



CONSULTING ENGINEERS

# FLOOD RISK ASSESSMENT

RESIDENTIAL DEVELOPMENT AT MURREVAGH, MULRANNEY, CO. MAYO

MAYO COUNTY COUNCIL

19167-RP-2301-DR01 | JANUARY 2020

# QUALITY CHECK SHEET

**DOCUMENT TITLE:** FLOOD RISK ASSESSMENT

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# 1 PROJECT DETAILS

## 1.1 INTRODUCTION

A planning application is being prepared for a Residential Development at Murrevagh, Mulranney, Co. Mayo. Langan Consulting Engineers (LCE) was appointed to carry out a Flood Risk Assessment (FRA) in support of the planning application.

This FRA comprised of:

- a desk study;
- a site visit;
- hydraulic modelling of adjacent watercourse; and
- a detailed assessment based on the Office of Public Works (OPW) “Planning System and Flood Risk Management Guidelines” as published in November 2009 by the Department of the Environment, Heritage and Local Government<sup>1</sup>.

The location of the proposed development is shown in Figure 1.1 and Figure 1.2 below. The proposed development lands are outlined in red.

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<sup>1</sup> “Planning System and Flood Risk Management Guidelines” published in November 2009 by the Department of the Environment, Heritage and Local Government, including the Technical Appendices.

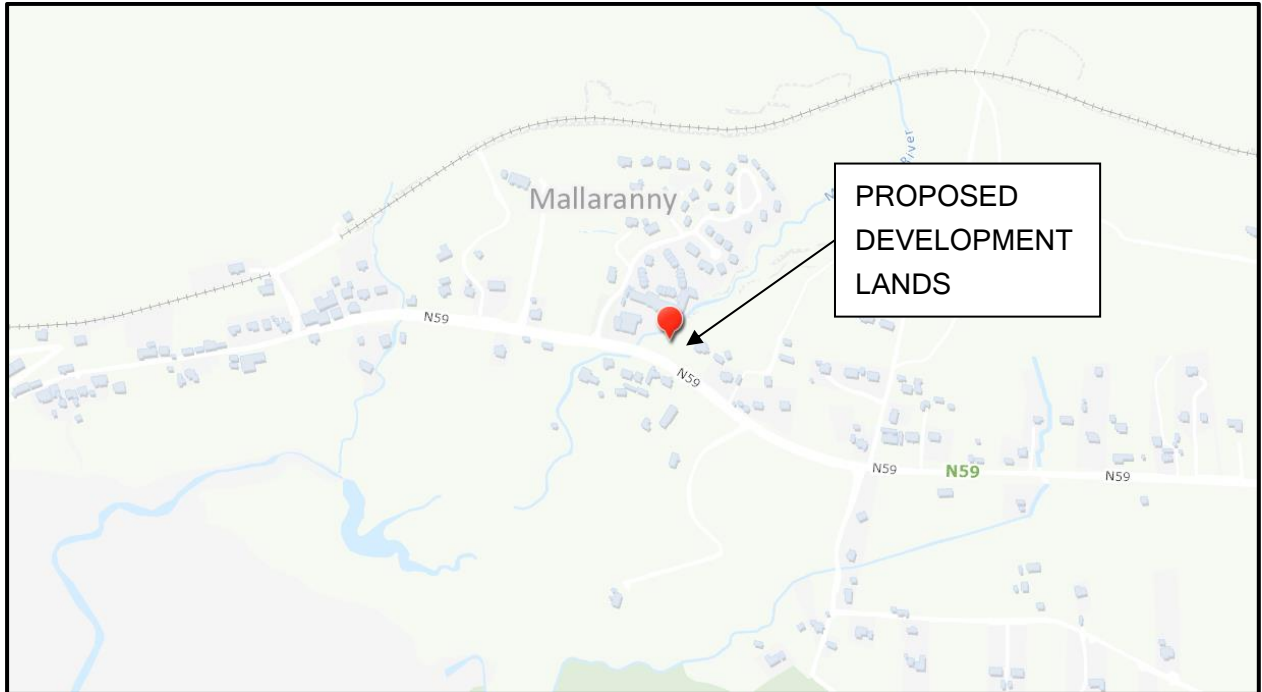


Figure 1.1 Location of the proposed development lands<sup>2</sup>



Figure 1.2 Location of the proposed development lands

<sup>2</sup> Site Location Plan drawing, as received on 21/11/2019.

## 1.2 PROPOSED DEVELOPMENT

It is proposed to construct a residential in-fill development together with ancillary works. The proposed site layout plan for the development is included in Appendix A. [HOLD]

## 1.3 SITE VISIT AND SURVEY

The proposed development lands was visited on the 3<sup>rd</sup> of December 2019. A topographical survey of hydraulic features in the vicinity of the site was carried out by LCE. The survey is relative to Irish Transverse Mercator (ITM) and Ordnance Datum Malin Head [Geoid: OSGM02]. A 3<sup>rd</sup> party topographical survey was received on the 05/12/2019. Both are used as part of this FRA.

## 1.4 ASSUMPTIONS

This report is based on the following assumptions:

- All development information is based on a data provided by Client.
- It is assumed all 3<sup>rd</sup> party information is current and accurate.
- Prediction of future flood levels is based on available historical records.
- The impact climate change will have on future trends is accounted for, however there remains a residual uncertainty in the prediction of the impact of climate change on flooding.
- The findings are subject to adequate design and maintenance of drainage networks and flood defences.
- It is assumed that CFRAM Ordnance Datum levels and modelling levels provided are based on the OSGM02 Geoid. All levels referred to in this report are relative to Ordnance Datum Malin Head (mOD) [Geoid: OSGM02].

## 1.5 ABBREVIATIONS AND DEFINITIONS

### 1.5.1 ABBREVIATIONS

AFA	Area for Further Assessment
CFRAM	Catchment Flood Risk Assessment and Management
CIRIA	Construction Industry Research and Information Association
EPA	Environmental Protection Agency
FRA	Flood Risk Assessment
GSI	Geological Survey of Ireland
ha	Hectares
ITM	Irish Transverse Mercator
LAP	Local Area Plan
LCE	Langan Consulting Engineers Ltd
mOD	Meters Ordnance Datum (Malin, unless otherwise noted)
mODPB	Meters Ordnance Datum (Poolbeg)
OPW	Office of Public Works
PFRA	Preliminary Flood Risk Assessment
RBMP	River Basin Management Plan
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems

### 1.5.2 KEY DEFINITIONS

<i>Alluvium</i>	<i>A deposit of clay, silt, and sand left by flowing floodwater in a river valley or delta, typically producing fertile soil.</i>
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## 2 SITE CHARACTERISTICS<sup>34</sup>

### 2.1 SITE TOPOGRAPHY

The proposed development site is a green-field site in an urban location. The existing entrance to the development lands is from a national road which forms the southern boundary of the proposed development lands. The road level at the site entrance is approximately +15.90mOD. The Murrevagh River forms the western boundary of the site. The site is bounded by residential developments to the east. The north of the site is bounded by agricultural lands. There are some earth mounds located close to the eastern boundary of the site. The ground levels within the site range from +19.87mOD to +30.24mOD. There are existing building ruins on the southern part of the site. The FFL of the existing building +22.12mOD.



Figure 2.1 View of the existing site entrance

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<sup>3</sup> LCE topographic survey, 18<sup>th</sup> April 2019.

<sup>4</sup> [www.gsi.ie](http://www.gsi.ie)

## 2.2 SITE DRAINAGE CHARACTERISTICS

The Murrevagh River flows in a southerly direction along western boundary of the proposed development lands. It has a slope of 1 in 492.

A single span, concrete culvert (bridge no.1) transverses the Murrevagh River at the south western corner of the proposed development lands. The bridge serves the N59. The recorded deck, soffit and water level on the day of the survey were +14.7mOD, +14.15mOD and +12.68mOD respectively. The bridge is approximately 8.8m in length and approximately 14.4m wide.

The Murrevagh River continues to flow in southerly direction for 1km before it discharges into Clew Bay approximately 1km downstream of the proposed development lands.

An overview of the regional drainage network is outlined in Figure 2.2. An overview of the local drainage network is outlined in Figure 2.3. Images of the subject river and local bridges are included in Figure 2.4 to Figure 2.7.

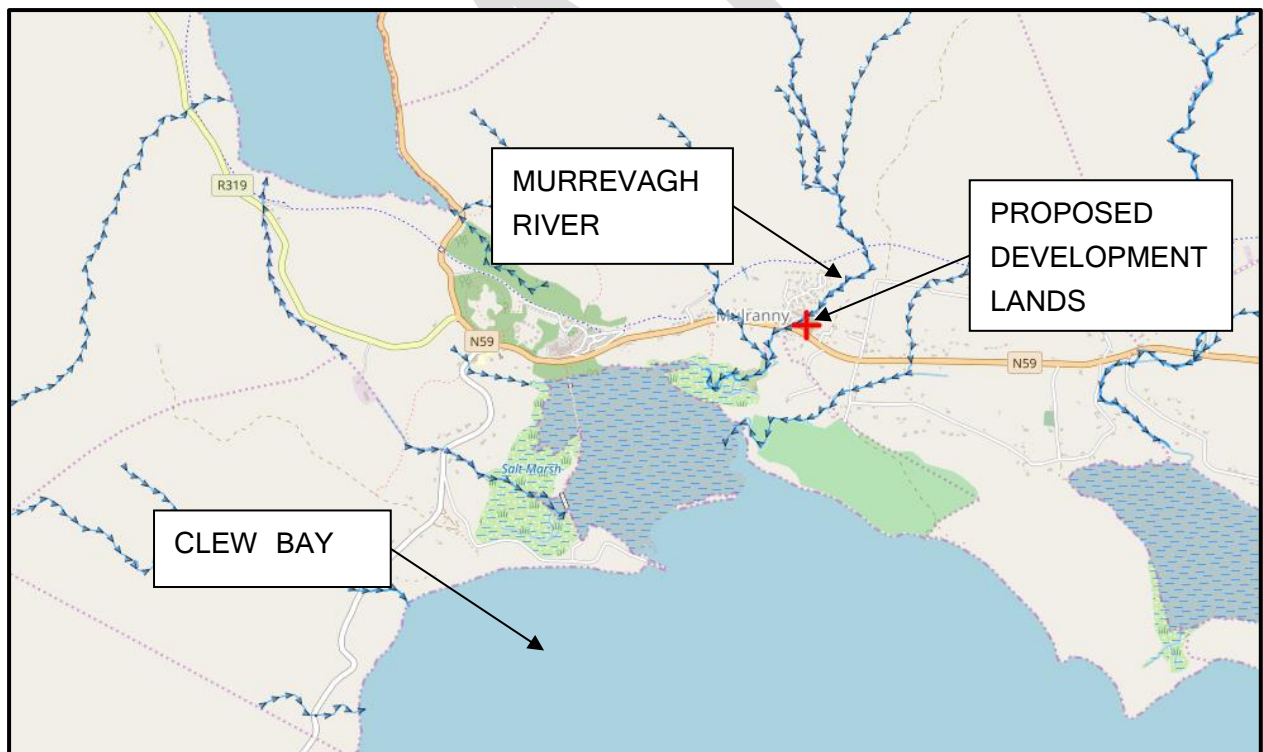


Figure 2.2 Regional drainage network overview<sup>5</sup>

<sup>5</sup> www.epa.ie



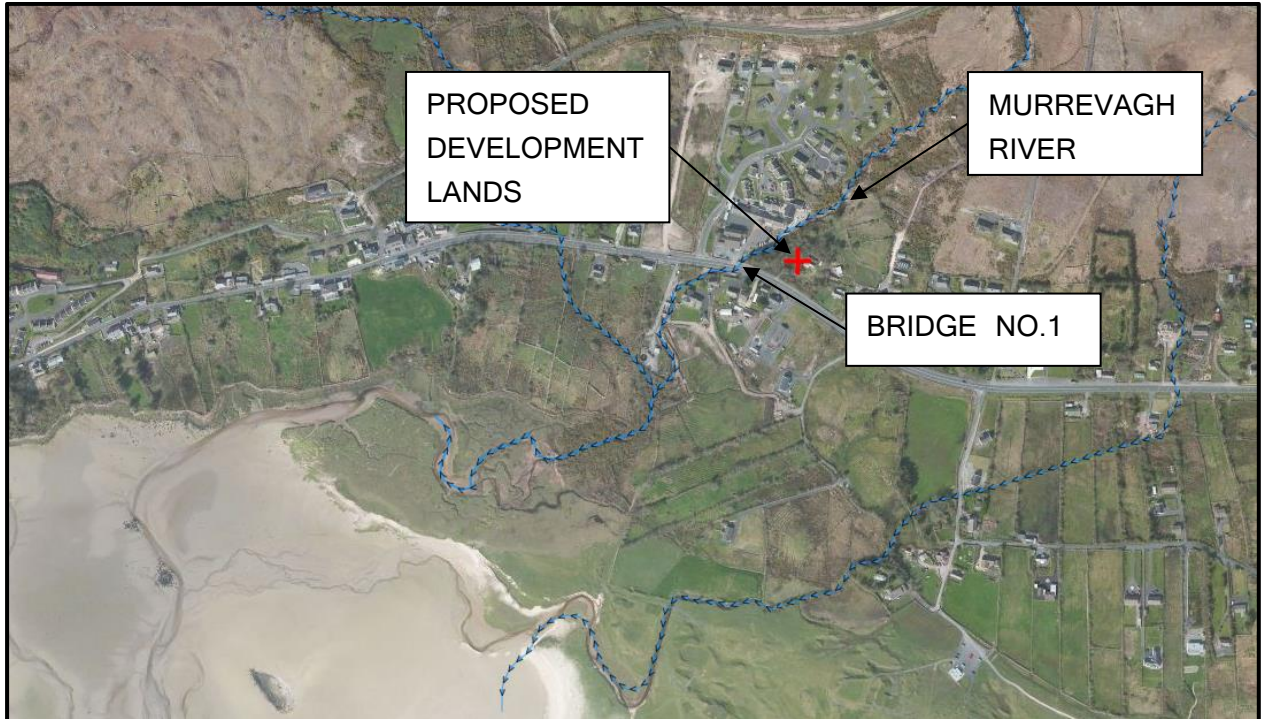


Figure 2.3 Local drainage network overview<sup>6</sup>



Figure 2.4 Single span concrete bridge (bridge no.1)

<sup>6</sup> www.epa.ie





**Figure 2.5 Concrete culvert (bridge no.1)**



**Figure 2.6 View of Murrevagh River (facing downstream)**





Figure 2.7 View of Murrevagh River (facing upstream)

### 2.3 GEOLOGY<sup>4</sup>

The Geological Survey of Ireland (GSI) national bedrock map (1:1,000,000) shows the bedrock geology at the proposed development lands to be “*ORS, sandstone, conglomerate & mudstone*” (see Figure 2.8).

There are no karst features noted in the vicinity of the proposed development lands.



Figure 2.8 GSI bedrock mapping

GSI soil maps (see Figure 2.9) show soils in the vicinity of the proposed development lands are classed as *“Tills derived from Devonian and Carboniferous sandstones”*. There is no alluvium soil noted within the proposed development lands.

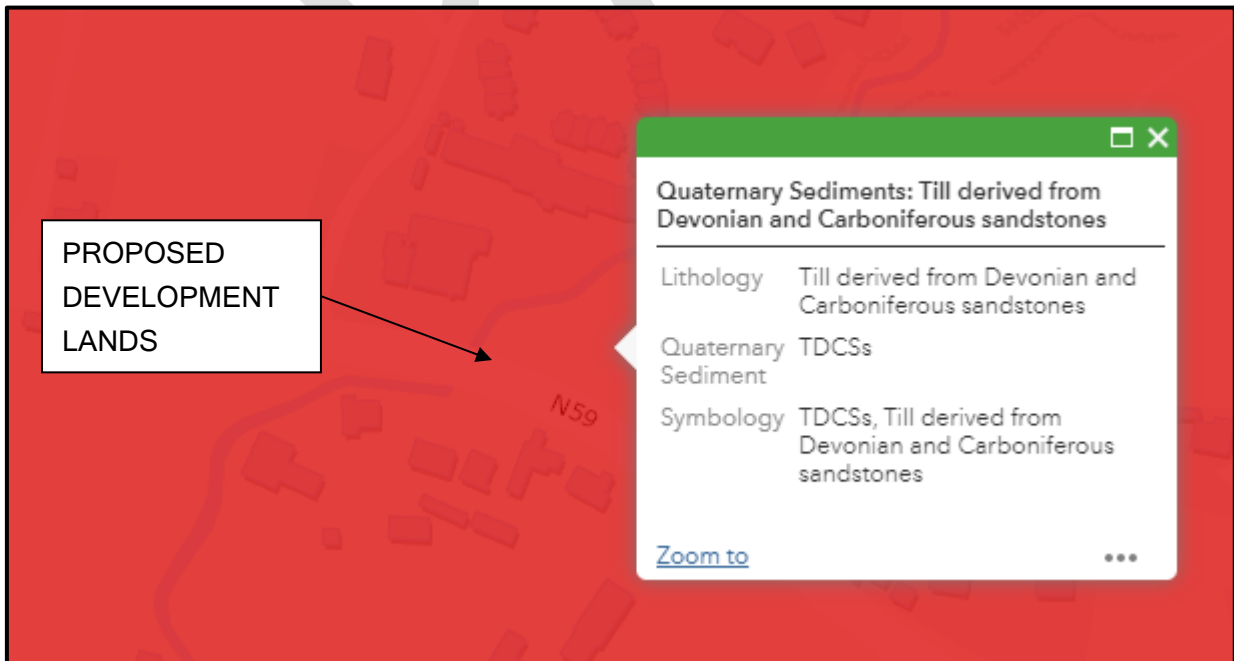


Figure 2.9 GSI Teagasc soils mapping

## 2.4 HYDROLOGY

### 2.4.1 HYDROLOGY

The Met Eireann average annual reference rainfall data (1981-2010) for the area is estimated as 1,809mm<sup>7</sup>.

### 2.4.2 SURFACE HYDROLOGY

Regionally the proposed development lands are located within the Western Basin District. A description of the drainage features and surface hydrology is included in section 2.2 above.

### 2.4.3 GROUNDWATER HYDROLOGY<sup>4</sup>

The area is classified as a *“Locally Important Aquifer- Bedrock which is Moderately Productive only in Local Zones”* (see Figure 2.10).

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<sup>7</sup> www.met.ie

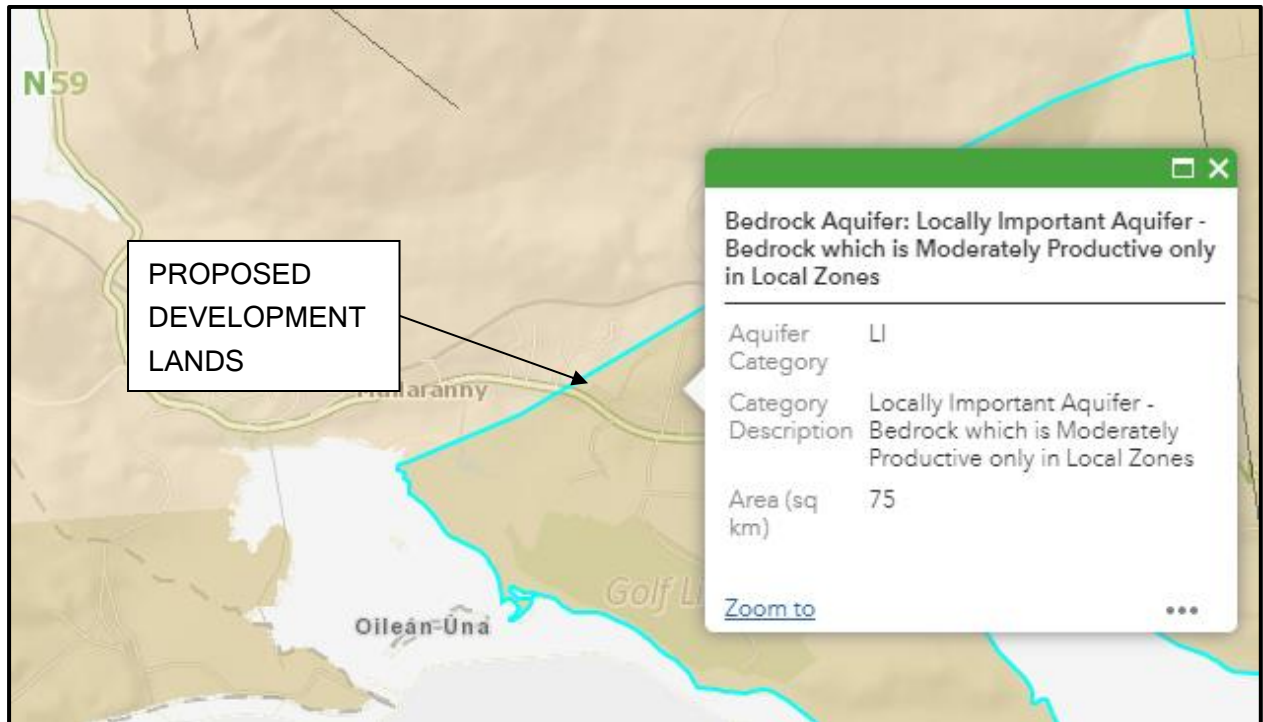


Figure 2.10 GSI groundwater aquifer mapping

The proposed development lands are located within the Mulranny groundwater body. The flow regime is noted as *"Poorly productive bedrock"*. The groundwater vulnerability is noted as *"Moderate"* and *"High"*. The recharge coefficient for the underlying aquifer is 60%.



## 3 FLOOD RISK ASSESSMENT - BACKGROUND INFORMATION

In order to inform the assessment of flood risk at the site, the following information sources were explored.

### 3.1 HISTORICAL FLOODING

#### 3.1.1 PUBLIC FLOODING RECORDS

Available historical flood maps and reports on floodmaps.ie and floodinfo.ie were consulted<sup>8</sup>. The floodmaps.ie mapping for the proposed development lands area is shown in Figure 3.1. The floodinfo.ie mapping for the proposed development land area is shown in Figure 3.2. There is one flood event noted in the vicinity of the proposed development lands. The flood event is a recurring localised flood event at a local depression on the N59 and not hydraulically linked to the proposed development lands. The flood event is located approximately 150m west of the proposed development lands.

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<sup>8</sup> [www.floodinfo.ie](http://www.floodinfo.ie) and [www.floodmaps.ie](http://www.floodmaps.ie)

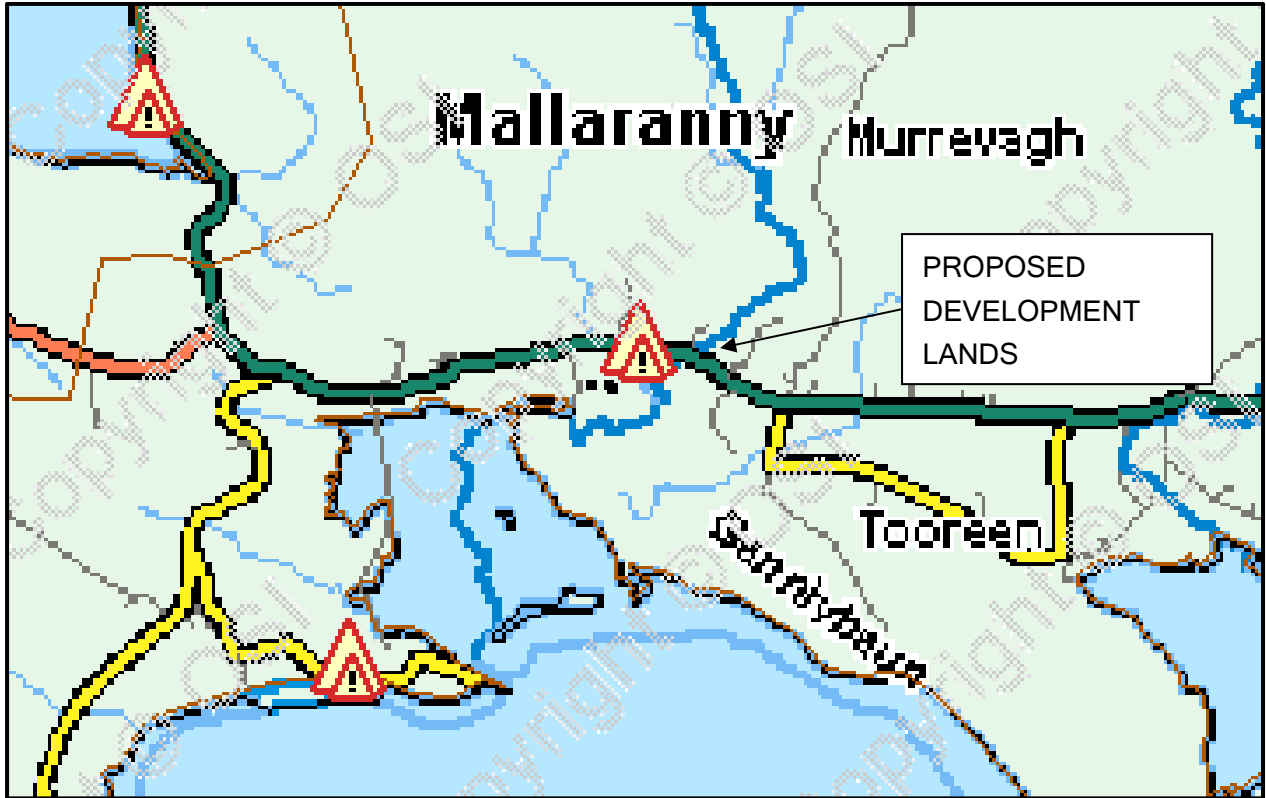


Figure 3.1 Floodmaps.ie

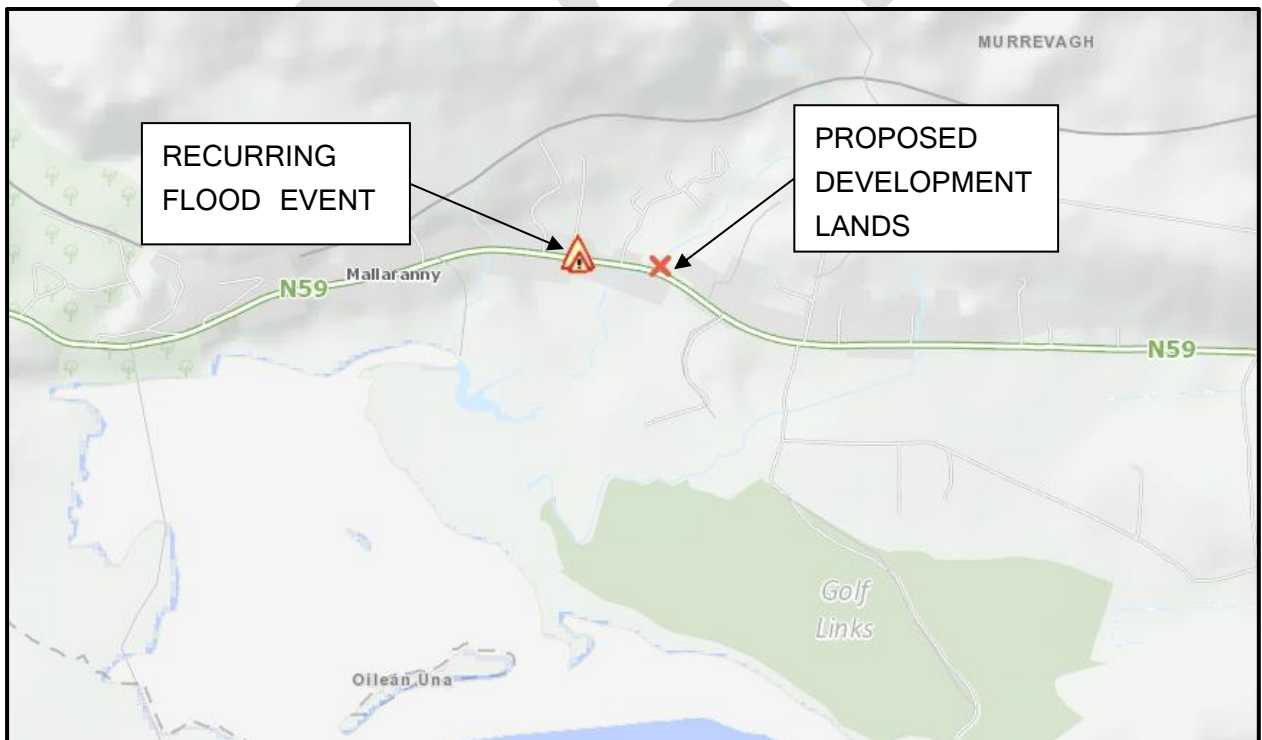


Figure 3.2 Floodinfo.ie

### 3.1.2 AERIAL PHOTOGRAPHICAL EVIDENCE

Not applicable.

### 3.1.3 ANECDOTAL EVIDENCE

#### SOURCE DESCRIPTION:

Local residents and societies may be able to provide knowledge on historic flood events and local studies etc.

#### SITE-SPECIFIC COMMENT:

The following anecdotal evidence was collected during the site survey by LCE.

*Local flooding issues were discussed with Ms. Teresa Keane a local who resides adjacent to the proposed development lands. Ms. Keane has lived in this area for two years and has never witnessed any flood waters encroach the proposed development lands or the N59 road and is not aware of any flooding issues in the area.*

*Local flooding issues were also discussed with Ms. Rose Doherty. She has lived in the vicinity of the proposed development lands for over 37 years. She has never witnessed any flood waters nearencroach the proposed development lands.*

*Local flooding issues were discussed with Ms. Mary Gallagher who works and has lived in the area all her life. She has never witnessed any flooding issues near or on the proposed development lands.*

### 3.1.4 COPERNICUS EMS MAPPING

Not applicable.

### 3.1.5 HISTORICAL FLOODING CONCLUSION

There is no recurring flooding issue in the vicinity of the proposed development lands. There is a localised issue caused by stormwater runoff. It is not hydraulically linked to the Murrevagh River.

## 3.2 OPW PFRA INDICATIVE FLOOD MAPS

### SOURCE DESCRIPTION:

The OPW Preliminary Flood Risk Assessment (PFRA) maps are preliminary flood risk maps as part of the Catchment Flood Risk Assessment and Management (CFRAM) programme. These maps highlight areas of potential flood risk.

### SITE-SPECIFIC COMMENT:

Available CFRAM PFRA flood maps were consulted<sup>9</sup>. The PFRA mapping for the proposed development lands area is shown in Figure 3.3.

The proposed development lands are located adjacent to an area noted as flooding locally during the 1 in 100 year pluvial event. However, these maps are at a very coarse resolution. A more accurate localised assessment shall be considered.

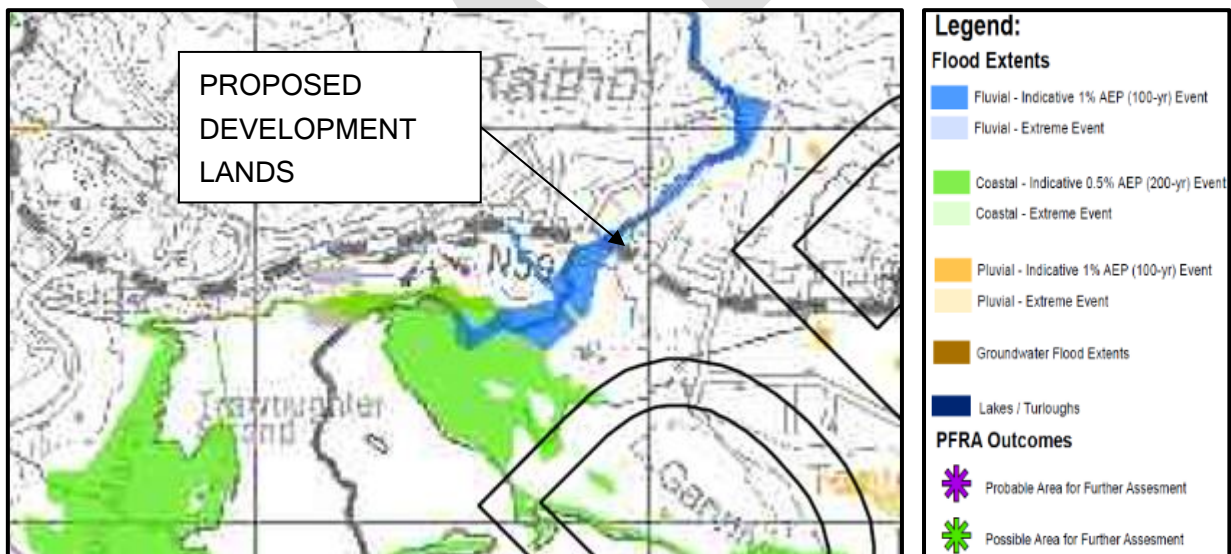


Figure 3.3 PFRA mapping

<sup>9</sup> OPW CFRAM data

### 3.3 PREDICTIVE FLOOD MAPS PRODUCED UNDER THE CFRAM STUDIES

#### SOURCE DESCRIPTION:

Predictive flood extent maps have been produced by the OPW as part of the Catchment Flood Risk Assessment and Management (CFRAM) programme. These maps highlight areas of potential flood risk, excluding and including an allowance for climate change.

#### SITE-SPECIFIC COMMENT:

Not applicable.

### 3.4 CONSULTATION WITH LOCAL AUTHORITIES

#### SOURCE DESCRIPTION:

The Local Authority may be able to provide knowledge on historic flood events and local studies etc.

#### SITE-SPECIFIC COMMENT:

Mr. Kieran Lynn, Area Engineer was contacted on the 17<sup>th</sup> of January 2020. LCE notified the area engineer that a flood risk assessment is currently being prepared for the proposed development lands. LCE requested feedback on historic flooding records. LCE await feedback on same.

### 3.5 HISTORIC ORDNANCE SURVEY MAPPING<sup>10</sup>

#### SOURCE DESCRIPTION:

Historical mapping often indicates areas liable to flooding.

#### SITE-SPECIFIC COMMENT:

Available historic maps were researched. The historical mapping for the proposed development lands area is shown in Figure 3.4 and Figure 3.5.

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<sup>10</sup> [www.osi.ie](http://www.osi.ie)

There is no reference to historical flooding in the vicinity of the proposed development site.

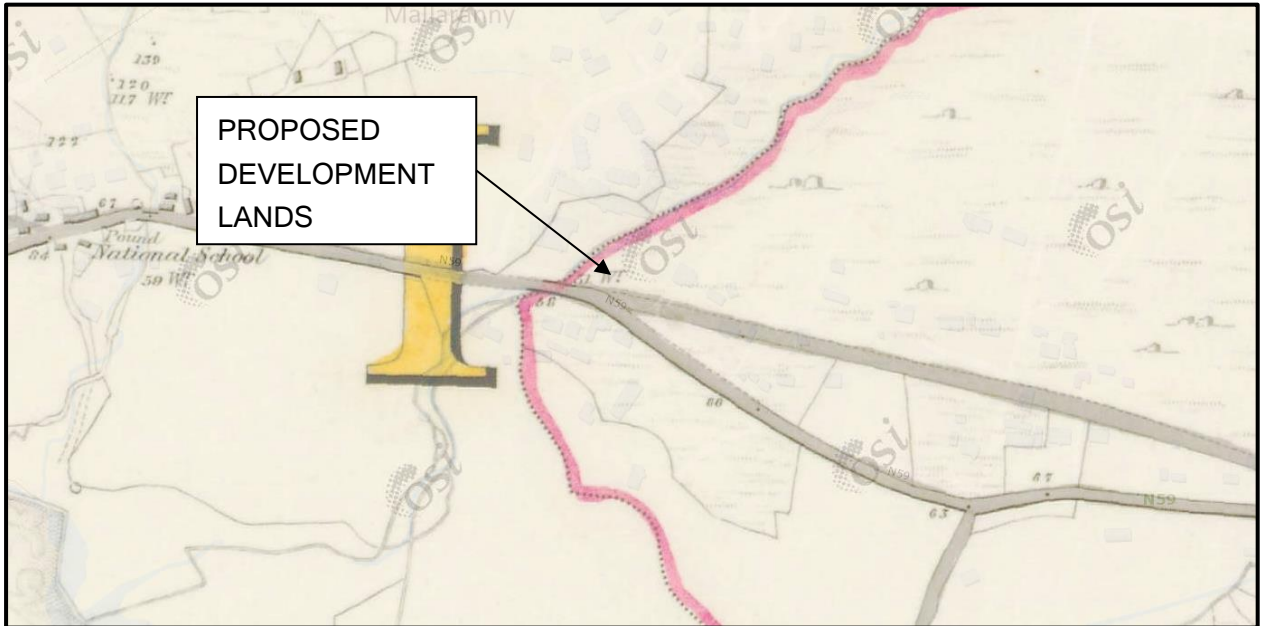


Figure 3.4 OSI Historical 6-Inch colour (1829-41)

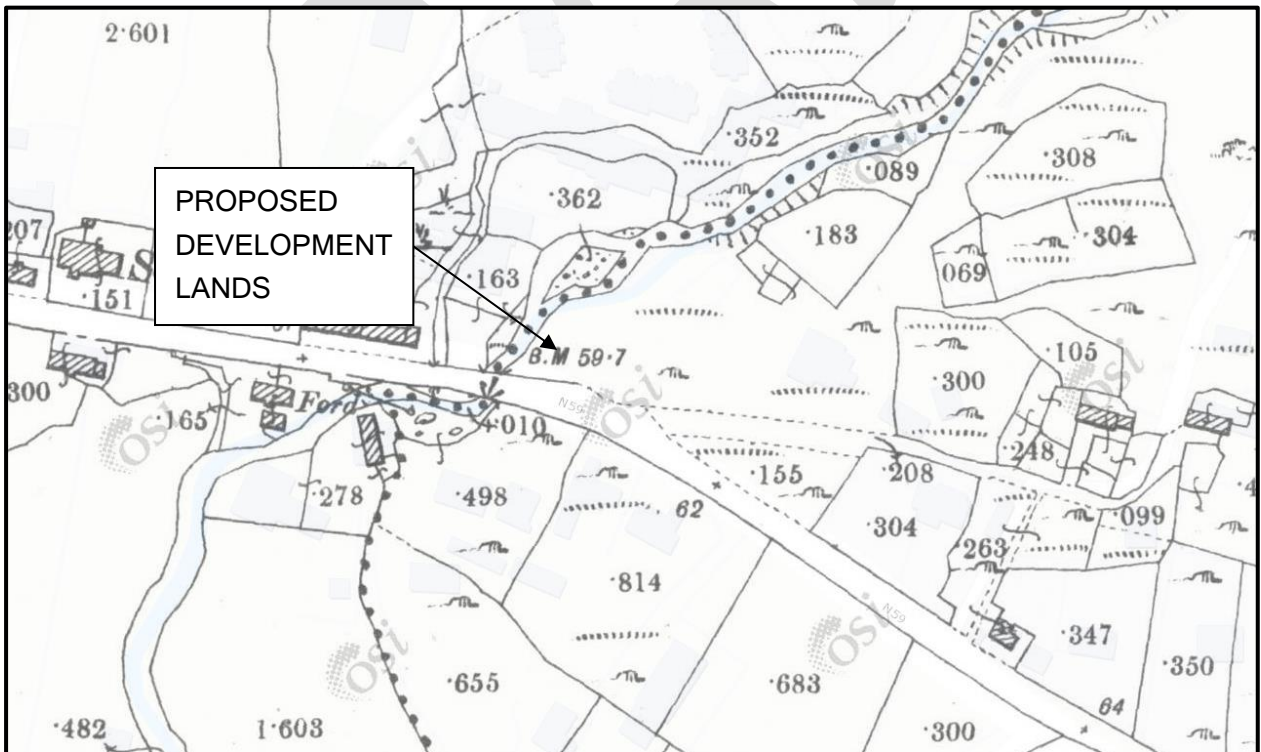


Figure 3.5 OSI Historical 25-Inch B&W (1897-1913)

### 3.6 RIVER BASIN MANAGEMENT PLANS AND REPORTS

#### SOURCE DESCRIPTION:

The Water Framework Directive was adopted by the EU in order to halt and reverse the decline in water quality. The Directive sets very strict deadlines for meeting water quality objectives, especially in protected areas. The River Basin Management Plans (RBMP) outline what is required in order to achieve the objectives of the Directive in the various River Basin Districts.

#### SITE-SPECIFIC COMMENT:

The RBMP for Ireland (2018-2021) was published in April 2018.<sup>11</sup> The RBMP does not contain any information or requirements which impact directly on this site-specific FRA. In line with the objectives of the RBMP all flood mitigation measures should be designed to consider the potential impact of possible measures on water bodies.

Where necessary, surface water run-off from the proposed development should be attenuated on-site, prior to discharge to the adjacent land drain. This will reduce the quantity of water to be disposed of to the existing land drains in the vicinity. On-site stormwater attenuation will reduce the quantity of water entering the adjacent land drain during extreme events.

Petrol interceptors and catch pits should be installed for surface water run-off during the operation of the proposed developments to prevent contaminants from entering the system.

All site drainage should be designed in accordance with Sustainable Drainage systems (SuDS) principles.<sup>12</sup>

### 3.7 BENEFITTING LANDS

#### SOURCE DESCRIPTION:

Benefiting land maps illustrate lands which have broadly benefited from arterial drainage campaigns historically.

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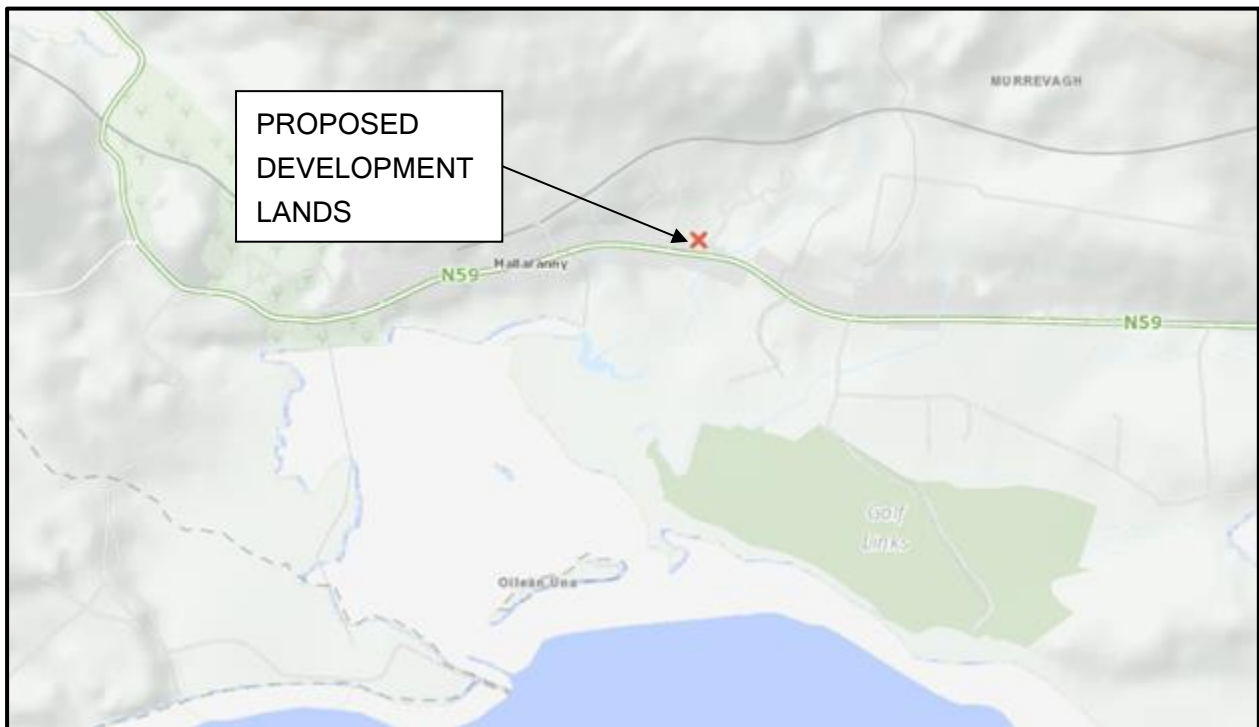
<sup>11</sup> River Basin Management Plan for Ireland 2018-2021, as prepared by the Department of Housing, Planning and Local Government, April 2018.

<sup>12</sup> CIRIA C609 Sustainable drainage systems.



**SITE-SPECIFIC COMMENT:**

The lands of the proposed development lands are not identified on the Arterial Drainage mapping as having benefitted by drainage works carried out historically by the OPW.



**Figure 3.6 Arterial Drainage Scheme**

**3.8 NATIONAL COASTAL PROTECTION STRATEGY STUDY****SOURCE DESCRIPTION:**

The National Coastal Protection Strategic Study maps highlight areas of potential flood risk from extreme tidal events, including storm surge.

**SITE-SPECIFIC COMMENT:**

Not applicable.



### 3.9 PREVIOUS STRATEGIC FLOOD RISK ASSESSMENTS

#### SOURCE DESCRIPTION:

Where necessary, Strategic Flood Risk Assessments (SFRA) have been carried out by Local Authorities in order to address flood risk in planning of future development.

#### SITE-SPECIFIC COMMENT:

A SFRA is included in the Mayo County Development Plan 2014-2020<sup>13</sup>. The SFRA mapping doesn't cover the proposed development lands. The mapping is based on the PFRA mapping as discussed above. As required by the SFRA, lands within an area of flood risk require a site-specific FRA. A detailed site-specific FRA is provided in this report to further investigate the extent of the flood risk as the site.

### 3.10 EXPERT ADVICE FROM THE OPW

#### SOURCE DESCRIPTION:

As the state agency responsible for flood risk management, the OPW provides expert advice on available flood risk data.

#### SITE-SPECIFIC COMMENT:

Not applicable as per the "Planning System and Flood Risk Management Guidelines". However, as part of this Flood Risk Assessment services, LCE are in regular contact with the OPW to avail of the latest information available for flood risk assessment.

### 3.11 TOPOGRAPHICAL MAPS

#### SOURCE DESCRIPTION:

Topographical maps, in particular digital elevation models produced by aerial survey or ground survey techniques. These maps provide greater accuracy for site-specific flood extent based on river and coastal modelling.

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<sup>13</sup> Strategic Flood Risk Assessment for the Draft Mayo County Development Plan 2014-2020.

**SITE-SPECIFIC COMMENT:**

LCE's site survey is used to develop flood zone mapping, as described in section 4 below.

Site-specific flood zone mapping is included in Appendix C of this report.

**3.12 INFORMATION ON FLOOD DEFENCE****SOURCE DESCRIPTION:**

Site survey/ walkovers provide details of existing flood defences, their condition and performance.

**SITE-SPECIFIC COMMENT:**

There were no flood defences noted during the site inspection.

**3.13 GEOLOGICAL SURVEY OF IRELAND MAPPING****SOURCE DESCRIPTION:**

Alluvial deposit maps of the GSI (which would allow the potential for the implementation of source control and infiltration techniques, groundwater and overland flood risk to be assessed). These maps, while not providing full coverage, can indicate areas that have flooded in the past, (source of alluvium) and may be particularly useful at the early stages of the FRA process where no other information is available.

**SITE-SPECIFIC COMMENT:**

Not applicable as per the "Planning System and Flood Risk Management Guidelines". However, available GSI mapping was researched<sup>4</sup>. See the information provided in section 2 above.

### 3.14 WALKOVER SURVEY

#### SOURCE DESCRIPTION:

To assess potential sources of flooding, likely routes for flood waters and the site's key features, including flood defences, and their condition.

#### SITE-SPECIFIC COMMENT:

A walkover survey was conducted. Details of the site characteristics are included in section 2 of this report.

### 3.15 NATIONAL, REGIONAL AND LOCAL SPATIAL PLANS

#### SOURCE DESCRIPTION:

Development plans and LAPA provide key information on existing and potential future receptors.

#### SITE-SPECIFIC COMMENT:

Not applicable.

## 4 HYDROLOGY<sup>141516</sup>

### 4.1 RAINFALL AND SOILS

The observed long-term annual total rainfall at the subject catchment is as detailed in section 2.4. The stream catchment area falls under the Flood Study Update (FSU) BFISOIL index value of 0.3354.

### 4.2 CATCHMENT CHARACTERISTICS

The upstream catchment area for the Murrevagh River at the proposed development lands is approximately 3.322km<sup>2</sup>. Lands in the catchment are mountainous and rural in nature as shown in Figure 4.1 below. There is minimal urban area in this catchment.



Figure 4.1 View of the adjacent river catchment<sup>14</sup>

<sup>14</sup> Flood Studies Update (FSU) Programme, OPW 2014.

<sup>15</sup> FSU- 7 Variable (Murphy, 2009)

<sup>16</sup> Comment on Estimation of Greenfield Runoff Rates, A.M Cawley & C. Cunnane, 2003.

### 4.3 FLOW MODELLING

The catchment associated with the proposed development is ungauged. The following flow estimation methods were analysed for the subject development site:

- FSU 7- variable (Murphy, 2009)

The FSU Method is deemed the most appropriate estimation method for the 100 year return period event and the 1000 year return period event.

#### 4.3.1 DESIGN FLOW ESTIMATE

Table 4.1 below presents the estimated 1 in 100 year and 1 in 1000 year return period design flood flows for the subject stream catchment, using the above methods.

**Table 4.1  $Q_{BAR}$  and return period flows**

Flows	Flow Estimation
	(m <sup>3</sup> /sec)
$Q_{100}$ (excl. climate change allowance)	2.49
$Q_{1000}$ (excl. climate change allowance)	4.96
$Q_{1000}$ (incl. climate change allowance)	5.95

### 4.4 HYDRAULIC MODELLING AND DESIGN FLOOD LEVEL ESTIMATION

#### 4.4.1 GENERAL

To estimate the return period flood levels in the vicinity of the proposed development a HEC-RAS hydraulic model was developed for the Murrevagh River.

The geometrics of the river channel was obtained during the LCE topographical survey.

#### 4.4.2 HYDRAULIC MODEL

The subject watercourse channel has bottom widths varying from 3 to 5m and top widths varying from 6 to 7m. The depths of the river channel vary from 1 to 3m. The river slope is 1 in 492. The channel bed materials comprise of exposed cobbles and rocks and have a number of natural weirs along the modelled reach of the river channel.

A Manning's 'n' value of 0.035 for the main channel and 0.035 for the over banks were specified in the model along with channel expansion and contraction coefficients of 0.1 and 0.3.

Considering the slope of the watercourse and the bridge geometrics, it is assumed the bridges will have negligible impact on the river conveyance capacity adjacent to the proposed development lands.

The HEC-RAS model simulation (steady state) was carried out for the 1 in 100 year and 1 in 1000 year flood events.

The HEC-RAS model output graphs for the above events are provided in the Appendix B of this report.

#### 4.4.3 FLOOD LEVEL ESTIMATION

The predicted 1 in 100 year and 1 in 1000 year return period modelled flood levels vary along the river length. As the river has a sharp gradient the site has been modelled based on four cross sections. Modelling confirms maximum estimated flood waters for the analysed storm return periods is significantly below the existing banks levels at cross sections 1, 2, and 3. The flood levels at the proposed development lands for the present day scenario for the subject watercourse are shown in Table 4.2 below.

**Table 4.2 Flood level estimates (excl. climate change)**

Return Period	Subject watercourse Section 1	Subject watercourse Section 2	Subject watercourse Section 3	Subject watercourse Section 4
	(mOD)	(mOD)	(mOD)	(mOD)
Q <sub>100</sub>	+20.24	+17.73	+16.49	+14.72
Q <sub>1000</sub>	+20.44	+17.90	+16.64	+14.91

The predicted 1 in 1000 year return period modelled site flood levels for the subject watercourse, including climate change, are shown in Table 4.3 below.

**Table 4.3 Flood level estimate (incl. climate change)**

Return Period	Subject watercourse Section 1	Subject watercourse Section 2	Subject watercourse Section 3	Subject watercourse Section 4
	(mOD)	(mOD)	(mOD)	(mOD)
Q <sub>1000 +cc</sub>	+20.51	+17.96	+16.69	+14.97

## 5 FLOOD RISK ASSESSMENT

### 5.1 FLOOD SOURCES AT THE SITE

The following potential flood sources exist at the site:

- a) Fluvial flooding from the adjacent watercourse; and
- b) Pluvial flooding from rainfall and surface water run-off.

The primary flood source to the site is a fluvial risk from the Murrevagh River.

A secondary flood risk exists from storm water generated within the proposed development lands. Storm water design and management of surface water will be the critical factor in the mitigation of this type of flood risk at the site.

The lands of the proposed development lands are not identified on the Arterial Drainage mapping as having benefitted by drainage works carried out historically by the OPW.

### 5.2 FLOOD ZONES

#### 5.2.1 ZONE DEFINITIONS

The “Planning System and Flood Risk Management Guidelines” as published in November 2009 by the Department of the Environment, Heritage and Local Government use three different flood zones to define areas of flood risk<sup>1</sup>. Flood zones are geographical areas within which the likelihood of flooding is in a particular range and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning.

There are three types or levels of flood zones defined for the purposes of these guidelines:

Flood Zone A - where the probability of flooding from rivers and the sea is highest (greater than 1 in 100 year for river flooding and 1 in 200 year for coastal flooding). Only water-compatible development, such as docks and marinas, dockside activities that require a waterside location, amenity open space, outdoor sports and recreation, would be considered appropriate in this zone.

Flood Zone B - where the probability of flooding from rivers and the sea is moderate (between 1 in 1000 year and 1 in 100 year for river flooding and between 1 in 1000 year and 200 year for coastal flooding). Less vulnerable development, such as retail, commercial and industrial uses, sites used for short-let for caravans and camping and secondary strategic transport and utilities infrastructure, and water-compatible development might be considered appropriate in this zone.

Flood Zone C - where the probability of flooding from rivers and the sea is low (less than 1 in 1000 year for both river and coastal flooding). Development in this zone is

appropriate from a flood risk perspective (subject to assessment of flood hazard from sources other than rivers and the coast).

## 5.2.2 FLOOD ZONE LEVELS

Flood zones are defined on the basis of the 1 in 100 year and 1 in 1000 year extreme water levels from the site specific HEC-RAS model prepared as part of this assessment. Results from the model together with site-specific topographical survey data was used to establish flood zoning at the proposed development lands.

**Table 5.1 Flood zone level**

Flood Zone	Flood Probability	Level (mOD) Section 1	Level (mOD) Section 2	Level (mOD) Section 3	Level (mOD) Section 4
A	Greater than 1% (1 in 100 year)	Below +20.24	Below +17.73	Below +16.49	Below +14.72
B	1% (1 in 100 year) to 0.1% (1 in 1000 year)	+20.24 to +20.44	+17.73 to +17.90	+16.49 to +16.64	+14.72 to +14.91
C	Smaller than 0.1% (1 in 1000 year)	Above +20.44	Above +17.90	Above +16.64	Above +14.91

The flood zones for the site are outlined on drawing no. 19167-DG-2301 in Appendix C. These flood zones are based on the levels in Table 5.1 above and the existing site levels from topographical surveys. Some interpolation was required to establish contours for flood zone extents.

All areas subject to development have been zoned. All of the proposed development site is classified as within Zone C.

## 5.3 DESIGN FLOOD LEVEL

The estimated safe design flood level for the proposed dwellings depends on the proposed locations, see flood zone map drawing no. 19167-DG-2301 in Appendix C. This is the 1 in 1000 year flood level, including climate change, a freeboard factor and a model uncertainty factor to provide a margin of safety in design. LCE recommend the damp proof membranes for all structures is constructed 0.1 meters above the safe design flood level.

The access and egress routes for the proposed development depends on proposed locations, see flood zone map drawing no. 19167-DG-2301 in Appendix C.



## 5.4 RESIDUAL RISK

There is a residual flood risk at the proposed development lands inherent in the design and maintenance of the drainage network. This residual risk is mitigated through freeboard; however, all findings are subject to adequate design and maintenance of drainage networks and flood defences.

## 5.5 APPROPRIATENESS OF DEVELOPMENT

[HOLD]

## 5.6 IMPACT OF DEVELOPMENT OF FLOODING ELSEWHERE

All site surface water management design should consider the impact of any discharge on flooding elsewhere. The final stormwater system should be designed by appropriately qualified and experienced personnel. [HOLD]

## 6 CONCLUSIONS AND GENERAL RECOMMENDATIONS

### 6.1 CONCLUSION

The primary source of flood risk in this area is fluvial flooding from the Murrevagh River which forms the eastern boundary of the proposed development lands.

There is no record of any significant flood history in the vicinity of the proposed development site by a statutory body. There is no flood history noted anecdotally by residents met during survey.

Adequate configuration of proposed ground levels and surface water management design can mitigate against any flooding on the site from the adjacent watercourses.

Lands in the proposed development lands are not identified on the Arterial Drainage mapping as having benefitted by drainage works carried out historically by the OPW.

The site has been zoned based on the OPW "Planning System and Flood Risk Management Guidelines". The proposed development is located predominantly in Zone C. The proposed development is considered appropriate for its flood zone classification.

Based on the location of the proposed development, the existing ground levels and the estimated flood extents, the proposed development is likely to have negligible impact on the flood storage in the area. [HOLD]

### 6.2 RECOMMENDATIONS

The estimated safe design flood level for the proposed dwellings depends on the proposed locations, see flood zone map drawing no. 19167-DG-2301 in Appendix C.

There should be no net change in flood storage volume in the proposed development. Where necessary, surface water run-off from the proposed development should be attenuated on-site, prior to discharge to the adjacent watercourse. All site drainage should be designed in accordance with Sustainable Drainage systems (SuDS) principles.

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Analysis contains inherent uncertainty. LCE recommends the application of the upper bound flood level estimate from all analysis, and the inclusion of a min. of 500mm freeboard. Selection of mid-range estimates and lesser freeboard is at the risk of the client and the planning authority. All information relating to drainage and water networks assumes ongoing maintenance of the network and removal of obstructions to flow.

This report is based on available CFRAM and FSU data at the time of appointment. The client is responsible for the cost of any additional services resulting from any CFRAM and FSU updates after this date.

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# APPENDIX A

## PROPOSED SITE DEVELOPMENT DRAWINGS

# APPENDIX B HECRAS MODEL OUTPUT

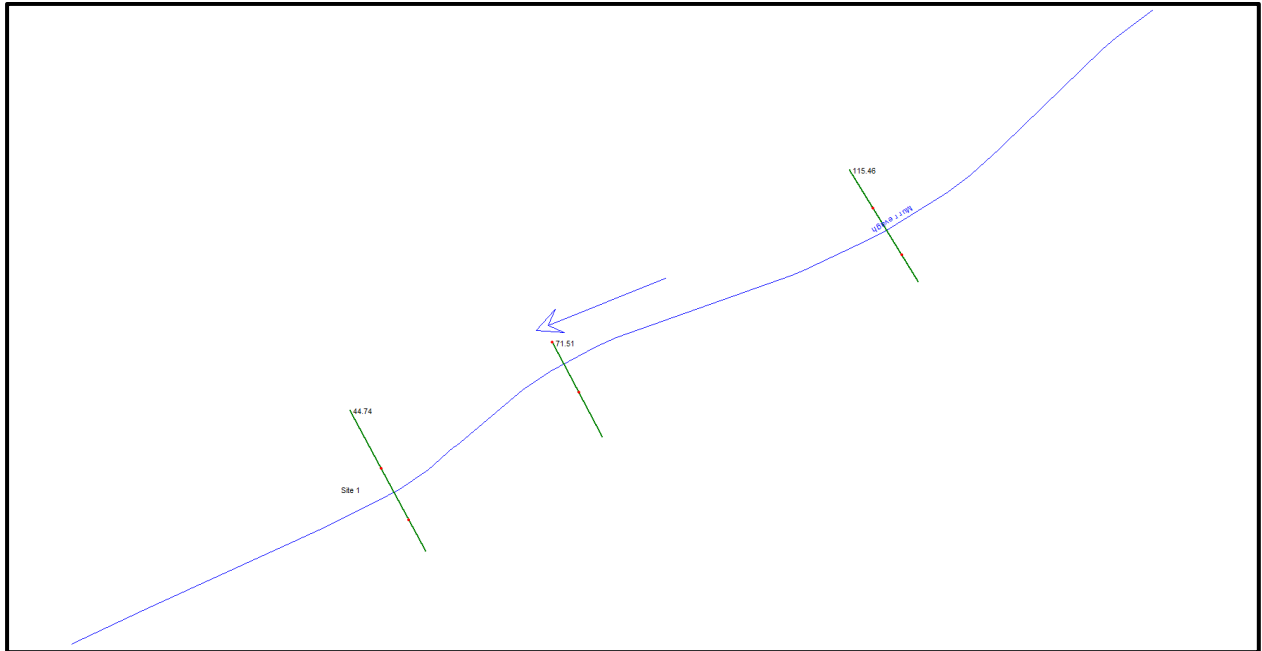


Figure B.1 HEC-RAS Model overview proposed scenario

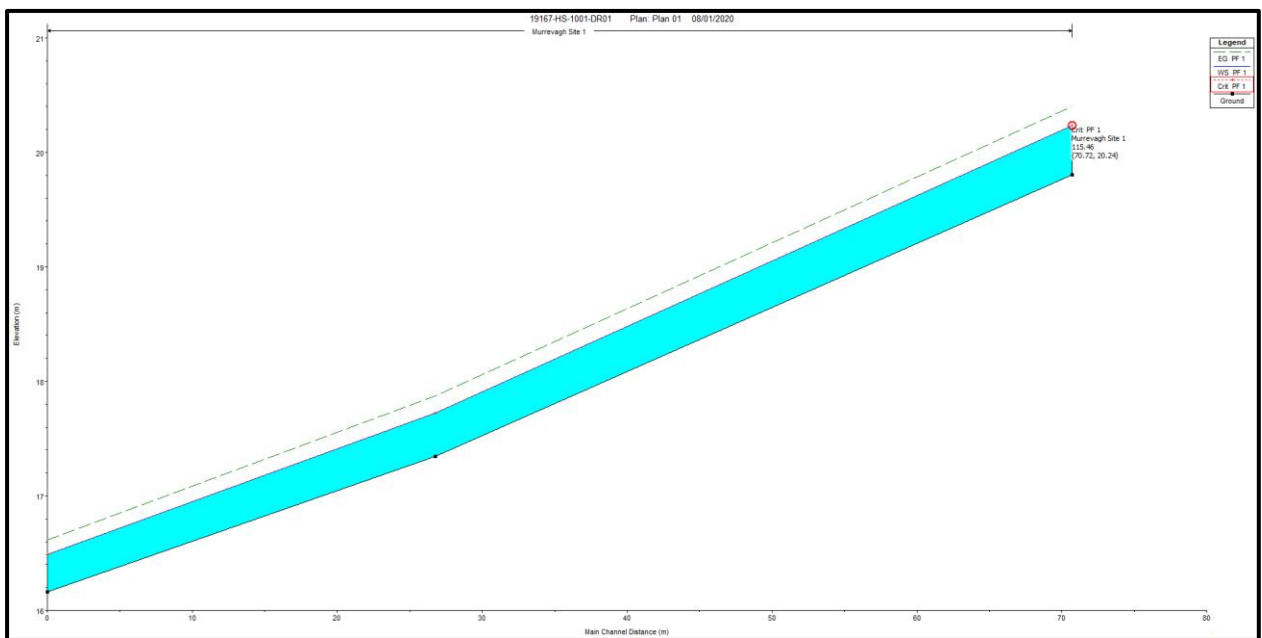
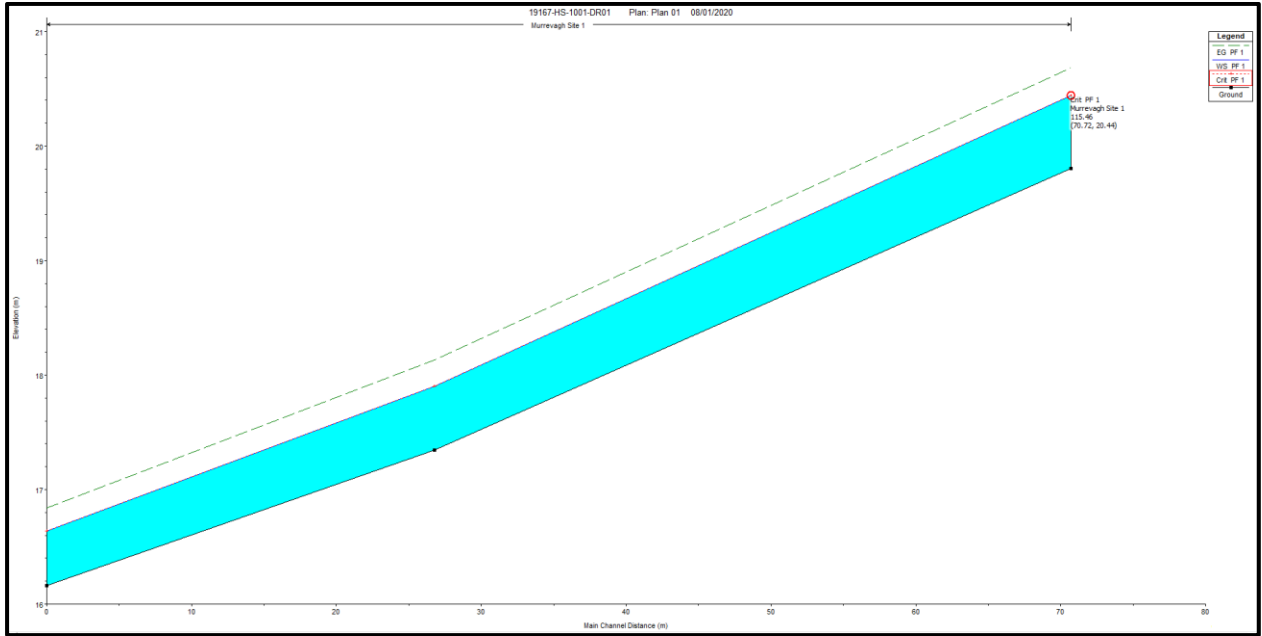
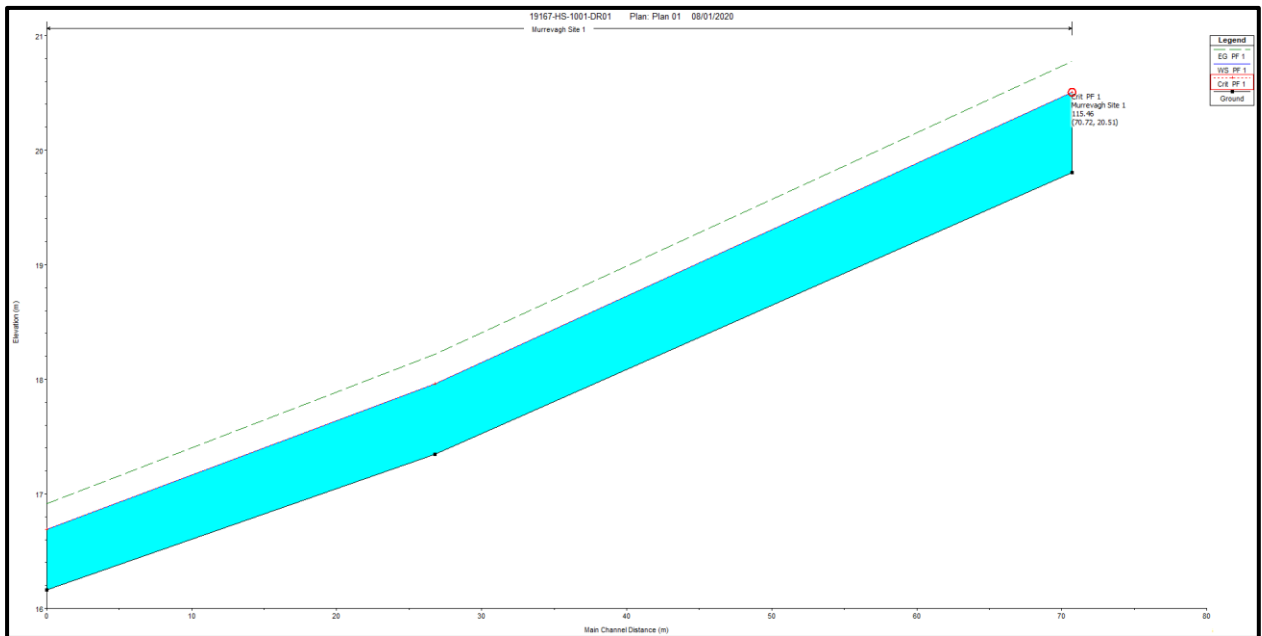


Figure B.2 HEC-RAS Model Longsection: 1 in 100 year flood profile



**Figure B.3 HEC-RAS Model Longsection: 1 in 1000 year flood profile**



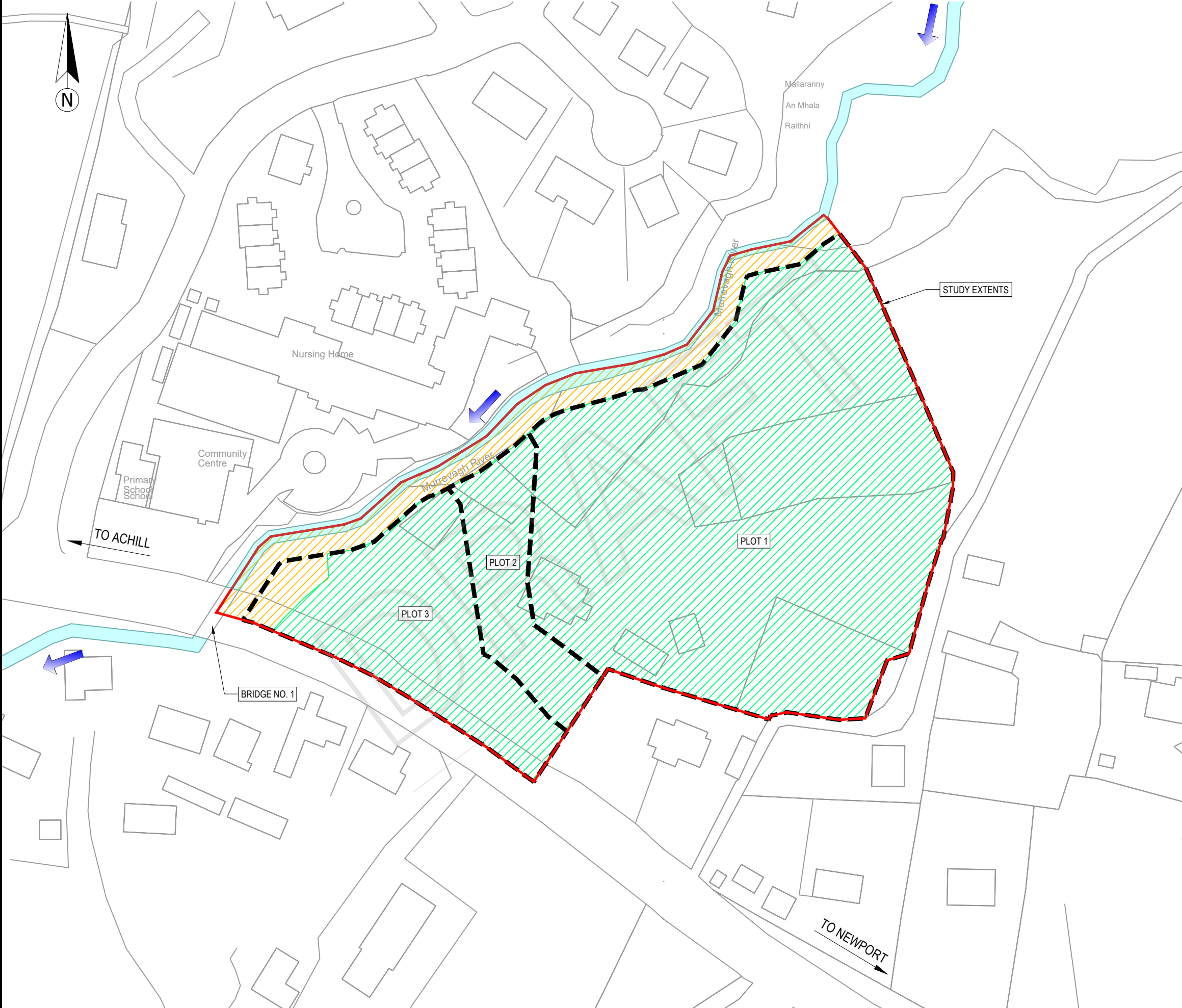
**Figure B.4 HEC-RAS Model Longsection: 1 in 1000 incl. CC year flood profile**

# APPENDIX C

## FLOOD RISK ASSESSMENT ZONE MAP



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- NOTES:**
1. ALL DIMENSIONS IN METERS UNLESS OTHERWISE NOTED.
  2. ALL COORDINATES ARE IN METERS AND RELATE TO ITM (IRISH TRANSVERSE MERCATOR) UNLESS OTHERWISE NOTED.
  3. ALL LEVELS IN METERS ARE RELATIVE TO ORDNANCE DATUM MALIN HEAD (OSGM02).
  4. DO NOT SCALE FROM DRAWINGS, USE FIGURED DIMENSIONS ONLY. ALL DIMENSIONS SHALL BE CONFIRMED ON SITE.
  5. DRAWINGS ARE FOR THE PURPOSES OUTLINED IN THE TITLE BOX ONLY.
  6. DRAWINGS ARE BASED ON SITE SURVEY INFORMATION AND OSI VECTOR MAPPING (2020).
  7. SITE LOCATION REFERENCE X = 483962 ; Y = 796746 (ITM)

**LEGEND**

<b>ZONE A</b>	
<b>ZONE B</b>	
<b>ZONE C (ELEVATION VARIES)</b>	

**FLOOD DESIGN LEVEL TO BE =>**

- +21.1 ODM (PLOT 1)
- + 18.5 ODM (PLOT 2)
- + 17.2 ODM (PLOT 3)

**PRELIMINARY**

THIS DRAWING TO BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATIONS AND REPORTS.

15/01/20	DR01	GC	JL	DRAFT ISSUE
DATE	REV	BY	CHK	DESCRIPTION

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PROJECT TITLE: PROPOSED RESIDENTIAL DEVELOPMENT	DATE: JAN 2020
AT: MULRANNY CO MAYO	DWG No: 2301
CLIENT: MAYO COUNTY COUNCIL	SCALE: 1:1000 @A3
JOB NUMBER: 19167	DRAWING BY: GC
DRAWING TITLE: FLOOD ZONE MAP	CHECKED BY: JL
REVISION:	DR01

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