5) and Painestown River (Cul 9 & 10) should be electro fished downstream of the proposed works in advance of any works to assess whether there are any fish or lamprey ammocoetes in the affected channels as advised by IFI. The fish removal must be completed by IFI or persons authorised under Section 14 of the Fisheries Consolidation Acts 1959 (as amended);
- Headwalls for Cul 5, Cul 9 and Cul 10 should be pre-fabricated and inserted or assembled on site without the use of bulk liquid concrete;
- In-channel works for upgrades on Culverts 5, 9, 10 and 22 and, where relevant, 1, 2, 7, 18 & 19 will use cofferdam type construction whereby flow can be restricted allowing the civil engineering works to be undertaken in the dry conditions. A cofferdam is a temporary watertight enclosure that is pumped dry to expose the bottom of a body of water so that construction can occur. Method statements for the construction of cofferdam structures should be agreed in advance with IFI personnel in advance of construction works; and
- For proposed works on Cul 5, Cul 9 and Cul 10, and, where relevant, at Culverts 1, 2, 4, 4a, 7, 18 & 19 effective silt management measures should be placed in stages downstream of the new channel in advance of commencing culvert alterations. These will be specified by the Contractor in the Method Statement and agreed with IFI, but the currently proposed measure would be triple silt curtains derived from Terram or other similar material, to first filter out the heaviest of materials and subsequently the finer material. These would need to be checked on a regular basis with the heavy material removed from the first silt curtain thereby keeping it functional. A procedure will need to be included in the Method Statement for the removal of the silt barrier on a staged basis, as even these preventative measures will lead to a build up behind the curtain. The curtain nearest to the point of works should be removed first followed by the others.

A detailed design and Method Statement should be drawn up by the contractor indicating how the above measures will be taken. IFI should be contacted prior to any works to review mitigation measures and offer additional advice on same.

11.4.1.5.7 Realignment of the channel

The design and construction of new channel with natural habitat characteristics will where possible replicate the existing and will incorporate riparian vegetation and other natural features such as meanders. This will require importation of various grades of stone and gravel to construct habitat features e.g. riffles, pools and gravel areas. Materials from original channel may be re-used to minimise quantities of new material required.

The creation of a new channel will be carried out in the dry in isolation from the existing watercourse and shall only be carried out in accordance with the timing constraints for instream works outlined in Table 11.22. The design of the realigned channel shall be carried out in accordance with best practice, i.e. Crossing of Watercourses during the Construction of National Roads Scheme (NRA, 2005), '*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*' (ERFB, 2003) and CIRIA Technical Guidance C648 (CIRIA 2006). Once construction of the channel is completed it shall be reconnected to the existing channel only during the approved operation window for in-stream works.

Provided pollution control measures are fully implemented and the realignment of the channel is carried out In accordance with best practice there should not be an adverse affect on the downstream water bodies and protected areas.

11.4.1.5.8 Made Ground Excavations

An outline Waste Management Plan (included as Appendix M in Volume 3 of this EIAR) has been developed to set out control measures for managing all potential wastes arising from the construction phase of the Morell River Flood Management Scheme.

All locations where made ground is known or suspected will require further investigations to assess if the made ground is contaminated during detailed design, prior to any excavation works. Further investigations will include extraction of a series of representative samples for laboratory analysis to quantitatively assess the potential for contamination. In addition, should evidence of contamination (such as staining or strong odours) be observed during excavations, further investigations will also be required to determine if there are any environmental or human health risks prior to further excavation works. Should contaminated ground be encountered, the site investigations will assess and delineate any contamination.

The outline Waste Management Plan in Appendix M has included a number of measures to prevent environmental risks associated with contaminated water arising from leaching of contaminated made ground, surface runoff and exposure of the aquatic environment to contaminants. These include the avoidance of onsite stockpiling of any potentially contaminated soils / made ground and direct loading of potentially contaminated soils / made ground into designated trucks for removal offsite. If temporary stockpiling is necessary, stockpile management will include the following measures to prevent leaching and surface runoff of potential contaminants to the aquatic environment:

- Stockpiling should be limited to a specific area of the site and not within 50m of any water course;
- Stockpiled made ground should be placed on impermeable plastic liners and covered to minimise rainfall infiltration; and,
- Berms should be constructed around the stockpiles.

A site specific Waste Management Plan shall be implemented onsite to mitigate any potential impacts from potentially contaminated made ground. The plan will include steps for the excavation, handling, storage and disposal of potentially contaminated material in accordance with industry best practices and waste management regulations which will inform the detailed Method Statement that will be drawn up by the contractor for each works area. These measures, in combination with other measures described in the sections above to prevent sediment mobilisation and escape of other pollutants, will reduce the likelihood of surface runoff from exposed made ground or migration of contaminants through the sub-surface.

Provided the plan is fully implemented and the excavation of made ground or other potentially contaminated soil is carried out in accordance with best practice there should not be an adverse affect on nearby water bodies and protected areas.

11.4.2 Operational Phase

Maintenance works for the proposed scheme may potentially give rise to adverse effects on water quality, aquatic ecology and therefore biodiversity. The effective protection of water quality within the proposed scheme during operational (maintenance) phase will minimise the risk to the ecological interests of this site and other water bodies within the Morell catchment. General mitigation will involve implementation of current best practice for riparian works at the time of maintenance e.g. the OPW's Standard Operating Procedures for Arterial Drainage Maintenance Service (OPW, 2011) or any subsequent updates.

Maintenance works to be carried out will be subject to the relevant environmental assessment requirements, including Screening for Appropriate Assessment and surveys for protected species.

The implementation of mitigation measures outlined in Section 11.4.1. above for construction – related impacts will ensure protection of water quality during maintenance, along with the requirement to implement current best practice for works at the time of maintenance.

11.5 RESIDUAL IMPACTS

11.5.1 Construction Phase

Following the full implementation of the mitigation measures described in Section 11.4.1 it is anticipated that there will be **Temporary Slight Negative** residual impacts on the natural resources (water quality, river substrate and aquatic ecology) of the Morell Catchment within the proposed scheme sub-catchment as a result of construction works. It is expected that watercourses should recover after a short period and return to similar pre-construction state.

11.5.2 Operational Phase

It is not anticipated that the annual maintenance measures outlined in Section 11.3.3 will involve any significant negative impacts to the water quality or aquatic ecology of the Morell River along the proposed scheme catchment (once recommended mitigation measures are followed) and therefore by extension there will be no significant residual impacts as a result of maintenance works.

12 HYDROLOGY & DRAINAGE

This chapter of the EIAR examines the existing baseline environment in terms of hydrology and sets out the flood modelling methods used for the proposed scheme. It also assesses the potential impact of the proposed scheme on the existing hydrological environment of the Morell River and its tributaries. Mitigation measures are recommended to minimise any adverse impacts where appropriate.

12.1 METHODOLOGY

The hydrology for the Morell catchment was developed over three stages. The first stage included data collection of relevant datasets for use in the Eastern CFRAM Study and conducting an initial analysis on the data prior to a more detailed analysis being carried out in the second stage.

In the second stage design flood flows were estimated using hydrological analysis methodologies.

For the final stage the hydrological outputs were input into a hydraulic model developed by RPS for the Morell River Catchment as part of the Eastern CFRAM study. The hydraulic modelling software 'MIKE' was used to estimate the flood flows and floodplain extent. The model produced was then used to develop flood management options and to help choose the preferred flood management Option. Following stakeholder consultations and feedback from a technical review undertaken by the OPW, the original Feasibility Stage Option design has been developed into the currently proposed scheme. Full details of the development of the final scheme design are given in the Preliminary Design Report (RPS, 2017) included as Appendix K in Volume 3 of this EIAR.

Data collected as part the first stage included:

- Flood Relief/Risk Management Measures -Previous reports or studies concerning flood hazard or risk or possible flood relief measures
- Historic Flood Data - Information on historic flooding, Maps of flood extents, Flood levels, Flood depths
- Hydrometric Data - Information on recorded water levels data, flows, flow gaugings and ratings (stage discharge relationships) for all gauging stations in the catchment
- Meteorological Data - Information on rainfall, air pressure, wind speed and direction, temperature and evapotranspiration for all rainfall stations in the catchment.
- Land-use Data - Information on current and past land use.
- Soil and Geological Data- Data on soil classifications, sub-soils, geology and aquifers.
- Mapping – OSI Maps, LiDAR, Aerial Photography
- Existing Survey Data - Topographical, channel and structural survey data
- Environmental Data - Information, reports, studies, zoning or assessments of environmental and archaeological status, issues, constraints and impacts.

The first stage also included a preliminary assessment of:

- Hydrometric Data – A rating review was undertaken for the hydrometric stations in the catchment. This entailed site visits, a review of the water level recordings, river channel surveys upstream and downstream of the station location and hydraulic modelling techniques to extrapolate rating curves to construct a theoretical rating curve that provides a relationship between stage and discharge for flood flows. Four hydrometric stations were specified for this analysis within HA09; and

- Historic Flood Data - A historical review of the severity of all flood events was carried out and subject to the availability of continuous water level records, a number of major flood events were selected to examine further their causes/mechanisms, behaviour and their frequency of occurrences. Based on the review flood events were selected for the hydraulic model calibration and verification. Where no flow records were available level information and photographs / mapped flood outlines were used to validate the models.

For the development of the hydrological processes in Stage 2, the data from Stage 1 was used to identify:

- Hydrological Estimation Points (HEPs) - These are located along the watercourses to denote points where hydrological analysis was required for the estimation of design flows that were used as hydraulic model inputs. They also served as check points at gauging station locations, so that the design flood events were properly derived.
- Catchment boundaries - Provided by the OPW but were reviewed by checking mapping, GIS datasets and LiDAR data where available.

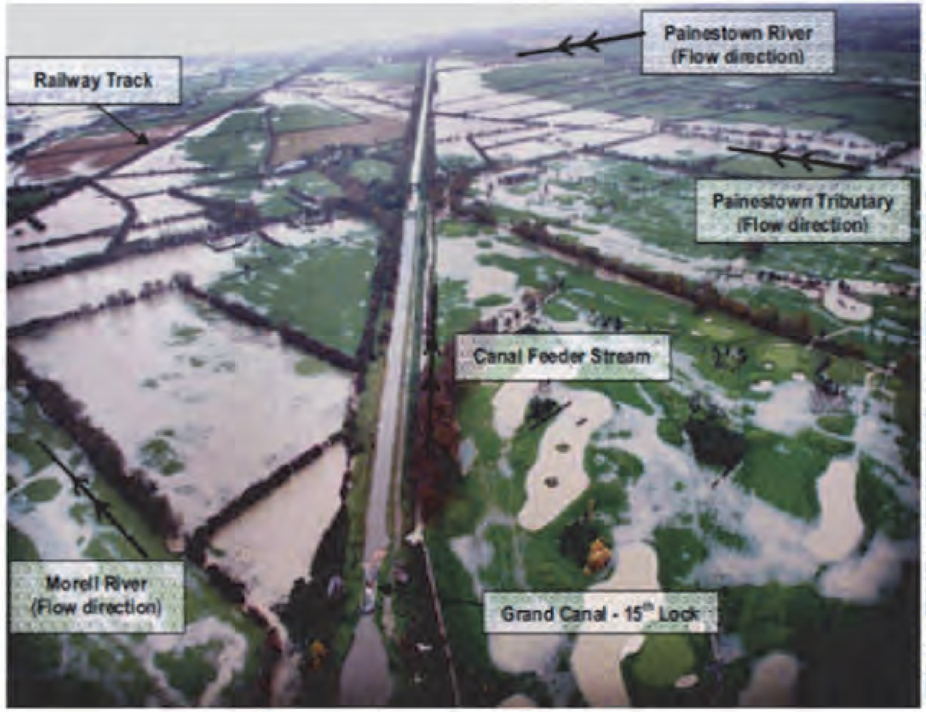
Stage 2 primarily involved design flow estimation undertaken using two processes depending on the location of the HEP being analysed. These processes were:

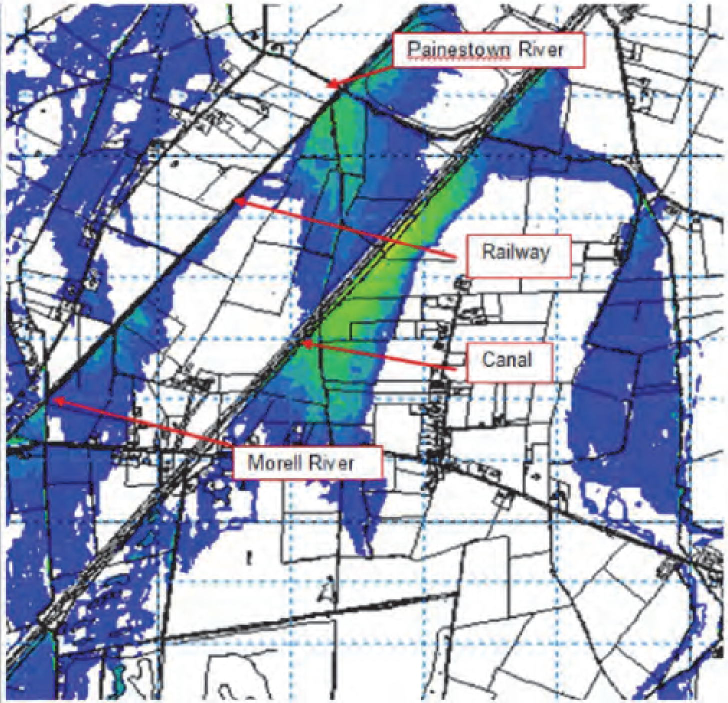
- Rainfall run off modelling using the MIKE NAM software
- Flood estimation mathematical equations based on catchment characteristics (such as land use, rainfall, soil properties). Flood estimation for catchments less than $25km^2$ was carried out using the Institute of Hydrology Report 124 (IH 124) equation. For catchments greater than $25km^2$ the OPW Flood Studies Update (FSU) 7 variable equation was used. The flood estimation derived from the FSU 7 variable equation can also be adjusted by gauging station which has similar hydrological characteristics or is geographically close.

Stage 3 involved the building of a hydraulic model using the hydraulic modelling software MIKE. The river channels and structures were developed from topographical survey collected from Stage 1 and supplemented by additional survey data procured in stages 2 & 3 if data gaps where identified. The surface of the land was generated from LiDAR data and combined together with the topographical surveys to create a representation of the river channel and its surrounding lands. The design flow estimates from stage 2 where input into the model to estimate flows and flood extents.

Stage 2 and Stage 3 form an integrated process between hydrology and hydraulics so when the design flows were derived, they were input into the hydraulic model and the outputs compared with observed flows at the gauging stations. Thus hydrological inputs were iteratively adjusted until calibration with the gauging station was achieved. Flood extents were calibrated against aerial photography taken post flooding events. Figure 12.1 shows an example of the flood extent calibration and verification undertaken during Stage 3.

The first stage is detailed in the Eastern CFRAM Study Hydrometric Area (HA) 09 Inception Report. The second stage is detailed in Eastern CFRAM Study Hydrometric Area (HA) 09 Hydrology Report and the Analysis of the Dublin Radar Data for the Eastern CFRAM Study Area Report. Stage 3 is detailed in the Eastern CFRAM Study Hydrometric Area (HA) 09 Hydraulics Report - Turnings / Killeenmore Model.





Legend

Kildare County Council

Project **River Morrell FMS**

Title

Hydraulic Calibration

Figure 12.1

RPS

RPS Consulting Engineers
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900
Fax: +353 1 462 0814

Issue Details

Drawn: BT	**Project No.** MDW0575
Checked: KK	**File Ref:**
Approved: JH	MDW0575QG1129D01
Scale: N/A	**Map Projection:**
Date: 31/07/2015	Irish National Grid (ING)

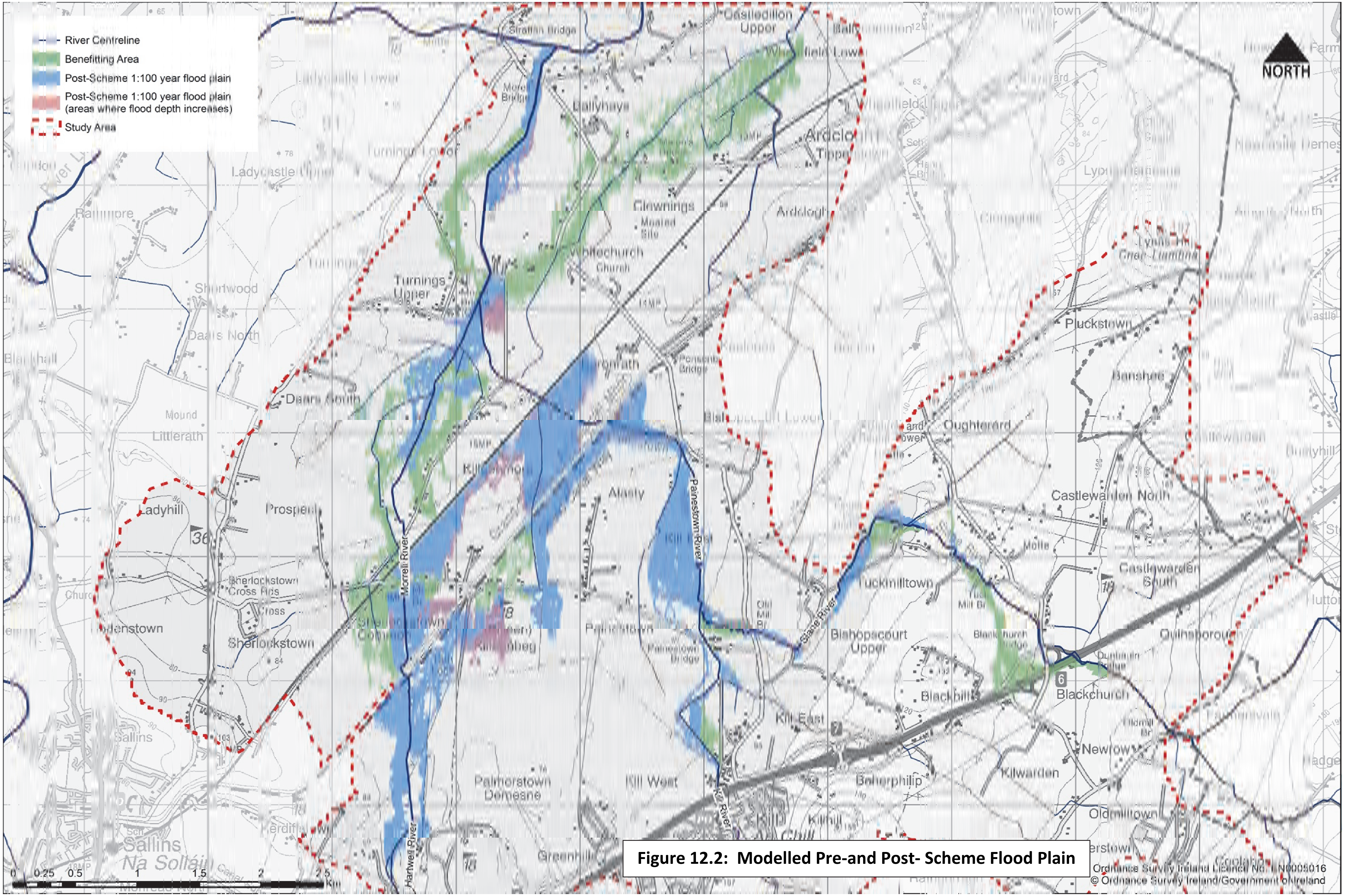


Figure 12.2: Modelled Pre-and Post- Scheme Flood Plain

12.2 RECEIVING ENVIRONMENT

12.2.1 Morell River Catchment

The Morell River forms part of the Liffey catchment and falls within Hydrometric Area 09 (HA 09) of the Eastern River Basin District.

The Morell River system is a substantial tributary of the River Liffey with a total catchment area of nearly 100 km^2. The upper extents of the catchment reach into the foothills of the Wicklow Mountains and there are a number of small tributary catchments including the Haynestown, Hartwell, Kill, and Slane Rivers (the Slane and Kill Rivers then combine to form the Painestown River within the study area). The catchment is predominantly rural pasture lands with some urban lands including the villages of Kill and Johnstown. The River Morell's confluence with the River Liffey is approximately 1.5 km southwest of the town of Straffan. An overview of the Morell River catchment and the study area is shown in Figure 1.1 (in Chapter 1).

12.2.2 Flood Risk

There is a history of flooding in the catchment. In recent years, the severity and frequency of the flood events have resulted in severe hardship for residents, farms and enterprises in the area. Figure 1.2 (in Chapter 1) illustrates the existing floodplain for the catchment and it is also shown in Figure 12.2 by the areas shaded green.

The principal source of flood risk within the catchment is fluvial flooding. Section 4.3.2 of the '*HA09 Inception Report*' (RPS, 2012[1]) for the Eastern CFRAM Study identifies historical flood events where flooding was caused by intense rainfall or prolonged and heavy rainfall with antecedent wet conditions. Key historical floods in the catchment occurred in April 1998, November 2000, November 2002 and November 2009. The relatively flat topography of the area in conjunction with the railway and canal embankments traversing the Morell and Painestown rivers has resulted in extensive areas being flooded in the past. Images 12.1 and 12.2 overleaf are aerial photographs taken two days after the November 2009 event and show the extent of flooding surrounding the Morell and Painestown Rivers.

The culverts on the Morell and Painestown rivers which pass under the Grand Canal restrict conveyance, preventing flood water from progressing downstream on both rivers. Downstream of the canal, the channel capacity is less than the flows passing under the canal, resulting in out-of-bank flooding of the area between the canal and the railway embankments. The out-of-bank flood waters pass to the downstream side of the railway embankment via four culverts. These culverts convey water to the Killeenmore Road area, flooding a number of properties. A watermain trench was also identified as a flow path from the upstream to downstream side of the railway embankment.

Downstream of the Morell/ Painestown confluence, the Morell Bridge (Old) restricts the flow resulting in out of bank flooding. The out of bank flooding progresses west along L6019 and north east across predominantly agricultural land towards the River Liffey (at higher return periods).

[1] Available at Eastern CFRAM study downloads page http://eastcfram.irish-surge-forecast.ie/?page_id=79

On the River Slane, culvert capacity causes out-of-bank flooding which occurs at the N7 interchange (Junction 6) at low return periods, causing flooding of the road network.

Image 12.1: November 2009 Flood event, Painestown River (to right of image) looking north west across Railway

Image 12.2: November 2009 Flood Event, Morell River at old Morell Bridge, looking southwest

12.2.3 Flood Hydrology

The flood hydrology for the catchment was developed using rainfall run-off models and flood estimation mathematical equations calibrated against actual rainfall and river flow data.

Four catchment rainfall run-off models were developed for the catchment using rainfall data taken from the rainfall gauge at Casement Aerodrome and from rainfall radar data at Dublin Airport. These models were calibrated against four gauging stations, which record flow data and are located within the Morell River catchment. A summary of the available gauging data is given in Table 12.1.

Table 12.1 – Hydrometric stations in the Morell River catchment

Station No.	Station Name	Flow Data Availability
09024 (EPA)	Morell Bridge	2001-2012
09027 (EPA)	Broguestown	2001 – 2011
09044 (EPA)	Kerdiffstown House	2009-2012
09047 (EPA)	Baronrath	2009-2011

All other hydrology within the catchment was derived using flood estimation mathematical equations based on catchment characteristics (such as land use, rainfall, soil properties). This was used to generate flood flows that where adjusted based data from the nearest hydrologically / geographically similar gauging station.

12.2.4 Additional Flood Hydrology following Public Consultation

Following public consultation, which took place on 23rd October 2014, concerns were raised that an existing unnamed stream in the Alasty townland was not included within the hydraulic model and also about the extent of the floodplain along the Painestown River in the Painestown townland. In response to these concerns, additional cross sections along the Painestown River and the existing unnamed stream (which flows through the townlands of Killeenbeg and Alasty before joining the Painestown River near the railway) were added to the hydraulic model. The hydrology was derived using the catchment characteristics based methods and adjusted where appropriate as described in Section 12.2.

12.2.5 Previous Morell Flood Alleviation Schemes

N7 - Castlewarden Junction 6

The river systems in the Morell catchment cross the N7 national roadway between Maudlins Interchange, south of Junction 9, and at Castlewarden Junction 6. The latter of these two crossings poses a serious flood risk for the N7. Severe and extensive flooding incidents have been documented from April 1998 in the '*Hydraulic Model and Flood Alleviation Measures Report'* for the N7 Naas Road Interchange Scheme, prepared by J.B. Barry's & Partners Limited in 2002. The report noted that the Morell river channel was under capacity between the N7 and the canal.

Following completion of the '*Castlewarden – Flood Mitigation – Minor Works'* detailed design report by J.B. Barry & Partners in June 2011 works were carried out between 2011 and 2012 to address the insufficient capacity and problematic flooding issue at the Castlewarden Junction.

However, the improvement works outlined in the detailed design report were not fully implemented as concerns were raised that works to the culvert at the N7 - Castlewarden Junction 6 would exacerbate flooding of residential properties downstream. As the improvement works were not fully implemented there is still a flood risk at the Castlewarden Junction.

Johnstown Flood Relief Scheme

Upstream of the N7 the Johnstown Flood Relief scheme was carried out in 2009. The works involved regrading / widening of the Hartwell River and other streams passing through the town. They also included regrading of the Morell River, upgrading of existing culverts and construction flood embankments. All defence works are incorporated in the Eastern CFRAM Turnings / Killeenmore hydraulic model.

12.2.6 Drainage

As described in Section 12.3.2 the principal source of flood risk within the catchment is fluvial flooding where the cause of flooding is intense rainfall or prolonged and heavy rainfall. The upstream part of Morell River catchment lies within the Wicklow Mountains and has a steep topography. The UK Flood Studies Report characterises this area as soil type 5 indicating a high runoff potential. The majority of the catchment has relatively flat topography predominant soil type 2 suggesting a low runoff potential.

Rainfall runoff from the steep upstream catchment flows downstream to the flatter areas overtopping the banks with flooding being exacerbated by antecedent wet conditions. The railway and canal embankments traversing the Morell and Painestown rivers restrict conveyance preventing flood water from progressing downstream causing out of bank flooding of the area at those locations as shown in Figure 1.2.

The lands along the study area drain as overland flows and also via a number of small drains and ditches/land drains to the Morell River and its tributaries.

The existing culverts drain the River Morell and its tributaries downstream towards to Liffey. The culverts are in varying condition; some of the larger culverts / bridges are showing signs of disrepair, with the structural supports being undermined by scour erosion, a number of the smaller culverts are screened and require debris to be cleared, and the culvert near Castlewarden at the N7 throttled and as a result is under capacity. As noted in Section 12.3.2 some the culverts restrict flow at higher return periods resulting in out of bank flooding.

In 2002 works were completed which included the construction of box culvert sections beside a number of the older bridges in the catchment for overflow requirements. Kildare County Council has undertaken some light maintenance work, specifically removing silt from these overflow culverts to restore them to full capacity, however the council has noted that the silt builds and blocks the culvert quite quickly after maintenance works has been completed.

12.3 POTENTIAL IMPACTS

12.3.1 Do Nothing

The Do nothing scenario will result in numerous properties continuing to flood on a regular basis. There are 15 properties at risk of flooding for the 10% AEP event and 30 properties at risk for the 1% AEP event. The Do nothing scenario would also result in the N7 at the Castlewarden junction continuing to flood on a regular basis. This section of the motorway is predicted to flood for events equal or greater than the 20% AEP.

12.3.2 Construction Phase Impacts

12.3.2.1 Flooding

During the construction phase of the works, the potential causes of flooding could include:

- Blockage to the river flows due to collapsing of unstable river banks or temporary or permanent stockpiles during construction;
- Flooding of adjacent lands and properties caused by any reduction of channel conveyancing capacity during the construction of flood defences.

12.3.2.2 Drainage

The existing land drainage system in the study area could be affected during the construction period of the works. Potential impacts on the existing drainage systems include:

- The pattern of runoff could change with some existing drains and ditches receiving significantly more or less flow than they receive currently; rainfall on elevated areas could wash peat and silt into the surrounding watercourses. Localised erosion and scouring could occur while reduced flow may result in stagnation in some drains and ditches; and
- Obstruction of flow paths could cause localised water logging in the vicinity of the proposed flood protection embankments.

12.3.3 Operational Phase Impacts

12.3.3.1 Flooding

- Morell River (Turnings Lower to Ballyhays) – There is a significant decrease in 1% AEP flood extents in Turnings Lower and Ballyhays. As a result of the installation of flood defences in these areas, there are increases in water level ranging from 0.035 m to 0.210 m between the abattoir bridge and the bridge under the R406. This increase results in a slight increase in flood extents to pastureland in these areas. There is no adverse increase in the floodplain near the Liffey confluence. Figure 12.2 shows changes to the floodplain.

- Morell River (Killeenmore to Turnings Lower) - There is a significant decrease in 1% AEP flood extents in Killeenmore where numerous properties are protected from flooding for events up to the 1% AEP event. Properties in these areas are predicted to flood for the 10% AEP event. In other areas along this stretch of river, there are increases in water level ranging from 0.025 m to 0.376 m.

- These increased water levels result in an additional flooding to pastureland adjacent to the proposed defences Morr 3 and Paines 1. The affected landowner has been accommodated by ensuring an adjacent land parcel is protected.
- Increased water levels adjacent to Morr 10 are contained within the channel with no increase in floodplain.
- Figure 12.2 shows changes to the floodplain.

- Morell River (Sherlockstown to Killeenmore) - There is a significant decrease in 1% AEP flood extents in Sherlockstown where numerous properties are protected from flooding for events up to the 1% AEP event. There are increases in water level ranging from 0.002m to 0.637 m.

  - Increased water levels adjacent to Morr 4, Morr 15, Morr 17 and Morr 19 are the result of flood defences being put in place to protect properties at risk in these areas. An affected landowner is being accommodated by ensuring an adjacent land parcel is protected.
  - Increased water levels result in an additional flooding to pastureland adjacent to Morr 17. However this is the result of a reduction in the floodplain in the surrounding areas which helps to protect a minimum of 8 properties. Affected landowners have been accommodated by ensuring adjacent land parcels are protected.
  - Figure 12.2 shows changes to the floodplain

- Morell River (Killeen Golf Club) - There is an increase in 1% AEP flood extents in Killen Golf Club. The Golf Club clubhouse has been protected but large areas of the golf course are to be used as floodplain storage during extreme events. The golf club lands do not flood for lower return period events such as the 10% AEP event. The increases in water level within the golf club lands range up to 1.2 m. Drainage measures will be put in place adjacent to the proposed development to ensure the golf club lands can be drained adequately after the flood event.

- Painestown River (Upstream of Canal) and its tributaries are categorised by minor reduction in water levels upstream of the canal ranging from -0.001 m to -0.015 m. This is the result of changes in the catchment upstream as a result of the scheme.

- Painestown River (Morell Confluence to Canal) - There are increases in flood levels ranging from 0.009m to 0.059m in this section. These increases are due to a changed flooding mechanism as a result of the scheme. Flooding flow paths through the railway embankment have been removed. Other flow paths at the old Morell Bridge have been cut off by the introduction of new embankments at this location. The introduction of these defences protects a minimum of 10 properties from flooding. The increases in flood levels are mitigated against by the presence of existing and proposed defences in this section of the river.

- The Kill River has minor increases in water level adjacent to the proposed defence. There is an overall reduction in the floodplain to the surrounding area and protection to a property. Figure 12.2 shows changes to the floodplain.

- The Slane River has a combination of reduced and increased water levels upstream and downstream of the N7 due to the opening of culvert under the road.
    - Upstream of the N7 and surrounding lands there is a significant reduction in the floodplain;
    - Downstream of the N7 there are increased water levels within the retention pond at Blackchurch. It is proposed to increase the height of retention pond embankments to maintain freeboard; and
    - In the townland of Tuckmilltown adjacent to the proposed defences there is an increase of water levels. However there are defences proposed in this area to protect a minimum of 4 properties from flooding. As a result of these defences, there is an overall reduction in the floodplain in this area.
    - Figure 12.2 shows changes to the floodplain

In the existing situation, the N7 as well as a number of local roads flood for low return period events, preventing local residents from travelling in the area, and in some cases preventing access or egress to their properties.

As a result of the scheme, a number of roads will be protected from flooding for events up to the 1% AEP. These include the N7, the L6016, the L2010, the L6021 and the Killeenmore Road. This will as a minimum allow access to all properties in the area from one direction and will prevent properties from being isolated during flood events. The scheme will also prevent major diversions as a result of the closure of the N7 for flood events up to the 1% AEP.

12.3.3.2 Drainage

The drainage pattern of the overland flows to the river channel along the embankments may be changed slightly. Construction of the embankments in the floodplain will change the slope of the existing lands in some areas which consequently may have an impact on the existing surface water drainage pattern. For example, the existing permeability of the soil could be reduced and the time of concentration to surface water flow could increase if the existing slope reduces.

Some existing land drainage culverts under the railway will be fully or partially blocked to prevent flood waters bypassing the defences.

12.4 MITIGATION MEASURES

The following mitigation measures have been proposed in order to minimise each identified impact during the construction and operational phases of the proposed flood management works.

12.4.1 Construction Phase

The following mitigation measures are proposed to manage flooding and land drainage during the construction phase of the works:

- To avoid any water logging in the lands adjacent to the river banks, it is proposed to maintain the existing drainage ditches that are crossed over by the proposed flood defences and similarly for any temporary or permanent stockpiles to ensure overland surface water flow is not restricted.

- An examination of historical flood records shows the worst of the fluvial flooding in this catchment occurs during the winter months as would be expected. It is therefore recommended that the works be undertaken when flooding risks are low.

- All works will be carried out in accordance with the "*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites, Eastern Regional Fisheries Board*" and the OPW Environmental Management Protocols and Standard Operating Procedures.

12.4.2 Operational Phase

There will be minimal impacts on the existing drainage regime during the operational phase of the works. Any impacts on the existing surface water drainage regime will be mitigated by maintaining the existing drainage channels discharging to the Morell River and its tributaries.

12.5 RESIDUAL IMPACTS

12.5.1 Construction Phase

It is predicted that impacts on the existing hydrological environment will be minimised as a result of the previously outlined mitigation measures.

12.5.2 Operational Phase

It is predicted that impacts on the existing hydrological environment will be minimised as a result of the previously identified protection measures. As described in Section 12.4 increased water levels do result in some pastureland areas adjacent to the proposed defences having increased flooding. The affected landowners have been accommodated by protecting their property and ensuring adjacent land parcels are protected in so far as is practicable.

13 SOILS, GEOLOGY AND HYDROGEOLOGY

This chapter of the EIAR examines the baseline environment of the study area in terms of soils, geology and hydrogeology and assesses the potential impact of the proposed scheme on these environmental attributes. Mitigation measures are recommended to minimise any adverse impacts where appropriate.

This section should be read in conjunction with the site layout plans, drawings and project description provided in Chapter 4, and the hydrology and drainage assessment in Chapter 12.

13.1 METHODOLOGY

The soils, geology and hydrogeology of the study area were assessed by means of a desk-based study of the study area and surrounding area. Information from site walkover surveys completed between March 2015 and June 2015 was also used in this assessment.

The desk-based study was completed utilising the following sources;

- River Morrell Flood Alleviation Scheme Ground Investigation, Causeway Geotech, December 2015;
- Geological Survey of Ireland (GSI) 1:100,000 Geology of Kildare-Wicklow (Sheet 16);
- G.S.I. Well Record Database;
- G.S.I. National Vulnerability Map;
- Teagasc Subsoils Map;
- Sallins Groundwater Body Description (G.S.I. 2004);
- Water Framework Directive (WFD) Water Body Reports;
- Ordnance Survey of Ireland (OSI) 1:50,000 Map Discovery Series and Historical Mapping;
- '*Guidelines on the Information to be contained in Environmental Impact Statements'*, EPA 2002;
- *"Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements"*, EPA, September 2015;
- *"Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements"* Institute of Geologists of Ireland (IGI), 2002; and,
- *"Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes"* National Roads Authority (NRA), 2009.

The methodology used for this impact assessment is defined by the EPA '*Guidelines to be contained in Environmental Impact Statements'* (EPA, 2002) and "*Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements*" (EPA, 2015). An application of these guidelines to Soils, Geology and Hydrogeology is outlined in the NRA document '*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes'* (NRA, 2009) and *"Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements*" (IGI, 2002).

The magnitude of the impacts on the existing environment of the attributes was defined in accordance with the criteria provided in the EPA Guidelines referenced above. These are presented in Table 13.1.

Table 13.1: Impact Assessment Criteria (EPA, 2002)

Magnitude of Impact	Description
Imperceptible	An impact capable of measurement but without noticeable consequences
Slight	An impact that alters the character of the environment without affecting its sensitivities
Moderate	An impact that alters the character of the environment in a manner that is consistent with existing or emerging trends
Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Profound	An impact which obliterates all previous sensitive characteristics

The NRA guidance considers the significance of an impact defined by considering the importance of the attribute impacted and the magnitude of the impact. The importance of geological and hydrogeological attributes (rating criteria) is defined in accordance with the NRA Guidelines presented in Table 13.2.

Table 13.2: Rating Criteria for the Hydrological Attributes (NRA, 2009)

Importance	Criteria	Typical Examples	
		Geology	Hydrogeology
Extremely high	Attribute has a high quality or value on an international scale	-	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. cSAC or SPA status
Very high	Attribute has a high quality or value on a regional scale	Geological feature rare on a regional or national scale (NHA)	Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status
High	Attribute has a high quality or value on a local scale	Geological feature of high value on a local scale (County Geological Site)	Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes
Medium	Attribute has a medium quality or value on a local scale	Small existing quarry or pit Sub-economic extractable mineral resource	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poorly drained and/or low fertility soils	Poor Bedrock Aquifer Potable water source supplying <50 homes

13.2 RECEIVING ENVIRONMENT

13.2.1 Site Specific Soils

A site investigation was undertaken by Causeway Geotech on behalf of RPS on the 16th and 29th July 2015 and between the 5th and 12th November 2015. The site investigation comprised of 5 No. cable percussion boreholes, 57 No. trial pits, 56 No. dynamic probes, 13 No. boreholes drilled by light percussion/dynamic sampling and in situ permeability testing. The site investigation report including the locations of the intrusive investigations is presented in Appendix L.

Ground conditions encountered across the study area comprised of topsoil overlying made ground at certain locations, typically followed by alluvium and fluviglacial sands and gravels. Bedrock was not encountered and no evidence of contamination was observed during any of the site investigations.

Made ground was identified in 1 No. (PT15) of 13 No. probeholes and in 25 No. of 57 No. trial pits. Made ground encountered mainly comprised of re-worked gravelly clay with occasional occlusions of glass, brick, concrete fragments, and brown hardcore fill. A summary table of the locations at which made ground was identified is present in Table 13.3. The source of the encountered made ground is unknown.

A limited number of samples (25 No.) were analysed for moisture, pH, Sulphate and organic matter. The laboratory analysis indicated low levels of these parameters. Samples (TP15 2.8mbgl, TP24 1.5mbgl and TP72 4mbgl) taken at depths below identified made ground did not indicate any evidence of contamination. A sample (TP32 0.5mbgl) taken from the made ground did not indicate any evidence of contamination.

Table 13.3: Locations and depths of Made Ground encountered at study area (Causeway Geotech, 2015)

Location and Depth	EIA Reference	Description of Made ground
TP10 0.3-2.0mbgl	Morr2, Morr3, Paines 1	MADE GROUND - Soft to firm brown slightly sandy slightly gravelly CLAY with concrete, glass and organic content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP15 0.1-1.5mbgl	Morr2, Morr3, Paines 1	MADE GROUND - Soft to firm grey brown sandy gravelly CLAY with cobbles and boulders. Sand is fine to medium. Gravel is subangular to subrounded fine to coarse
TP16 0.05-1.0 mbgl	Morr2, Morr3, Paines 1	MADE GROUND Brown hardcore fill
TP21 0.0-1.5 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly sandy gravelly CLAY with frequent cobbles and boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP23 0.0-1.3 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly sandy slightly gravelly CLAY with glass brick fragments. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP24 0.0-1.1 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly sandy gravelly CLAY with cobbles and boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP25 0.0-1.2 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly sandy gravelly clay with glass and brick fragments. Gravel is subangular to subrounded fine to coarse.

Location and Depth	EIA Reference	Description of Made ground
TP26 0.0-1.3 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly sandy gravelly CLAY with frequent cobbles and boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP28 0.0-1.2 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly sandy gravelly CLAY with cobbles and boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP29 0.0-1.0 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly sandy gravelly CLAY with cobbles and large boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP30 0.0-1.0 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly sandy gravelly CLAY with cobbles and boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP31 0.0-0.16 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly sandy slightly gravelly CLAY with large boulders, cobbles, concrete and brick fragments. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse
TP32 0.0-0.8 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly gravelly sandy SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse
TP33 0.0-1.0 mbgl	Paines 2, Paines 3	MADE GROUND - Firm brown slightly sandy gravelly CLAY with cobbles and large boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP68 0.0 -0.6 mbgl	Paines 5	MADE GROUND - Firm brown slightly sandy gravelly CLAY with cobbles and boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP42 0.0-0.8 mbgl	Morr 10	MADE GROUND - Firm brown slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse.
TP44 0.0-1.5 mbgl	Morr 10	MADE GROUND - Firm brown slightly sandy gravelly CLAY with a high cobble content, and occasional boulders. Sand is fine to coarse. Gravel is subangular to subrounded, fine to coarse.
TP45 0.1 -0.7 mbgl	Morr 10	MADE GROUND - Firm brown slightly sandy gravelly CLAY with cobbles and boulders. Gravel is subangular to subrounded fine to coarse. Sand is fine to coarse.
TP61 0.0 – 1.0 mbgl	Morr 23	MADE GROUND - Soft to firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.
TP62 0.0- 1.2 mbgl	Morr 23	MADE GROUND - Soft to firm brown slightly sandy slightly gravelly CLAY with cobbles and boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP63 0.0- 1.1 mbgl	Morr 23	MADE GROUND - Soft to firm brown slightly sandy slightly gravelly CLAY with cobbles and occasional boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
TP71 0.0 -0.5 mbgl	Slane 5	MADE GROUND - Firm slightly sandy gravelly CLAY with frequent brick, timber and concrete fragments. Gravel is subangular to subrounded fine to coarse. Sand is fine to coarse
TP72 0.0 – 1.5 mbgl	Slane 6	MADE GROUND - Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse
PT15 0.0 – 0.2 mbgl PT15 0.2 – 0.6 mbgl	Slane 7	MADE GROUND: 5-50mm Aggregate MADE GROUND: Granular Fill including concrete fragments, brown sandy gravel with occasional cobbles. Sand is �ne to coarse. Gravel is subangular to subrounded �ne to coarse. Cobbles are subangular to subrounded

Location and Depth	EIA Reference	Description of Made ground
TP73 0.0- 0.6mbgl	Slane 7, Slane 11	MADE GROUND - Subangular fine to coarse slightly sandy slightly silty GRAVEL (Hardcore Fill)
TP74 0.0 – 0.7 mbgl	Slane 7, Slane 11	MADE GROUND - Subangular fine to coarse slightly sandy slightly silty GRAVEL (Hardcore Fill)

13.2.2 Soils and Subsoils

The main subsoil type within the study area is limestone till. Glaciofluvial sands and gravels are more prevalent to the north of the study area, bordering the River Liffey corridor. Areas of made ground exist at Straffan Demesne to the north and Killeenbeg to the south of the study area. The Liffey and Morell River corridors are predominantly comprised of alluvium. Outcrops of karst rock exist mainly towards the eastern boundary of the study area, in localised pockets. Subsoils in the study area are shown on Figure 13.1.

13.2.3 Bedrock Geology

The bedrock geology of the area is predominately limestone Calp, comprised of dark grey limestone and shale mainly located within the northern part of the study area and extends to just north of the Grand Canal. Calcareous greywacke of siltstone and shale as part of the Carrighill Formation is prevalent for much of the south eastern part of the study area towards the N7 Dual Carriageway. A number of rock types make up the central region of the study area. These are faulted and aligned predominantly in a north-east to south-west direction. This mainly includes the Waulsortian Limestone Formation comprising massive unbedded fine grained limestone, with significant bands of the Feighcullen Formation bounding to the east, comprising skeletal, oolitic and micritic limestone. Smaller bands of the Allenwood Formation (thick bedded limestone) occur to the north and the Old Red Sandstone Formation (conglomerate of sandstone and mudstone) also features to the south.

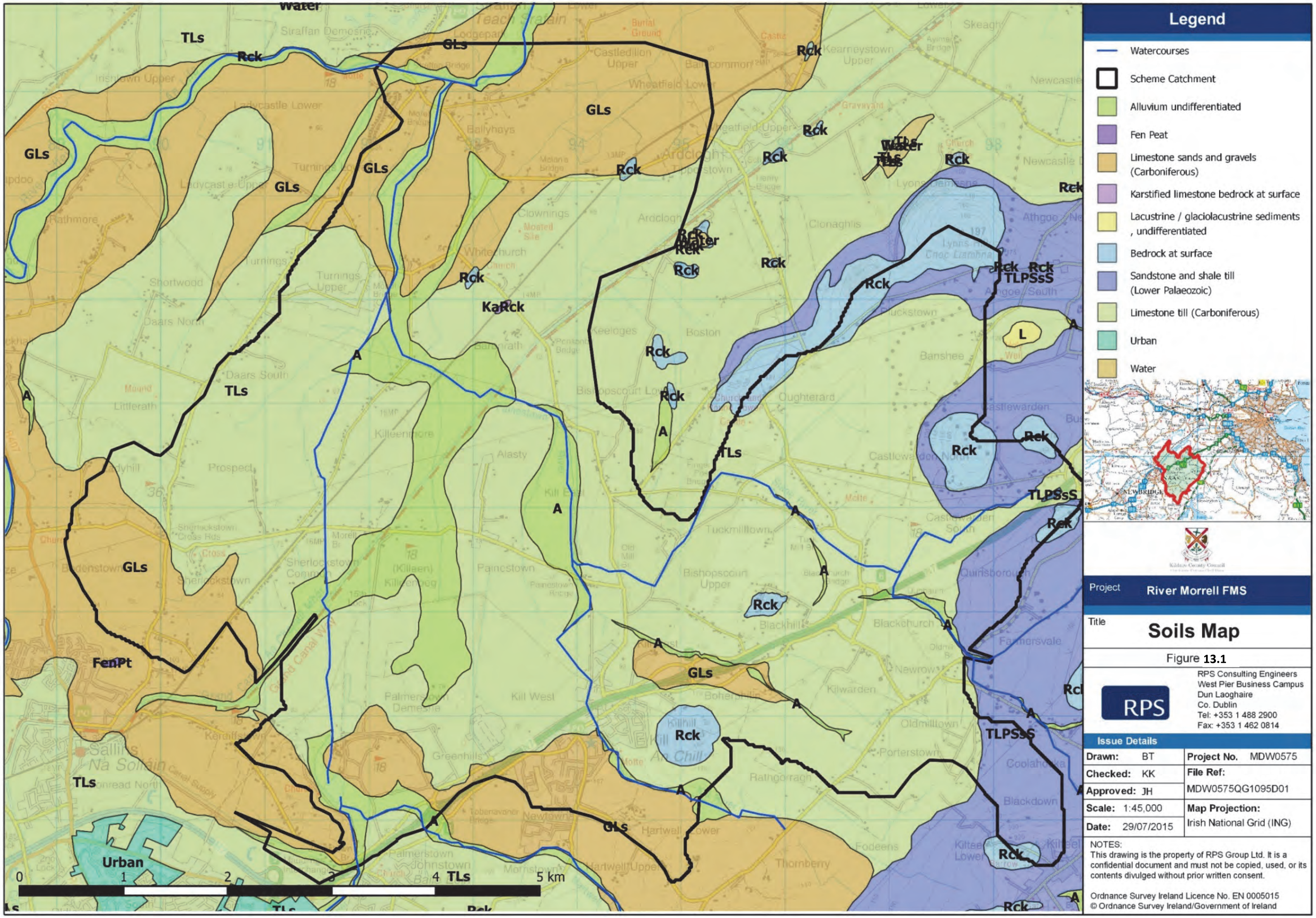
An overview map of bedrock geology is shown on Figure 13.2. The locations of mineral sites and quarries in proximity to the study area are also shown on Figure 13.2 and detailed in Table 13.4 and Table 13.5.

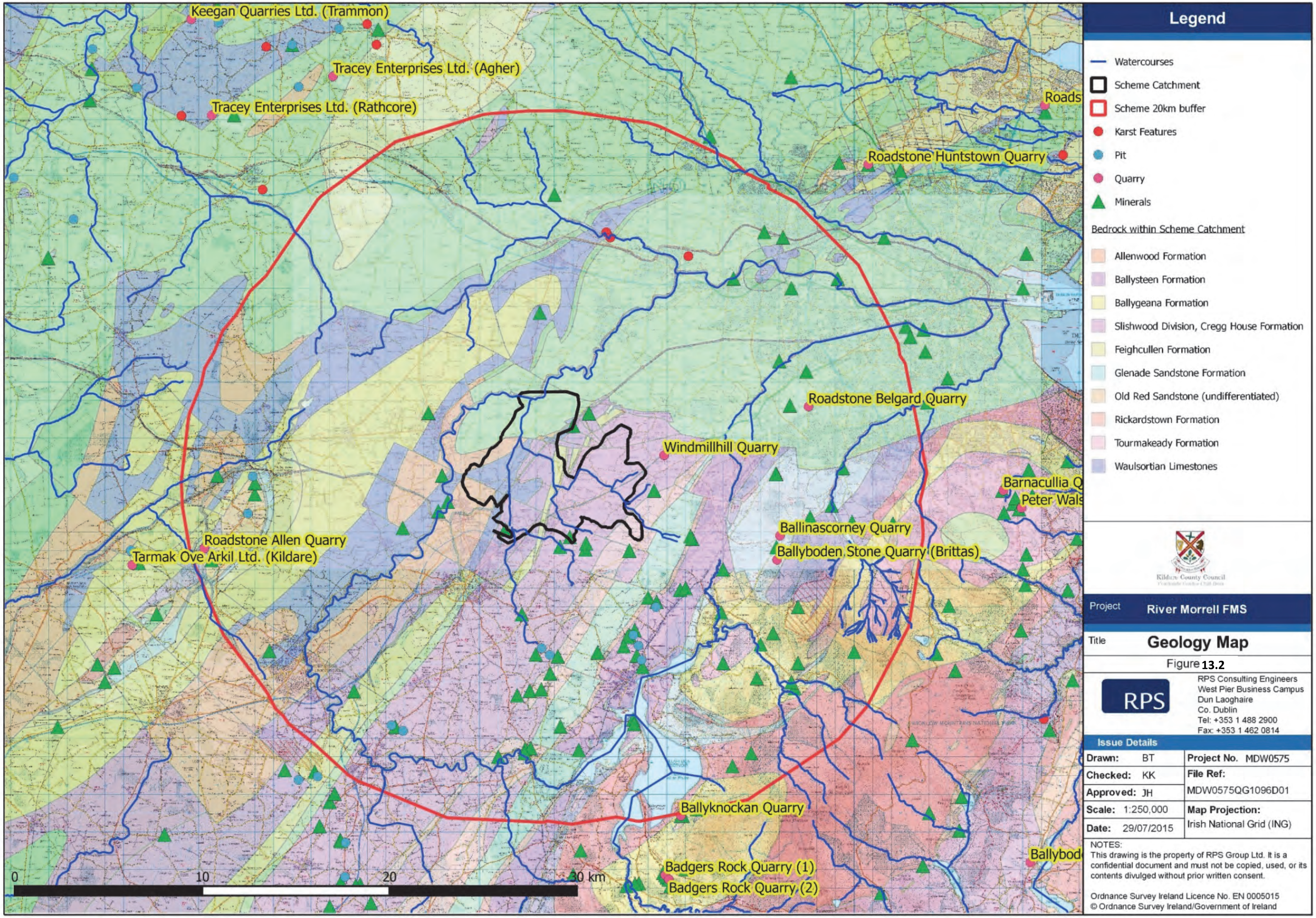
The GSI maintains a database of karst features in Ireland. There are no karst features identified within the study area, and no additional features were identified during the site walkovers or the Ground Investigation works.

Table 13.4: Mineral Sites Located within Proximity to the Study Area

Location No.	Mineral	Townland	Description	Notes
834	Sand and Gravel	Hartwell	Non-metallic	Sand and gravel pit noted here.
835	Sand and Gravel	Arthurstown	Non-metallic	Sand and gravel pit noted here.

Location No.	Mineral	Townland	Description	Notes
842	Sand and Gravel	Thornberry	Non-metallic	Sand and gravel pit noted here.
845	Sand and Gravel	Kilteel	Non-metallic	Sand and gravel pit noted here.
846	Sand and Gravel	Kerdiffstown	Non-metallic	Active pit producing sand. Visited by AMF 29th Oct 1987. Worked out by 1993.
882	Galena	Clonaghlis	Metallic	Disused lead mine in Carboniferous limestone. Noted on old GSI 6in. map.
882	Limestone (in general)	Clonaghlis	Metallic	Disused lead mine in Carboniferous limestone. Noted on old GSI 6in. map.
882	Lead	Clonaghlis	Metallic	Disused lead mine in Carboniferous limestone. Noted on old GSI 6in. map.
1759	Tufa	Hartwell	Non-metallic	Tufa or travertine is found in fields adjacent to Hartwell Castle 2 km S. of Kill in Co. Kildare. Previously used in the construction of C.12th churches could be used in horticulture.
3288	Clay, Brick	Barrettstown	Non-metallic	Brick field noted on old 6 inch map.
4760	Lead	Ardclough	Metallic	Some lead ore was found in this townland during the last century.
4760	Galena	Ardclough	Metallic	Some lead ore was found in this townland during the last century.


Legend
Watercourses
Scheme Catchment
Alluvium undifferentiated
Fen Peat
Limestone sands and gravels (Carboniferous)
Karstified limestone bedrock at surface
Lacustrine / glaciolacustrine sediments , undifferentiated
Bedrock at surface
Sandstone and shale till (Lower Palaeozoic)
Limestone till (Carboniferous)
Urban
Water
Project River Morrell FMS
Title Soils Map
Figure 13.1
RPS
RPS Consulting Engineers
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900
Fax: +353 1 462 0814
Issue Details
Drawn: BT
Checked: KK
Approved: JH
Scale: 1:45,000
Date: 29/07/2015
Project No. MDW0575
File Ref: MDW0575QG1095D01
Map Projection: Irish National Grid (ING)
NOTES:
This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
Ordnance Survey Ireland Licence No. EN 0005015
© Ordnance Survey Ireland/Government of Ireland
0 1 2 3 4 5 km
TLs
GLs
Rck
A
L
TLPSsS
FenPt
KaRck
Urban
Water



Keegan Quarries Ltd. (Trammon)
Tracey Enterprises Ltd. (Agher)
Tracey Enterprises Ltd. (Rathcore)
Roadstone Huntstown Quarry
Roads
Roadstone Belgard Quarry
Windmillhill Quarry
Barnacullia Q
Peter Wals
Ballinascorney Quarry
Ballyboden Stone Quarry (Brittas)
Roadstone Allen Quarry
Tarmak Ove Arkil Ltd. (Kildare)
Ballyknockan Quarry
Badgers Rock Quarry (1)
Badgers Rock Quarry (2)
Ballybod
0
10
20
30 km
Legend
Watercourses
Scheme Catchment
Scheme 20km buffer
Karst Features
Pit
Quarry
Minerals
Bedrock within Scheme Catchment
Allenwood Formation
Ballysteen Formation
Ballygeana Formation
Slishwood Division, Cregg House Formation
Feighcullen Formation
Glenade Sandstone Formation
Old Red Sandstone (undifferentiated)
Rickardstown Formation
Tourmakeady Formation
Waulsortian Limestones
Kildare County Council
Project River Morrell FMS
Title Geology Map
Figure 13.2
RPS
RPS Consulting Engineers
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900
Fax: +353 1 462 0814
Issue Details
Drawn: BT
Checked: KK
Approved: JH
Scale: 1:250,000
Date: 29/07/2015
Project No. MDW0575
File Ref:
MDW0575QG1096D01
Map Projection:
Irish National Grid (ING)
NOTES:
This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
Ordnance Survey Ireland Licence No. EN 0005015
© Ordnance Survey Ireland/Government of Ireland

Table 13.5: Quarries/Pits Located in Proximity to the Study Area

Quarry Name	Quarry Address	Operation Name
Roadstone Quarry Belgard/Newlands Cross	Tallaght, Co. Dublin	Roadstone Ltd.
Roadstone Quarry Naas	Allen, Kilmeague, Naas, Co. Kildare	Roadstone Ltd.
Windmill Hill Quarry	Windmill Hill, Naas Road, Rathcoole, Co. Dublin	L Behan and Sons Ltd

13.2.4 Geological Heritage Sites

There are no geological heritage areas within the study area.

13.2.5 Hydrogeology

13.2.5.1 Aquifer Characteristics

The study area is intersected by three Groundwater Bodies (GWB): the Dublin GWB, Kilcullen GWB, and Naas GWB. These are the management units for the purposes of the Water Framework Directive (WFD), and are described as follows:

- The Dublin GWB (IE_EA_G_008) covers much of the study area, particularly the north and central parts of the study area. There are no groundwater dependent terrestrial ecosystems (GWDTE) identified within this groundwater body. The Groundwater Body is classified as having Good Status under the WFD, and has an Overall Risk Result 2a, which means it is 'Probably Not at Risk'. The objective set for this water body is to protect its 'good' status under the WFD.

- The Kilcullen GWB (IE_EA_G_003) covers the south eastern corner of the study area towards the N7 Dual Carriageway. There are no groundwater dependent terrestrial ecosystems (GWDTE) identified within this groundwater body. The Groundwater Body is classified as having Good Status under the WFD; however it has an Overall Risk Result 1a, which means it is 'At Risk'. This appears to be mainly due to risks associated with contaminated land. The objective set for this water body is to protect its 'good' status under the WFD, and to reduce the risk status to 'Not at Risk' by 2021.

- The Naas GWB (IE_EA_G_027) is a smaller groundwater body to the west of the study area that intersects a localised area near the townlands of Turnings and Whitechurch. There are no groundwater dependent terrestrial ecosystems (GWDTE) identified within this groundwater body. The Groundwater Body is classified as having Good Status under the WFD; however it has an Overall Risk Result 1a, which means it is 'At Risk'. This appears to be mainly due to pressure from diffuse sources of pollution, particularly agriculture. Other potential risks are due to Nutrient Loading (MRP) of rivers, and pressure from urban areas. The objective set for this water body is to protect its 'good' status under the WFD, and to reduce the risk status to 'Not at Risk' by 2021.

- The bedrock aquifer underlying the centre, north, south, and west of the study area is classified by the GSI as a Locally Important Aquifer which is moderately productive in local zones (Ll). The bedrock underlying the eastern part of the study area is classified as a Poor Aquifer where the bedrock is predominantly unproductive (Pu). A karstified Locally Important Aquifer (Lk) intersects a small part of the study area to the north west, and a karstified Regionally Important Aquifer intersects a small portion to the south west. The aquifer classification in the study area is shown in Figure 13.3.

13.2.5.2 Groundwater Flow

Groundwater recharge occurs via diffuse infiltration mechanisms, point infiltration mechanisms such as losing streams, swallow holes, dolines etc. As there are no evidenced karst features in the study area, groundwater recharge would expected to be predominantly by diffuse infiltration. Groundwater recharge rates of between 50 and 100mm/yr. are indicated for the groundwater bodies in the study area, with the hydrogeological setting described as low permeability subsoil. This indicates very slow rates of recharge within the study area.

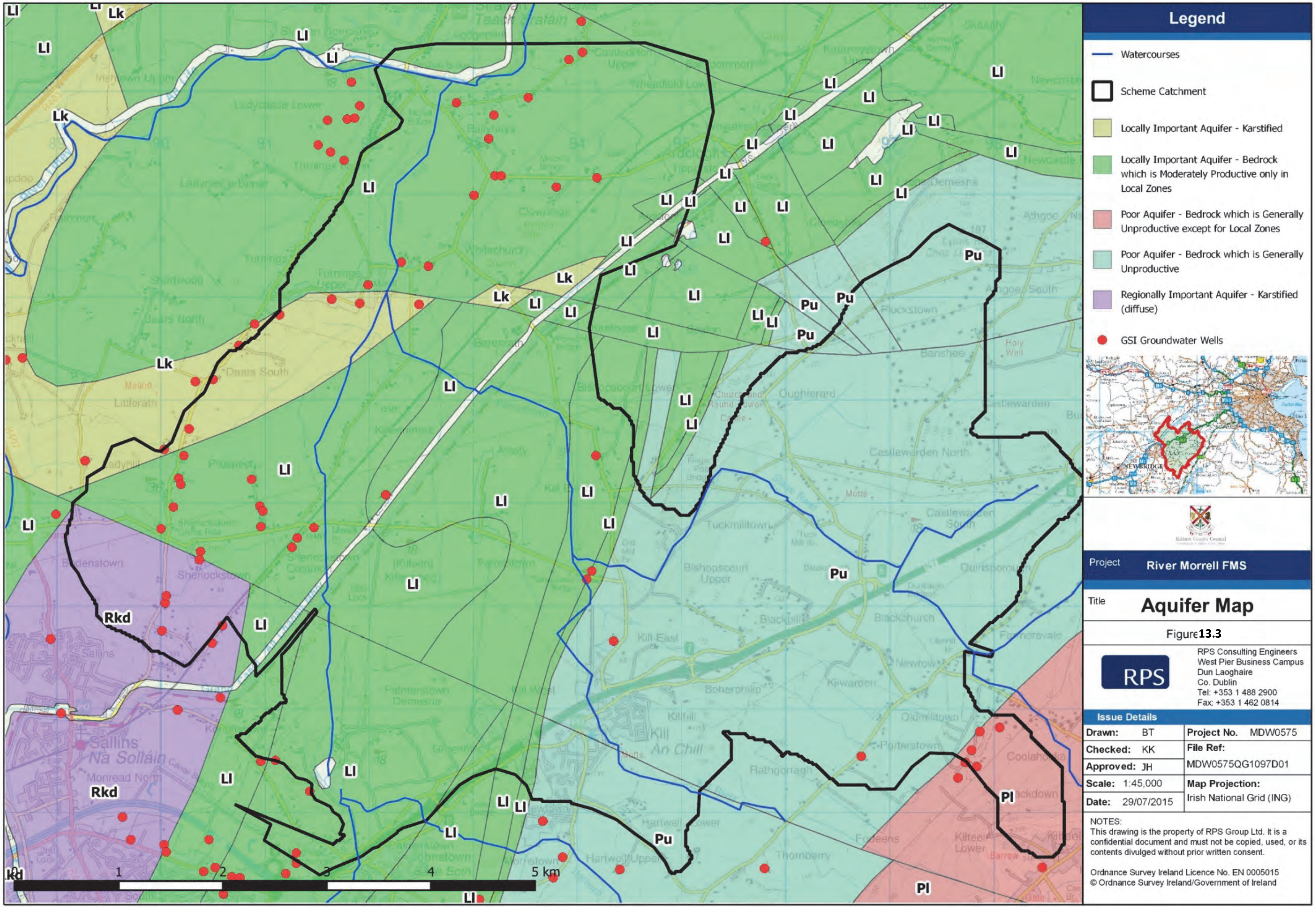
13.2.5.3 Aquifer Classification and Vulnerability Rating

The vulnerability across the study area ranges from Extreme to Low.

In the central portion of the study area the vulnerability along the Morell and Painestown river corridor is predominantly high with areas of extreme vulnerability located around the periphery of the study area, particularly in the east. The western part of the study has predominantly moderate to low vulnerability.

13.2.5.4 Groundwater Use

The GSI groundwater well records show that there are a significant number of registered wells located within the study area and surrounding areas as shown in Figure 13.3 and in Table 13.6: .
The majority of these wells are classified as domestic and agricultural use. A Kildare County Council. public supply well at Clownings and the Boston Group Water Scheme well are located within the vicinity of the study area, however both wells are reported to be decommissioned and no longer in use. According to the GSI there are no designated Source Protection Zones (SPZ) within the study area or surrounding area.


Legend
Watercourses
Scheme Catchment
Locally Important Aquifer - Karstified
Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
Poor Aquifer - Bedrock which is Generally Unproductive
Regionally Important Aquifer - Karstified (diffuse)
GSI Groundwater Wells
Project River Morrell FMS
Title Aquifer Map
Figure13.3
RPS Consulting Engineers
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900
Fax: +353 1 462 0814
Issue Details
Drawn: BT
Checked: KK
Approved: JH
Scale: 1:45,000
Date: 29/07/2015
Project No. MDW0575
File Ref: MDW0575QG1097D01
Map Projection: Irish National Grid (ING)
NOTES:
This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
Ordnance Survey Ireland Licence No. EN 0005015
© Ordnance Survey Ireland/Government of Ireland
1 2 3 4 5 km

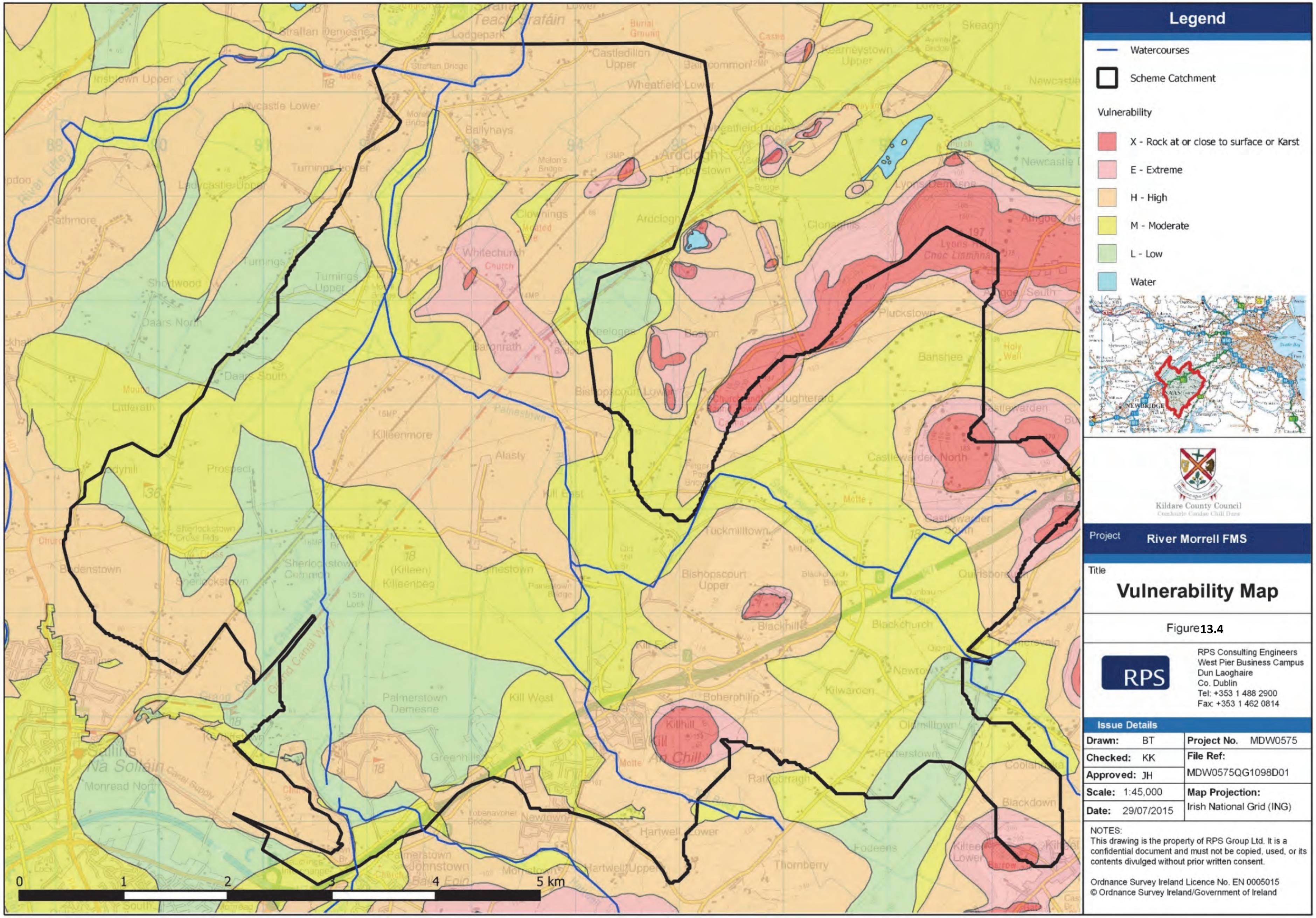

Legend
Watercourses
Scheme Catchment
Vulnerability
X - Rock at or close to surface or Karst
E - Extreme
H - High
M - Moderate
L - Low
Water
Kildare County Council
Project
River Morrell FMS
Title
Vulnerability Map
Figure 13.4
RPS Consulting Engineers
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900
Fax: +353 1 462 0814
Issue Details
Drawn: BT
Checked: KK
Approved: JH
Scale: 1:45,000
Date: 29/07/2015
Project No. MDW0575
File Ref: MDW0575QG1098D01
Map Projection: Irish National Grid (ING)
NOTES:
This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
Ordnance Survey Ireland Licence No. EN 0005015
© Ordnance Survey Ireland/Government of Ireland
0
1
2
3
4
5 km

Table 13.6: GSI Well Data (GWS = Groundwater Supply)

GSI Name	Source Name	Townland	Type	Depth (m)	Source Use
2621NEW057	Unknown	OSBERSTOWN	Borehole	27.4	Domestic use only
2621NEW180	Unknown	FIRMOUNT EAST	Dug well	10.6	Agri & domestic use
2621NEW189	Unknown	BLACKHALL	Dug well	2.2	Agri & domestic use
2621NEW190	Unknown	LADYHILL	Dug well	4.6	Agri & domestic use
2621NEW248	Unknown	OSBERSTOWN	Borehole	19.8	Domestic use only
2621NWW184	Unknown	DAARS SOUTH	Dug well	2.7	Agri & domestic use
2621NWW185	Unknown	DAARS SOUTH	Borehole	21.0	Agri & domestic use
2621NWW186	Unknown	DAARS SOUTH	Dug well	10.8	Agri & domestic use
2621NWW187	Unknown	DAARS SOUTH	Dug well	3.0	Agri & domestic use
2621NWW188	Unknown	PROSPECT	Dug well	4.5	Agri & domestic use
2621NWW189	Unknown	LITTLERATH	Dug well	7.8	Agri & domestic use
2621NWW190	Unknown	PROSPECT	Dug well	9.2	Agri & domestic use
2621NWW192	Unknown	PROSPECT	Borehole	9.9	Agri & domestic use
2621NWW194	Unknown	PROSPECT	Dug well	11.1	Agri & domestic use
2621NWW195	Unknown	PROSPECT	Dug well	10.5	Agri & domestic use
2621NWW197	Unknown	PROSPECT	Dug well	6.8	Agri & domestic use
2621NWW198	Unknown	PROSPECT	Dug well	4.4	Agri & domestic use
2921NWW121	BOSTON GROUP WATER SCHEME (decommissioned)	BOSTON	Unknown	27.3	Group Scheme
2921NWW123		PAINESTOWN	Borehole	39.6	Domestic use only
2921NWW149		MONREAD NORTH	Borehole	11.9	Industrial use
2921NWW153	FORBAIRT	BLACKDOWN	Borehole	23.0	Unknown
2921NWW154		KERDIFFSTOWN	Borehole	11.6	Other
2921NWW183		DAARS SOUTH	Dug well	4.8	Agri & domestic use
2921NWW199		SHERLOCKSTOWN	Dug well	14.1	Agri & domestic use
2921NWW200		SHERLOCKSTOWN	Dug well	4.2	Agri & domestic use
2921NWW201		SHERLOCKSTOWN	Unknown		Agri & domestic use

GSI Name	Source Name	Townland	Type	Depth (m)	Source Use
2921NWW203		TURNINGS UPPER	Dug well	2.7	Agri & domestic use
2921NWW204		TURNINGS UPPER	Dug well	2.7	Agri & domestic use
2921NWW205		TURNINGS UPPER	Dug well	3.0	Agri & domestic use
2921NWW206		TURNINGS UPPER	Dug well	1.5	Agri & domestic use
2921NWW207		KILLEENMORE	Dug well	3.9	Agri & domestic use
2921NWW208		SHERLOCKSTOWN COMMON	Dug well	2.0	Agri & domestic use
2921NWW209		SHERLOCKSTOWN COMMON	Dug well	2.0	Agri & domestic use
2921NWW210		SHERLOCKSTOWN COMMON	Dug well	1.5	Agri & domestic use
2921NWW211		CASTLEDILLON LOWER	Dug well	5.7	Agri & domestic use
2921NWW212		CASTLEDILLON UPPER	Dug well	9.0	Agri & domestic use
2921NWW213		CASTLEDILLON UPPER	Dug well	6.0	Agri & domestic use
2921NWW214		BALLYHAYS	Dug well	3.3	Agri & domestic use
2921NWW215		BALLYHAYS	Dug well	1.8	Agri & domestic use
2921NWW220	Kildare Co. Co. Decommissioned	CLOWNINGS	Dug well	9.6	Public supply (Co Co)
2921NWW265		MAUDLINGS	Borehole	15.0	Industrial use

13.3 POTENTIAL IMPACTS

The project description including the details of the activities required to construct the proposed scheme are provided in Chapter 4 of this EIAR. The scheme proposes to address the flood risk in the Morell River catchment by controlling existing storage adjacent to the river using hard defences, including embankments and flood walls, to protect vulnerable areas. Refer to Section 4.3.4 of Chapter 4 for further details.

The floodplain storage will be located adjacent to the river channel within the existing (baseline) flood extents, the peak flows will increase by approximately 5% at the confluence with the River Liffey as a result of the scheme. This increase in flow within the Morell channel is due to some overland flow paths that were flooding properties being diverted back into the main river channel. This increase in flow has been mitigated within the proposed scheme by adding embankments in the downstream reaches of the scheme to convey these additional flows safely.

13.3.1 Do Nothing

The Do Nothing scenario will result in numerous properties continuing to flood on a regular basis. There are 15 properties at risk of flooding for the 10% AEP event and 30 properties at risk for the 1% AEP event. The Do Nothing scenario would also result in the N7 at the Castlewarden Junction continuing to flood on a regular basis. This section of the dual carriageway is predicted to flood for events equal to or greater than the 20% AEP.

13.3.2 Construction Phase Impacts

The potential impacts of the individual engineering items are summarised in Table 13.7**.** The potential impacts as they relate to proposed activities are outlined in the subsequent sub-sections of this Section 13.3.2. Refer also to Section 4.4.2 of Chapter 4 for further details of site preparation.

3 No. material stockpiling locations have been identified throughout the site (see Figure 4.1 in Chapter 4, Project Description). The first site is adjacent to Paines 1, 2 & 3, in Turnings Upper. The location of this site avoids the need for delivery trucks to traverse the Old Morell Bridge. The second site is just north of the Grand Canal at Morr 19. The third site is just south of the Grand Canal at Morr 23. All the proposed material stockpiling locations will allow materials to be delivered to site at central locations, and is not bound by the works programme at each particular satellite compound (embankment works area). A central site compound will be maintained either at one of these locations or off-site at a nearby existing OPW facility (location to be confirmed with OPW). Satellite compounds will be located within the Temporary Working Area at intervals along the development, as required. For further details, refer to Figure 4.1 and Section 4.4.2 of Chapter 4.

A comprehensive ground investigation has been carried out by Causeway Geotech Ltd between May and December 2015 across the proposed study area. This was targeted at the particular locations of embankment and wall construction, the results of which have fed into the assessment process for this soils, geology and hydrogeology chapter. Due to later revisions to the scope of works, particularly in relation to the addition of embankments along the railway line (Morr 4, 9, and 15), there may be perceived gaps within the information available. However it has been assessed and is considered that given the detailed level of GI information available for the study area, including in close proximity to the abovementioned areas, that this is more than adequate to form an assessment of the soils, geology and hydrogeology issues pertaining to the project. In any case as is the norm, further GI is recommended as part of the detailed design stage, to refine the development of the design.

13.3.2.1 Embankment Construction

The proposed works include the construction of approximately 7,420m of new embankments as flood defences along the banks of the streams/rivers within the Morell catchment. This includes the construction of approximately 2,150m of new embankment adjacent to the Dublin-Cork Railway Line. The proposed works also include the remediation of approximately 1,850m of existing flood defence embankments, as outlined in Figure 4.1 (in Chapter 4).

These activities will involve the import of approximately 70,500m^3 of material, constituting approximately 43,300m^3 of engineered fill for embankment construction, and approximately 27,200m^3 of clay to construct the clay core. The expected volumes of imported material are included in Table 4.3 of Chapter 4.

There is no perceived permanent negative impact expected due to the import of suitable material to construct the embankments, however construction activities relating to the import and placement of fill material would be considered to constitute a temporary negative impact on the soils, geology and hydrogeology of the area. Over compaction of soil and subsoil due to plant activities and potential for sediment run-off to the adjacent watercourses are particular risks that need careful management. Ensuring that a Construction & Environmental Management Plan is in place will mitigate any risks associated with embankment construction activities, thus reducing these impacts to an imperceptible level.

Table 13.7: Proposed Scheme Measures and Potential Impacts

Item	Area	Reference	Type	Proposed Measures	Type	Quality	Duration	Significance
1	Ballyhays	Morr 1	New Embankment & Culvert Upgrade	Construction of 50m embankment to a max height of 1.1m (average height 0.9m). Embankment tie-in works at Culvert 1, may require scour protection measures.	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
2	Ballyhays	Morr 1a	New Embankment	Construction of 100m embankment to a max height of 0.84m (average height 0.7m)	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
3	Turnings Lower	Morr 2	Existing Embankment & Culvert Upgrade	Upgrade of 217m of existing embankment to a max height of 1.25m (average height 1.18m). Embankment tie-in works at Culvert 2, may require scour protection measures.	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
4	Turnings	Morr 3	New Embankment	Construction of 293m embankment to a max height of 1.40m (average height 1.14m)	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
5	Turnings	Paines 1	New Embankment	Construction of 569m embankment to a max height of 2.06m (average height 1.69m)	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
6	Turnings	Paines 2	Existing Embankment & Culvert Upgrade	Upgrade of 649m of existing embankment to a max height of 2.00m. Restoration work required at Culvert 9.	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
7	Turnings	Paines 3	Existing Embankment	Upgrade of 665m of existing embankment to a max height of 1.80m	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
8	Killeenmore	Morr 4	New Embankment	Construction of 1613m embankment to a max height of 1.60m (average height 1.18m)	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
9	Killeenmore	Morr 5	Culvert Upgrade	Upgrade of Culvert 4 to include throttle to restrict flow.	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Imperceptible
10	Killeenmore	Morr 6	Culvert Upgrade	Upgrade of Culvert 4a to include throttle to restrict flow.	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Imperceptible
11	Killeenmore	Morr 7	New Wall	Construction of 76m of flood wall to a max height of 1.69m (average height 1.40m)	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
12	Killeenmore	Morr 8	Stream Diversion	79m realignment of existing stream	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight

Item	Area	Reference	Type	Proposed Measures	Type	Quality	Duration	Significance
13	Baronrath	Morr 9	New Embankment & Culvert Upgrade	Construction of 532m embankment to a max height of 1.52m (average height 1.31m). Installation of scour protection measures at Culvert 5.	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
14	Killeenmore	Morr 10	Existing Embankment	Upgrade of 374m of existing embankment. Height to be confirmed.	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
15	Killeenmore	Morr 15	New Embankment	Construction of 290m embankment to a max height of 1.47m (average height 1.25m)	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
16	Killeenmore	Morr 16	New Embankment & Culvert Upgrade	Construction of 143m embankment to a max height of 0.75m (average height 1.25m). Installation of scour protection measures at Culvert 5.	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
17	Killeenmore	Morr 16a	New Embankment	Construction of 187m embankment to a max height of 0.82m (average height 0.7m)	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
18	Sherlockstown	Morr 17	New Embankment & Culvert Upgrade	Construction of 867m embankment to a max height of 1.70m (average height 1.13m). Embankment tie-in works at Culvert 7, may require scour protection measures.	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
19	Killeenmore	Morr 19	New Embankment	Construction of 555m embankment to a max height of 1.73m (average height 1.32m)	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
20	Killeenmore	Morr 20	New Embankment & Culvert Upgrade	Construction of 11m embankment to a max height of 1.05m, and existing ditch to be throttled through introduction of a culvert	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
21	Killeenmore	Morr 21	New Embankment	Construction of 314m embankment to a max height of 1.73m	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
22	Killeenmore	Morr 22	New Wall	Construction of 76m of flood wall to a max height of 1.9m (average height 1.8m)	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
23	Killeenmore	Morr 23	New Embankment	Construction of 578m embankment to a max height of 2.06m (average height 1.51m)	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
24	Alasty	Paines 4	New Embankment	Construction of 107m embankment to a max height of 0.50m	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight

Item	Area	Reference	Type	Proposed Measures	Type	Quality	Duration	Significance
25	Painestown	Paines 5	New Embankment	Construction of 186m embankment to a max height of 1.20m	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
26	Tuckmilltown	Slane 1	New Wall	Construction of 120m of flood wall to a height of 1.40m	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
27	Tuckmilltown	Slane 2	New Embankment & Culvert Upgrade	Construction of 121m embankment to a max height of 1.40m. Embankment tie-in works at Culvert 18, may require scour protection measures.	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
28	Tuckmilltown	Slane 3	New Embankment	Construction of 302m embankment to a max height of 1.80m (average height 1.40m)	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
29	Tuckmilltown	Slane 4	New Wall	Construction of 131m of flood wall to a height of 1.60m (average height 1.40m)	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
30	Tuckmilltown	Slane 5	New Embankment	Construction of 144m embankment to a max height of 1.30m	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
31	Tuckmilltown	Slane 6	Existing Embankment & Culvert Upgrade	Upgrade of 155m of existing embankment to a max height of 2.00m. Embankment tie-in works at Culvert 19, may require scour protection measures.	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
32	Blackchurch	Slane 7	New Embankment	Construction of 177m embankment to a max height of 1.50m	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
33	Tuckmilltown	Slane 8	Stream Diversion	21m realignment of existing stream	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight
34	Tuckmilltown	Slane 9	New Embankment	Construction of 67m embankment to a max height of 0.75m (average height of 0.6m)	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
35	Blackchurch	Slane 10	Culvert Upgrade	Unblocking of Culvert 22 under the existing N7 dual carriageway.	Construction	Negative	Temporary	Slight
					Operation	Neutral	Permanent	Slight
36	Kill East	Kill 1	New Wall	Construction of 101m of flood wall to a height of 1.50m	Construction	Negative	Temporary	Moderate
					Operation	Neutral	Permanent	Slight

13.3.2.2 Soil Excavation and Soil Spreading

The construction activities for the proposed and remediated embankments will involve the excavation of approximately 25,100m³ of soil materials. This will include approximately 19,600m³ of topsoil stripping, and approximately 5,500m³ of excavation for the clay core. Refer to typical embankment detail shown in Figure 4.2 of Chapter 4. The expected volume of excavated material is also included in Table 4.3.

The excavated material will be reused for topsoil and side-slope protection for the embankments. It is expected that any excess topsoil material will be spread on adjacent lands within the Temporary Working Area. Where this material is spread, it will be between 0m and 0.5 m thick. Initial treatment will require removal and storage of topsoil, which will minimise the transport of material offsite and aim to return the soils to the pre-works quality.

Where the nature of the soil cannot be returned to a similar pre-construction quality due to soil spreading activities, this would constitute a permanent negative impact on the soils and geology of the area. The attributed importance of the soils is considered to be medium as they are considered in general moderately drained with moderate fertility. A permanent impact on a significant proportion of the soil in the area would constitute a moderate impact on the soils and geology.

It is proposed that temporary soil storage will be adjacent to the embankment footprint, along the length of the works. A maximum height of 1 metre will apply for all temporary spoil heaps, with maximum side slopes of 1V:3H, to ensure that risk of instability is reduced. This will be subject to stability analysis by a suitably qualified geotechnical engineer at design stage.

13.3.2.3 Made Ground Excavations

Construction of new embankments and the restoration of existing embankments will require excavations at locations of made ground. Based on the results from the site investigations (Causeway Geotech, 2015 – included as Appendix L) it is estimated that approximately 17,391m^3 of made ground will be encountered as part of the works.

Intrusive site investigations indicated that the made ground is mainly comprised of re-worked gravelly clays with rare inclusions of glass, concrete fragments, timber and brick. The presence of contamination within the made ground would potentially impact the excavation, handling, processing, transport and offsite disposal method of the made ground. The excavation and handling of potentially contaminated made ground could result in the increased mobilisation of contaminants which could increase the potential impacts on the surrounding areas. Dependant on the contaminant of concern; these impacts could include;

- Leaching of any contaminants from the made ground to the surrounding area could lead to further areas of soils within the vicinity becoming impacted;
- Surface run off from exposed contaminated made ground;
- Migration of contaminants through the subsurface could result in the impacting of groundwater (and surface water);
- The risk from gas production; and,
- Human health risk, as excavation of made ground could expose construction works to potential contaminants. If contaminant levels exceed soil guideline values (SGVs) this could

present a risk to human health due to direct contact and from volatile or semi-volatile vapours.

The excavation of potentially contaminated made ground would have a temporary negative effect on the soils, geology and hydrogeology of the study area. These may be slight to significant negative impacts depending on the nature of the contamination and the sensitivity of the receiving environment. It is noted that groundwater vulnerability is high and extreme in parts of the study area but there are no source protection zones identified.

13.3.2.4 New Flood Wall Construction

The proposed works involve the construction of approximately 550m of new retaining walls along the banks of watercourses to act as flood defences. Typically such walls are proposed where space is limited and provision for flood defence embankments is not considered feasible. Refer to Figure 4.2 in Chapter 4 for typical wall detail.

Activities relating to the wall construction will involve excavation of soil and subsoil material to a suitable bearing stratum for the foundation formation level. The excavated material will be reused for topsoil and regrading adjacent to the new walls. The potential impacts as previously identified will apply. The import and pouring of concrete material for the foundations and walls could result in spillage and contamination of adjacent watercourses and soils. This would be considered to constitute a temporary significant negative impact on the soils, geology and hydrogeology of the area. Chapter 11 Aquatic Ecology also outlines the potential impacts in relation to watercourses.

13.3.2.5 In-Channel Works

In-channel works relating to the upgrade of 3 No. existing culverts within the Morell catchment will be required. Figure 4.3 in Chapter 4 shows the location of existing culverts in the study area. Refer also to Sections 4.3.4 and 4.3.5 for further details. Culverts 5 and 10 will require in stream works for the installation of scour protection measures. Culvert 9 is in a poor state of repair and will require restoration work to bring it to the required standard.

Maintenance works will also be required at Culvert 22 (under the N7 dual carriageway) to unblock it.

There are also 2 No. small culverts crossing the railway (identified in Figure 4.3 as Culverts 4 and 4a) that will be throttled in order to limit flow through them.

It is furthermore proposed that flood defences will tie into Culverts 1, 2, 7, 18 and 19. These culverts will be structurally assessed at the detailed design stage to determine if they require scour protection measures or underpinning, in which case these works will be subject to an approved Method Statement.

It is proposed to complete any in-channel works using cofferdam type construction whereby flow can be restricted allowing the civil engineering works to be undertaken in dry conditions.

It is proposed to use surface dewatering pumps to dewater sections of channel where works are taking place. It is possible that during such works slight to moderate groundwater inflows from the channel bed could occur where fractured limestone is exposed. Inflows can be expected laterally though the weathered bedrock and also vertically where discrete fissures are intercepted in the riverbed.

13.3.2.6 Stream Realignment Works

Stream realignment works are also proposed at Morr 8 in Killeenmore and Slane 8 in Tuckmilltown, as shown in Chapter 4. This will involve excavation of new sections of channel to reduce bank erosion and improve flow. It is proposed that the plant required can operate from the river bank in each case, without need to enter the stream. However, works have the potential for significant sediment disturbance and run-off during this operation.

Where water management controls may be required, this may involve dewatering within the channel in the vicinity of the works. Dewatering would constitute a temporary, slight negative impact on the groundwater flow regime. In-channel works can lead to river sediment disturbance with subsequent siltation and deposition downstream of the location which is considered a slight impact on soils and geology.

The new channels will be open cut through the existing bends, the streams will be diverted through this new channel and the old channel will be filled in. The opening of the new channels will be completed from the field, it will start at the centre point and move progressively in both directions until it reaches the stream banks. Once it reaches the banks, both banks will be opened and the upstream section of the stream diverted in a controlled manner by restricting flow down the old channel, the down stream section will also have flow restiction to minimise backflow, this will allow the old section to drain slowly. The old channel will be backfilled from the upstream side starting with the new upstream bank around the bend to the downstream section where the second new bank will be created.

The filling in of the old channels will be from the temporary island that the new channel will have created. During re-alignment the temporary work areas will be set up in the field, this is where the excavated material will be stock piled for use when backfilling the old channel. The machinery will traverse the stream twice, once to access the island to fill in the old channel and the second time to exit the works area upon completion.

13.3.2.7 Temporary Access Roads

The works will be accessed through existing farm tracks where possible, and access routes will not traverse rivers, except potentially at Morr 9 (see Chapter 4) and Slane 8 (see above). Where temporary haul routes are required, this may necessitate the need for import of additional material to construct the haul roads. This material will be removed after works are complete, unless an agreement is reached with the relevant landowners to leave it in place.

13.3.2.8 Accidental Spillages and Leaks

There is the potential for accidental soil and groundwater contamination due to spills and leaks of oils and other contaminants during the construction stage of the proposed works. The potential for these impacts to occur is minimised by adhering to the relevant construction guidelines (CIRIA C532 and C648).

13.3.2.9 Water Features

There is the potential to hydrogeological impact on local water features such as ground water wells where dewatering may be required e.g. at culvert upgrades. However, the extent of dewatering required over a short timeframe is not expected to result in any significant impact.

13.3.3 Operational Phase Impacts

The potential impact of the individual engineering items is summarised in Table 13.7**.** The potential impacts as they relate to proposed activities are outlined in the following sections.

13.3.3.1 Accidental Spillages and Leaks

Maintenance activities during operational stage will involve periodic inspection of flood defence measures at most (likely to be annual). This is expected to be carried out as visual walkover inspections and general landscaping activities. As a result, there is no expected impact due to spillages or leaks.

13.3.3.2 New and Remediated Embankments

Monitoring of the constructed and remediated embankments will be required periodically, expected to be on an annual basis, to check for any signs of instability or soil slippage. Slippages could result in sediment run-off into watercourses or blockage of watercourses/culverts. This would result in a temporary negative impact on the adjacent watercourse in the locality of the slippage, and a temporary negative impact due to potential flooding caused by any blockage.

13.3.3.3 New Flood Walls

There are no expected negative impacts during the operational stage due to the presence of the proposed flood walls.

13.3.3.4 In-channel Activities

Inspection of culverts may require in-stream activities during operation stage. This has the potential to result in contamination of watercourses if not managed properly, particularly the silting up of the watercourses due to bed disturbance. However the impact on soils and geology due to such activities is expected to be temporary, localised, and imperceptible.

13.4 MITIGATION MEASURES

Appropriate mitigation measures have been proposed in order to minimise each of the identified impacts both during the construction and operational phases of the proposed scheme.

13.4.1 Construction Phase

The potential negative impacts on geology and hydrogeology at construction stage are considered to be moderate to slight. The existing design contains a number of mitigating measures which will ensure to minimise any impacts on the geology and hydrogeology including soil and water management.

All construction works should be completed in line with the following best practice guidelines to ensure the potential for accidental soil and groundwater contamination is minimised:

- CIRIA (Construction Industry Research and Information Association) guidance on '*Control of Water Pollution from Construction Sites*' (CIRIA Report No C532, 2001)

- CIRIA (Construction Industry Research and Information Association) guidance on '*Control of Water Pollution from Linear Construction Projects*' (CIRIA Report No. C648, 2006)

Spoil spreading of excavated materials should be undertaken in line with the Construction Environmental Management Plan (a draft version is included in Appendix B of this EIAR). Appropriate soil spreading methodology should be employed to ensure the soil is returned to the same quality of that present before the works commenced. A sediment barrier shall be installed on the river side of embankments under construction within 10m of the river. Material deposition should be excluded from the river side of the sediment barrier to ensure that the risk of run-off is minimised. Further sediment barriers such as silt fences may be required adjacent to or within watercourses to intercept suspended sediment.

Permanent cut-off ditches are also proposed on the land side of all embankments to direct overland flow away from the embankments.

The construction of the embankments should be completed to ensure slope stability based on the mixture of rock and soil type used in the construction. The final design of these features should be approved by a geotechnical engineer to ensure slope failure will not occur.

Construction activities relating to the stream realignments at Morr 8 in Killeenmore and Slane 8 in Tuckmilltown will require rigorous management of contaminants and potential run-off. Please refer to Chapter 11 'Aquatic Ecology' for details on site-specific mitigation.

The construction of new river banks at the stream realignment should be completed to ensure slope stability based on in-situ material. The final design of these features should be approved by a geotechnical engineer to ensure slope failure will not occur.

Excavated made ground which is unsuitable for reuse onsite and/or has evidence of contamination is required to be correctly classified as inert, non-hazardous or hazardous for offsite disposal in accordance with '*Establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC (2003/33/EC)*'. A representative number of samples shall be taken from the excavated made ground and sent to an accredited laboratory for Waste Acceptance Criteria (WAC) analysis. Based on the WAC results the excavated material should be correctly recovered or disposed of at an appropriately licenced or permitted facility.

Appropriate health and safety measures shall be implemented as outlined in the CEMP and a site specific waste management plan shall be implemented onsite to mitigate any potential impacts from potentially contaminated made ground. The plan will include steps for the excavation, handling, storage and disposal of potentially contaminated material in accordance with industry best practices and waste management regulations.

13.4.2 Operational Phase

There are no operational mitigation measures required with regards to soils, geology and hydrogeology.

13.5 RESIDUAL IMPACTS

There are no significant residual negative impacts expected to the soils, geology and hydrogeology. Slight negative impacts on the geology and hydrogeology are expected, but these will not be significant. The removal of potentially contaminated made ground encountered during excavations can be viewed as a slight positive impact on the geology and hydrogeology of the area.

The proposed scheme will be completed in a predominantly limestone bedrock environment which is dominated by a locally important aquifer and a poor aquifer. The flood alleviation measures have been designed to minimise the impacts on the soils, geology and hydrogeology of the area.

The proposed works have been assessed to determine their potential impact on the soils, geology and hydrogeology. There are slight to imperceptible impacts expected on the soils, geology and hydrogeology as a result of the proposed works. Mitigation measures have been recommended in relation to the control of water pollution and exclusion zones for spoil deposition adjacent to watercourses.

This page has been left intentionally blank.

14 CULTURAL HERITAGE

This chapter of the EIAR was prepared by Irish Archaeological Consultancy Ltd and examines the potential impacts of the Morell Flood Management Scheme on the archaeological, architectural and cultural heritage resources.

The assessment involved detailed interrogation of the archaeological, historical and architectural background of the development area. This included information from the Record of Monuments and Places of County Kildare, the County Development Plan, the topographical files of the National Museum of Ireland and cartographic and documentary records. Aerial photographs of the assessment area held by Ordnance Survey Ireland were also consulted. A field inspection was carried out on 10th April 2015 and 27th January 2017 in an attempt to identify any known cultural heritage sites and previously unrecorded features, structures and portable finds within the proposed scheme area.

The following sections describe the methodology used in the assessments and the existing environment from an archaeological, architectural and cultural heritage perspective. It also examines the potential impacts of the proposed scheme and recommends mitigation measures to ameliorate these impacts on features of archaeological potential, architectural heritage or cultural heritage. Supplementary information to this assessment is contained within Appendix G, in Volume 3 of the EIAR.

Definitions

In order to assess, distil and present the findings of this assessment, the following definitions apply. ‘Cultural Heritage’ where used generically, is an over-arching term applied to describe any combination of archaeological, architectural and cultural heritage features, where:

- The term ‘archaeological heritage’ is applied to objects, monuments, buildings or landscapes of an (assumed) age typically older than AD 1700 (and recorded as archaeological sites within the Record of Monuments and Places);

- The term ‘architectural heritage’ is applied to structures, buildings, their contents and settings of an (assumed) age typically younger than AD 1700; and

- The term ‘cultural heritage’, where used specifically, is applied to other (often less tangible) aspects of the landscape such as historical events, folklore memories and cultural associations. This designation can also accompany are archaeological or architectural designation.

14.1 METHODOLOGY

Research has been undertaken in two phases. The first phase comprised a paper survey/desk study of all available archaeological, architectural, historical and cartographic sources. The second phase involved a field inspection of the proposed scheme area.

14.1.1 Paper Survey/Desk Study

This assessment determines, as far as reasonably possible from existing records, the nature of the cultural heritage resource within the area of proposed scheme using appropriate methods of assessment. Desk-based assessment is defined as a programme of study of the historic environment within a specified area or site that addresses agreed research and/or conservation objectives. It consists of an analysis of existing written, graphic, photographic and electronic information in order to identify the likely heritage assets, their interests and significance and the character of the assessment area, including appropriate consideration of the settings of heritage assets (Institute of Field Archaeologists, 2012). This leads to the following:

- Determining the presence of known archaeological and built heritage sites that may be affected by the proposed scheme;
- Assessment of the likelihood of finding previously unrecorded archaeological remains during the construction programme;
- Determining the impact upon the setting of known cultural heritage sites in the surrounding area; and
- Suggested mitigation measures based upon the results of the above research.

The following sources were examined and a list of areas of archaeological, architectural and cultural heritage potential was compiled:

- Record of Monuments and Places for County Kildare;
- Sites and Monuments Record for County Kildare;
- Monuments in State Care Database;
- Preservation Orders;
- Topographical files of the National Museum of Ireland;
- Cartographic and written sources relating to the assessment area;
- Kildare County Development Plan (2011–2017);
- National Inventory of Architectural Heritage;
- Place name analysis;
- Aerial photographs; and
- Excavations Bulletin (1970–2016).

Record of Monuments and Places (RMP) is a list of archaeological sites known to the National Monuments Section, which are afforded legal protection under Section 12 of the 1994 National Monuments Act and are published as a record. Details of all sites located within c. 250m of the proposed scheme are included within Appendix G of this EIAR.

Sites and Monuments Record (SMR) holds documentary evidence and field inspections of all known archaeological sites and monuments. Some information is also held about archaeological sites and monuments whose precise location is not known e.g. only a site type and townland are recorded. These are known to the National Monuments Section as 'un-located sites' and cannot be afforded legal protection due to lack of locational information. As a result these are omitted from the Record of Monuments and Places. SMR sites are also listed on a website maintained by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs (DoAHRRGA) – www.archaeology.ie.

National Monuments in State Care Database is a list of all the National Monuments in State guardianship or ownership. Each is assigned a National Monument number whether in guardianship or ownership and has a brief description of the remains of each Monument. There are no National Monuments recorded within the vicinity of the proposed scheme.

The Minister for the DoAHRRGA may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Preservation Orders List contains information on Preservation Orders and/or Temporary Preservation Orders, which have been assigned to a site or sites. Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Topographical files of the National Museum of Ireland is the national archive of all known finds recorded by the National Museum. This archive relates primarily to artefacts but also includes references to monuments and unique records of previous excavations. The find spots of artefacts are important sources of information on the discovery of sites of archaeological significance. Details of all stray finds recorded within the townlands surrounding the proposed scheme are included within **Appendix G** of this EIAR.

Cartographic sources are important in tracing land use development within the development area as well as providing important topographical information on areas of archaeological potential and the development of buildings. Cartographic analysis of the following relevant maps has been made to identify any topographical anomalies or structures that no longer remain within the landscape:

Sir William Petty, '*Down Survey Map'*, 1654–56, Barony of Naas

Noble and Keenan's '*Map of County Kildare'*, 1752

Alex Taylor's '*Map of the County of Kildare'*, 1783

Ordnance Survey Map Editions '*County Kildare'* (1837–8, 1907–9)

Documentary sources were consulted to gain background information on the archaeological, architectural and cultural heritage landscape of the proposed scheme area.

Aerial photographic coverage is an important source of information regarding the precise location of sites and their extent. It also provides initial information on the terrain and its likely potential for archaeology. A number of sources were consulted including aerial photographs held by the Ordnance Survey and Google Earth.

Place Names are an important part in understanding both the archaeology and history of an area. Place names can be used for generations and in some cases have been found to have their root deep in the historical past.

Development Plans contain a catalogue of all the Protected Structures and archaeological sites within the county. The Kildare County Development Plan (2011–2017) was consulted to obtain information on cultural heritage sites in and within the immediate vicinity of the proposed scheme. Details of all RMP sites and protected structures located within *c*. 250m of the proposed scheme are included within Appendix G of this EIAR.

The National Inventory of Architectural Heritage is a government based organisation tasked with making a nationwide record of significant local, regional, national and international structures, which in turn provides county councils with a guide as to what structures to list within the Record of Protected Structures. The architectural survey for County Kildare was completed during 2003. The NIAH have also carried out a nationwide desk based survey of historic gardens, including demesnes that surround large houses. This has also been completed for County Kildare and was examined in relation to the surviving demesnes within the surrounding area of the proposed scheme.

Excavations Bulletin is a summary publication that has been produced every year since 1970. This summarises every archaeological excavation that has taken place in Ireland during that year up until 2010 and since 1987 has been edited by Isabel Bennett. This information is vital when examining the archaeological content of any area, which may not have been recorded under the SMR and RMP files. This information is also available online (www.excavations.ie) from 1970–2016.

14.1.2 Field Inspection

Field inspection is necessary to determine the extent and nature of archaeological and architectural remains, and can also lead to the identification of previously unrecorded or suspected sites and portable finds through topographical observation and local information.

The archaeological and architectural field walking inspection, undertaken on 10th April 2015 and 27th January 2017 entailed:

- Walking the proposed scheme and its immediate environs;
- Noting and recording the terrain type and land usage;
- Noting and recording the presence of features of archaeological, architectural or cultural heritage significance;
- Verifying the extent and condition of recorded sites; and
- Visually investigating any suspect landscape anomalies to determine the possibility of their being anthropogenic in origin.

Please see Appendix G of the EIAR for protective guidelines and legislation that were taken into account during the assessment of the archaeological and architectural heritage of the proposed scheme.

14.1.3 Consultations

Following the initial research a number of statutory and voluntary bodies were consulted to gain further insight into the cultural background of the background environment, receiving environment and assessment area, as follows:

- Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs – the Heritage Service, National Monuments and Historic Properties Section: Record of Monuments and Places; Sites and Monuments Record; Monuments in State Care Database; Preservation Orders;
- National Museum of Ireland, Irish Antiquities Division: topographical files of Ireland;
- National Inventory of Architectural Heritage: County Kildare;
- Kildare County Council: Planning Section; and
- Trinity College Dublin, Map Library: Historical and Ordnance Survey Maps.

14.2 RECEIVING ENVIRONMENT

14.2.1 Archaeology

The proposed scheme is located within an area of rich archaeological and historical context. The scheme works are proposed for sections of the Morell River, Painestown River, Slane River and Kill River within the townlands of Ballyhays, Turnings Lower, Turnings Upper, Killeenmore, Sherlockstown Common, Killeenbeg, Painestown, Tuckmilltown, Baron Rath and Kill East. The general area comprises low-lying, agricultural pasture and parkland to the south of the River Liffey, which is prone to flooding.

There are seven groups or individual archaeological sites located within 250m of the proposed works. Of these, three represent sites that were have been excavated in the past. These include a *fulacht fiadh* located c. 25m east of Morr 2, which was excavated during the construction of flood embankments in 2003 (KD014-056). Of the four remaining sites, the closest is a ringfort (KD014-024), located c. 145m southeast of Paines 1. Sites are listed in Table 14.1.

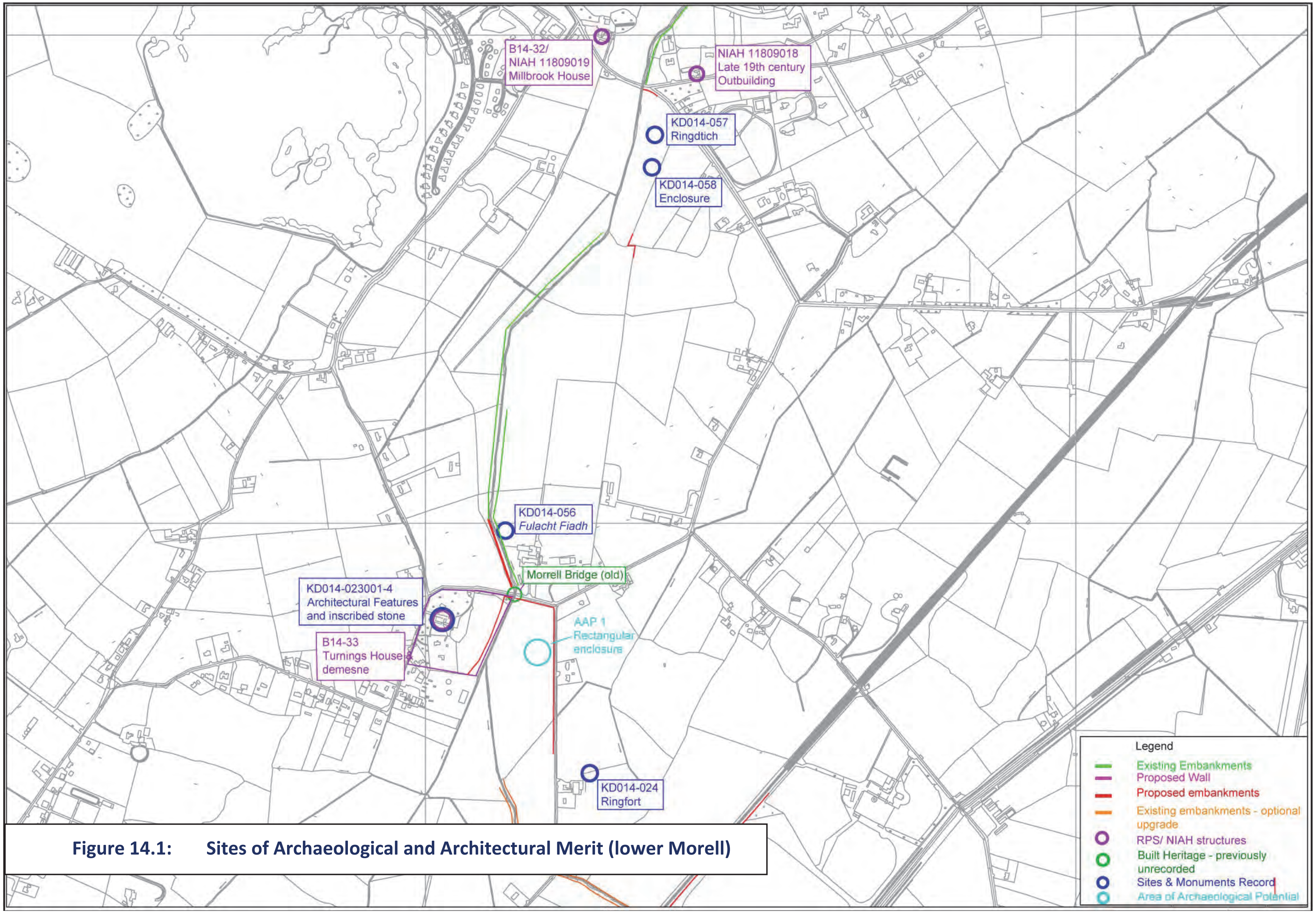


Figure 14.1: Sites of Archaeological and Architectural Merit (lower Morell)

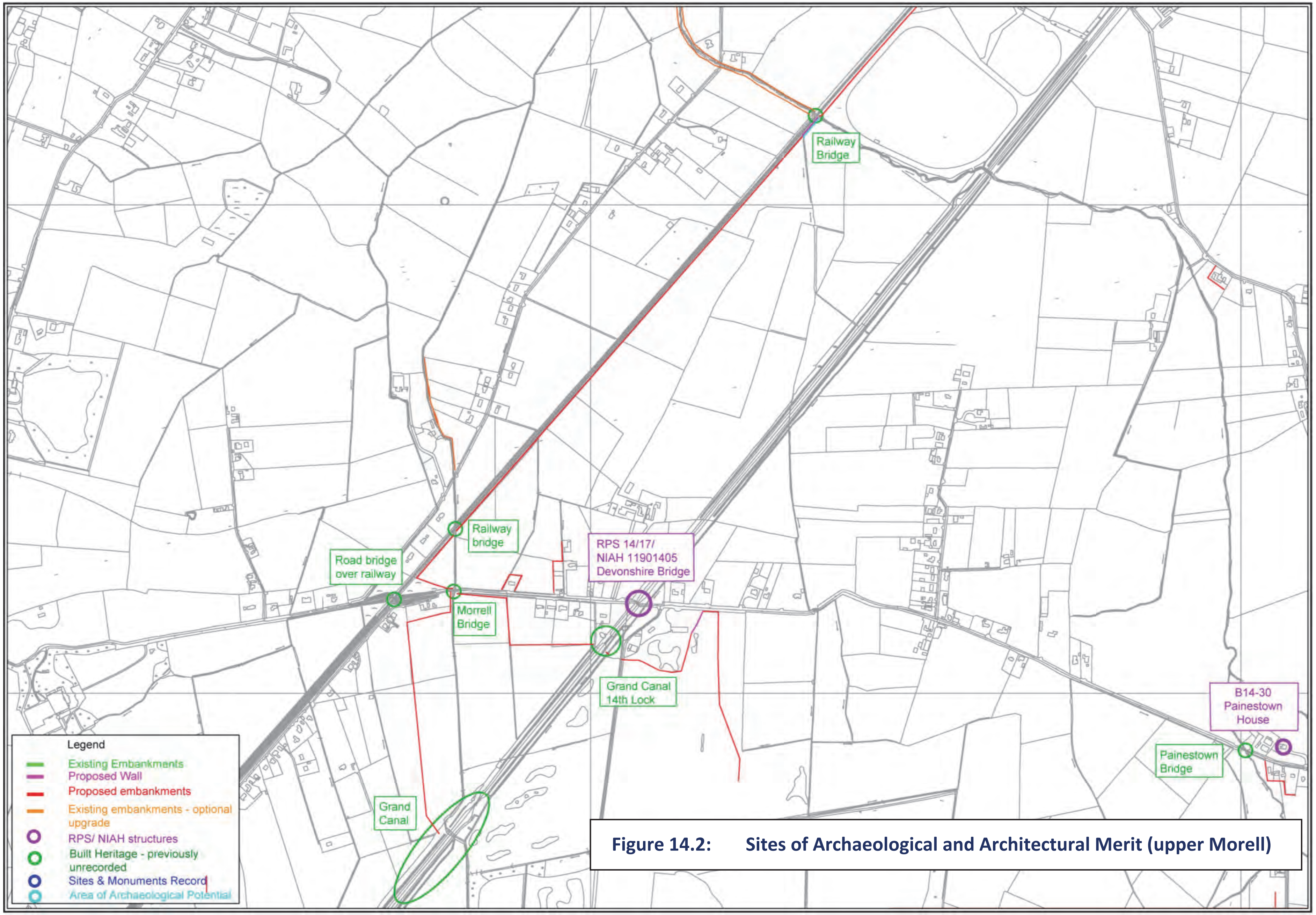


Figure 14.2: Sites of Archaeological and Architectural Merit (upper Morell)

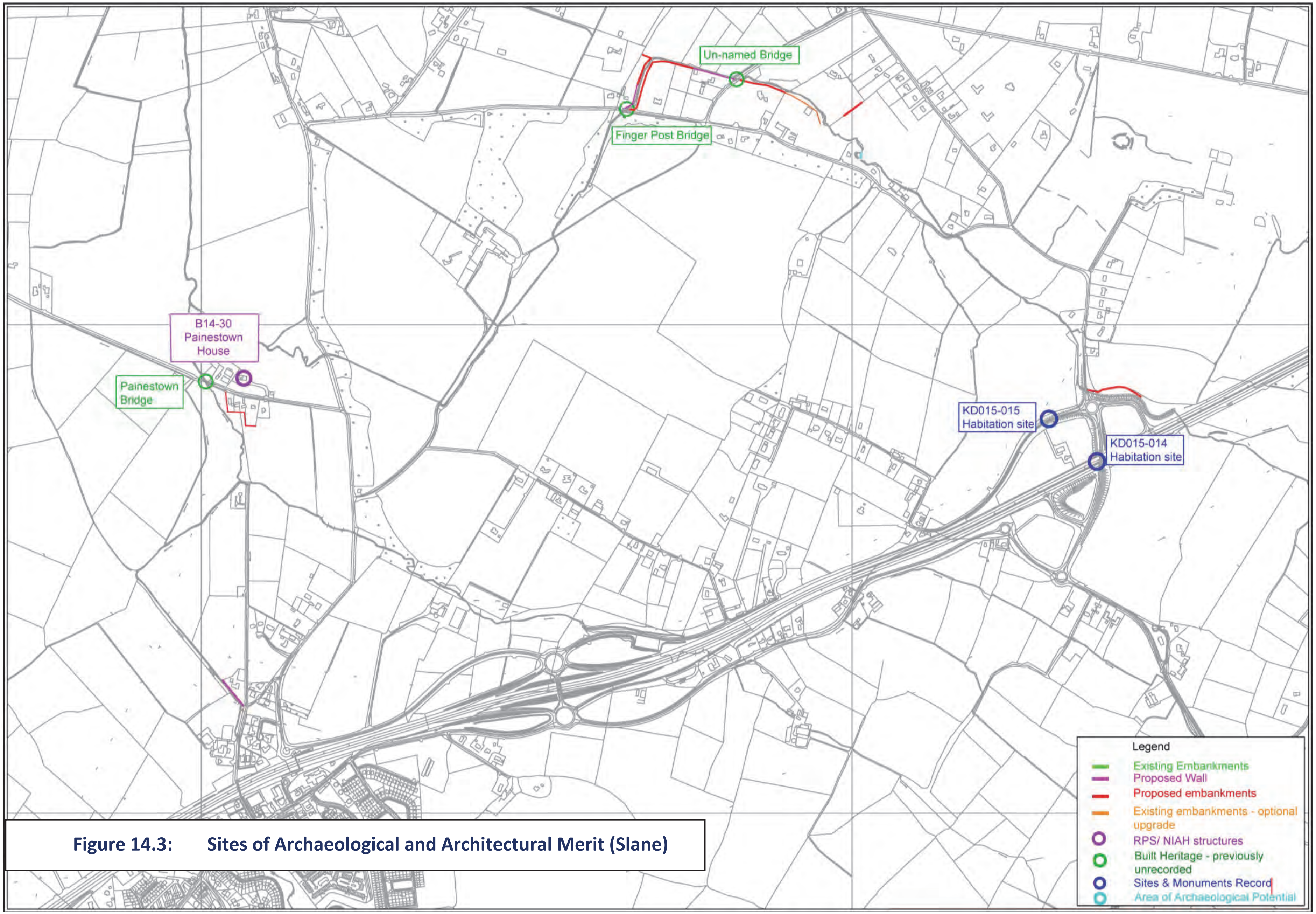


Figure 14.3: Sites of Archaeological and Architectural Merit (Slane)

Table 14.1: SMR/ RMP sites located within 250m of proposed scheme

SMR	Classification	Townland	ITM	Statutory Protection?	Distance to scheme
KD014-057	Ring-ditch	Ballyhays	692634, 728691	Yes	c. 160m south Morr 1
KD014-058	Enclosure	Ballyhays	692629, 728623	Yes	c. 215m north Morr 1A
KD014-056	Site of Fulacht fiadh (fully excavated)	Turnings Upper	692167, 727499	No	c. 25m east Morr 2
KD014-023001–4	Architectural feature (x2), Inscribed stone (x2)	Turnings Upper	691971, 727228	Yes	c. 170m west Morr 3
KD014-024	Ringfort - unclassified	Turnings Upper	692431, 726760	Yes	c. 145m southeast Paines 1
KD015-015	Habitation site	Blackchurch	696530, 724254	No	c. 175m west-southwest Slane 7
KD015-014	Habitation site	Blackchurch	696684, 724151	No	c. 175m south Slane 7

A review of the Excavations Bulletin (1970–2016) has shown that a number of programmes of archaeological investigation have been carried out in advance of works along N7 Naas Dual Carriageway which revealed prehistoric and medieval occupation near the southeast limit of the proposed scheme in Kill and Blackchurch townlands. Monitoring of the Ballygoran to Castlewarden Water Pipeline scheme failed to identify any features within the vicinity of the current proposed scheme. Three sites were excavated in advance of flood alleviation works by Kildare County Council north of the Morell Bridge, one of which comprised the *fulacht fiadh* KD014-056.

Analysis of the aerial photographic coverage of the landscape containing the proposed scheme has resulted in the identification of a rectangular enclosure to the west of Paines 1. This is situated within a field containing numerous paleo-channels and some relic field boundaries. The enclosure may relate to the post medieval landscape. However, it has the potential to represent earlier activity. It has been designated as Area of Archaeological Potential 1.

Analysis of the cartographic resource indicated that the proposed scheme is located within an area characterised by large houses and demesne parkland as shown in Figure 14.4 and Figure 14.5. The 18th century maps show the course of the Morell River and tributaries (Painestown, Kill and Slane Rivers) although these are not individually annotated until the 19th century mapping. The surrounding lands are shown as regular plots of undeveloped greenfield agricultural and parkland. Most of the river courses are maintained within relatively narrow channels and it is likely that some straightening/canalisation works were carried out along the rivers prior to the first accurate mapping of the early 19th century. No previously unidentified archaeological features were noted in the mapping.

A review of the townlands names within the receiving environment of the proposed scheme has revealed some common topographical terms, which were used to describe portions of the landscape.

The majority of the townland names within the vicinity are derived from topographical features, land ownership and associations with religious/ industrial or hospital institutions. Several stretches of the Morell and Painestown Rivers form townland and parish boundaries.

The entire length of the proposed scheme was walked during the field inspection. The AAP noted above did not have definitive surface expression. No other specific sites of archaeological potential were noted. However, the overall landscape can be considered to possess archaeological potential due to the presence of the water courses, which have attracted human activity since the prehistoric period. Sites such as burnt mounds/*fulachta fiadh* are regularly identified in proximity to water courses during construction works.

14.2.1.1 Potential Stockpile Areas

As part of the proposed scheme, three possible areas that may be used for stock piling materials have been identified. These are areas located adjacent to Morr 23, Morr 19 and Paines 3. The main compound may be located at one of these identified stockpiling/compound areas and be established specifically for the project, or may alternatively use suitable existing premises, if one is available.

Morr 23

This area consists of a linear section of level pasture to the immediate east of a golf course within the townland of Killeenbeg. There are no recorded monuments within the site or its locale. No specific features or areas of archaeological potential were noted within the historic mapping, aerial photographs or field inspection. It appears that some landscaping and ground disturbances have taken place within the area that are associated with the golf course.

Morr 19

This area consists of a triangular section of level pasture to the immediate west of the canal within the townland of Sherlockstown Common. There are no recorded monuments within the site or its locale. No specific features or areas of archaeological potential were noted within the historic mapping, aerial photographs or field inspection.

Paines 3

This is a sub-triangular area located within the townland of Turnings Upper. The area is level and under pasture and is bordered to the east by a small local road and to the west by a stream. A recorded ringfort is located c. 80m to the east of the area (KD014-024). However, the first edition shows a large circular area, defined by a dashed line, surrounding the ringfort. The SMR file notes this feature, which has a diameter of 400m, but states it is of unknown significance. The very western section of the path of this feature extends into the proposed stock pile area. However, it possesses no surface expression and is not visible within the aerial photographic coverage. Due to the presence of the water course to the west of the site, this area possesses archaeological potential as it may contain burnt mounds or *fulachta fiadh*. The presence of the ringfort to the east and the possible associated enclosing feature that extends into the site increases the archaeological potential of this area.

14.2.2 Architecture

The landscape surrounding the proposed scheme is characterised by large houses and demesne lands. Two demesnes, including Bishopscourt and Turnings, are located within the immediate proximity of the proposed scheme.

There are four buildings that are recorded as Protected Structures within 250m of the proposed scheme (Figure 14.1-14.3). Architectural features at Turnings House are also listed in the Record of Monuments and Places (B14-33/ KD014-023). The closest is Painestown House (B14-30), which is located c. 70m northeast of the proposed works at Paines 5. Turnings House possesses a small demesne landscape, which is marked on the first edition OS map. The proposed embankment at Morr 3 will run through the demesne in a north-south direction. However, it will replace an existing denuded embankment that currently runs adjacent to the River Morell.

Three buildings are recorded in the NIAH survey for County Kildare, within 250m of proposed scheme area. Both Devonshire Bridge and Millbook House are protected structures also. The closest to the scheme is an outbuilding, located c. 145m east-northeast of the embankment at Morr 1.

Table 14.2: RPS/ NIAH structures located within 250m of proposed scheme

RPS No.	NIAH No.	Classification	Townland	Distance to proposed development
B14-33	N/a	Turning House and lodge/ entrance/ wall	Turnings Upper	c. 115m west of Morr 3
B14-32	11809019	Millbrook House	Turnings Lower	c. 200m northwest of Morr 1
B14-30	N/a	Painestown House	Painestown	c. 70m northeast of Paines 5
B14-17	11901405	Devonshire Bridge	Killeenbeg/ Killeenmore	c. 180m west and northeast of Morr 19-23
N/a	11809018	Outbuilding	Ballyhays	c. 145m east-northeast of Morr 1

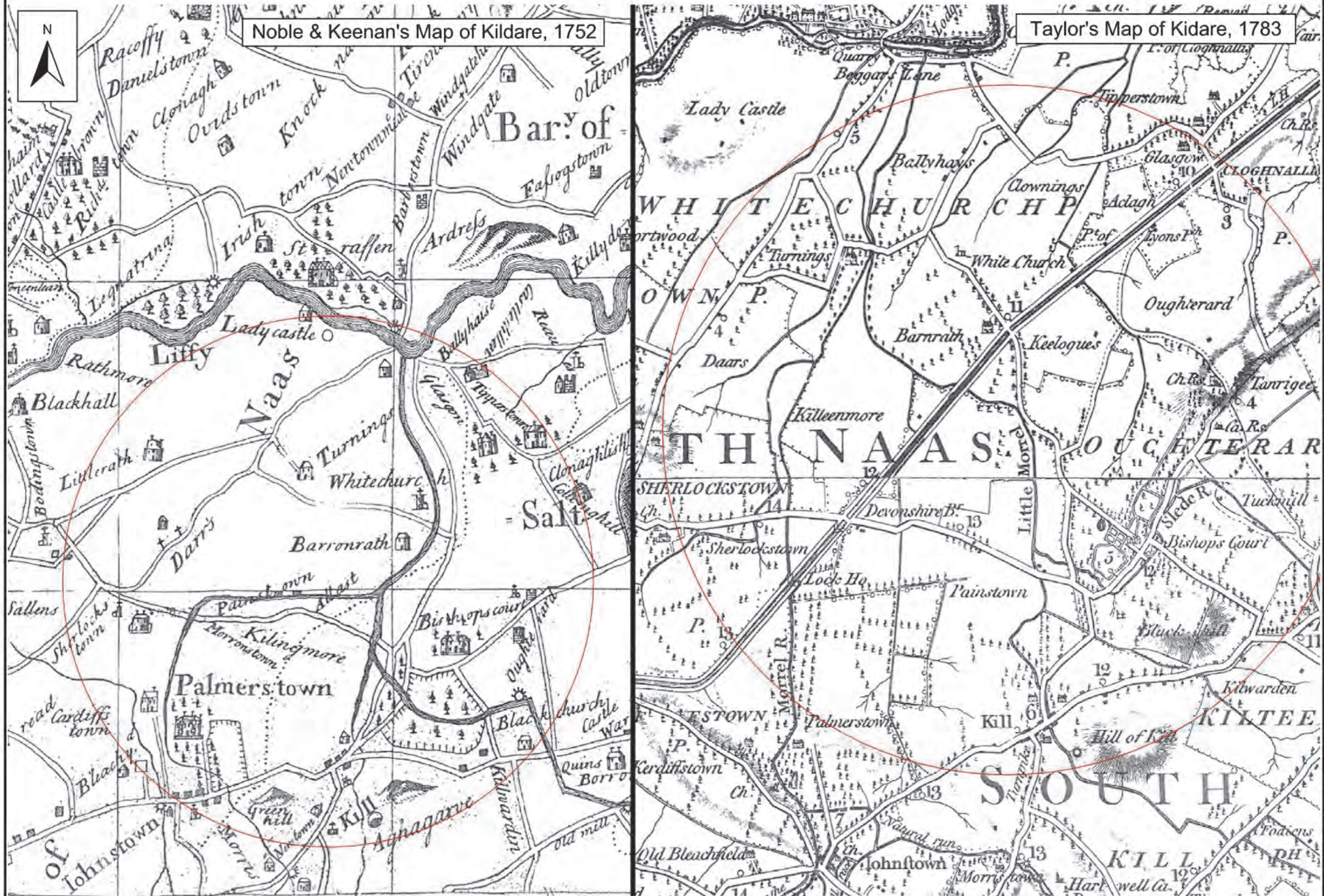
Analysis of the cartographic resource indicated that the proposed scheme is located within an area characterised by large houses and demesne parkland (Figure 14.5 and 14.6). The progression and development of infrastructural projects within the vicinity of the proposed scheme, such as the Grand Canal and the Great Southern and Western Railway, are detailed in the late 18th and early 19th century mapping. Some of the larger road bridges associated with the Morell, Painestown and Slane Rivers have been annotated by the time of the 25-inch OS map at turn of the 20th century, including Morell Bridge, Painestown Bridge and Finger Post Bridge.

The field inspection identified further sites of built heritage significance comprising bridges of various dates crossing the Morell, Painestown and Slane Rivers; including ‘Morell Bridge (old)’, ‘Morell Bridge’, ‘Painestown Bridge’, ‘Finger Post Bridge’ and an un-named bridge at Tuckmilltown. Several railway structures have also been identified, including two small bridges over water courses and a road bridge. All of the bridges identified will be crossed by proposed haulage routes for the construction phase of the proposed scheme. However, the structures are all still in use and open to traffic.

14.2.2.1 Potential Stockpile Areas

As part of the proposed scheme, three possible areas that may be used for stock piling materials have been identified. These are areas located adjacent to Morr 23, Morr 19 and Paines 3. The main compound may be located at one of these identified stockpiling/compound areas and be established specifically for the project, or may alternatively use suitable existing premises, if one is available.

With the exception of the path of the canal to the immediate west of the proposed stock pile area at Morr 19, there are no sites of architectural heritage located within the immediate environs of the three stock pile areas.



Legend

Kildare County Council

Project	River Morrell FMS
Title	Extracts from the first edition OS map showing proposed scheme
	Figure 14.4

RPS

RPS Consulting Engineers
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900
Fax: +353 1 462 0814

Issue Details

Drawn: BT	Project No. MDW0575
Checked: KK	File Ref:
Approved: JH	MDW0575QG1125D01
Scale: NTS	Map Projection:
Date: 29/07/2015	Irish National Grid (ING)

NOTES:
This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.

Legend

Kildare County Council

Project River Morrell FMS

Title **Extracts from the first edition OS map showing proposed scheme**

Figure 14.5

RPS

RPS Consulting Engineers
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Tel: +353 1 488 2900
Fax: +353 1 462 0814

Issue Details

Drawn:	BT	**Project No.**	MDW0575
Checked:	KK	**File Ref:**	MDW0575QG1126D01
Approved:	JH		
Scale:	NTS	**Map Projection:**	Irish National Grid (ING)
Date:	29/07/2015		

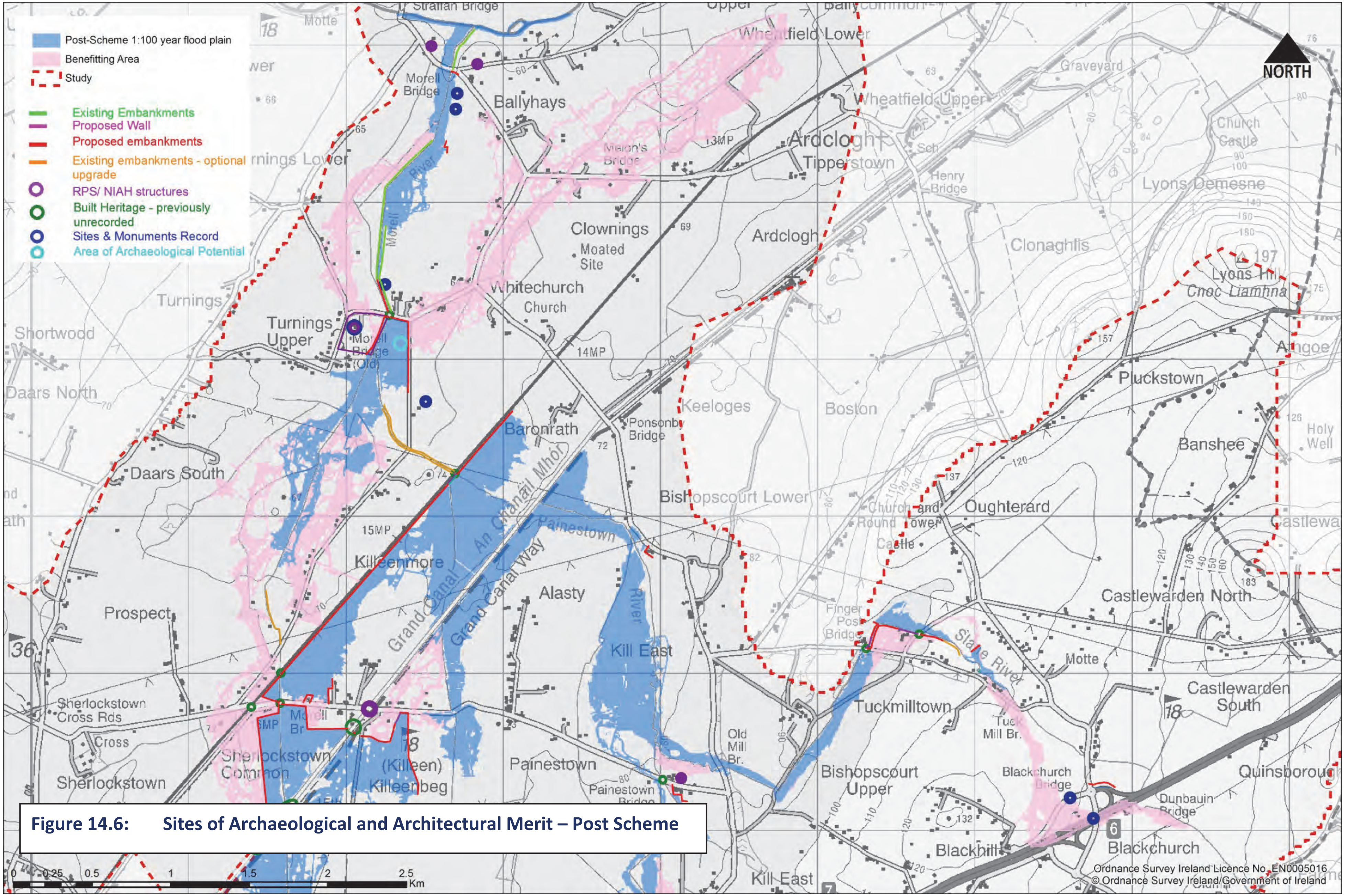


Figure 14.6: Sites of Archaeological and Architectural Merit – Post Scheme

14.3 POTENTIAL IMPACTS

The following Impact Definitions (as defined by the EPA 2002 Guidelines, 23) are used in this assessment:

Imperceptible Impact: An impact capable of measurement but without noticeable consequences

Slight Impact: An impact that causes noticeable changes in the character of the environment without affecting its sensitivities.

Moderate Impact: An impact that alters the character of the environment in a manner that is consistent with existing or emerging trends.

Significant Impact: An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.

Profound Impact: An impact that obliterates sensitive characteristics.

14.3.1 Do Nothing

If the proposed development were not to proceed there would be no impact on the archaeological or architectural resource.

14.3.2 Construction Phase Impacts

14.3.2.1 Archaeology

- No recorded monuments will be impacted upon by ground disturbances associated with the construction of the proposed scheme. In addition, the works a Paines 1 will not impact on the rectangular enclosure identified as AAP 1. However, ground disturbances, such as topsoil stripping, have the potential to have a direct and negative impact on previously unrecorded archaeological features or deposits that may survive beneath the current ground level with no surface expression.

- The current proposals include the realignment of a section of the Slane River (Slane 8) in Tuckmilltown. This will involve excavation of a new section of channel to remove a sharp bend in the river and the infill of the original channel. These works have the potential to have a direct and negative impact on previously unrecorded archaeological features, deposits or artefacts that may survive within this area.

- Three potential stock pile areas may be required as part of the proposed scheme. Topsoil stripping within these sites has the potential to have a direct and negative impact on archaeological features that have the potential to survive within these areas, especially in the site at Turnings North.

14.3.2.2 Architecture

- Ground disturbances associated with the construction of embankments adjacent to a number of bridge structures: 'Morell Bridge (old)', 'Morell Bridge', 'Painestown Bridge', 'Finger-post Bridge' and an un-named bridge in Tuckmilltown, have the potential to directly and negatively impact on these structures. This may occur through inadvertent damage from plant, or burying of portions of the structures from the construction of embankments.

14.3.2.3 Cultural Heritage

- With the exception of the above impacts there are no predicted impacts to the cultural heritage resource.

14.3.3 Operational Phase Impacts

14.3.3.1 Archaeology

- There will be a moderate positive impact on Recorded Monuments KD014-057 (ringditch), KD014-058 (enclosure) and KD014-023 (Architectural fragments) during the operation of the proposed scheme. This will be due to the predicted reduction in the flood plain area.

14.3.3.2 Architecture

- There will be a moderate positive impact on Turnings House (B14-33) during the operation of the proposed scheme. This will be due to the predicted reduction in the flood plain area.

14.3.3.3 Cultural Heritage

- With the exception of the above impacts there are no predicted impacts to the cultural heritage resource.

14.4 MITIGATION MEASURES

14.4.1 Construction Phase

14.4.1.1 Archaeology

- All topsoil stripping associated with the proposed scheme should be subject to full time archaeological monitoring. This will be carried out by a suitably qualified archaeologist under licence by the National Monuments Service. Full provision will be made available for the resolution of any archaeological features or deposits that may be identified, should that be deemed the most appropriate manner to proceed.

- A wade survey will be carried out within the section of Slane River to be realigned prior to any construction works going ahead. This will be carried out by a suitably qualified archaeologist, under licence by the National Monuments Service. Full provision will be made available for the resolution of any archaeological features or deposits that may be identified, should that be deemed the most appropriate manner to proceed.

- It is recommended that topsoil stripping within Morr 19 and 23 stock pile areas is monitored by a suitably qualified archaeologist. It is recommended that the area at Paines 3 only be used as a last resort. To avoid the need for topsoil stripping at this site, the contractor will instead temporarily stockpile fill material on top of a geotextile layer at this location, if it required for material storage.

- If topsoil stripping is required at this site, it is recommended that the site be subject to archaeological testing in the first instance. This should be undertaken by an archaeologist under licence to the DoAHRRGA. Full provision should be made available for the resolution of any archaeological features that may be discovered, should that be deemed an appropriate manner in which to proceed.

14.4.1.2 Architecture

- A written and photographic record will be carried out of ‘Finger-post Bridge’ prior to construction and any direct impact on the structural remains of the bridge will be avoided. Furthermore a sufficient buffer (minimum of 1m) will be maintained between the embankment and bridge during construction.

- Any direct impact to the remaining three bridges ‘Morell Bridge (old)’, ‘Morell Bridge’ and ‘Painestown Bridge’ will be avoided during use of the haulage and due care will be taken by all vehicles during construction phase.

Cultural Heritage

- With the exception of the measures outlined above there are no mitigation measures required for the cultural heritage resource.

14.4.2 Operational Phase

14.4.2.1 Archaeology

- There are no mitigation measures required with regard to the archaeological resource during the operational phase of the proposed scheme.

14.4.2.2 Architecture

- There are no mitigation measures required with regard to the architectural resource during the operational phase of the proposed scheme.

14.4.2.3 Cultural Heritage

- There are no mitigation measures required with regard to the cultural heritage resource during the operational phase of the proposed scheme.

14.5 RESIDUAL IMPACTS

14.5.1 Construction Phase

No residual impacts are anticipated upon the archaeological, architectural or cultural heritage resource by the proposed scheme if all outlined mitigation measures are carried out.

14.5.2 Operational Phase

No residual impacts are anticipated upon the archaeological, architectural or cultural heritage resource by the proposed scheme.

Please note that all recommendations are subject to approval by the National Monument Service of the Heritage and Planning Division, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.

This page has been left intentionally blank

15 SUMMARY OF IMPACTS AND MITIGATION MEASURES, INTERACTIONS

15.1 SUMMARY OF IMPACTS AND MITIGATION MEASURES

Chapters 5 to 14 of this EIAR assess the likely significant impacts arising from the proposed Morell Flood Management Scheme.

Tables 15.1 to Table 15.10 of this Chapter provide a summary of the potential impacts identified within each Chapter of the EIAR and identify the mitigation measures outlined to reduce or eliminate these impacts. The timescale during which the mitigation is appropriate is also outlined, as well as who will be responsible for implementing the mitigation.

An outline Construction Environmental Management Plan (oCEMP) is included in Appendix B. The purpose of the CEMP is to ensure that the mitigation measures outlined in the EIAR and any other requirements that arise from the planning process will be carried forward to the construction phase of the project. This oCEMP will be developed by the main works contractor into a final CEMP and agreed with the relevant authorities in advance of the works.

Table 15.1: Population and Human Health: Summary of Mitigation Measures

Potential Impact (Population and Human Health)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction Potential impacts include construction noise, and temporary dust and vibration arising from the construction works and associated construction traffic.	Mitigation measures for traffic, noise, & vibration and dust are presented in their respective chapters.	n/a	n/a	n/a
There is potential for some disruption to the residential/working population and economic activity within the study area during the construction phase of the flood management scheme. Some disruption to residents and businesses may arise during the construction period, from works occurring close to commercial premises, road restrictions, etc.	Impacts will also be mitigated by the adoption of good construction and traffic management measures and by the dissemination of information to owners and operators of places of work. Such measures should be identified in a formal Construction and Environmental Management Plan (CEMP) and Construction Traffic Management Plan (CTMP). The CEMP will be implemented by the contractor to mitigate against adverse impacts during construction. The CEMP will incorporate mitigation measures to avoid nuisance from construction activities including dust and noise. The CTMP will also be prepared in advance of the proposed works to minimise any impacts on other road users and to maximise road safety along the haul routes. The aim of a CTMP is to put in place procedures to manage construction traffic effectively. The plan will consider construction traffic accessing the site via the public road network as well as traffic circulation within the construction site. The working and resident community would also benefit from an organised information campaign on temporary access arrangements and proposed construction detail.	Prior to and throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
During construction, potential impacts in respect of education and health are not expected to be significantly different from the existing situation. There will be a temporary increase in the number of HGVs on routes within the works areas during construction and the resultant temporary traffic management procedures may result in some minor disruption to local traffic which may include increases to typical journey times.	Construction phase impacts in respect of education and health will be mitigated in the same way as for the resident/working population in the section above, by the adoption of good construction and traffic management measures and by the dissemination of information to schools and healthcare providers. Such measures should be identified in the CEMP and CTMP plan as previously outlined, and an organised information campaign on temporary access arrangements and proposed construction detail as previously identified.	Prior to and throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Population and Human Health)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Site investigations have established the presence of made ground in a number of works areas. If contaminated ground is encountered during construction, the excavation and handling of contaminated ground has the potential to result in the increased mobilisation of contaminants. Dependant on the contaminant of concern; these impacts could include: ▪ Leaching of any contaminants from the made ground to the surrounding area could lead to further areas of soils within the vicinity becoming impacted and the impacting of groundwater and surface water; ▪ Risk from gas production; and, ▪ Human health risk, as excavation of made ground could expose construction works to potential contaminants. If contaminant levels exceed soil guideline values (SGVs) this could present a risk to human health from direct contact and from volatile or semi-volatile vapours.	▪ Additional Site Investigations will be carried out in accordance with BS5930:2015 and BS10175:2011+A1:2013 during detailed design. ▪ Should evidence of contamination be encountered in the identified areas of made ground or other excavated areas, appropriate health and safety measures shall be implemented, as discussed in Table 15.9 below. A site specific Waste Management Plan shall be implemented onsite to mitigate any potential impacts from potentially contaminated made ground. An outline example has been appended to the EIA report (Appendix M). The plan will include steps for the excavation, handling, storage and disposal of potentially contaminated material in accordance with industry best practices and waste management regulations. ▪ Mitigation measures for the preservation of water quality are set out in Tables 15.7 and 15.9 below.	Prior to and throughout the construction phase.	These measures will be implemented by the design team and Contractor.	Not Significant.
Whilst the proposed works will have little impact on many sectors of the tourism industry within the catchment, there is potential for an impact to angling activity. The proposed scheme will have a localised temporary adverse impact on the angling amenity during any in-stream works.	▪ Construction phase impacts in respect of tourism and leisure will be mitigated in the same way as for the resident/working population above. ▪ Phasing of works around peak user times of other uses such as specific sports facilities, in particular Killeen Golf Club and seasonal tourist facilities should be considered. ▪ Local angling clubs and IFI have been included in the consultation process and will be kept informed throughout the construction process. Mitigation and control measures to address the impact from suspended sediments associated with construction activities should follow good work practices and sound design principles (see also Table 15.7, Aquatic Ecology). Contractors shall establish contact with the relevant authorities, e.g. IFI before works commence, with ongoing liaison throughout the construction. ▪ Regular updates and consultation with all sports clubs/schools affected by construction works will be required. Ongoing consultation with other land users specifically affected by proposed construction works will be required.	Prior to and throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Population and Human Health)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction works may affect land uses within the study area through temporary land take for construction purposes. Particular land areas may temporarily severed from access to facilitate construction works and/or have temporary access restrictions (short term access to land may be affected immediately adjacent to the works) causing a short term adverse impact.	▪ Extensive landowner consultation has been carried out during the development of the proposed scheme. ▪ Consultation with landowners will continue throughout detailed design and construction of the scheme to ensure that appropriate mitigation for individual landowners is agreed between the landowner and the Contractor and will be implemented. ▪ Existing accesses to property or severed areas, including homes and farms will, where practicable, be maintained during construction; otherwise reasonable temporary access will be provided. Discussions have taken place with landowners in this regard and these discussions will continue throughout the construction period. ▪ All lands, temporarily acquired, will be re-instated to pre-construction conditions, subject to the agreement of the landowners.	Throughout the construction phase and at the completion of construction.	These measures will be implemented by the Contractor.	Not Significant.
Construction works may affect safety within the study area.	▪ The works will be subject to the Safety, Health and Welfare at Work Act 2005 (S.I. No. 10 of 2005) and at a minimum the Safety, Health and Welfare at Work (Construction) Regulations, 2013 (S.I. No. 291 of 2013). All aspects of design construction will be reviewed with regard to health and safety and risk assessments will be carried out. ▪ A project supervisor design process (PSDP) has been appointed. As part of their duties they will be required to produce a Preliminary Safety and Health Plan for the project. The main contractor will be appointed as project supervisor construction stage (PSCS) and will be responsible for the control and co-ordination of health and safety during the construction phase of the works. ▪ A CTMP will be prepared in advance of the proposed works to minimise any impacts on other road users and to maximise road safety along the haul routes.	Prior to and throughout the construction phase.	These measures will be implemented by Kildare County Council, the Design Engineer and the Contractor.	Not Significant.
Potential impacts to agricultural activities within the proposed works areas.	▪ Mitigation measures regarding construction traffic, dust and noise are outlined in the Tables 15.2, 15.3 and 15.4 below. ▪ Any disruption to water supply will be reinstated immediately	Prior to and throughout the	These measures will be	Not Significant.

Potential Impact (Population and Human Health)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	by the Contractor or an alternative source supplied until the original source is reinstated, unless otherwise agreed with the landowner. Discussions have taken place with landowners in this regard and these discussions will continue throughout the construction period. ▪ Existing accesses to all properties will, where practicable, be maintained during construction otherwise reasonable temporary access will be provided. ▪ Where necessary, suitable stock proof temporary fencing will be erected for the duration of construction. ▪ Where any fences, walls or hedges are damaged they will be made stock proof immediately, where necessary. Any necessary permanent restoration of fences, walls, drains or land will be completed as soon as practicable after work has concluded ▪ During the construction stage the contractor will be instructed that any gates used by them are closed so as to prevent animals from straying. ▪ All machines will be treated with appropriate disinfectant prior to arrival on site. The contractor will verify to the construction manager engineer that this has been done. ▪ The construction manager will liaise with the local District Veterinary Office (DVO) to establish the location of any restricted herds along the proposed scheme. The liaison will continue on a regular basis throughout the construction period. ▪ Where the construction manager has been informed of a restricted herd along the scheme, all machinery and personnel will be disinfected appropriately before leaving the land concerned. The contractor will arrange for disinfectant mats/baths to be replenished with disinfectants, as required. ▪ In the event of an outbreak of a serious Class A Disease, the project will be subject to such operational restrictions as are imposed by the Department of Agriculture, Food and Marine.	construction phase.	implemented by the Contractor.	
Operation Impacts will arise particularly to the residential amenity of the occupants of specific residential properties within the study area where some of the proposed flood defences are to be constructed	▪ The proposed scheme will alleviate intermittent flooding to the residential properties in the catchment area. This is a significant positive and long term impact. ▪ For the resident and working community, no mitigation is	At the conclusion of the construction	These measures will be implemented	Not Significant.

Potential Impact (Population and Human Health)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
adjacent to residential properties (i.e. embankments constructed close to residence boundaries).	required; provided plans to reinstate areas damaged or disturbed during the construction phase are implemented in a timely manner following the carrying out of the works and that the necessary maintenance to ensure the continued effectiveness of the scheme is carried out.	phase and throughout operation.	by the Contractor and Kildare County Council	
During the operation phase, significant areas of land and a wide range of land uses such as residential and agricultural will benefit from reduced flood risk, though some agricultural areas will be included in the post scheme floodplain.	▪ There are no mitigation measures to off-set significantly reduced land usage due to new embankment and wall locations. Landowners have been consulted with extensively in the development of the scheme design and for those affected landowners; an appropriate accommodation works compensation package will be agreed. There are also no mitigation measures to off-set those areas that will experience significantly increased flooding due to the proposed scheme. However, adversely affected landowners have been accommodated either through an appropriate accommodation works compensation package or by protecting adjacent land parcels, where possible without being detrimental to the scheme. The overriding benefits to the area are considered to outweigh any localised negative impacts.	During detailed design and prior to/ throughout construction.	These measures will be implemented by the design team and Kildare County Council	The proposed scheme will have a long term negative impact on some individuals. However on a national/regional perspective the scheme will have a long term positive impact on agriculture.

Table 15.2: Traffic, Transport and Infrastructure: Summary of Mitigation Measures

Potential Impact (Traffic, Transport and Infrastructure)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction Phase Increase in HGV movements along roads that may not normally be used for HGV journeys.	Statutory Undertakers are required to agree temporary traffic management procedures with the local authority to carry out their works. The traffic management proposals will be carried out using the following industry recognised standards: ▪ Traffic Signs Manual 2010 Chapter 8 – temporary Traffic Measures and Signs for Roadworks (Department of Transport, Tourism and Sport). Chapter 8 assists with planning all works activities and temporary closures to optimise safety, road space and work efficiency, whilst minimising road user congestion,	In advance of and throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Traffic, Transport and Infrastructure)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	delay and inconvenience. Safe and efficient traffic management is founded upon the following simple principles: ▫ Provision of clear and early warning of obstructions in the highway; ▫ Optimisation of road space and the provision of adequate safety zones and working space at works locations; ▫ Clear directions relating to decisions/actions required from the road users; ▫ Minimisation of potential conflict between road users, and between road users and road workers and their operations; ▫ Credibility of traffic signs and temporary requirements; ▫ Speed limits and restrictions appropriate for the temporary highway geometry and safety features. The underlying design of traffic management arrangements should be to produce a safety performance no worse than the rate for non-works conditions, whilst minimising delays for traffic passing the works. Therefore the use of these measures will mitigate the potential temporary, localised traffic delays that may be caused by the construction of the scheme. A Construction Traffic Management Plan (CTMP) will be prepared in advance of the proposed works to minimise any impacts on other road users and to maximise road safety along the haul routes. It should also outline measures to enhance the efficient transportation of construction materials and machinery whilst minimising delay and disruption to the general traffic. The Traffic Management Plan will address the following issues:- ▪ Consultation with Kildare County Council / TII to minimise road works on the N7 during the construction programme; ▪ Maintenance of the haul route – ensuring that it is adequately swept to avoid the safety hazard of mud building up on the road, and pavement condition monitored so that developing potholes are dealt with promptly; ▪ Ensuring that Emergency Response Systems are in place to deal with incidents, written notification of the commencement of the delivery periods shall be given to the Gardaí, Fire and Ambulance services, and TII to allow the coordination of the work and the			

Potential Impact (Traffic, Transport and Infrastructure)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	mobilisation of the safety procedures; ▪ Local residents in the area would also be notified prior to the commencement of works; ▪ Systems to encourage HGV drivers not to exceed the speed limit, not to over-rev engines etc. and to drive with consideration for other road users; ▪ Application of maintenance standards to minimise emissions by ensuring all HGVs are well-maintained; ▪ Systems to ensure that roles and responsibilities of all parties are clearly appreciated; ▪ Reuse of materials on site where possible to reduce HGV movements; and ▪ Backloading - removing waste material from site using the return journeys of HGVs that bring material to site - would reduce the amount of empty running associated with the transport of materials. Backloading options will be explored at the project progresses to detailed design. The proposed mitigation measures for the above and provision of a CTMP may include, but not limited to, the following: ▪ Signage and temporary traffic control measures and devices at specific locations; ▪ Plan drawings providing the details of the proposed traffic management measures including the text and location of the proposed temporary signage:- advisory, warning and Variable Message Signage (VMS); ▪ Details of times that the heavy vehicles are permitted on the public roads; ▪ Details of speed limits for the heavy vehicles; ▪ Details of the Public information Strategies; and ▪ Details of the Traffic Incident Management. The traffic management mechanisms described above will ensure that the works will be co-ordinated and controlled. The detailed CTMP will be agreed with the local authority post consent.			
Ground investigations undertaken to date have identified made ground in the vicinity of the following works areas totalling	▪ An outline Waste Management Plan has been prepared to support the proposed development. It is anticipated that	During the construction	These measures will	Not Significant.

Potential Impact (Traffic, Transport and Infrastructure)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
approximately 17,391m³. Excavated made ground which is unsuitable for reuse onsite and / or which has evidence of contamination will have to be classified and taken away for offsite disposal.	dedicated HGVs should be used for the transport of any contaminated soils identified as unsuitable for onsite use. Any additional traffic associated with removal of unsuitable waste material will not exceed the maximum 60 vehicles per day threshold; however, the construction programme might extend slightly as a result of the necessity to remove any contaminated soils. ▪ A dedicated waste management company which holds a valid Waste Collection Permit will be used for the transport of any contaminated material identified as unsuitable for onsite use. The outline Waste Management Plan states that any waste removed from the site shall be taken to facilities which hold either a valid Waste Facility Permit issued by KCC or a Waste Licence issued by the EPA.	phase.	be implemented by the Contractor.	
Potential impact of excavation work on underground utilities. Potential impact of construction plant on overhead utilities	Precautions will be necessary during construction of the works in order to ensure there is no damage to any of this infrastructure. These precautions will be determined at detailed design stage in consultation with the Service Providers.	In advance of and throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
Operation Phase Only minor traffic requirements will be associated with scheme maintenance. These are not predicted to present significant residual impacts for the operational phase of the development. The scheme will result in protection from flooding for events up to the 1% AEP for a number of roads including the N7, the L6016, the L2010, the L6021 and the Killeenmore Road which will represent a very substantial improvement over the existing situation.	No mitigation measures are required.	n/a	n/a	Not Significant

Table 15.3: Air and Climate: Summary of Mitigation Measures

Potential Impact (Air and Climate)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction Phase The movement of machinery will generate exhaust fumes and subsequently contribute to potential emissions of the following compounds; oxides of nitrogen, carbon monoxide, sulphur dioxide, particulate matter (including $PM_{10}/PM_{2.5}$), volatile organic compounds (VOCs) and polyaromatic hydrocarbons (PAHs).	While concentrations of these pollutants are expected to increase in the immediate vicinity of the machines during site works it is not anticipated that they will have any impact on the air quality of the region or in turn on the sensitive receptors in the area considering the size and nature of the proposed scheme and the number of machines proposed. Proposed measures to reduce construction vehicle emissions are given below in the third section of this table.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
Construction activities are likely to generate some dust emissions. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive receptors locations and whether the wind can carry the dust to these locations. Site investigations carried out have also indicated that the made ground (in the vicinity of work areas Morr 2, 3 10 and 23, Paines 1, 2, 3 and 5, and Slane 5, 6, 7 and 11) totalling approximately 17,391m³ to be excavated is comprised of re-worked gravelly clays with rare inclusions of glass, concrete fragments, timber, brick and other potentially contaminated materials. The excavation, handling, processing and transport of this material therefore have the potential to give rise to contaminated dust. The contractor may employ a mobile screen on site to sift out the larger elements of the excavated made ground material and this could also give rise to construction dust.	In order to mitigate construction dust emissions during the construction phase, a dust minimisation plan will be prepared as part of the Construction Environmental Management Plan (CEMP). The dust minimisation plan will be based upon the industry guidelines in the Building Research Establishment document entitled 'Control of Dust from Construction and Demolition Activities'. The implementation of a dust minimisation plan during the construction phase of the project will include measures such as: ▪ Site roads shall be regularly cleaned and maintained as appropriate. Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads shall be restricted to essential site traffic only; ▪ Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions (also applies to vehicles delivering material with dust potential); ▪ All vehicles exiting the site shall make use of a wheel wash facility prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads. Wheel washes should be self-contained systems that do not require discharge of the wastewater to water bodies; ▪ Public roads outside the site shall be regularly inspected for cleanliness, and cleaned as necessary; ▪ Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind; ▪ Water misting or sprays shall be used as required if particularly dusty activities, or activities generating potentially contaminated	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Air and Climate)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	dust (associated with the excavation of made ground), are necessary during dry or windy periods; ▪ All vehicles which present a risk of spillage of materials, while either delivering or removing materials, will be loaded in such a way as to prevent spillage on to the public road; ▪ Vehicles delivering material with dust potential shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust; ▪ The Contractor will be required to ensure that all vehicles are suitably maintained to ensure that emissions of engine generated pollutants is kept to a minimum; ▪ The contractor will be required to put a mobile screen on site in areas where made ground is to be excavated, to sift out the larger elements of the spoil. This will minimise the generation of construction dust; ▪ Due to the transient nature of the works, it is recommended that regular inspections are carried out by the construction contractor to monitor the potential for dust deposition. Where the duration of works are estimated to be longer than 4 weeks, it is recommended that the construction Contractor monitors monthly dust deposition levels for the duration of construction using the Bergerhoff method (German Standard VD 2119, 1972). Results should be compared to the TA Luft guidelines of 350mg/m^2/day (for non-hazardous dusts). This will be applicable for works at Paines 1, Morr 4, Morr 17 and Morr 23. The monitoring is only deemed necessary where residential receptors are located within 1km of the proposed works locations. In this instance, monitoring should take place along the boundary of the location of works or at the nearest residential location; and ▪ In order to minimise the likelihood of complaints, the Council and affected residents should be kept informed of the works to be carried out. A complaints procedure should be operated by the Contractor throughout the construction phase.			
Construction activities will require energy resources and will generate vehicle emissions such as CO_2 which have potential to influence climate change.	A Traffic Management Plan will be prepared in advance of the construction works. This will form part of the specification for the construction works. The CTMP will outline measures to minimise congestion and queuing, reduce distances of deliveries and	Throughout the construction phase.	These measures will be implemented	Not Significant.

Potential Impact (Air and Climate)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	eliminate unnecessary loads; ▪ Reducing the idle times by providing an efficient material handling plan that minimises the waiting time for loads and unloads. Reducing idle times could save up to 10% of total emissions during construction phase; ▪ Turning off vehicular engines when not in use for more than five minutes. This restriction will be enforced strictly unless the idle function is necessary for security or functionality reasons; and ▪ Regular maintenance of plant and equipment. Technical inspection of vehicles to ensure they will perform the most efficiently. As part of the Construction Environmental Management Plan, the Contractor will be required to implement an Energy Management System for the duration of the works. This Energy Management system may include such measures as:- ▪ The use of thermostatic controls on all space heating systems in site buildings to maintain optimum comfort at minimum energy use; ▪ The use of sensors on light fittings in all site buildings and low energy lighting systems; ▪ The use of adequately insulated temporary building structures for the construction compound fitted with suitable vents; ▪ The use of low energy equipment and "power saving" functions on all PCs and monitors in the site offices; ▪ The use of low flow showers and tap fittings; and ▪ The use of solar/thermal power to heat water for the on-site welfare facilities and contamination unit (sinks and showers).		by the Contractor.	
Operational Phase No energy requirements will be associated with the proposed scheme post construction and as such there are no scheduled emissions planned for the scheme. Therefore it is not envisaged that the proposed scheme's operation will have any significant impacts on air or climate.	There will be no operational phase impacts on air quality/climate as a result of the proposed scheme.	n/a	n/a	Not Significant.

Table 15.4: Noise: Summary of Mitigation Measures

Potential Impact (Noise)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction Phase The most noticeable noise impact will occur during general construction activities associated with the proposed scheme. During the construction phase the majority of works to be undertaken will comprise of site preparation works, involving use of earth moving and excavation equipment. There are a number of noise sensitive receptors located adjacent to the proposed work areas where embankments and new walls will be constructed. Site investigations have indicated that the made ground present in the vicinity of the following work areas (Morr 2, 3, 10 and23, Paines 1, 2, 3 and 5 and Slane 5, 6, 7 and 11) totalling approximately 17,391m³ to be excavated is mainly comprised of re-worked gravelly clays with rare inclusions of glass, concrete fragments, timber, brick, and other potentially contaminated material. For this reason, the contractor may employ a mobile screen on site to sift out the larger elements of the spoil. There will also be additional traffic noise generated by construction site traffic, which will include HGV movements associated with the delivery of the earthworks, which would have potential for a noise impact along the haul routes to the site.	Reference will be made to BS 5228-1: 2009: *Code of Practice for Noise and Vibration Control on Construction and Open Sites: Noise*, which offers detailed guidance on the control of noise and vibration from demolition and construction activities. The following proposed practices will be adopted during construction and will be outlined in the Construction Management Plan, including: ▪ The normal working hours for the construction of this scheme will be 7.30am – 4:30pm Monday to Friday. Working hours may be extended to 7.00am - 7.00pm Monday to Friday; and 9.00am and 4.00pm on Saturdays on occasion. There will be no activity on Sundays or Bank Holidays. Where additional or alternative working hours outside those stated above are required, these will require notification to Kildare County Council and to be agreed in advance;; ▪ All construction related traffic should only use the designated and approved haul routes; ▪ Provision of a 2.4m high hoarding should be provided around contractor's compound; ▪ A mobile system of screens or temporary hoarding should be placed close to the noisy construction works within embankment areas to provide acoustic screening in locations with residential properties in close proximity to construction works. ▪ The contractor will be required to put a mobile screen on site in areas where made ground is to be excavated to sift out the larger elements of the spoil. This will minimise the generation of construction dust and noise. ▪ Establishing channels of communication between the client/ contractor, Kildare County Council and residents through implementation of a communications procedure for noise and vibration related issues; ▪ Appointing a site representative responsible for matters relating to noise and vibration; and	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Noise)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	▪ Monitoring typical levels of noise and vibration during critical periods and at sensitive locations. Furthermore, it is envisaged that a variety of practicable noise control measures will be employed. These may include: ▪ Selection of plant with low inherent potential for generation of noise and/ or vibration; ▪ Erection of enclosures as necessary around noisy processes and items such as generators, heavy mechanical plant or high duty compressors; and ▪ Placing of noisy/ vibratory plant as far away from sensitive properties as permitted by site constraints and the use of vibration isolated support structures where necessary. It is also recommended that periodic noise monitoring be undertaken during the initial construction phase to determine noise levels at noise sensitive receptors, in particular during 'noisy' activities. If the recommended noise exposure levels are exceeded, further mitigation measures will be employed including temporary enclosures or screens around particularly 'noisy' plant.			
Potential sources of vibration during typical construction projects include rock-breaking equipment, sheet piling machinery, excavators, dump trucks and HGVs.	It has been identified that sheet-piling will not be used during the construction works. If this changes during detailed design and sheet piling is undertaken of the flood defence walls as part of the proposed scheme, vibration measurements will need to be carried out at any requisite monitoring points in the vicinity of residential properties. The chosen locations will be agreed in advance with Kildare County Council. This would help to ensure that any vibration generated by the construction of the proposed scheme would not give rise to nuisance in the vicinity of the proposed scheme. If vibration-monitoring results were to indicate that levels were approaching the standard limits, appropriate mitigation measures will need to be put in place to ensure that vibration levels were reduced to acceptable levels. It is proposed that vibration monitoring will be carried out for all properties in close proximity to construction works and haul routes. Precondition surveys will be carried out at residential properties in close proximity to the construction works and haul routes. Survey and monitoring locations will be identified during detailed design and agreed with residents/owners as part of the	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Noise)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	CEMP in advance of the construction works. The vibration limits for the duration of the construction works are set out in Table 8.3 and represent the allowable vibration in order to minimise the risk of building damage. Specifically, Noise & Vibration levels shall be kept below those levels specified in Table 8.3, or if further limits are imposed by the Local Authority. A programme of noise monitoring and vibration (if required) at sensitive receptors will be detailed by the Contractor prior to works beginning. This will allow for a constant review of noise and vibration (if required) levels generated by the construction of the proposed scheme and will highlight the need for further mitigation measures should they be required			
Operational Phase There is no significant noise impact predicted to be emitted from the operational phase of the proposed scheme. Maintenance requirements will consist of clearing the overgrowth from the river banks and embankments in addition to removing debris from the rivers, embanked areas and culverts and will be completed on an annual basis, as required.	No mitigation measures are necessary.	n/a	n/a	Not Significant.

Table 15.5: Landscape and Visual: Summary of Mitigation Measures

Potential Impact (Landscape and Visual)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction Phase Potential construction stage impacts relate to the following: (i) Obstruction of views; (ii) Change in landscape character; (iii) Machinery for site preparation/enabling works and operations; and (iv) Site access and vehicular and plant movements. The proposed scheme has lengths of both flood walls and embankments extending to approximately 2.00m in height. The construction of flood walls will be required at certain locations	The impact of the proposed scheme should be ameliorated through a landscape rehabilitation plan, prepared in conjunction with the engineering design which would, in time, go some way to insuring integration of the proposals into the broader environment. Given the nature of the proposals, particular mitigation measures shall be incorporated as part of the proposed scheme. A list of objectives in terms of mitigation for visual quality and landscape character shall include the following for the construction and operational stage. ▪ Materials chosen for flood wall construction to be of similar	As part of the design and pre- during and post-construction.	These measures will be implemented by the Contractor and by Kildare County Council.	Moderate negative, not significant.

Potential Impact (Landscape and Visual)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
particularly in proximity to properties. The proposed scheme will result in loss of riverside vegetation at some locations.	colour, size and scale to existing flood walls within the locality. Walls where visible at roadsides will be masonry stone faced and where appropriate stone capped; ▪ Temporary storage heaps associated with infill materials and soil not to exceed 1m height; ▪ Storage compound areas will be reinstated to former agricultural use upon completion of the works. ▪ Vehicles exiting compound areas will be subject to wheel wash facilities or road sweepers shall be used in order to maintain clean roads; ▪ Any lighting used will be kept to a minimum, providing for site safety only and shall be directed into the compound and away from adjacent residential properties. Lighting shall be shielded to avoid light spill onto adjacent properties and roads. ▪ Fencing used around site offices, welfare units and parking within the compound areas shall be painted green in order to merge with surrounding landscape. ▪ Construction of Embankments. The embankments will be planted with grass; ▪ Protection of existing trees. The services of a qualified aboriculturist will be sought to perform a tree survey of the proposed scheme. The trees should be assessed to quantify their age, condition and amenity value and tagged with metal tags. Prior to commencement of construction, existing trees which are to be retained will be protected by erection of timber post and wire fence to ensure no works are carried out under reach of their canopies. Unstable trees should be removed under direction of the aboriculturist; ▪ Ensuring landscape framework remains dominant by cleaning up of debris on river banks and providing a landscape management programme to protect and reinforce bank side vegetation.			
Operational Phase The key potential direct impact on the landscape is from the positioning of new vertical flood walls and embankments and loss of any vegetation as permanent features in this landscape. There are existing flood embankments at locations within the wider	Ensuring the landscape management programme identified previously is implemented during the lifetime of the proposed scheme to protect and reinforce bank side vegetation with the aim of ensuring landscape framework remains dominant; and Ongoing landscape maintenance and debris cleaning from the river	During the operation phase	These measures will be implemented by Kildare	Minor to moderate negative, not significant.

Potential Impact (Landscape and Visual)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Morell floodplain and therefore such features are not uncharacteristic of this landscape. The permanent loss of vegetation will have localised but significant impacts at locations, particularly at Morr 2; Morr 7; Morr 20-23; and Slane 1-4. The new flood walls and embankments will read as part of the wider landscape from most locations.	channel.		County Council and the OPW	

Table 15.6: Biodiversity - Terrestrial Ecology: Summary of Mitigation Measures

Potential Impact (Terrestrial Ecology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction Phase	It is recommended that a Construction Manager with appropriate experience and expertise be employed for the duration of the construction phase to ensure that all the mitigation measures outlined in relation to the environment are implemented. This manager will be awarded a level of authority and will be allowed to stop construction activity if there is potential for adverse environmental effects other that those predicted in the EIAR. In addition a Project Ecologist will be appointed to assist with potential ecology queries as they may arise during the course of the project.	Throughout the construction phase.	These measures will be implemented by the Developer and the Contractor.	Not Significant.
There is potential for indirect impacts as a result of run-off from construction areas, eutrophication and sedimentation decreasing water quality in the Grand Canal pNHA.	The effective protection of water quality within the proposed scheme during the construction and operation phases will minimise the risk to the ecological interests of this site and other water bodies within the Morell catchment. The measures outlined in Table 15.7 below to ensure protection of water quality during operation, along with the requirement to implement current best practice for works at the time of maintenance will ensure the protection of waterbodies.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
The proposed scheme will involve the construction of c. 7683m of new embankments, potential restoration works to c. 1843m of existing embankments, construction of c.544m of new flood walls, c. 100m of stream alignment (over two areas) and a number of culvert upgrades. Construction activities and site clearance could lead to direct loss of habitats and disturbance through trampling or	General mitigation will involve implementation of best practice, such as the OPW's Standard Operating Procedures for Arterial Drainage Maintenance Service (OPW, 2011). Works shall be carried out ideally during a period of settled weather with no flood risk which will allow sufficient time for construction materials to settle. Effective measures to prevent silt	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Terrestrial Ecology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
damage by machinery. There will be a permanent loss of habitat in the footprint of any new flood alleviation measures, although impacts arising from disturbance to habitats would last longer than the construction period, it is likely to be reversible in time once construction ceases allowing the habitat to re-establish in the vicinity of the proposed scheme.	runoff will be in place at the foot of each embankment as it develops and for a settling period following completion.			
Wet Grassland and Marsh Scheme measures Morr 4, Morr 7, Morr 8, Morr 15 and Morr 17 will involve *c.* 400m of walls and embankment to be built on *Wet Grassland and Marsh habitat,* and a stream diversion adjoining the habitat, constituting direct habitat removal. *Riparian Woodland* Scheme measures Slane 8 will involve the realignment of a small section of the stream to remove a sharp bend. Although this will largely involve the direct removal of improved agricultural grassland to dig the realignment channel, there may be a very small portion of riparian woodland removed at either end of the new channel. *Mixed Broadleaved Woodland* Scheme measure Morr 3 will likely involve the removal of a small area of *Mixed Broadleaved Woodland* habitat c. <30m in length, immediately adjoining the south side of Turnings Upper road on western bank of River Morell.	Where construction activity takes place in habitat types that are identified as sensitive ecological receptors it is important that construction activity is restricted to the footprint required for development of the proposed scheme measures. Therefore, the proposed works area must be clearly demarcated with temporary fencing or another suitable method to restrict access to areas outside the necessary working area. When establishing central base compounds and access tracks, vegetation should only be removed where absolutely essential. The implementation of the proposed scheme will not result in the drying out of wet grassland and marsh habitat. Therefore, no indirect impacts are anticipated. The embankments will be positioned in relatively species poor areas of wet grassland. Therefore the loss of wet grassland habitat is not deemed to be significant. No further mitigation is required. The stream realignment at Slane 8 will encourage the establishment of riparian woodland within in the old stream alignment lands. Therefore the loss of a very small section of riparian woodland is not deemed to be significant. No further mitigation is required The *Mixed Broadleaved Woodland* habitat at Morr 3 was not classified as semi-natural habitat and the loss of a very small portion is not deemed to be significant. No further mitigation is required.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
Treelines, Hedgerows and Scrub Scheme measures Morr 1-6, Morr 8 - 10, Morr 15-23, Paines 1, 2, 4 & 5, Kill 1, Slane 1-6 and Slane 9 will necessitate removal of small sections of treelines, hedgerows and scrub where the proposed scheme embankments, walls and stream realignments will cross field boundaries. Some scrub/ tree removal may also be required at the junction of Killeenmore Road and the L2010 for haulage routes accessibility. In the absence of mitigation, the loss of these habitats	Trees, hedgerows, treelines, woodland and scrub shall be retained intact where possible. Trees located adjoining/adjacent to the construction/compound areas shall be protected from root damage by machinery by an exclusion zone of at least seven metres or equivalent to canopy height. Such protected trees shall be fenced off by adequate temporary fencing prior to other works commencing. NRA (TII) guidelines on the protection of trees and hedges prior to and during construction should be followed (NRA,	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Terrestrial Ecology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
could result in a permanent, irreversible, negative impact significant at the local level.	2006d). No soil, spoil, construction materials or rubbish will be stored or tipped and no construction plant or vehicles will be parked within the spread of existing trees, shrubs or hedges. Where treeline, hedgerow or scrub removal as part of the proposed scheme was unavoidable, a new native planting scheme should be implemented to function as replacement habitat for that removed.			
Invasive Species Invasive species can be introduced into a location or spread from a location by contaminated vehicles and equipment, in particular tracked vehicles which have been used previously in locations that contained invasive alien plant species. They can also be spread to a location via vector materials such as soil. Therefore, construction works for the scheme measures have the potential to introduce invasive alien plant species into the proposed scheme area. In the absence of mitigation this could result in a long term reversible negative impact significant at the local level.	The introduction of invasive alien plant species (including Japanese Knotweed (*Fallopia japonica*)) will be avoided during the construction and operation phase of the proposed scheme by ensuring that appropriate precautionary measures are in place. ▪ Prior to undertaking any construction works of the various scheme measures, or establishing central base compounds and access tracks, the OPW shall engage a suitably qualified ecologist to carry out an invasive plant species survey, in the appropriate botanical season (April through to September). This should entail a walkover of each location of the proposed scheme measures due for construction in that phase, to identify any stands of invasive plants species that may have become established in the intervening period between the EIA surveys and construction. Particular attention should be given to identifying those invasive plant species listed on the Third Schedule of the Birds and Natural Habitats Regulations 2011 (as amended). If any invasive alien plant species are identified then the suitably qualified ecologist shall outline the appropriate course of action to be taken with regard to treatment during construction works. ▪ All plant and equipment employed on the construction/compound sites (e.g. excavator, footwear, etc.) must be thoroughly cleaned down using a power washer unit and washed into a dedicated and contained area prior to arrival on site to prevent the spread of invasive aquatic / riparian species such as Japanese Knotweed *(Fallopia japonica)* and Himalayan Balsam *(Impatiens glandulifera).* A sign off sheet must be maintained by the contractor to confirm cleaning. ▪ The treatment and control of invasive alien species will follow *Guidelines for the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads* (NRA 2010), and	Prior to and throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Terrestrial Ecology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	any other best practice guidance which may become available in the interim. ▪ For any material entering the site, including all fill material, the supplier must provide an assurance that it is free of non-native invasive species. ▪ Should any invasive plant species be encountered, the infested areas will be clearly demarcated accounting for potential underground rhizome spread, creating an exclusion zone. ▪ Ensure all site users are aware of invasive species management plan and treatment methodologies. This can be achieved through "toolbox talks "before works begin on the site. ▪ Adequate site hygiene signage should be erected in relation to the management of non-native invasive material.			
Badger Potential badger setts/mammal burrows were identified in the vicinity of scheme measures Morr 1a, Morr 3, Morr 4, Morr 6, Morr 18 and Slane 9. The construction of the proposed scheme could result in direct destruction of setts via excavation for embankment/wall construction or via machinery driving over setts en route to the construction area.	Precise mitigation measures for badger will be informed by a badger survey prior to construction works commencing on each phase of the development (including establishing central base compounds, satellite sites and access tracks) to identify setts and confirm the level of activity and breeding status of setts/mammal burrows at that time. The following measure is proposed: ▪ Prior to construction works commencing on each phase of the development (including establishing central base compounds, satellite sites and access tracks) the Contractor will engage the services of a suitably qualified ecologist to conduct a badger survey of the proposed scheme measure areas and all access routes. This shall be undertaken to NRA (2006a) specifications, and no more than 10 months in advance of construction; ▪ If an active sett is encountered, mitigation measures as outlined in national guidelines *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (NRA, 2006a) will apply. In brief these are, but are not limited to: - During the breeding season (December to June inclusive) a clearly marked exclusion zone of 50m should be established around the active sett and no works should take place within this exclusion zone; - Outside of the breeding season (July – November inclusive) a clearly marked exclusion zone of 30m should be established around the active sett and no heavy machinery used within this exclusion zone. Lighter machinery (wheeled vehicles)	Prior to the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Terrestrial Ecology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	should not be used within 20m of a sett entrance and light work such as digging by hand should not take place within 10m of a sett entrance; - Any works in and around setts must be supervised/carried out by a suitably qualified and experienced ecologist; - If the above detailed exclusion zones cannot be adhered to and disturbance to setts is deemed likely during construction works then the local NPWS Ranger will be contacted. This may require an application for a derogation licence from the NPWS to exclude the sett. If required, any further mitigation measures required will follow those outlined in NRA (2006a) and will be agreed with the NPWS at the time of licence application.			
Bat A number of trees and treelines were identified as having low to moderate bat roost potential, which could be affected by scheme measures Morr 1, Morr 1a, Morr 16, Morr 16a, Morr 17, Morr 18, Morr 20-23, Paines 1, Paines 5, Kill 1 and Slane 9. One building near Killeenmore was identified as having low bat roost potential, located near Morr 16-16a. In the absence of mitigation, if any of these trees/treelines and buildings supported bat roosts and had to be removed as a result of the construction works, there would be potential for bat mortality. This could result in a short term negative impact, significant at a local level. Hedgerows, treelines and rivers act as commuting corridors for bats in the landscape. The proposed scheme requires the removal of some hedgerows and treelines for creation of the scheme measures. Temporary negative impacts are likely but are not expected to be significant at a local level.	As no bats have so far been identified as roosting within the study area no specific mitigation in relation to roost loss is recommended. In the unlikely event that bats are found on the site during construction works, works will immediately cease in that area and the local NPWS Conservation Ranger will be contacted. The bats will be removed by hand by a suitably qualified and licenced bat surveyor. A number of trees/treelines, buildings and bridges in the proposed scheme area were identified as potential bat roots and the following mitigation applies. ▪ Where possible, trees, treelines and woodland shall be retained. Any existing trees adjacent to the works, construction sites or compounds to be retained shall be protected from root damage by machinery by an exclusion zone of at least seven metres or equivalent to canopy height. Such protected trees shall be fenced off by adequate temporary fencing prior to other works commencing. ▪ Any trees requiring removal to facilitate construction works, establishment of compounds or access tracks, must be subject to a visual inspection by a suitably qualified and licenced bat surveyor to identify bat roosts potential and advise on additional surveys required. If potential bat roosts are identified then bat activity surveys at such trees will be required. If bats are found, the suitably qualified and licenced bat surveyor will advise on	During the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Potential Impact (Terrestrial Ecology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	the appropriate course of action, including the need for application for a derogation licence from the NPWS. ▪ All trees requiring removal in the proposed scheme area should be felled and left in place on the ground for 24 hours prior to removal/disposal to allow any bats beneath foliage to escape overnight. ▪ Should the removal of mature broadleaved trees be unavoidable, it is recommended that two bat boxes, of Schwegler Type 1FF flat box, for each felled mature broadleaved tree shall be attached to suitable alternative trees in order to compensate for the loss of potential roosting space. The bat box locations and supervision of installation of same shall be carried out by a suitably qualified ecologist in line with best practice measures. One abandoned cottage and associated outhouses was identified in Killeenmore adjacent to scheme measures Morr 16 and Morr 16a. Although not identified as requiring removal for construction for the proposed scheme, adopting a precautionary approach, in the event that demolition or other construction works on the abandoned cottage and associated outhouses are required, the Contractor will refer to the mitigation outlined in section 10.5.1 of the EIAR. No construction or upgrade works to bridges have been identified for the proposed scheme, rather the works identified are either in relation to culverts but that may be associated with bridges, or embankment/wall tie ins to bridges which will not affect the underside of the bridge structure. However, adopting a precautionary approach, mitigation has been specified for any works to culverts or bridges adjoining or adjacent to culverts to ensure that any potential disturbance to potential roosting bats is considered prior to construction activities commencing and in the event that any works to bridges becomes apparent during construction. The bridge must be subject to a visual inspection by a suitably qualified and licenced bat surveyor to identify bat roost potential and advise on additional surveys required. If potential bat roosts are identified then bat activity surveys will be required. If bats are found, the suitably qualified and licenced bat surveyor will advise			

Potential Impact (Terrestrial Ecology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	on the appropriate course of action, including the need for application for a derogation licence from the NPWS. Lighting should be avoided where possible. If any external lighting is required to facilitate night time working, security lighting in the proposed works areas or within the central base compounds, it must be sensitive to the presence of bats in the area. Directional lighting shall be used to prevent overspill. Lighting levels should be the minimum required for health and safety requirements, and vertical light spill at light sources should be below 3m to avoid potential bat flight paths. Existing hedgerows and treelines, semi-natural scrub or semi-natural grasslands should be retained where possible and incorporated into the landscaping programme. Where hedgerow or treeline removal is unavoidable, the severed linear features should, where possible, be reconnected using native hedgerow or tree species to compensate for the loss of hedgerows that are currently used by bats. The exact locations of such planting will be designed at detailed landscaping stage. Treelines are of far greater benefit to bats than single, free-standing trees or shrubs as they provide corridors for movement, avoidance of light and predators, a better shelter belt for the clustering of insects and provide greater substrate for insect breeding and feeding (bats food source). Native species of broadleaved trees are generally more beneficial to bats.			
Other Mammals It is likely that Pygmy shrew and Hedgehog occur in hedgerows, woodlands and grasslands. The proposed scheme will involve the removal of sections of these habitats in a number of locations. In the absence of mitigation, if the species were present then negative impacts could arise via direct mortality or disturbance. As a relatively widespread mobile species, it is considered likely that both Pygmy shrew and Hedgehog could re-establish in adjacent habitats and that the proposed scheme is extremely unlikely to negatively affect the conservation status of the species locally. Therefore it is unlikely that a significant impact would arise.	No mitigation measures are necessary	n/a	n/a	Not Significant
Amphibians In the absence of mitigation, there could be a negative impact on amphibians through direct mortality during construction works. It is	The Construction Manager and Project Ecologist shall maintain a watching brief for frog spawn and frogs throughout construction works. If frog spawn is identified, this should be translocated to an	During the construction phase.	These measures will be	Not Significant.

Potential Impact (Terrestrial Ecology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
considered likely that this short term impact could negatively affect the conservation status of frogs locally.	alternative suitable habitat under derogation licence from the NPWS.		implemented by the Contractor.	
Birds If vegetation clearance and/or building demolition is carried out during the breeding bird season (i.e. from the 1st March to the 31st August), there is the potential for significant negative impacts to local breeding bird populations. During the breeding season noise, vibration, increased human presence and movement of construction vehicles associated with the construction phase of the proposed scheme has the potential to result in a disturbance to local breeding bird populations. This could result in reduced breeding success of birds in habitats adjacent to the construction zone and could potentially impact on the conservation status of bird species locally. Therefore a significant effect at a local level is concluded. The construction of the proposed scheme will require the removal of hedgerows, trees, treelines, scrub and some woodland. It may also involve the removal of some buildings/structures. These habitats have the potential to provide breeding habitat for birds. Removal of these areas of habitat during the breeding bird season could potentially impact on the conservation status of bird species locally.	To limit the potential impact of construction on breeding birds, vegetation removal/trimming (including trees, treelines, hedgerow, woodland and) will not be permitted during the breeding bird season (1st March to 31st August inclusive). If this seasonal restriction cannot be accommodated, a suitably qualified ecologist with experience in nest-finding will be required to check all vegetation for nests (under licence from NPWS to permit potential disturbance to nesting birds) prior to removal/trimming.	During the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
Operational Phase During the operational phase of the proposed scheme there will be considerably less site activity than during the construction phase. Maintenance will be carried out to maintain the completed flood relief scheme in proper repair and effective condition. This may mean, inter alia: ▪ Clearing obstructions to flows from time to time e.g., fallen trees, significant weed growth, build-up of materials likely to impact on the performance of the scheme; ▪ Repairing and rebuilding structures (walls and embankments); and ▪ Prevention of erosion/undermining of the completed works of the proposed scheme.	General mitigation will involve implementation of current best practice for riparian works at the time of maintenance, e.g. the OPW's Standard Operating Procedures for Arterial Drainage Maintenance Service (OPW, 2011) or any subsequent updates. No additional mitigation measures are required.	During the operation phase.	These measures will be implemented by Kildare County Council.	Not Significant.
Maintenance works for the proposed scheme located in the vicinity of the Grand Canal may be hydrologically connected to the Grand	The effective protection of water quality within the proposed scheme during the construction and operation phases will	During the operation	These measures will	Not Significant.

Potential Impact (Terrestrial Ecology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Canal via wet field drains and/or wet ditches. There is potential for indirect impacts as a result of run-off from construction areas, eutrophication and sedimentation decreasing water quality in the Grand Canal. This may in turn impact on the aquatic species therein. In the absence of mitigation this could result in a temporary, reversible negative impact.	minimise the risk to the ecological interests of this site and other water bodies within the Morell catchment. The water quality mitigation measures for avoidance, reduction and remediation of impacts outlined in Table 17.7 below and the he requirement to implement current best practice for works at the time of maintenance will ensure the protection of waterbodies.	phase.	be implemented by Kildare County Council.	
Once completed, areas from which vegetation was removed will gradually re-vegetate through succession. Some smaller areas of arable land, amenity grassland and broadleaved woodland will also be subject to reduced flooding. This is unlikely to result in any significant changes in species composition as these areas will still be subject to periodic flooding, albeit reduced. New flooding areas and the 1% AEP floodplain are also mainly located in areas of agricultural grasslands (and associated hedgerows and treelines) and buildings and artificial surfaces (mainly associated with residential dwellings). Some smaller areas of habitat located within the flood area include arable land, amenity grassland, wet grassland, scrub, broadleaved and riparian woodland will also be subject to reduced flooding. This is unlikely to result in any significant changes in species composition as much of these areas will only be subject to periodic flooding.	No mitigation measures are necessary	n/a	n/a	Not Significant
Maintenance work poses a potential risk of introducing invasive species, via contaminated vehicles and equipment. In the absence of mitigation this could result in a long term reversible negative impact, significant at the local level.	Prior to undertaking any maintenance works along the scheme measures, the OPW shall engage a suitable qualified ecologist to carry out an invasive plant species survey, in the appropriate botanical season (April through to September) and in advance of any maintenance works. This should entail a walkover of the scheme measures due for maintenance works to identify any stands of invasive plants species that may have become established in the intervening period between construction and maintenance. Particular attention should be given to identifying those invasive plant species listed on the Third Schedule of the Birds and Natural Habitats Regulations 2011 (as amended). If any invasive alien plant species are identified then the suitably qualified ecologist shall outline the appropriate course of action to be taken with regard to treatment during maintenance works. Specific mitigation measures in respect of invasive species are as per those stated for the construction phase above.	During the operation phase.	These measures will be implemented by Kildare County Council.	Not Significant.

Potential Impact (Terrestrial Ecology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
In the absence of mitigation, there could be a negative impact on badger through direct destruction or disturbance to badger setts during maintenance works. It is considered likely that this short term impact could negatively affect the conservation status of badger locally.	Prior to undertaking any maintenance works along the scheme measures, the OPW shall engage a suitably qualified ecologist to assess the potential ecological impact of the maintenance works (including but not limited to badgers, bats, otters, bird, water quality and invasive species) and identify potential constraints. Dependent on the extent of the works, this may require a survey of the scheme measures due for maintenance works to confirm presence/absence of species and to identify potential impact pathways that may exist between the maintenance works, access routes and flora and fauna. The ecologist should be engaged in advance of works to allow adequate time for survey, monitoring if required, and developing measures to avoid ecological impacts where possible, and to propose mitigation measures for those impacts that cannot be avoided. Where appropriate, construction methodology for maintenance works should detail how water quality will be maintained throughout the maintenance works. All mitigation measures outlined should be in line with current best practice and national guidelines	During the operation phase.	These measures will be implemented by Kildare County Council.	Not Significant.
In the absence of mitigation, there could be a negative impact on bats through direct destruction or disturbance to bat roosts in trees or works to bridges during maintenance works. Maintenance works could result in a short term negative impact on the conservation status of bats locally.				
In the absence of mitigation, there could be a negative impact on amphibians through direct mortality during maintenance works. Wet areas that host frogs and frog spawn could be directly trampled by machinery. Removal of bank side vegetation also has the potential to result in direct mortality of frogs that utilise this habitat. It is considered likely that this short term impact could negatively affect the conservation status of frogs locally.				
Maintenance works requiring the removal of vegetation such as scrub and trees during the breeding bird season (i.e. from the 1st March to the 31st August), have the potential for significant negative impacts to local breeding bird populations. During the breeding season noise, vibration, increased human presence and movement of vehicles associated with the maintenance of the proposed scheme has the potential to result in a disturbance to local breeding bird populations. This could result in reduced breeding success of birds in habitats adjacent to the maintenance area and could potentially impact on the conservation status of bird species locally. Therefore a significant effect at a local level is concluded.				

Table 15.7: Biodiversity - Aquatic Ecology and Water Environment: Summary of Mitigation Measures

Potential Impact (Aquatic Ecology and Water Environment)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction Phase The proposed scheme has been identified as potentially giving rise to adverse effects on aquatic ecology and other natural resources such as water quality and substrate condition of the Morell River catchment and therefore the overall biodiversity of the area.	Standard pollution control and mitigation measures, as outlined in Table 11.21, will be employed where relevant when working in and near the watercourses affected by the proposed works, to prevent the transport of deleterious substances to the Morell River Catchment and its associated water-dependent habitats and species. The CEMP and Method Statements will include how these mitigation measures will be monitored for effectiveness. An outline water quality monitoring plan has been included in the draft CEMP but this will be developed by the contractor and a detailed programme of water quality monitoring, will be agreed with the IFI. Direct instream works such as stream alignment, culvert upgrades or proposed measures along the riverbank have the greatest potential for negative impacts during spawning / breeding and early nursery periods for aquatic protected species in the study area. **No instream or potentially significantly damaging out of river works should occur during restricted periods for relevant species in relation to individual measures (Table 11.22 of the EIAR).**	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant
Haul routes, access roads and parking areas can generate significant quantities of water polluted with sediment. During heavy rainfall surface run-off can erode the surface of the haul route. The tracking of plant and machinery across wet or saturated soil can also loosen and mobilise additional sediment.	Surface water should be directed away from haul routes to prevent uncontaminated run-off flowing onto the road. Excess water should be prevented from running along haul routes by installing small earth bunds (like speed bumps) or cut-off ditches at regular spacing to direct water into roadside ditches. Where haul routes cross watercourses, adopt measures to prevent sediment-laden run-off from entering them, e.g. ensuring crossing structures have edge upstands or bunds e.g. straw bales, sandbags or earth; and making sure bridge decks are sealed. Water polluted by sediment should not be allowed to leave the site untreated; polluted runoff should be routed for treatment by filtration, settlement or specialist techniques. Where inlets to existing surface water drainage are present on- site (e.g. road gullies or yard drains), they should be protected them from run-off polluted with sediment. Water should be diverted away from the inlet to treatment facilities. Where this is not	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant

Potential Impact (Aquatic Ecology and Water Environment)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	possible, a bund should be created around the surface water drain to prevent contaminated water entering.			
There is potential for the release of sediment during the construction phase. The potential for sediment loss would primarily arise as a result of earth movement and excavation associated with the placement of embankments and defence walls, particularly those proposed along riverbanks. Such an impact would be more likely during very heavy rain giving to slumping of the bank edges or run-off of silt-laden water.	Works should be carried out ideally during a period of settled weather with no flood risk which will allow sufficient time for construction materials to settle. Embankment material should be selected that has low silt content. All working materials and excavated material should be stockpiled on the land side of the works within the assigned 15m temporary working area. Where embankments which are within 10 metres of a river, sediment barriers, e.g. silt fencing, should be used on the river side to minimise the potential for sediment transport. Once the embankment is complete the sediment should be left in-situ to allow the reinstated ground around the wall to settle in. The sediment barriers should only be removed after inspection of the reinstated ground confirms that it is stable.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant
There is potential for the release of sediment during instream works and in particular stream realignments. Sediment loss can give rise to increased bottom sedimentation, which, in turn, can adversely impact macroinvertebrates and aquatic habitat quality. Elevated suspended solids levels within the water column can impact on the gills of salmonid fish, white-clawed crayfish and benthic macroinvertebrates and can smother fish spawning areas when deposited. Plumes of silt could result in a reduced food supply for otters- i.e. where reductions in water quality affect macro-invertebrate diversity and abundance and fisheries production or temporarily displace fish from sections of channel.	All instream works should adhere to timing restrictions for aquatic protected species of the Morell Catchment (Table 11.22 in Chapter 11). Operation of machinery instream should be kept to an absolute minimum. All construction machinery operating instream should be mechanically sound to avoid leaks of oils, hydraulic fluid, etc. In-stream works will be carried out outside of the salmonid spawning season and the times that early life stages of salmonid fish will be present. In-stream work within the period 1st October to 1st May (inclusive) will only be undertaken with the advanced approval of Inland Fisheries Ireland. Stream realignments shall be carried out in accordance with the recommendations within the document '*Requirements for the protection of Fisheries Habitat during construction and Development Works at River Sites*' (ERFB, 2003). Method Statements will be prepared by the Contractor and approved; Stream diversions will be excavated in the dry to an agreed specification. Fish will need to be removed from the impacted section of the existing channel being diverted at Slane 8 in advance. The fish removal must be completed by IFI or persons authorised under Section 14 of the Fisheries Consolidation Acts	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant

Potential Impact (Aquatic Ecology and Water Environment)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	1959 (as amended). During realignment works on the Slane River, contractor SOPs will be applied to respond in the case white-clawed crayfish are present and emerge from refuges at the times of stream realignment. In the event that significant populations of white clawed crayfish emerge, advice will be sought from IFI and NPWS to facilitate any necessary rescue and relocation. The banks and bed of the new channel will be lined with a biodegradable geotextile; The stream diversions will have a natural stream bed and will replicate insofar as practicable the stream bed material characteristics of the watercourse. Bungs will be fixed at both ends of the existing channel and removed in a controlled manner at IFI's direction ensuring the river flow remains uninterrupted from above to below the works. Effective silt management measures should be placed in stages downstream of the new channel in advance of opening the channel. These will be specified by the Contractor in the Method Statement and agreed with IFI, but the currently proposed measure would be triple silt curtains derived from Terram or other similar material, which would be placed in stages downstream of the confluence with the new channel to first filter out the heaviest of materials and subsequently the finer material. These would need to be checked on a regular basis with the heavy material removed from the first silt curtain thereby keeping it functional. A procedure will need to be included in the Method Statement for the removal of the silt barrier on a staged basis, as even these preventative measures will lead to a build up behind the curtain. The curtain nearest to the point of works should be removed first followed by the others; The design and construction of new channel with natural habitat characteristics will where possible replicate the existing and will incorporate riparian vegetation and other natural features such as meanders. This will require importation of various grades of stone and gravel to construct habitat features e.g. riffles, pools and gravel areas. Materials from original channel may be re-used to minimise quantities of new material required.			

Potential Impact (Aquatic Ecology and Water Environment)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
There is potential for the release of sediment and other pollutants during culvert alteration works.	All instream works should adhere to timing restrictions for aquatic protected species of the Morell Catchment. Works should be carried out ideally during a period of settled weather with no flood risk which will allow sufficient time for construction materials to settle. In-channel works for upgrades on Culverts 5, 9, 10 and 22 and, where relevant, 1, 2, 4, 4a, 7, 18 & 19 will use cofferdam type construction whereby flow can be restricted allowing the civil engineering works to be undertaken in the dry. Method statements for the construction of cofferdam structures should be agreed in advance with IFI personnel in advance of construction works. The Morell River (Cul 5) and Painestown River (Cul 9 & 10) should be electro fished downstream of the proposed works in advance of any works to assess whether there are any fish or lamprey ammocoetes in the affected channels as advised by IFI. The fish removal must be completed by IFI or persons authorised under Section 14 of the Fisheries Consolidation Acts 1959 (as amended); If there is significant water ingress into the cofferdam (dependant on river levels), an approved pumping and settlement system will be set up. Pumps will transfer accumulated standing water into a settlement tank, or tanks, which in turn will discharge into a 'silt buster' or 'dirt bag' prior to being returned to the watercourse, to minimise the discharge of suspended solids into the watercourse. Water quality monitoring will be carried out to monitor the effectiveness of the mitigation measures. Headwalls for Cul 5, Cul 9 and Cul 10 should be pre-fabricated and inserted or assembled on site without the use of bulk liquid concrete; For proposed works on Cul 5, Cul 9 and Cul 10, and, where relevant Culverts 1, 2, 4, 4a, 7, 18 & 19 effective silt management measures should be placed in stages down-stream of the new channel, in advance of commencing culvert alterations. The proposed measures are as per the mitigation for stream realignment above and will be specified by the Contractor in the Method Statement and agreed with IFI. A procedure will also need to be included in the Method Statement for the removal of the silt management measures.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant

Potential Impact (Aquatic Ecology and Water Environment)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
There exists the risk of sediment loss from stockpiled construction materials held within the temporary working areas associated with each of the various measures and also stored at the larger stockpiling/compound areas that will be established for the project beside Paines 3, Morr 19 and Morr 23 as illustrated in Figure 11.1. Haul routes, access roads and parking areas can generate significant quantities of water polluted with sediment. Being temporary in nature, they are often formed by simply stripping topsoil and grading the subsoil to suit. This means that during heavy rainfall surface run-off can erode the surface. The tracking of plant and machinery across wet or saturated soil can also loosen and mobilise additional sediment.	The compounds have been selected to be located away from vulnerable watercourses (or, in the case of Paines 3, separated from them by existing embankments) and outside the flood plain to reduce the risk of sediment mobilisation. Stockpile run-off must be prevented from entering drains, ditches and watercourses. Surface water should be directed away from exposed soils. Diversion drains should be implemented on the upstream/upslope side of the stockpile area. Drains should be lined with a non-erodible material such as turf/geotextiles. Bunds should be placed around exposed soils. This will prevent clean water entering the area and dirty water from leaving the area. Bunds should be made of non-erodible material such as straw bales/geotextiles. Water polluted by sediment should not be allowed to leave the site untreated; polluted runoff should be routed for treatment by filtration, settlement or specialist techniques.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant
There is a potential for the loss of cement or hydrocarbons such as diesel and hydraulic fluids during the construction phase particularly at locations proposed for defence walls along select riverbanks of the Slane and Kill (EIAR REF: Slane 1, Slane 4 & Kill 1) as well as construction of head walls within the Morell River Lower and Painestown River (EIAR REF: Cul 5 & Cul 10) respectively and culvert upgrading at Cul 9, also on the Painestown River. Cement is highly alkaline and can give rise to very serious fish kills with similar effects on invertebrates, including white-clawed crayfish. Wash off from poorly cured cement can also be highly alkaline and potentially dangerous to fish.	Operation of machinery instream should be kept to an absolute minimum. All construction machinery operating instream should be mechanically sound to avoid leaks of oils, hydraulic fluid, etc. Concreting works will only occur ‘in the dry’ Headwalls for Cul 5, Cul 9 and Cul 10 should be pre-fabricated and inserted or assembled on site without the use of bulk liquid concrete. Disposal of raw or uncured waste concrete will be controlled to ensure that the watercourse will not be impacted; Best practice will be adopted in bulk-liquid concrete management addressing pouring and handling, secure shuttering / form-work, adequate curing times and management of spills; Where shuttering is used, measures should be put in place to prevent against shutter failure and control storage, handling and disposal of shutter oils; Wash water from cleaning ready mix concrete lorries and mixers may be contaminated with cement and is therefore highly alkaline. Due to the size of the site and the proximity of sensitive watercourses, it is recommended that lorries and mixers are washed out offsite.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant

Potential Impact (Aquatic Ecology and Water Environment)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Invasive species can be introduced into a location or spread from a location by contaminated vehicles and equipment.	Refer to mitigation in Table 15.6 above.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant
Otter Loss of habitat/vegetation cover (scrub clearance) could result in reduced habitat quality and cover for otter utilising the various rivers throughout the catchment. Plumes of silt could result in a reduced food supply - i.e. where reductions in water quality affect macro-invertebrate diversity and abundance and fisheries production or temporarily displace fish from sections of channel.	Where possible, flood measures will be set back from the river bank, leaving a buffer zone of natural riparian vegetation. The removal of natural riparian vegetation should be minimised. Where possible, bank slopes should be protected - minimise scraping of bank slope on working bank. This will ensure that riparian habitat is permanently available for otters, thus providing potential breeding and sheltering opportunities; Prior to construction works commencing, the Contractor will engage the services of a suitably qualified ecologist to conduct an otter survey of the proposed scheme measures, construction compounds and all access routes to identify whether the species occurs or not at the site of the proposed measure to be constructed and whether there is a breeding or resting place present. The OPW Environmental Management Protocols and SOPs (for Otter) should be followed: ▪ Operational Staff will walkover the works area one week in advance in conjunction with the Health & Safety assessment noting dense cover with access directly to the water that is to be avoided where feasible. ▪ Any recognisable signs of Otter presence observed such as Spraints, Footprints or suspected Holts, will be recorded on the Weekly Record Cards. ▪ While holts are usually well concealed, where Operational Staff observe a suspected holt such as a burrow opening, in consultation with Management Staff, subject to flood risk management functions, no works are to occur within a 50m buffer each side. It is important that any otter holts identified during survey work are dealt with appropriately, to stay within the obligations of relevant legislation. Where a holt is identified by a suitably trained	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant

Potential Impact (Aquatic Ecology and Water Environment)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	ground staff member, work should not commence until NPWS have been consulted for advice and on the requirement for a licence to proceed. Where construction activities are required within 150m of a breeding Otter holt, a derogation licence will be required from NPWS. In relation to nonbreeding holts, no wheeled or tracked vehicles should be permitted within 20m of active holts or scrub clearance by hand within 15m (NRA, 2008). Where possible, mature trees within the river corridor should be retained. Similarly, large in-stream boulders and substrate should be retained where possible. Where in-stream works are required, the replacement of in-stream boulders will also ensure that features are available for otters to use as territorial sign posts, and substrate is available for fish spawning/hiding places. Steps to enhance fisheries (loosen bed gravels and if channel bed is composed of suitable material, excavate pools and create riffles) should also be undertaken. This will ensure that fisheries habitat, fish populations and food availability for otters are improved (Envirocentre, 2006).			
The excavation and handling of potentially contaminated made ground could result in the increased mobilisation of contaminants which could increase the potential impacts on the surrounding areas. Dependant on the contaminant of concern; these impacts could include: ▪ Surface run off from exposed contaminated made ground; and ▪ Migration of contaminants through the subsurface could result in the impacting of groundwater (and surface water). In the absence of mitigation, the excavation of potentially contaminated made ground would have a temporary negative effect on the water quality with associated impacts on aquatic ecology and therefore biodiversity within the study area.	The outline Waste Management Plan in Appendix M has included a number of measures to prevent environmental risks associated with contaminated water arising from leaching of contaminated made ground, surface runoff and exposure of the aquatic environment to contaminants. These include the avoidance of onsite stockpiling of any potentially contaminated soils / made ground and direct loading of potentially contaminated soils / made ground into designated trucks for removal offsite. If temporary stockpiling is necessary, stockpile management will include the following measures to prevent leaching and surface runoff of potential contaminants to the aquatic environment: ▪ Stockpiling should be limited to a specific area of the site and not within 50m of any water course; ▪ Stockpiled made ground should be placed on impermeable plastic liners and covered to minimise rainfall infiltration; and, ▪ Berms should be constructed around the stockpiles.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant
Operational Phase Maintenance works for the proposed scheme may potentially give rise to adverse effects on water quality. The effective protection of water quality within the proposed scheme during operational	General mitigation will involve implementation of current best practice for riparian works at the time of maintenance e.g. the OPW's Standard Operating Procedures for Arterial Drainage	Throughout the operation phase.	These measures will be implemented	Temporary Slight Negative, not significant

Potential Impact (Aquatic Ecology and Water Environment)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
(maintenance) phase will minimise the risk to the ecological interests of this site and other water bodies within the Morell catchment.	Maintenance Service (OPW, 2011) or any subsequent updates. Maintenance works to be carried out will be subject to the relevant environmental assessment requirements, including Screening for Appropriate Assessment and surveys for protected species.		by Kildare County Council and any maintenance Contractors	
Culvert Alterations can result in potential impacts on aquatic ecology during the operation of the proposed scheme. Culvert works, particularly if incorrectly designed, may prevent fish from migrating through them due to the flow pattern in the culvert or behavioural changes resulting from the imposition of a new structure i.e. increased shade, etc. if not appropriately designed. This can lead to a net loss of large areas of habitat as fish are unable to colonise or spawn within aquatic habitats upstream of an inappropriately designed culvert.	The design of any alteration to a culvert will ensure the unimpeded passage of fish at all times.	During design and implemented in the construction phase	These measures will be implemented by the design team, Developer and the Contractor.	Temporary Slight Negative, not significant
Instream structures may change flow patterns resulting in loss of gravel substrate, increased siltation and may remove meanders and natural riffle-pool sequences, which are important for fish populations.	Alterations to the channel will be designed such that they display hydraulic and morphological characteristics fulfilling the requirements of salmonid habitats.	During design and implemented in the construction phase	These measures will be implemented by the design team, Developer and the Contractor.	Temporary Slight Negative, not significant
Stream diversions - Certain proposed works at the Slane River (Slane 8) will involve realigning the stream channel to alleviate bank erosion (See Section 4.3.4 in Chapter 4 for complete description of works). At Morr 8, a short section (70 metres) of a small tributary of the Painestown River running adjacent to the railway embankment will be diverted to allow construction of the flood defence at this location. If poorly designed, stream diversions can result in changes to the hydraulic and morphological characteristics of the channel, making them less desirable for fish populations. Permanent diversions of watercourses can result in permanent loss of habitat if the new channel is significantly shorter than the original or if it is not reinstated to a standard at least equivalent to the original in terms of fish habitat type and quality.	The design and construction of new channel with natural habitat characteristics will where possible replicate the existing and will incorporate riparian vegetation and other natural features such as meanders. This will require importation of various grades of stone and gravel to construct habitat features e.g. riffles, pools and gravel areas. Materials from original channel may be re-used to minimise quantities of new material required. The design of the realigned channel shall be carried out in accordance with best practice, i.e. Crossing of Watercourses during the Construction of National Roads Scheme (NRA, 2005), 'Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites' (ERFB, 2003) and CIRIA Technical Guidance C648 (CIRIA 2006).	During design and implemented in the construction phase	These measures will be implemented by the design team, Developer and the Contractor.	Temporary Slight Negative, not significant
Loss of bank riparian cover as a result of installation of walls and	Vegetation removal will be kept to a minimum. Mature trees will	During design	These	Temporary

Potential Impact (Aquatic Ecology and Water Environment)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
embankments will result in increased light incidence to the channel and may encourage greater in-stream productivity, i.e. increased algal growth and benthic macroinvertebrate density. A decrease in channel shading can also impact negatively on fish and crayfish distribution. Riparian tree cover plays an important role in regulating stream ecology, e.g. stream temperature, carbon inputs, and in-stream vegetation cover. Recent IFI research, for example, shows the importance of channel shading in avoiding lethal stream temperatures for salmonids in Irish rivers (Gretta Hannigan, IFI, *pers. comm*.). Lack of shade has been shown to be correlated with absence of crayfish in habitat that would otherwise be optimal for the species (Besson et al., 2007). Whilst it is not proposed for any removal of canopy cover along the riparian zone for operational purposes, there may be some incidental requirement for removal of individual canopy stands during proposed construction works.	be retained, where possible (see also mitigation in Table 15.5). A landscape management programme will be implemented during the lifetime of the proposed scheme to protect and reinforce natural bank side vegetation.	and implemented during construction. Landscape will be managed during Operation	measures will be implemented by the design team, Developer and the OPW.	Slight Negative, not significant

Table 15.8: Hydrology and Drainage: Summary of Mitigation Measures

Potential Impact (Hydrology and Drainage)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction Phase During the construction phase of the works, the potential causes of flooding could include: ▪ Blockage to the river flows due to collapsing of unstable river banks or temporary or permanent stockpiles during construction; ▪ Flooding of adjacent lands and properties caused by any reduction of channel conveyancing capacity during the construction of flood defences.	The construction of new river banks at the stream realignment should be completed to ensure slope stability based on in-situ material. The final design of these features should be approved by a geotechnical engineer to ensure slope failure will not occur. A maximum height of 1 metre will apply for all temporary spoil heaps, with maximum side slopes of 1V:3H, to ensure that risk of instability is reduced. This will be subject to stability analysis by a suitably qualified geotechnical engineer at design stage. An examination of historical flood records shows the worst of the fluvial flooding in this catchment occurs during the winter months as would be expected. It is therefore recommended that the works be undertaken when flooding risks are low.	Throughout the construction phase.	These measures will be implemented in by the Contractor.	Temporary Slight Negative, not significant

Potential Impact (Hydrology and Drainage)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
The existing land drainage system in the study area could be affected during the construction period of the works. Potential impacts on the existing drainage systems include: ▪ The pattern of runoff could change with some existing drains and ditches receiving significantly more or less flow than they receive currently; rainfall on elevated areas could wash peat and silt into the surrounding watercourses. Localised erosion and scouring could occur while reduced flow may result in stagnation in some drains and ditches; and ▪ Obstruction of flow paths could cause localised water logging in the vicinity of the proposed flood protection embankments.	To avoid any water logging in the lands adjacent to the river banks, it is proposed to maintain the existing drainage ditches that are crossed over by the proposed flood defences and similarly for any temporary or permanent stockpiles to ensure overland surface water flow is not restricted.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Temporary Slight Negative, not significant
Operational Phase *Morell River (Turnings Lower to Ballyhays)* As a result of the installation of flood defences in these areas, there are increases in water level ranging from 0.035 m to 0.210 m between the abattoir bridge and the bridge under the R406. This increase results in a slight increase in flood extents to pastureland in these areas.	No mitigation measures are necessary	n/a	n/a	Not Significant.
Morell River (Killeenmore to Turnings Lower) In areas along this stretch of river, there are increases in water level ranging from 0.025 m to 0.376 m. These increased water levels result in an additional flooding to pastureland adjacent to the proposed defences Morr 3 and Paines 1.	The affected landowner has been accommodated by ensuring an adjacent land parcel is protected.	During the design phase	These measures will be implemented by the Contractor.	Not Significant.
Morell River (Sherlockstown to Killeenmore) There are increases in water level ranging from 0.002m to 0.637 m. Increased water levels adjacent to Morr 4, Morr 15, Morr 17 and Morr 19 are the result of flood defences being put in place to protect properties at risk in these areas. Increased water levels result in an additional flooding to pastureland adjacent to Morr 17. However this is the result of a reduction in the floodplain in the surrounding areas which helps to protect a minimum of 8 properties.	Affected landowners have been accommodated by ensuring adjacent land parcels are protected.	During the design phase	These measures will be implemented by the Contractor.	Not Significant.
Slane River The Slane River has a combination of reduced and increased water levels upstream and downstream of the N7 due to the opening of	It is proposed to increase the height of the retention pond embankments at Blackchurch to maintain freeboard. At Tuckmilltown defences are proposed to protect a minimum of 4	During the design phase	These measures will be	Not Significant.

Potential Impact (Hydrology and Drainage)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
culvert under the road. Downstream of the N7 there will be increased water levels within the retention pond at Blackchurch. In the townland of Tuckmilltown adjacent to the proposed defences there will be an increase of water levels.	properties from flooding. As a result of these defences, there is an overall reduction in the floodplain in this area.		implemented by the Contractor.	
The drainage pattern of the overland flows to the river channel along the embankments may be changed slightly. Construction of the embankments in the floodplain will change the slope of the existing lands in some areas which consequently may have an impact on the existing surface water drainage pattern. For example, the existing permeability of the soil could be reduced and the time of concentration to surface water flow could increase if the existing slope reduces. Some existing land drainage culverts under the railway will be fully or partially blocked to prevent flood waters bypassing the defences.	Toe drains will be included at the base of the embankments, where required, in order to ensure that adjacent fields can continue to drain. Existing field drains that intersect the proposed embankments will be dealt with, by diverting them to adjacent field drains or by maintaining a limited flow path through the proposed defence.	During the design phase	These measures will be implemented by the Contractor.	Not Significant.

Table 15.9: Soils, Geology and Hydrogeology: Summary of Mitigation Measures

Potential Impact (Soils, Geology and Hydrogeology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction Phase General	All construction works should be completed in line with the following best practice guidelines to ensure the potential for accidental soil and groundwater contamination is minimised: CIRIA (Construction Industry Research and Information Association) guidance on 'Control of Water Pollution from Construction Sites' (CIRIA Report No C532, 2001) CIRIA (Construction Industry Research and Information Association) guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006)			
Construction activities relating to the import and placement of fill material would be considered to constitute a temporary negative impact on the soils, geology and hydrogeology of the area. Over-compaction of soil and subsoil due to plant activities and potential for sediment run-off to the adjacent watercourses are particular risks that need careful management.	Ensuring that a Construction & Environmental Management Plan is in place will mitigate any risks associated with embankment construction activities, thus reducing these impacts to an imperceptible level.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
Where the nature of the soil cannot be returned to a similar pre-construction quality due to soil spreading activities, this would constitute a permanent negative impact on the soils and geology of the area. The attribute importance of the soils is considered to be medium as they are considered in general moderately drained with moderate fertility. A permanent impact on a significant proportion of the soil in the area would constitute a moderate impact on the soils and geology.	Land used as the temporary working area will be restored to its original condition.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
The proposed scheme will necessitate the requirement to store soil along the length of works areas. In the absence of mitigation, soil storage may present a risk of instability.	A maximum height of 1 metre will apply for all temporary spoil heaps, with maximum side slopes of 1V:3H, to ensure that risk of instability is reduced. This will be subject to stability analysis by a suitably qualified geotechnical engineer at design stage.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
In the absence of mitigation, construction of new embankments and river banks may present a risk of slope instability.	The construction of the embankments should be completed to ensure slope stability based on the mixture of rock and soil type used in the construction. The final design of these features should be approved by a geotechnical engineer to ensure slope failure will not occur. The construction of new river banks at the stream realignment	During detailed design and throughout the construction	These measures will be implemented by the design team and the	Not Significant.

Potential Impact (Soils, Geology and Hydrogeology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
	should be completed to ensure slope stability based on in-situ material. The final design of these features should be approved by a geotechnical engineer to ensure slope failure will not occur.	phase.	Contractor.	
The import and pouring of concrete material for the foundations and walls could result in spillage and contamination of adjacent watercourses and soils.	Refer to Table 15.7 above for proposed mitigation measures in respect of concrete management.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
It is proposed to use surface dewatering pumps to dewater the section of the channel where works are taking place. It is possible that during such works slight to moderate groundwater inflows from the channel bed could occur where fractured limestone is exposed. Inflows can be expected laterally though the weathered bedrock and also vertically where discrete fissures are intercepted in the riverbed. Stream realignment works are also proposed at Slane 8 in Tuckmilltown and Morr 8 at Killeenmore. It is proposed that the plant required can operate from the river bank without need to enter the stream. However, works have the potential for significant sediment disturbance and run-off during this operation. Where water management controls may be required, this may involve dewatering within the channel in the vicinity of the works. Dewatering would constitute a temporary, slight negative impact on the groundwater flow regime. In-channel works can lead to river sediment disturbance with subsequent siltation and deposition downstream of the location which is considered a slight impact on soils and geology.	Effective silt management measures such as the use of silt curtains will be placed in stages down-stream of the new channel, in advance of commencing stream realignments. These will be specified by the Contractor in the Method Statement and agreed with IFI. A procedure will also need to be included in the Method Statement for the removal of the silt management measures. An approved pumping and settlement system will be established to deal with dewatering activities. Pumps will transfer accumulated standing water into a settlement tank, or tanks, which in turn will discharge into a 'silt buster' or 'dirt bag' prior to being returned to the watercourse, to minimise the discharge of suspended solids into the watercourse. Water quality monitoring will be carried out to monitor the effectiveness of the mitigation measures.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
There is the potential for accidental soil and groundwater contamination due to spills and leaks of oils and other contaminants during the construction stage of the proposed works.	Refer to Table 15.7 above for proposed mitigation measures in respect of fuels and oils.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
There is the potential to hydrogeological impact on local water features such as ground water wells where dewatering may be required e.g. at culvert upgrades. However, the extent of dewatering required over a short timeframe is not expected to	No mitigation measures are necessary.	n/a	n/a	Not Significant

Potential Impact (Soils, Geology and Hydrogeology)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
result in any significant impact.				
Made ground will be encountered at locations during the construction works. There is the potential that pockets or larger tracts of made ground are contaminated and the excavation and handling of any potentially contaminated made ground could increase the mobilisation of any contaminants present. This presents a risk from leaching, surface run, migration through the subsurface and direct contact (human health).	▪ Further site investigations will be carried out during detailed design to identify and, if necessary, delineate any potential contamination within the made ground. ▪ Identified contaminated made ground will require Waste Acceptance Criteria (WAC) testing to classify the made ground as either: inert, non-hazardous or hazardous. ▪ The made ground should be disposed of at the appropriate licenced or permitted waste facility. ▪ The testing, excavation, handling and disposal of any contaminated made ground should be implemented in accordance with the methodology detailed in the outline Waste Management Plan (WMP) Appendix M.	During detailed design and throughout the construction phase.	These measures will be implemented by the design team and the Contractor.	Not Significant.
Operational Phase Maintenance activities during operational stage will involve periodic inspection of flood defence measures at most (likely to be annual). This is expected to be carried out as visual walkover inspections and general landscaping activities. As a result, there are no expected impacts due to spillages or leaks.	No mitigation measures are necessary.	n/a	n/a	Not Significant
The existing land drainage system in the study area could be affected during the construction period of the works (see also Table 15.8).	Permanent cut-off ditches are proposed on the land side of all embankments to direct overland flow away from the embankments.	During the construction phase.	These measures will be implemented by the Contractor.	Not Significant.

Table 15.10: Cultural Heritage: Summary of Mitigation Measures

Potential Impact (Cultural Heritage)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
Construction Phase Ground disturbances, such as topsoil stripping, have the potential to have a direct and negative impact on previously unrecorded archaeological features or deposits that may survive beneath the	All topsoil stripping associated with the proposed scheme should be subject to full time archaeological monitoring. This will be carried out by a suitably qualified archaeologist under licence by the National Monuments Service. Full provision will be made	Throughout the construction phase.	These measures will be implemented	Not Significant.

Potential Impact (Cultural Heritage)	Summary of Proposed Mitigation	Time scale, relative to project, of mitigation implementation	Who will be responsible for implementation	Residual Impact
current ground level with no surface expression.	available for the resolution of any archaeological features or deposits that may be identified, should that be deemed the most appropriate manner to proceed. A wade survey will be carried out within the section of Slane River to be realigned prior to any construction works going ahead. This will be carried out by a suitably qualified archaeologist, under licence by the National Monuments Service. Full provision will be made available for the resolution of any archaeological features or deposits that may be identified, should that be deemed the most appropriate manner to proceed. It is recommended that topsoil stripping within Morr 19 and 23 stock pile areas is monitored by a suitably qualified archaeologist. It is recommended that the area at Paines 3 only be used as a last resort. If it is required, it is recommended that the site be subject to archaeological testing in the first instance. This should be undertaken by an archaeologist under licence to the DoAHRRGA. Full provision should be made available for the resolution of any archaeological features that may be discovered, should that be deemed an appropriate manner in which to proceed.		by the Contractor.	
Ground disturbances associated with the construction of embankments adjacent to a number of bridge structures: 'Old Morell Bridge', 'Morell Bridge', 'Painestown Bridge', 'Finger-post Bridge' and an un-named bridge in Tuckmilltown, have the potential to directly and negatively impact on these structures. This may occur through inadvertent damage from plant, or burying of portions of the structures from the construction of embankments.	A written and photographic record will be carried out of 'Finger-post Bridge' prior to construction and any direct impact on the structural remains of the bridge will be avoided. Furthermore a sufficient buffer (minimum of 1m) will be maintained between the embankment and bridge during construction. Any direct impact to the remaining three bridges 'Old Morell Bridge', 'Morell Bridge' and 'Painestown Bridge' will be avoided during use of the haulage and due care will be taken by all vehicles during the construction phase	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
Three potential stock pile areas may be required as part of the proposed scheme. Topsoil stripping within these sites has the potential to have a direct and negative impact on archaeological features that have the potential to survive within these areas, especially in the site at Turnings North.	It is recommended that topsoil stripping within Morr 19 and 23 stock pile areas is monitored by a suitably qualified archaeologist. It is recommended that the area at Paines 3 only be used as a last resort. To avoid the need for topsoil stripping at this site, the contractor will instead temporarily stockpile fill material on top of a geotextile layer at this location, if it required for material storage.	Throughout the construction phase.	These measures will be implemented by the Contractor.	Not Significant.
Operational Phase No operational phase impacts are predicted to occur.	No mitigation measures are necessary.	n/a	n/a	Not Significant

15.2 INTERACTIONS

The EIA Directive and its transposing Regulations requires that in addition to assessing impacts on population & human health, biodiversity, land and soils, water, air, climate, landscape, material assets and cultural heritage on the environment, the interrelationship between these factors must be taken into account as part of the environmental impact assessment process.

15.2.1 Inter-relationships - Interactions

Table 15.11 overleaf is a matrix table indicating the significant interactions that are likely to occur between the various environmental disciplines with regard to the proposed scheme. Where a tick exists in a box in the table, this indicates that a relationship exists between the two environmental areas. The purpose of the table is to allow interaction between various disciplines to be recognised, although the level of interaction will vary in each case. It is assumed in presenting this table that an environmental discipline has a potential inter-relationship during either the construction or operational phases of the scheme, or both.

A summary of expected interactions is given in Table 15.12 on page 15-44.

Table 15.11: Interaction of Impacts

Interaction / Cumulative Effect on Receptors	Population & Human Health (inc. Land Use)	Material Assets/ Traffic and Transport	Air and Climate	Noise and Vibration	Landscape and Visual	Biodiversity (Terrestrial and Aquatic Ecology)	Soils, Geology, Hydrology and Hydro-geology	Archae-ology and Cultural Heritage
Population & Human Health (inc. Land Use)								
Material Assets/ Traffic and Transport	✓							
Air and Climate	✓	✓						
Noise and Vibration	✓	✓						
Landscape and Visual	✓							
Biodiversity (Terrestrial and Aquatic Ecology)	✓	✓	✓	✓	✓			
Soils, Geology, Hydrology and Hydro-geology	✓	✓	✓	✓		✓		
Archaeology & Cultural Heritage	✓	✓			✓			

Table 15.12: Summary of Impact Interactions

Environmental Discipline	Interaction With	Interaction
Population and Human Health	**Traffic & Transport** **Air & Climate** **Noise & Vibration** **Landscape and Visual** **Ecology** **Soils, Geology, Hydrology and Hydro-geology** **Archaeology & Cultural Heritage**	The construction phase of the proposed development has the potential to generate impacts upon land uses, sensitive receptors and persons within locale of the works. Temporary air and noise pollution, loss of visual amenity, access and traffic congestion may occur as a result of the construction works and there may also be disruption to agricultural activity. Consideration of air quality, noise and vibration, visual amenity and traffic are provided in relevant chapters within the EIAR with appropriate mitigation measures included. It should however be noted, impacts associated with the construction phase shall be temporary in nature and reduced or eliminated entirely, at the operational phase of the development.
Land Use/ Agriculture	**Noise and Vibration**	Construction noise and vibration may have an impact on sensitive stock. Landowners will be consulted with throughout the project and mitigation to prevent these potential impacts is included in Chapter 8.
	Hydrogeology and Hydrology	Construction activities may impact on in-situ field drainage or damage soil structure and future mobility of water in soils may be affected. Mitigation to prevent these potential impacts is included in Chapters 12 and 13.
	Water Quality	Construction activities may impact on surface and ground waters currently use as drinking sources. Mitigation to prevent these potential impacts is included in Chapters 10, 11 and 12 and an outline emergency pollution response plan is included in the oCEMP, Appendix B.
	Traffic	Construction activities may impact on farming operations that require the use of local roads. Furthermore, increased noise from HGV construction traffic may impact on sensitive livestock. Mitigation in respect of construction traffic is presented in Chapter 6 and a TMP will be implemented in advance of construction, to manage the impacts from construction vehicles.
	Geology/Soil	Construction activities may impact soil structure and future mobility of water in soils may be affected. Mitigation to prevent these potential impacts is included in Chapter 5 and 13.
	Atmospheric Emissions	Dust and other particulate matter may affect crop quality and also impact on livestock through eye irritations. A Dust Minimisation Plan will be implemented via the CEMP, as recommended in Chapter 7.
	Socio Economics	There will be a temporary change in land use during the construction period which may impact on agriculture both from a land take and severance perspective. Furthermore, land will be required for flood embankments and walls on a long-term basis. Landowners have been consulted with throughout the development of the proposed scheme. Coordination and planning of construction activity will aim to minimise the degree of temporary disruption to landowners as the scheme is built. The operation of the scheme will result in a significant reduction in disruption from flooding for the majority of residents and landowners within the study area.
Traffic and Transportation / Material Assets	**Air & Climate**	The levels of traffic generated by the project during both construction and operation phases is deemed to be insignificant. Chapter 12 – Air Quality concludes that due to the relatively low levels of traffic involved the impact of traffic on air quality is negligible.
	Noise & Vibration	Construction traffic will have the potential for noise and vibration impacts. The Noise & Vibration chapter has been prepared in close co-operation with the traffic consultant and potential noise and vibration impacts in respect of construction traffic are assessed in Chapter 8. The noise impact assessment concludes that the construction traffic noise level increases associated with the proposed development will be imperceptible at the nearest noise sensitive properties. The traffic levels associated with the operational phase will be substantially lower than any levels of traffic that could contribute to increasing the road traffic noise in the study area and hence there will be a negligible noise impact

Environmental Discipline	Interaction With	Interaction
		from operational phase traffic movements.
	Ecology **Soils, Geology, Hydrology and Hydro-geology**	Construction traffic has potential to result in contamination of surface water and groundwater through fuel/oil spillage and through tracking of mud and other fine sediment into watercourses. Detailed mitigation to protect pollutants reaching sensitive receptors via surface and groundwater is given in Chapters 9, 10 and 11. Construction vehicles may give rise to compaction of soils, resulting in alteration to drainage and soil productivity. Mitigation to prevent these potential impacts is included in Chapters 12 and 13.
Soils, Geology, Hydrology and Hydro-geology	**Aquatic Ecology and Environment** **Terrestrial Ecology** **Population and Human Health** **Land Use / Agriculture** **Noise and Vibration**	The mobilisation and erosion of sediment can have interactions with the hydrological and ecological assessments with regards to potential impacts on suspended solids in rivers. Detailed mitigation measures have been given in Chapter 11 to ensure the residual impact as a result of sediment mobilisation to river courses is slight. Potential impacts on the hydrogeological environment have close interactions with the hydrological and ecological assessments particular for specific ecological receptors which are groundwater dependant ecosystems. Construction dewatering, which is a direct impact on the hydrogeological environment, can have an associated impact on groundwater dependant ecosystems such as base flow to rivers and the hydraulic head sustaining artesian conditions in springs, fens and marshes. Dewatering associated with the majority of the proposed development will be very limited, as the depth of any excavation is shallow. Groundwater drawdown also has the potential to impact on the yield of water supply boreholes which leads to an interaction with the human environment in terms of the consumers of the water. The potential impact on groundwater supplies is considered to be negligible. Interactions are possible in terms of contamination impacts that occur from accidental spillages which result in impacted soils and groundwater on site which ultimately migrate to groundwater dependant habitats. Industry standard mitigation measures have been proposed to prevent the occurrence of accidental spillages and mitigate their potential impact in the unlikely chance they do occur. The mobilisation of contaminants during the excavation of made ground or other contaminated soils may present a risk to human health through surface run off and /or leaching of contaminants into groundwater. Excavation of made ground could expose construction works to potential contaminants. If contaminant levels exceed soil guideline values (SGVs) this could present a risk to human health due to direct contact and from volatile or semi-volatile vapours. A site specific Waste Management Plan shall be implemented onsite to mitigate any potential impacts from potentially contaminated made ground. If, following testing, made ground is found to be suitable for re-use in embankment restoration, the contractor may employ a mobile screen on site to sift out larger elements of the spoil. This may generate additional construction noise and acoustic screening has been recommended in the noise assessment at locations where this may affect sensitive receptors.
Flood Risk /Hydrology	**Aquatic Ecology and Environment** **Terrestrial Ecology** **Land Use**	Pollution of water bodies during flood events can potentially impact on ecological interests. Detailed mitigation is given in Chapters 10-13 to protect the water environment and in doing so, it also protects the sensitive aquatic ecological resource of the study area and any downstream sites. The maintenance of buffer areas around water bodies will also help to minimise potential impacts from flooding on water quality while retaining biodiversity. The CEMP will specifically address measures to be undertaken at individual

Environmental Discipline	Interaction With	Interaction
		works areas in the event of a flood warning. Chapter 13 concludes that there is little potential for migration of any contaminants to groundwater or of any significant discharge from the site. The proposed scheme will not result in changes to the hydrological regime or alteration of river flows except during significant flood events. Therefore, changes in agricultural practices are unlikely to occur as a result of the scheme.
Aquatic Ecology and Water Environment	**Soils, Geology, Hydrology and Hydro-geology, Water Environment, Terrestrial Ecology**	The assessment of interactions has taken into consideration the connections between various aspects of the environment likely to be affected by the development and the interrelationship between them. The most significant interactions in relation to fisheries and the aquatic environment are considered to be water quality and hydrogeology and terrestrial ecology. Consideration of terrestrial ecology, hydrology/drainage and water quality are provided in relevant chapters within the EIAR with appropriate mitigation measures included.
Terrestrial Ecology	**Landscape**	The project will result in the short term loss of some hedgerows, trees and scrub areas. Once the project has been constructed and during the reinstatement phase, vegetation reinstatement using established plants and a suitable mix of native species will occur as soon as possible after completion of the works having due regard to the appropriate landscape planting season.
	Noise and Vibration	Disturbance from noise can affect wildlife. The ecologists have liaised with the noise consultant to include impacts from noise in their assessments and no significant effects are predicted from noise.
	Aquatic Ecology and Water Environment	Pollution of water bodies can potentially impact on ecological interests. Detailed mitigation as outlined in Chapter 11 seeks to protect the water environment. In doing so, it also protects the sensitive aquatic ecological resource of the study area and downstream sites.
Noise and Vibration	**Terrestrial Ecology**	Disturbance from noise can affect wildlife. The ecologists have liaised with the noise consultant to include impacts from noise in the ecological assessment and no significant effects are predicted from noise.
	Land use and Socio Economics	Noise levels may be temporarily increased in the vicinity of some of the nearest noise sensitive properties for short periods of time during the construction phase. The implementation of the noise control measures outlined will reduce these impacts so that no significant impact arises.
	Traffic	Noise levels may be temporarily increased in the vicinity of some of the nearest noise sensitive properties for very short periods of time during the construction phase. The implementation of the noise control measures outlined will reduce these impacts so that no significant impact arises.
Air and Climate	**Terrestrial Ecology** **Soils, Geology, Hydrology and Hydro-geology,**	Dust from the construction phase of the development has potential to impact on the fauna in the vicinity of the proposed development. However, it is predicted that following suitable mitigation, no significant impacts will occur. The levels of traffic (interaction with the Traffic and Transport chapter) generated by the project during both construction and operation phases is deemed to be insignificant. In terms of dust and soil type there are interactions with the relevant sections of the geology and soils chapter.
Landscape and Visual	**Terrestrial Ecology**	The landscape and visual assessment has a direct interaction with Chapter 10, Biodiversity - Terrestrial Ecology. The loss of habitats is described fully in Chapter 10. The mitigation proposed will provide reinstated hedgerows and vegetation using native species to restore biodiversity along the temporary working areas for the proposed embankments and flood walls. New trees and hedgerows at these sites will create beneficial ecological impact.
Cultural Heritage and Archaeology	**Landscape and Visual** **Traffic**	The Landscape and Visual assessment (Chapter 9) states that the retention, where possible, of the existing vegetation and the use of stone for flood walls will help to integrate the proposed scheme within the existing environment and the proposed scheme will be read as part of the wider landscape where similar embankments and walls are an existing feature. The passage of HGVs over the Old Morell Bridge, Morell Bridge and Painestown Bridge has the potential to impact these bridges. A Traffic Management Plan will be implemented during construction which may employ measures such as

Environmental Discipline	Interaction With	Interaction
		speed restrictions, one-way routes and temporary traffic signals to reduce the potential impact of HGVs.
Traffic and Transportation/ Material Assets	**Geology and Hydrogeology Aquatic Ecology and Water Environment**	Construction traffic has potential to result in contamination of aquifers through fuel/oil spillage. Detailed mitigation is given in Chapters 10, 11 & 12 to protect the water environment.
	Noise and Vibration	Construction traffic has potential to generate noise and vibration impacts. The Noise & Vibration chapter has been prepared in close co-operation with the Traffic consultant. Potential noise impacts are described and assessed in Chapter 8. The noise impact assessment concludes that the construction traffic noise level increases associated with the proposed development will not be significant at the nearest noise sensitive properties. Vibration monitoring has been proposed at properties close to construction areas and access routes. The traffic levels associated with the operational phase will be substantially lower than any levels of traffic that could contribute to increasing the road traffic noise in the study area and hence there will be a negligible noise impact from operational phase traffic movements.
	Air Quality and Climate	The levels of traffic generated by the project during both construction and operation phases is deemed to be insignificant. Chapter 7 – Air Quality concludes that due to the relatively low levels of traffic involved the impact of traffic on air quality is negligible. A number of mitigation measures have been proposed to reduce vehicle emissions and energy usage during construction.

15.2.2 Indirect & Cumulative Impacts & Impact Interactions

Although indirect impacts as they relate to particular issues (e.g. air and noise, landscape, etc.) have generally been discussed within the relevant chapters of this EIAR, the purpose of this chapter is to assess the ‘indirect’ (or secondary) and ‘cumulative impacts’ of the overall proposed development.

In addition, while each individual chapter established the full extent of the ‘direct’ impacts associated with the proposed development, this section provides a discussion on the inter-relationship of these impacts during the construction and operational phases of the proposed development.

Section 15.2.3 below describes the ‘indirect’ (secondary) impacts of the proposed development while the impact inter-relationships have been discussed in Section 15.2.1. Some overlap exists in the discussion between these impacts. Cumulative impacts relate to the potential for incremental changes to environmental parameters due to the combined effect of this project added to changes which have been, or which may yet be, brought about by past, present or reasonably foreseeable future projects or actions.

The assessment of these impacts has been undertaken with regard to EU (Environmental Impact Assessment) (Waste) Regulations 2012, the EPA documents ‘*Guidelines on the Information to be contained in Environmental Impact Statements*’, 2002 and draft revised editions 2015 & 2017 and ‘*Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)*’ 2003 (also draft revised edition 2015). It has also been prepared with consideration to the EU ‘*Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions*’, prepared for the European Commission (1999).

15.2.3 Indirect (Secondary Impacts)

The EPA's draft '*Guidelines on the Information to be contained in an Environmental Impact Assessment Reports*' (EPA, 2017) describe indirect and secondary impacts as:

"Impacts 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."

In the case of this development, indirect impacts include those which are considered to be caused by consequential associated development, i.e. not directly part of the project, but associated with the project, e.g. possible new development in areas that will not now flood.

15.2.3.1 Economic

In addition to the direct employment opportunities for construction workers carrying out the works, indirect employment opportunities are expected to be created during the construction phase for a range of goods and services. These may include local purchase of construction materials and increased use of services such as shops and cafes in the local areas by construction workers. This will have temporary indirect positive socio-economic benefits for local residents, retailers and other commercial operators e.g. accommodation services and transport companies, including increased workforce participation and income levels.

15.2.3.2 Sourcing Materials

The project requires the importation of approximately 70,000m^3 of fill material. Given the large quantum of material required for these works, material will be required to be sourced from outside the site to cater for this development. As outlined in Chapter 4 it is proposed to source material from licenced quarry sites with sufficient available capacity. The extraction of material from commercial quarries has potential to have a minor indirect negative impact as it depletes locally available natural resources. Material will only be extracted, however, within licenced volume limits. Where possible, materials excavated on site will be re-used on site. The sourcing and purchasing of materials could have a positive local economic impact.

15.2.3.3 Possible Future Development

During the preparation of the EIAR, RPS undertook a planning search for any developments which may arise during the course of the constrution of the proposed development. The search showed that only one off housing developments or small clusters of up to 3 dwellings are proposed within the study area.

As only one off / small cluster housing developments are planned, these should not add cumulative impacts to the operational phase of the proposed scheme.

The main long tem impacts of the proposed scheme are positive. However, there is a long term landscape impact arising from the embankments and also new areas that will flood, which had not been subject to floods in the past.

15.2.4 Cumulative Impacts

The following section considers the possible cumulative impacts associated with the proposed scheme combined with other possible developments in the surrounding area. It should be noted that once constructed, the proposed Morell flood management scheme will not give rise to negative cumulative impacts. The potential for cumulative impacts will only arise during the construction stage with the accumulation of potential impacts arising from other projects, particularly those where the construction programmes may overlap. However, such impacts will be temporary or short term in nature and will be minimised with the implementation of mitigation measures.

It is understood that the remediation of Kerdiffstown landfill is expected to take place over the coming years, which may lead to some overlap with the construction programme for the proposed development.

The Eastern CFRAM Study's draft Flood Risk Management Plan for Unit of Management 09 was published for public consultation in September 2016. The final Plan is expected to be adopted in latter half of 2017. This Plan sets out a sustainable, long-term strategy to manage the flood risk within the Liffey-Dublin Bay River Basin, focused on the areas of potentially significant flood risk (AFAs), and the sources of flooding giving rise to that risk. The plan has put forward flood risk management measures incorporating physical works at eleven AFAs within the Liffey-Dublin Bay River Basin. There is the potential for cumulative impacts on water quality in the lower Liffey catchment if FRM works on adjoining reaches of rivers in the catchment are carried out simultaneously.

15.2.4.1 Traffic

The main area for potential cumulative impact as a result of other possible development or construction activity in the study area is traffic-related. In particular, if the construction of any new development projects coincides with that of the proposed flood management scheme, it could give rise to increased negative effects of traffic flows on the local road network.

A CTMP will be put in place during construction of the flood management scheme, to manage construction traffic effectively. The plan will consider construction traffic accessing the site via the public road network as well as traffic circulation within the construction site. Should other construction projects be occurring locally which may increase traffic on local routes, these will be taken into consideration in the development of the detailed CTMP and appropriate measures applied to minimise impacts.

15.2.4.2 Noise & Vibration

Any cumulative impacts from traffic increases could potentially give rise to a cumulative effect on noise impact. The limit on daily HGV movements in the cordon area during construction of the proposed flood management scheme and the implementation of the CTMP and CEMP which will manage traffic and monitor both noise & vibration, will aid in mitigating against this potential cumulative impact.

15.2.4.3 Aquatic Ecology and Water Environment

The potential physical flood relief works set out in the Flood Risk Management Plan for the Liffey-Dublin Bay River Basin that have been developed through the CFRAM Programme are to an outline design, and are not at this point ready for construction. The Appropriate Assessment carried out on the Plan has identified the potential for in-combination or cumulative effects with parallel or preceding projects in the catchment. A project-level of assessment will be required for physical works arising out of the CFRAM Study before implementation. The main mitigation against potential in-combination or cumulative impacts on water quality will be the phasing and management of projects in the CFRAM programme so that potentially impacting activities do not occur simultaneously with the construction of the Morell FMS. As the OPW has a role in both the Morell FMS and the CFRAM Study, the possible interaction of neighbouring schemes will be apparent during project planning and cumulative effects are therefore unlikely.

15.3 TECHNICAL DIFFICULTIES

The studies involved in undertaking this Environmental Impact Assessment have been undertaken throughout a period spanning more than 18 months, during which extensive baseline surveying was carried out, during the appropriate season. As a result, there were no technical difficulties encountered during the preparation of this Environmental Impact Assessment Report.

REFERENCES

Balmer D.E, Gillings, S., Caffrey B.J., Swann, R.L., Downie, I.S., & Fuller, R.J., 2013. Bird Atlas 2007-2011: *the breeding and wintering birds of Britain and Ireland.* BTO Books, Thetford.

Besson, S., Bau, F., Durlet, P. (2008) *Movement capacity and habitat use of the white-clawed crayfish* (*Austropotamobius pallipes*, Lereboullet, 1858): Radio telemetry study in the wild. Technical report PNRM/ONEMA. LIFE04NAT/FR/000082. 40 pp;

BirdWatch Ireland (2011). *Action Plan for Lake, Fen and Turlough Birds in Ireland 2011-2020.* BirdWatch Ireland's Group Action Plans for Irish Birds. BirdWatch Ireland, Kilcoole, Co. Wicklow.

BRE (2003) *Control of Dust from Construction and Demolition Activities*

Bjorn T.C & Reiser D.W. (1991). *Habitat requirements of salmonids in streams.* In: Meehan WR (ed). Influences of forest management on salmonid fishes & their habitats. American Fisheries Society, Bethseda

CIEEM (2016). *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd Edition.* Chartered Institute of Ecology and Environmental Management, Winchester.

Colhoun, K. & Cummins, S. (2013). *Birds of Conservation Concern in Ireland 2014-2019*. Irish Birds 9 (4) 523-544.

Collins, J. (ed.) (2016). *Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn.).* The Bat Conservation Trust, London.

CSO (2016a) *Census of Population 2016 - Preliminary Results, Geographic Changes* http://www.cso.ie/en/releasesandpublications/ep/p-cpr/censusofpopulation2016-preliminaryresults/geochan/ accessed 13th March 2017

CSO (2012) *Small Area Population Statistics Map summary Electoral Division Bodenstown (CSO Area Code ED 06059)* http://census.cso.ie/sapmap2011/Results.aspx?Geog_Type=ED&Geog_Code=06059&CTY=06 accessed 13th March 2017

CSO (2012) *Small Area Population Statistics Map summary Electoral Division Donaghcumper* (CSO Area Code ED 06037) http://census.cso.ie/sapmap2011/Results.aspx?Geog_Type=ED&Geog_Code=06037&CTY=06 accessed 13th March 2017

CSO (2012) *Small Area Population Statistics Map summary Electoral Division Kill (CSO Area Code ED 06072)* http://census.cso.ie/sapmap2011/Results.aspx?Geog_Type=ED&Geog_Code=06072&CTY=06 accessed 13th March 2017

CSO (2012) *Small Area Population Statistics Map summary Electoral Division Oughterard (CSO Area Code ED 06082)* http://census.cso.ie/sapmap2011/Results.aspx?Geog_Type=ED&Geog_Code=06082&CTY=06 accessed 13th March 2017

DEHLG (2006) *Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects*

Department of the Environment and Local Government (1998) *Waste Management - Changing our Ways*

Department of Transport Welsh Office, HMSO (1988) *Calculation of Road Traffic Noise (CRTN)*

Eastern River Basin District (2009). *Eastern River Basin District, River Basin Management Plan 2009 – 2015*.

Eastern Regional Fisheries Board (2003) *Requirements for the Protection of Fisheries Habitat During Construction and Development Works at River Sites*

Edgar, P., Foster, J. and Baker, J. (2010). *Reptile Habitat Management Handbook.* Amphibian and Reptile Conservation, Bournemouth.

English Nature (2005). *The butterfly handbook – General advice note on mitigating the impacts of roads on butterfly populations*. English Nature, Peterborough, PE1 1UA, England.

Envirocentre (2006) *The Office of Public Works Ecological Impact Assessment (EcIA) of the Effects of Statutory Arterial Drainage Maintenance Activities on the Otter (Lutra lutra)*

Environment Agency (UK) (2016) Carbon Planning Tool, October 2016 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/571707/LIT_7067.pdf (accessed 9/3/17)

EPA [Environmental Protection Agency] (2002). *Guidelines on information to be contained in Environmental Impact Statements.* EPA, Wexford.

EPA [Environmental Protection Agency] (2003). A*dvice Notes on Current Practice (in the preparation of Environmental Impact Statements).* EPA, Wexford.

EPA [Environmental Protection Agency] (2012) G*uidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*

EPA [Environmental Protection Agency] (2015). *Guidelines on information to be contained in Environmental Impact Statements –Draft September 2015.* EPA, Wexford.

EPA [Environmental Protection Agency] (2015). A*dvice Notes on Current Practice (in the preparation of Environmental Impact Statements –Draft September 2015).* EPA, Wexford.

European Commission. (2000). *Managing Natura 2000 sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC.* Office for Official Publications of the European Communities, Luxembourg.

European Commission. (2002). *Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC.* Office for Official Publications of the European Communities, Luxembourg.

European Commission. (2006). *Nature and biodiversity cases: Ruling of the European Court of Justice.* Office for Official Publications of the European Communities, Luxembourg.

European Commission. (2007a). *Guidance document on Article 6(4) of the 'Habitats Directive'* 92/43/EEC. Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the Commission.

European Commission. (2007b). *Interpretation manual of European Union habitats*. EUR27. European Commission, DG Environment.

Fáilte Ireland (2016) Failte Ireland Regional Tourism Performance in 2015 http://www.failteireland.ie/FailteIreland/files/c4/c42b5249-242d-4860-b3b5-8720df101d4c.pdf accessed 14th March 2017

Fáilte Ireland (2016a) Visitors To Top Fee Charging Attractions 2015

Fáilte Ireland (2016b) Visitors To Top Free Attractions 2015

Fáilte Ireland (2015) Failte Ireland Regional Tourism Performance in 2014 http://www.failteireland.ie/Research-Insights/Regional/Archive/Regional-tourism-performance-in-2014-pdf-885kb.aspx?feed=Failte-Ireland accessed 14th March 2017

Fáilte Ireland (2014) Failte Ireland Regional Tourism Performance In 2013 http://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/2_Regional_SurveysReports/Regional-tourism-performance-in-2013.pdf?ext=.pdf accessed 14th March 2017

Fáilte Ireland (2014a) Visitors to Tourist Attractions 2009-2013 http://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/1_Sectoral_SurveysReports/Visitors_to_tourist_attractions_in_Ireland_2009-2013.pdf?ext=.pdf accessed 14th March 2017

Fáilte Ireland (2013) Failte Ireland Regional Tourism Performance in 2012 http://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/2_Regional_SurveysReports/Regional_tourism_performance_in_2012.pdf?ext=.pdf accessed 14th March 2017

Fáilte Ireland (2016) Open Data Activities Dataset 2016 http://www.failteireland.ie/Research-Insights/Open-data.aspx accessed 24 May 2017

Fáilte Ireland (2016) Open Data Accomodation Dataset 2016 http://www.failteireland.ie/Research-Insights/Open-data.aspx accessed 24 May 2017

Fossitt, J.A (2000). *A Guide to Habitats in Ireland*. The Heritage Council, Kilkenny, Ireland.

Golf Ireland (2017) *Search Golf Courses : County 'Kildare'* http://www.golf.discoverireland.ie/Search-and-Plan/Golf-Courses?pg=3#sr accessed 14th March 2017

Hundt, L. (2012). *Bat Surveys: Good Practice Guidelines, Second Edition*. Bat Conservation Trust.

IEEM (2006). *Guidelines for Ecological Impact Assessment*. The Institute for Ecology and Environmental Management.

Inland Fisheries Ireland (2016) '*Guidelines on Protection of Fisheries During Construction works in or adjacent to Waters'*

Institute of Ecology and Environmental Management (IEEM) (2006). *Guidelines for Ecological Impacts Assessment Institute of Ecology and Environmental Management,* UK. Available at: http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/EcIA_Guidelines/TGSEcIA-EcIA_Guidelines-Terestrial_Freshwater_Coastal.pdf (December 2015).

Kelleher, C. & Marnell, F. (2006). *Bat Mitigation Guidelines for Ireland*. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Kennedy, Eoin B. (2014) *" Irish economy unexpectedly contracts in setback for Government"* The Irish Times, 13th March 2014 http://www.irishtimes.com/business/economy/irish-economy-unexpectedly-contracts-in-setback-for-government-1.1723610 accessed 14th March 2017

Maitland, P.S. (2003) *Ecology of the river, brook, and sea lamprey.* In: Conserving Natura 2000 Rivers. Conservation Techniques Series No. 5 English Nature, Peterborough

National Parks and Wildlife Service. (2009). *Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities* Revised February 2010. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

National Parks and Wildlife Service. (2013). *The Status of EU Protected Habitats and Species in Ireland. Conservation status in Ireland of habitats and species listed in the European Council directive on the conservation of habitats, flora and fauna 92/43/EEC*. Volumes 1, 2 and 3. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

National Roads Authority (2007) T*raffic and Transport Assessment Guidelines*

National Roads Authority (2009) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Scheme

NRA (2006a). *Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes*. National Roads Authority, Dublin.

NRA (2006b). *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes*. National Roads Authority, Dublin.

NRA (2006c). *Guidelines for the Treatment of Bats during the Construction of National Road Schemes*. National Roads Authority, Dublin.

NRA (2006d). *Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub prior to, during and post Construction of National Road Schemes*. National Roads Authority, Dublin.

NRA (2009a). *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.* National Roads Authority, Dublin.

NRA (2009b). *Guidelines for Assessment of Ecological Impacts of National Road Schemes*. Revision 2 National Roads Authority, Dublin.

NRA (2010). *Guidelines for the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads.* National Roads Authority, Dublin.

O'Neill, F.H., Martin, J.R., Devaney, F.M. & Perrin, P.M. (2013). The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland.

Office of Public Works (2011). *Arterial Drainage Maintenance Service Environmental Management Protocols and Standard Operating Procedures*. Office Of Public Works, Galway.

OPW (2004) *Report of the Flood Policy Review Group*

OPW & DEHLG (2009) Planning System and Flood Risk Management – Guidelines for Local Authorities

OPW (2011).*Arterial Drainage Maintenance Service Environmental Management Protocols & Standard Operating Procedures.* The Office of Public Works, Galway.

RPS (2016) *Morrell Flood Management Scheme Feasibility Report (Version F01, July 2016)*

Smith, G.F., O'Donoghue, P., O'Hora, K. & Delaney, E. (2011). *Best Practice Guidance for Habitat Survey and Mapping*. The Heritage Council, Kilkenny, Ireland.

Stace, C. (1992). *New Flora of the British Isles.* Cambridge University Press.

The Landscape Institute and Institute of Environmental Management & Assessment (2013) *Guidelines for Landscape and Visual Impact Assessment, Third Edition (*GLVIA3).

Therivel, R. (2009). *Appropriate assessment of plans in England.* Environmental Impact Assessment Review 29, 261-272.

UK Highways Agency Design Manual for Roads and Bridges [DMRB] (2007), Volume 11, Section 3, *Air Quality Assessment*

World Health Organisation (1999) *Guidelines for Community Noise 1999*

This Environmental Impact Assessment Report was prepared by:

RPS
West Pier Business Campus
Dun Laoghaire
Co Dublin
A96 N6T7

Telephone	01 488 2900
Facsimile	048 90 668286
email	ireland@rpsgroup.com
Web	www.rpsgroup.com/ireland

On behalf of:

Kildare County Council
Áras Chill Dara,
Devoy Park,
Naas West,
Naas,
Co. Kildare
Telephone: (045) 980 200

Facsimile	(045) 980240
Web	www.kildarecountycouncil.ie

The following sub-consultants carried out specialist studies:

IAC	Archaeology and Cultural Heritage