Rathmullan, Co. Meath

Flood Risk Assessment

Final Report

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www.jbaconsulting.ie

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Contract

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Purpose

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Abbreviations

AEP ..... Annual Exceedance Probability
CDP..... County Development Plan
CFRAM ..... Catchment Flood Risk Assessment and Management
DoEHLG ..... Department of the Environment, Heritage and Local Government
FRA ..... Flood Risk Assessment
GSI ..... Geological Survey of Ireland
LAP ..... Local Area Plan
LDP ..... Local Development Plan
OPW ..... Office of Public Works
PFRA ..... Preliminary Flood Risk Assessment
SFRA ..... Strategic Flood Risk Assessment
mOD ..... Meters above Ordinance Datum

1 Overview

Under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009) proposed development must undergo a Flood Risk Assessment to ensure sustainability and effective management of flood risk. This requires a review of all available flood information and assessment of Flood Zones for the development site.

1.1 Term of Reference and Scope

JBA Consulting was appointed by Trailford Limited to prepare a Flood Risk Assessment (FRA) for the proposed development in Rathmullan, Co. Meath.

1.2 Aims and Objectives

This study is being completed to assess the level of flood risk to the proposed site. It aims to identify, quantify and communicate to the applicant, Planning Authority officials and other shareholders, the risk of flooding to land, property and people and the measures required to manage the risk. The objectives are to:

- Identify potential sources of flood risk,
- Confirm the level of flood risk and identify key hydraulic features,
- Assess the impact that the proposed development has on flood risk in adjacent areas,
- Develop appropriate flood risk mitigation and management measures which will allow for the development to appropriately manage flood risk.

1.3 Development Proposal

The proposed development consists of a Strategic Housing Development on residential zoned lands west of Drogheda town centre. The accommodation provided on the site consists of;

- 661 residential units with a crèche and retail unit.

The application includes all associated infrastructure necessary to service the above. This includes a network of foul water and storm water pipes, watermains, and a network of roads and footpaths.

The total surfaced area of the proposed development, including roads, roofs, and other paved areas is approximately 10.39 Ha.

The proposed estate road levels around the site range from 18.73 to 36.50 m OD Malin and proposed finished floor levels range between 19.25 to 36.50 m OD Malin.

The main access for the site will be provided via a new 4 arm signalised junction with arms linking the Rathmullan Road (East), the Rathmullan Road (West) the proposed site access and the local access road to the south of the signalised junction. A second access into the housing development is proposed via a new priority junction to the south of the site onto the existing local access road.

The design and layout of the proposal has been prepared to fully comply with the current relevant design standards and specifications applicable to this form of development. The applicant has drawn upon considerable experience in the design and implementation of such proposals.

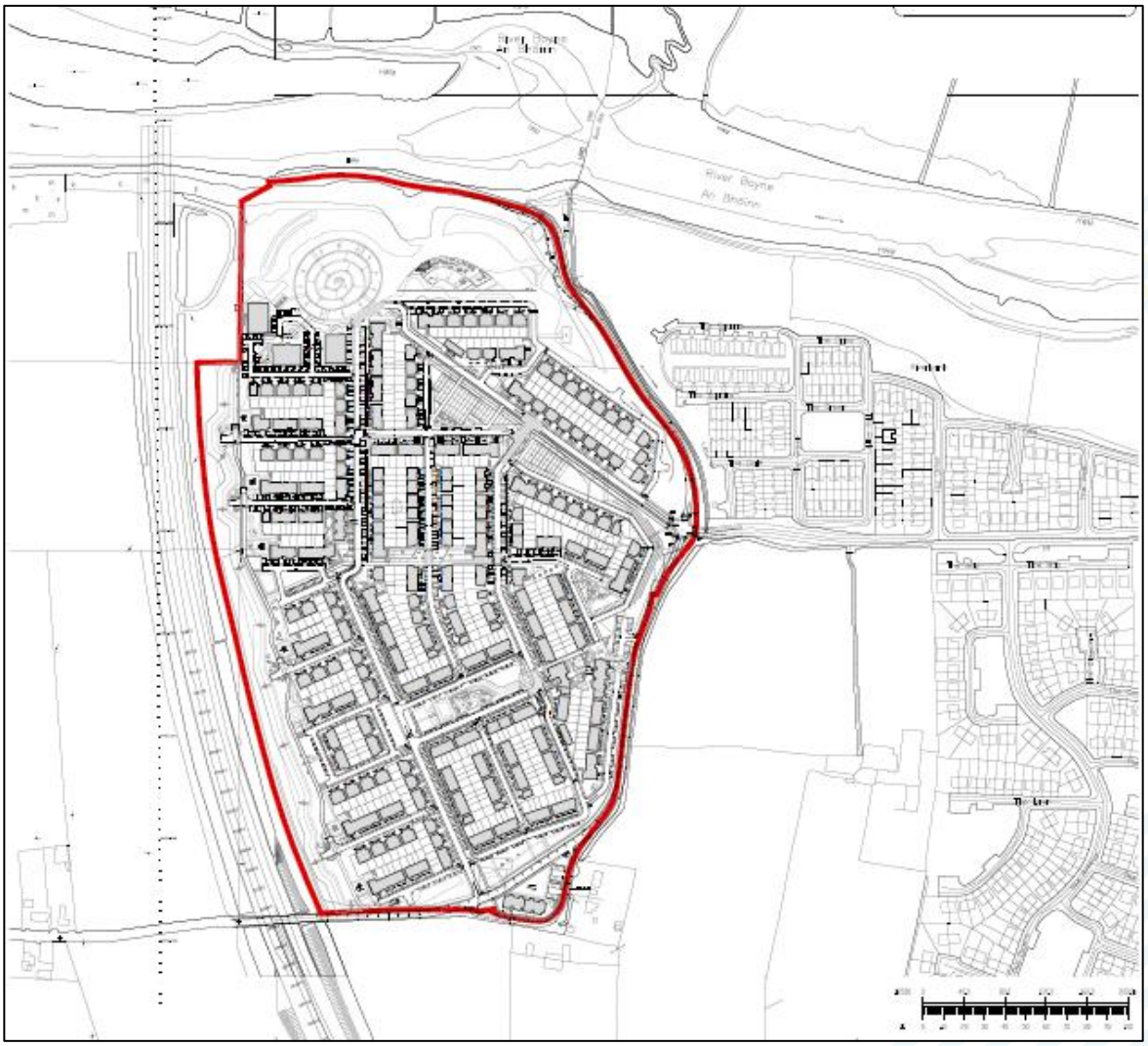


Figure 1-1: Development Proposal Layout (extract from Waterman Moylan)

2 Site Background

2.1 Location

The site is located on the western fringe of Drogheda, Co. Meath. It is situated south of the River Boyne between the M1 Motorway and Rathmullan Road. Riverbank and Highlands residential estates are neighbouring developed areas to the east of the site. The site is currently greenfield with further agricultural fields to the south and west of the site intersected by the M1 Motorway. The site location is shown in Figure 2-1.

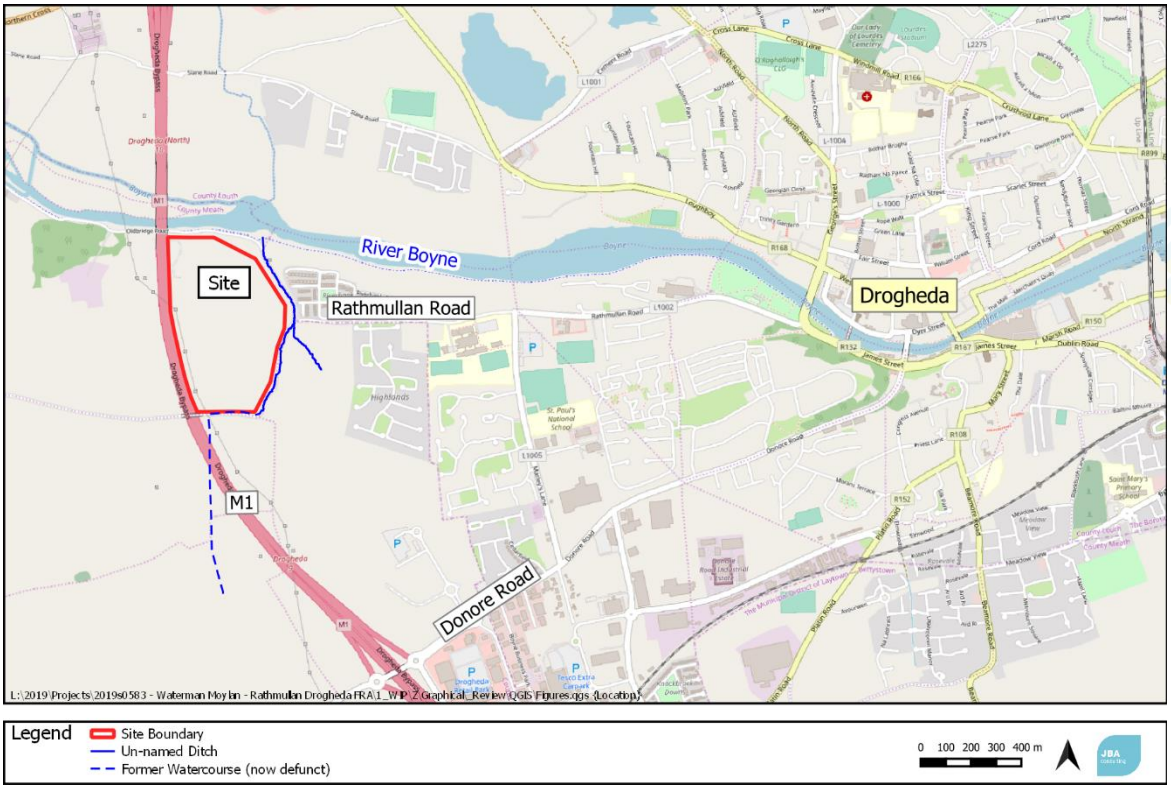


Figure 2-1: Site Location

2.2 Watercourses

There are two identified watercourses within the vicinity of the site.

1 River Boyne

The River Boyne flows from west to east adjacent to the northern boundary of the site. The River Boyne is approximately 112km long flowing from Trinity Well, Newberry Hall, near Carbury in County Kildare and discharges into the Irish Sea between Mornington and Baltray just downstream of Drogheda. The total catchment area is approximately 2,695km^2.

2 Un-named ditch

Located adjacent to Rathmullan Road there is an un-named ditch running in a south-north direction as identified in Figure 2-1. This ditch is a dry feature which does not appear to have any active hydraulic connectivity with lands to the south of the site. Prior to construction of the M1 motorway this ditch formed the lower reach of a watercourse originating to the south west of the site, however significant cutting required for the M1 has disconnected this former watercourse (see Figure 2-1).

As discussed further in Section 2.5, flows from the upper catchment of the former watercourse are now incorporated into the surface water drainage network of the M1 and do not continue to flow into the now defunct ditch. Photographs taken from site provided in Section 2.6 confirm the current disconnected status of the ditch and that it is no longer a functional fluvial watercourse adjacent to the site.

2.3 Topography

As shown in Figure 2-2, the construction of the M1 motorway has significantly altered the natural drainage direction of the lands to the south of the site.

Lidar surveyed by FUGRO-BKS from May 2010-May 2011 is publicly available from Open Topographic Data Viewer provided by Transport Infrastructure Ireland. The LiDAR as shown in Figure 2-2 confirms the cutting of the M1 motorway to a depth of approximately 4-5m below natural levels within the vicinity of the site. An open surface water collection drain intercepts surface water flow on the western side of the M1 and redirects flow into the M1 piped surface water drainage network running north to outfall into the River Boyne. This restricts the naturally draining catchment of the un-named ditch to the eastern side of the M1 with an area of approximately 0.8km^2. Of this area, only 0.15km^2 is located upstream of the site. Figure 2-3 provides a topographic cross-section illustrating the severe cutting of the M1 below natural ground levels.

The cross-section profile in Figure 2-4 shows the significant fall in elevation from south to north across the site with existing ground levels dropping by approximately 30m across the site. The northern boundary of the site still remains at elevation at approximately 10mOD, before dropping steeply down to the River Boyne.

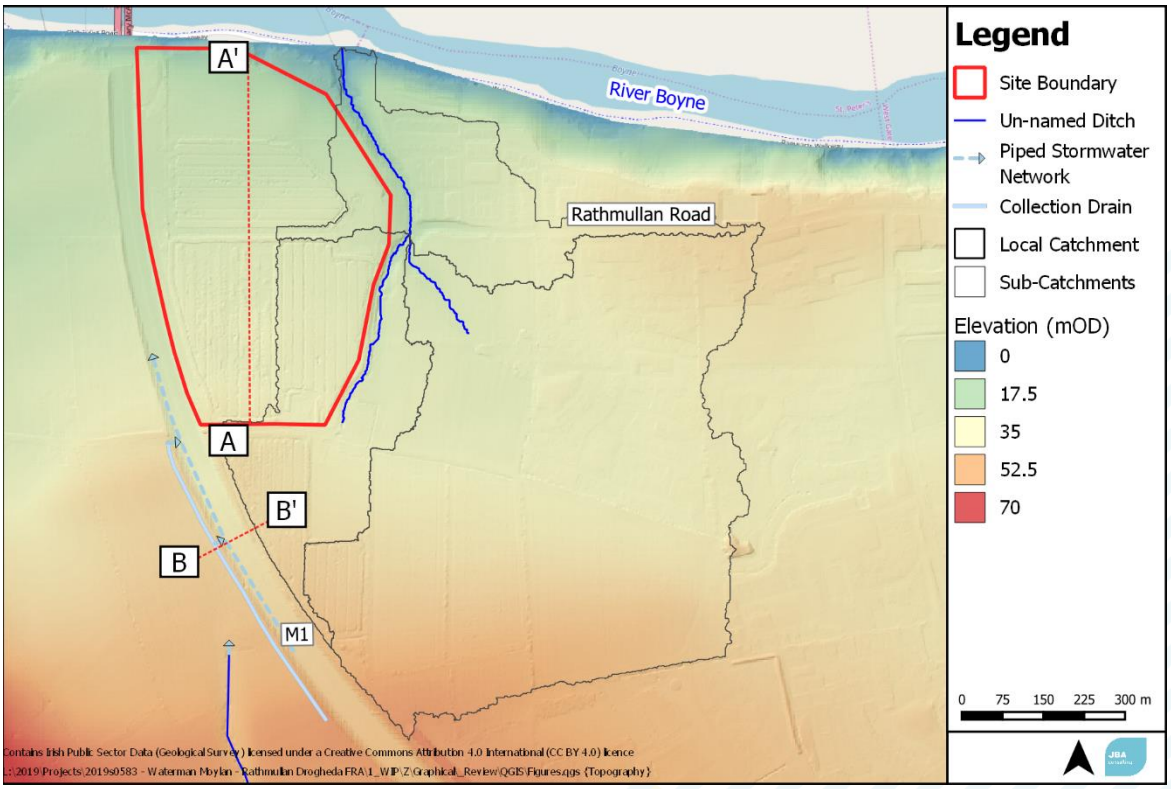


Figure 2-2: Topography of the site and local catchment

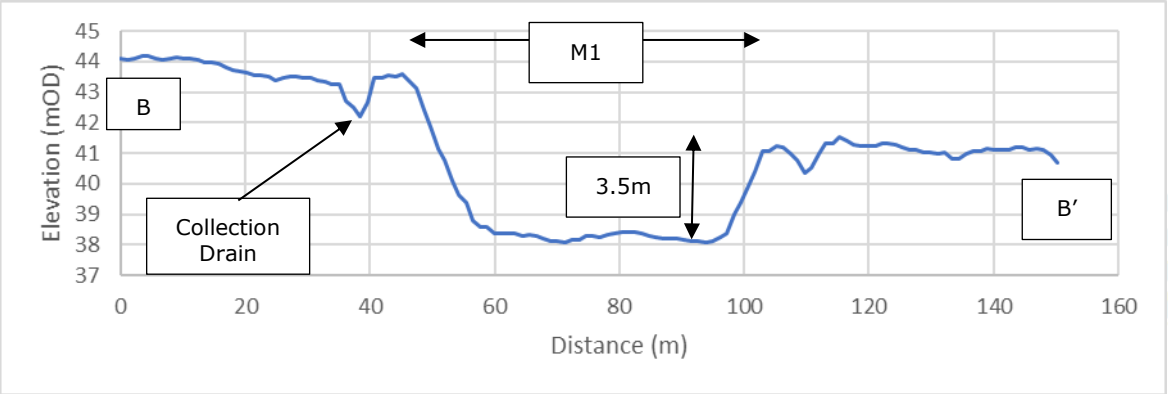


Figure 2-3: Cross-section profile across M1

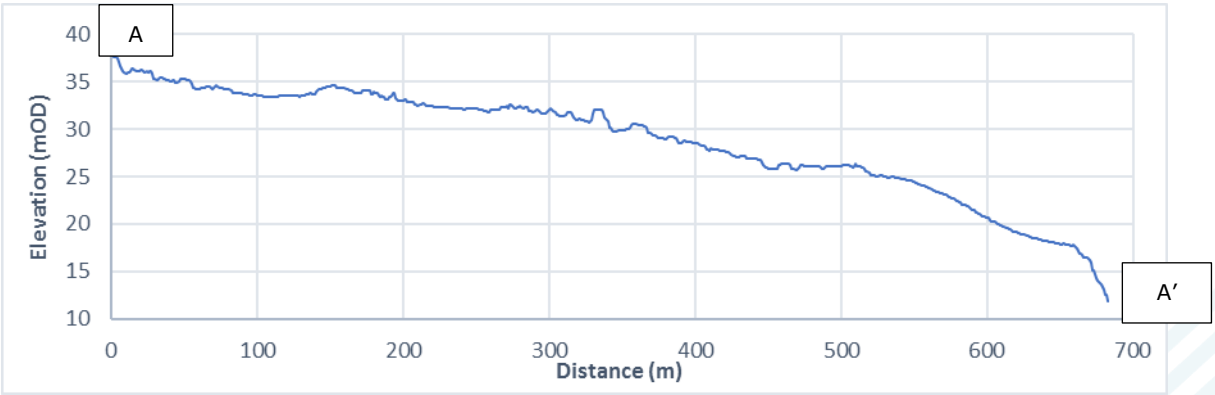


Figure 2-4: Cross-section profile south-north across the site

2.4 Site Geology

The groundwater and geological maps of the total site, provided by the Geological Survey of Ireland (GSI), have been studied and an extract of the quaternary soils map is presented in Figure 2-5 with a brief summary of each soil type in Table 2-1. The subsoil at the proposed sites is till derived from sandstone and shales, a largely heterogenous and mixed soil type. There are no alluvium deposits mapped within the site boundary, which would indicate historic fluvial flooding.

The underlying bedrock formation is Platin Formation. The dominant lithology is crinoidal and peloidal grainstone, locally conglomeratic. Cherty and micritic units are also present. It is generally coarser, paler and less well-sorted than the underlying Crufty Formation

Patches of Karstified bedrock are isolated to the historical drainage line of the un-named ditch adjacent to the eastern boundary of the site.

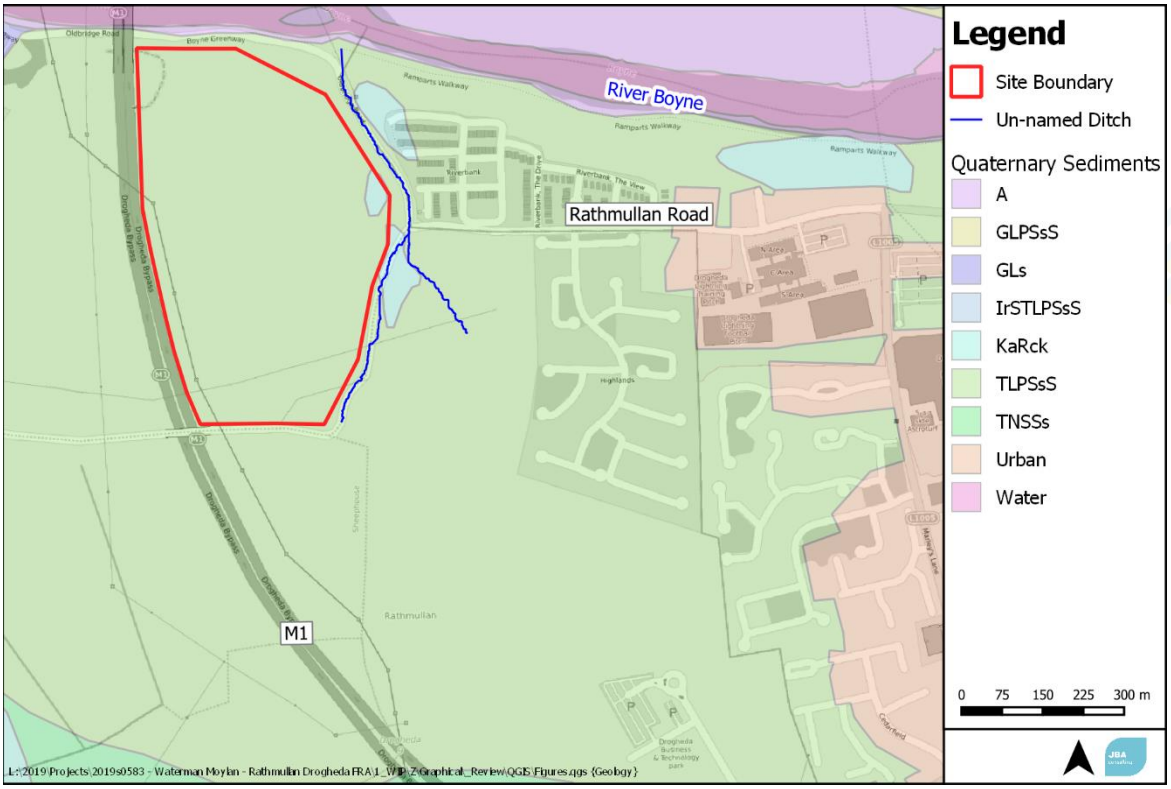


Figure 2-5: Quaternary Soils

Table 2-1 Subsoil Lithology

Quaternary Sediment	Lithology
A	Alluvium
GLPSsS	Gravels derived from Lower Palaeozoic sandstones and shales
GLs	Gravels derived from Limestones
IrSTLPSsS	Irish Sea Till derived from Lower Palaeozoic sandstones and shales
KaRck	Karstified bedrock outcrop or subcrop
TLPSsS	Till derived from Lower Palaeozoic sandstones and shales
TNSSs	Till derived from Namurian sandstones and shales
Urban	Urban
Water	Water

2.5 M1 Motorway

Prior to construction of the M1, the previous watercourse had a catchment area of approximately 1.9km^2 extending further to the south west. As shown in Figure 2-6, the Flood Studies Update (FSU) hydrological catchment still includes this larger catchment area pre-dating construction of the M1. The un-named watercourse is also shown to be crossing M1.

However, as discussed in Section 2.3, the construction of the M1 Motorway has significantly altered the topography of the natural catchment of the former watercourse. Appendix A includes construction drawings from the Northern Motorway Project (the M1) for the portion of the road crossing the prior watercourse. An extract of this is also provided in Figure 2-7. This confirms the significant cutting of the M1 road levels of at least 3.5m below natural ground levels.

The construction drawings also clearly show piped culverts intercepting the drain line of the prior watercourse along with overland flows from adjacent fields and redirects these flows into the surface water drainage network of the motorway. The culverted system then flows parallel to the road surface and discharges directly into the River Boyne.

None of the former overland flow or flows contained within the former watercourse are now able to cross the M1, resulting in the disconnection of the former watercourse into a dry ditch and reducing the catchment area to that as shown in Figure 2-2.

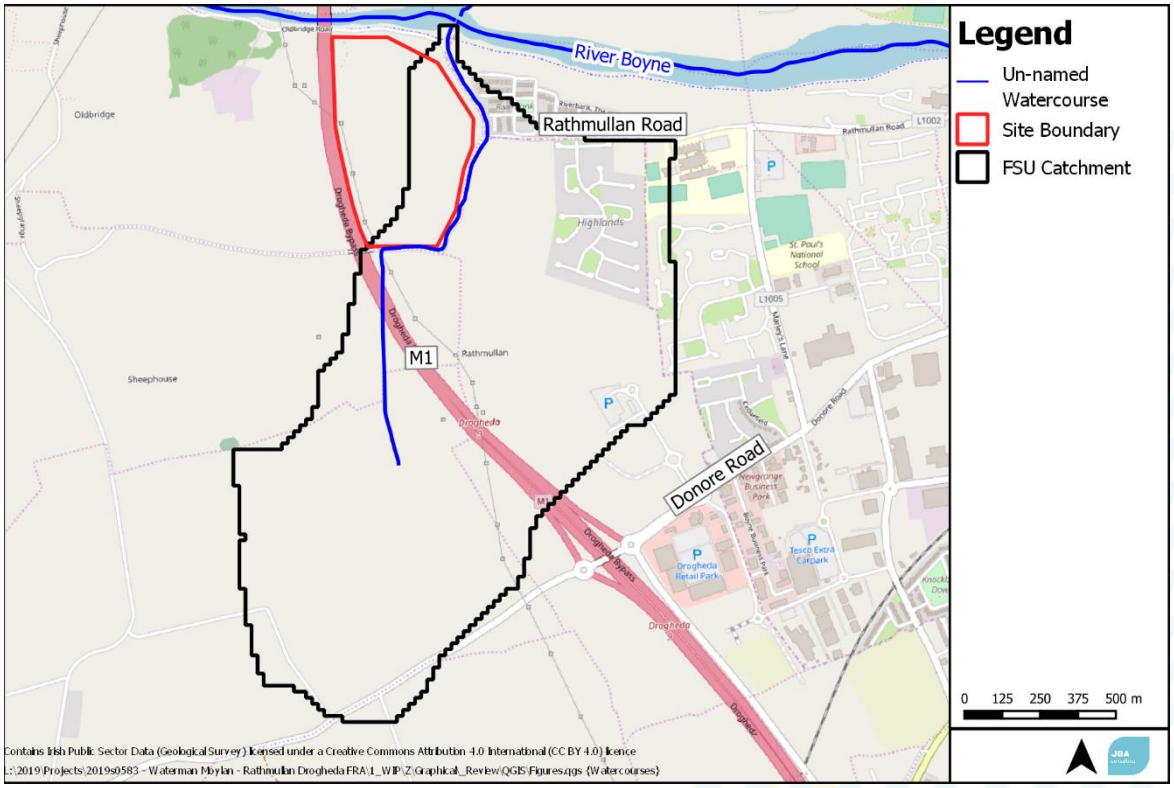


Figure 2-6: Former watercourse and catchment

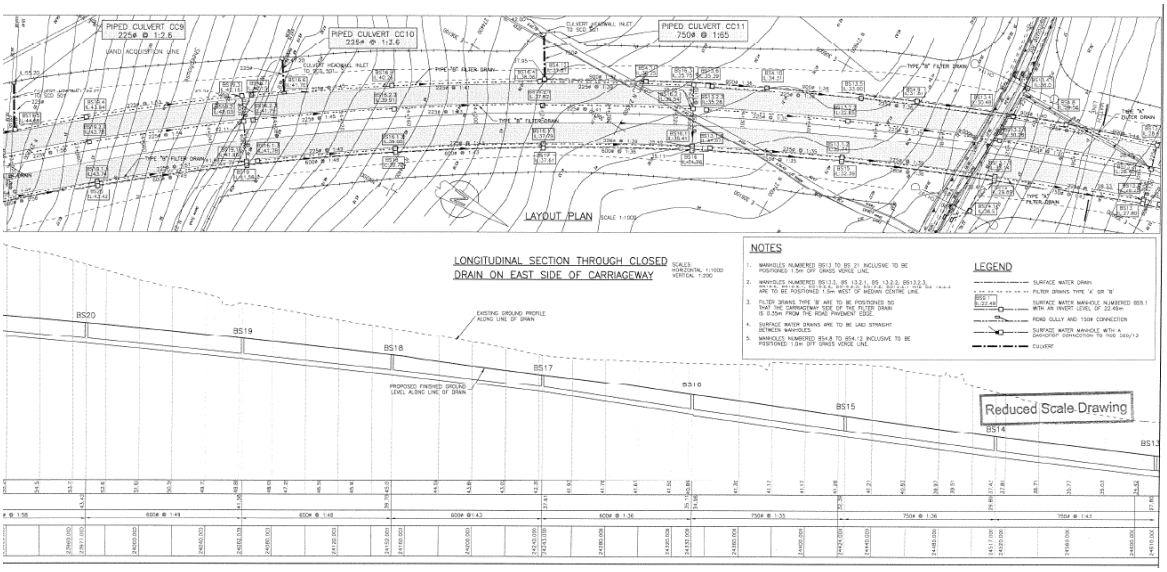


Figure 2-7: Extract of M1 Motorway construction drawings

2.6 Site Visit

A site visit was undertaken by JBA Consulting on Wednesday 24th April 2019. The site visit was able to confirm that the former watercourse has been disconnected by the M1 Motorway, verified the presence of piped culverts diverting surface water flows into the M1 surface water drainage network, and that the former watercourse adjacent to the site now exists as a dry ditch unable to convey flow. Figure 2-8 identifies the locations and corresponding identification numbers for the photographs and details of the site visit summarised in Table 2-2.

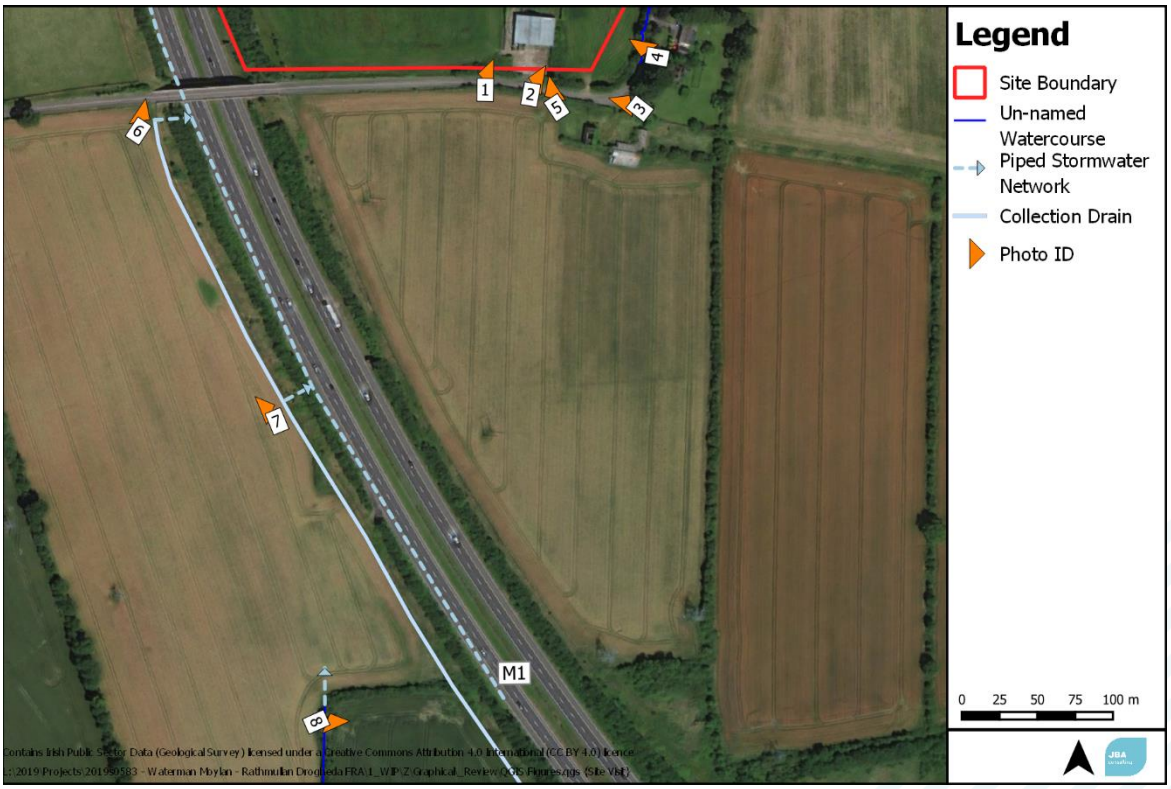


Figure 2-8: Site Visit Locations

Table 2-2: Photographs from Site

Photo No. 1 Dry ditch located between the southern boundary of the site and Rathmullan Road. The ditch is completely overgrown with vegetation and brambles, contained no water and shows no evidence of fluvial activity	
Photo No. 2 Access to farm sheds from Rathmullan Road across the ditch on the southern boundary of the site. The culvert under the vehicular access to the site has been completely collapsed with 100% blockage. The hole at the location of collapse is clearly visible in the photograph.	

Photo No. 3 The ditch between residential properties and Rathmullan Road adjacent to the south-eastern corner of the site (looking north). The outlet of the culvert under Rathmullan Road has been completely blocked and is no longer visible. The ditch has been almost entirely infilled with garden refuse and green waste. There is no fluvial connection or possible watercourse remaining within the ditch.	
Photo No. 4 The ditch between residential properties and Rathmullan Road adjacent to the south-eastern corner of the site (looking south). The ditch has been almost entirely infilled with garden refuse and green waste.	
Photo No. 5 View of fields looking south from Rathmullan Road towards the M1. The blue motorway sign is barely visible highlighting the significant cutting of the M1 below natural ground levels. There is no ability for surface water flows to cross the M1.	

Photo No. 6 Culverted pipe entrance collecting surface water flows from the fields to the west of the M1 and redirecting into the motorway stormwater drainage network.	
Photo No. 7 Second observed culverted pipe entrance collecting surface water flows from the fields to the west of the M1 and redirecting into the motorway stormwater drainage network.	
Photo No. 8 Culverted pipe entrance of the former drain upstream of the M1	

3 Flood Risk Identification

An assessment of the potential and scale of flood risk at the site was conducted using historical and predictive information. This has identified any sources of potential flood risk to the site and reviewed historic flood information. The findings from the flood risk identification stage of the assessment are provided in the following sections. Further detail on the Planning Guidelines and technical concepts is provided in Appendix B.

3.1 Flood History

Several sources of flood information were reviewed to establish any recorded flood history at, or near the site. This includes the OPW's website, www.floodmaps.ie. Which highlights areas at risk of flooding through the collection of recorded data and observed flood events. Refer to Figure 3-1 for location of the identified historic flood events in the area.

3.1.1 Floodmaps.ie

There is a well recorded history of flooding within Drogheda Town and surrounds however none of which has been recognised as having any impact on the site. Due to the rising topography of the site, flooding of the River Boyne at locations identified as 1, 2 and 3 in Figure 3-1 do not impact upon the site. Similarly, localised recurring flooding from heavy rain, insufficient drainage capacity or stream overflow have occurred in adjacent areas but none of which have any record of affecting the site.

Table 3-1 provides further details of the recorded flood history in the general area.

Figure 3-1: Historic Flood Map

Table 3-1: Local Flood History

Location ID	REPORT
1	***Drogheda/Louth Collection Meeting – Minutes/Map (21.02.2006/21.10.2006) – Minutes of meeting identifying areas subject to flooding in Drogheda Town Council area***

57. River Boyne, Left Bank upstream Drogheda
Area subject to flooding. Part of floodplain. (Photos, report to be provided) [Flood ID 4599]

71. Simcock's Lane/Trinity Street Junction
Historically heavy rain caused flooding of two properties. Remedial works have been carried out. [Flood ID 4613]

72. Rathmullan Road
Road floods due to insufficient drainage capacity. Backing up of drains results in lifting of manholes. [Flood ID 4614]

2	***Louth/Cooley/Slane Area Meeting – Minutes/Map (10.10.2005/05.04.2005) – Minutes of meeting identifying areas subject to flooding***

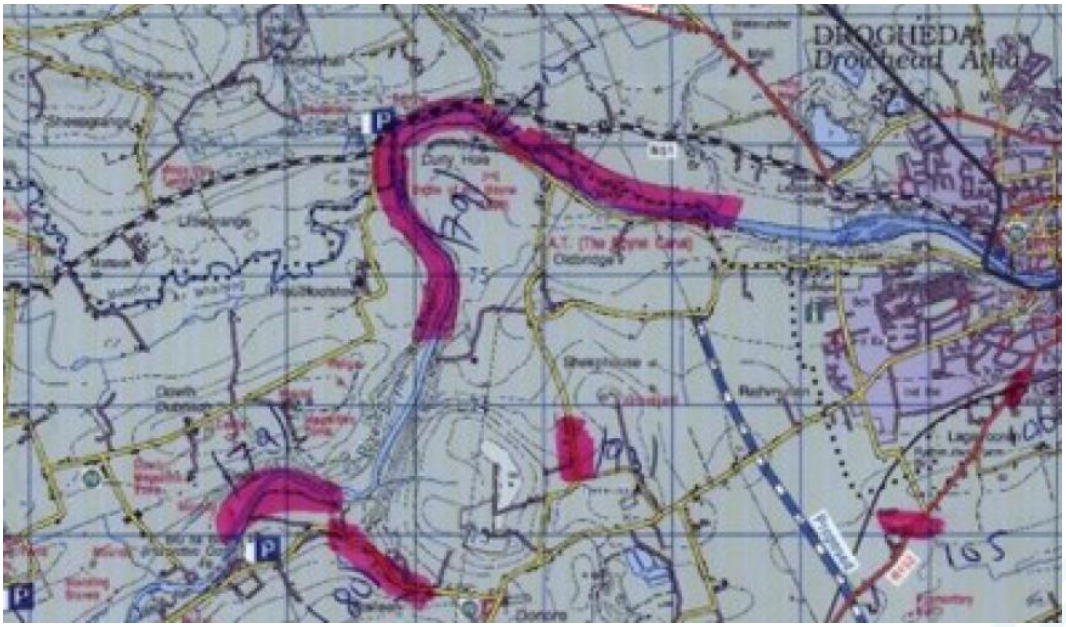
14. Slane Road (N51) near Curley Hole.
Stretch of road floods due to combination of river flooding and high tide. [Flood ID 3086]

3	***Slane Area Engineer Meeting – Minutes/Map (15.04.2005) – Minutes of Meeting identifying areas subject to flooding***

79. 4 stretches of the Boyne from Slane to Drogheda– River Boyne flood plain. Floods 1 to 2 times per year. Roads are liable to flood.
Flood Id = 3086, 935, 936, 937

93. Sheephouse Road, Donore– Stream overflows its banks every year after heavy rain. Road is liable to flood.

105. R152 south of Drogheda – Stream overflow its banks after heavy rain every year. Road is liable to flooding.
Flood Id = 964



3.1.2 Internet Search

An internet search was conducted to gather any additional information of flood history at the site not found within floodmaps.ie. Whilst flooding in the Drogheda area has occurred at regularly intervals, no further information was available that indicated any flood impacts affecting the site.

3.2 Predictive Flood Mapping

The subject area has been assessed by 3 flood mapping or modelling studies which are listed below:

- OPW Preliminary Flood Risk Analysis (PFRA)
- Eastern CFRAM
- Meath County Council Strategic Flood Risk Assessment (SFRA)

The level of detail presented by each method varies according to the quality of the information used and the approaches involved. The Eastern CFRAM is the most detailed assessment of flood extent and supersedes the fluvial flood outlines presented by the OPW PFRA study.

3.2.1 OPW PFRA

The Preliminary Flood Risk Assessment (PFRA) is a requirement of the EU Flood Directive (2007/60EC). One of the PFRA deliverables is flood probability mapping for various sources, pluvial (surface water), groundwater, fluvial and tidal. The PFRA is a preliminary or 'indicative' assessment and analysis has been undertaken to identify areas potentially prone to flooding and should not be used as the sole basis for defining the Flood Zones.

Figure 3-2 presents the OPW PFRA flood extents at the site and surrounding area, which shows no risk of groundwater, fluvial or coastal flooding to the site, but does indicate two small isolated spots of indicative flooding for the 1% AEP pluvial event.

Figure 3-2: OPW PFRA Pluvial and Groundwater flood map

3.2.2 Eastern Catchment Flood Risk Assessment (Eastern CFRAM)

The Eastern CFRAM study is the most detailed flood mapping produced for the Drogheda region. The Study commenced in June 2011 with final flood maps issued during 2016. The study involved detailed hydraulic modelling of rivers and their tributaries. Flood maps have been finalised for Drogheda and an extract of the fluvial flood map covering the site and surrounding area is provided in Figure 3-3.

The mapped CFRAM fluvial flood extents identified mottled flooding originating at the southern boundary of the site and flowing northwards across the site for all events equal to and greater than the 10%AEP. The mottled appearance indicates that predicted depths are extremely shallow, and the steep slope of the site suggests that this is overland flow across the site and are not floodplain storage.

However, the CFRAM hydraulic modelling does not replicate the existing form or function of the watercourse. Predicted flood extents have included the full former watercourse catchment to the west of the M1 as discussed within the Eastern CFRAM Study HA07 Hydrology Report and UoM07 Hydraulics Report. The CFRAM model fails to acknowledge the presence of the M1 Motorway and the discontinuation of the stream from its previous course. As discussed in Section 2 and confirmed during the site visit, the former watercourse is now redirected into the M1 surface water drainage network, leaving a disconnected and inactive dry ditch to the east of the M1. The predicted mapping produced within the ECFRAM Study is therefore not an accurate representation of fluvial flood risk to the site.

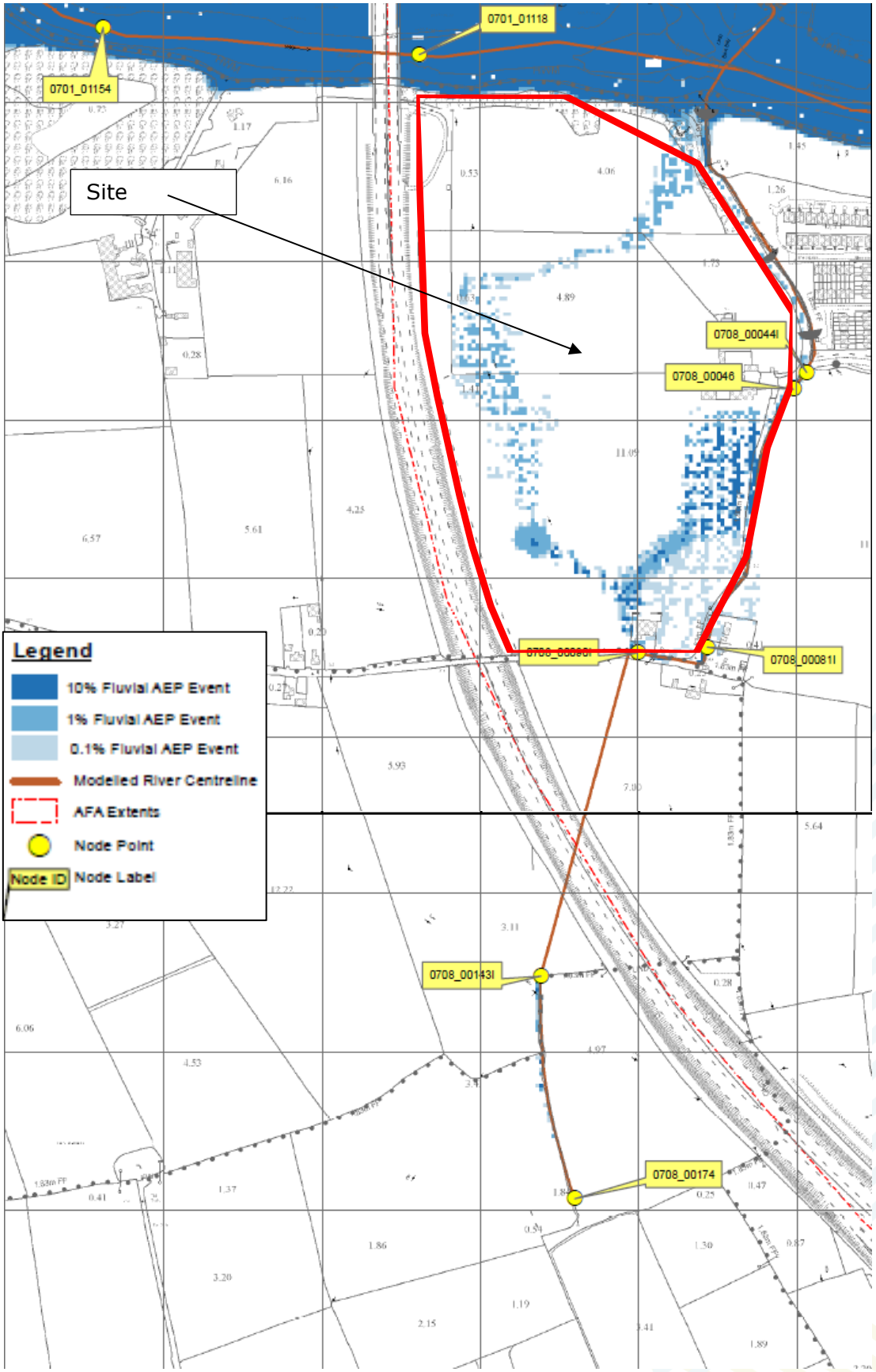


Figure 3-3: Eastern CFRAM Fluvial map

3.2.3 Flood Risk Assessment and Management Plan for Proposed Variation 3 to Meath CDP 2013 – 2019

The Strategic Flood Risk Assessment is designed to be updated as further flood risk information becomes available and changes to the development plan are proposed under a formal variation. There are two prior iterations of the SFRA for the Meath CDP 2013-2019 that are currently published. This variation aligns the development plan with the Economic Development Strategy for County Meath 2014-2022 in relation to statutory land use planning. Draft CFRAM mapping was incorporated into this document as shown in Figure 3-4.

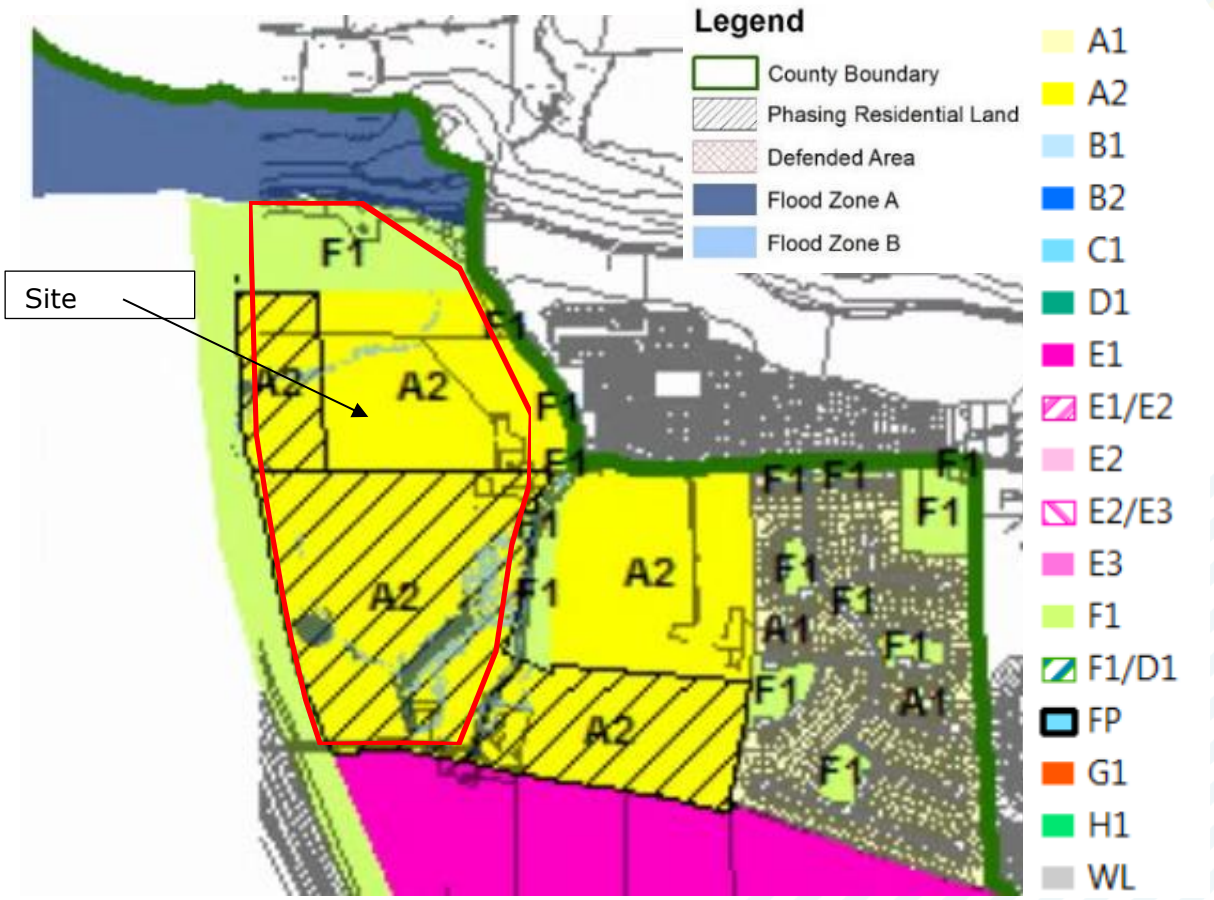


Figure 3-4: CDP Flood Zone Mapping

3.3 Sources of Flooding

The initial stage of a Flood Risk Assessment requires the identification and consideration of probable sources of flooding. Following the initial phase of this Flood Risk Assessment, it is possible to summarise the level of potential risk posed by each source of flooding. The flood sources are described below.

3.3.1 Fluvial

Prior to the construction of the M1 motorway, the primary source of flood risk to the site was fluvial flooding. This is recognised within the mapping output of the Eastern CFRAM Study. This study has however, been shown within Section 2 and confirmed during the site visit, to not accurately represent current conditions of the site and associated fluvial flood risk. The Eastern CFRAMs mapping does not consider the interception of the former watercourse and incorporation of flows into the stormwater drainage network of the M1 motorway. Nor does it take it account the derelict nature of the former watercourse adjacent to the site which no longer serves as a functional fluvial channel. Upon detailed review of all available fluvial flood information and surface water drainage construction drawings of the M1 Motorway, it is determined within this report that fluvial flood risk from the former un-named watercourse is no longer present, as there is no watercourse remaining which could be a source of flooding to the site. Figure 2-2 identifies the upland catchment of the site as only 0.15km^2, and that a third of this is contained within the site boundary. The upslope area of the site should no longer be considered as a fluvial catchment as it is limited to localised surface run-off and is therefore pluvial. Additionally, site elevation levels remain sufficiently high that there is no direct risk of fluvial flooding from the River Boyne. Fluvial flood risk to the site is therefore screened out at this stage.

3.3.2 Coastal

The site has a fall in excess of 30m across the site, with the lowest proposed Finished Floor Level on the northern boundary adjacent to the River Boyne is at 19.25mOD, well above any potential coastal flood levels. Tidal flood sources have therefore been screened out at this stage.

3.3.3 Groundwater

Groundwater flooding results from high sub-surface water levels that impact upper levels of the soil strata and overland areas that are usually dry. There has been no groundwater flooding reported in this area by the OPW PFRA maps.

No groundwater strikes were noted during the Site Investigation works which included trial pits and boreholes to depths of up to 8m below ground level. These works were carried out in November 2018 when it would be expected that ground water is relatively high due to the predominance of winter rainfall in Ireland.

Groundwater is not expected to be a risk confirmed by the OPW PFRA mapping and the geology on site. It has therefore been screened out at this stage.

3.3.4 Pluvial/Surface Water

Pluvial or surface water flooding is the result of rainfall-generated flows that arise before run-off can enter a watercourse or sewer. The OPW PFRA mapping indicates minimal potential for pluvial flood on the site, however, the poor design of a surface water system or the inappropriate design of road, ground and finished floor levels can influence the specific surface water flood risk to a site.

To manage the potential generation of surface water run-off by the proposed development, careful consideration has been given to the overall site design. Proposed mitigation measures to reduce risk of pluvial flooding are discussed in detail in Section 4.

4 Flood Risk Assessment

Following detailed review of all available flood information, groundwater, coastal and fluvial sources have been screened out for this site.

Whilst two small isolated spots of pluvial flooding are identified within the indicative PFRA pluvial mapping, the steep slope of the site and the mitigation measure included within the proposed design adequately address any flood risk from pluvial sources.

As discussed throughout Section 2 and summarised in Section 3.3.1, due to the outdated catchment conditions represented within the Eastern CFRAMs flood modelling and mapping incorrectly identifying fluvial flood risk to the site, it is the finding of this site-specific flood risk assessment that the current Flood Zones for the site are not appropriate and the entire site should be redefined as Flood Zone C.

The Planning System and Flood Risk Management Guidelines for Planning Authorities, classes residential development as a highly vulnerable land use and is therefore appropriate for development only within Flood Zone C without the need to provide a justification test.

This FRA confirms the proposed development footprint within the subject site as being located wholly within Flood Zone C and is therefore appropriate for residential development from a flood risk perspective.

4.1 Mitigation

Although this site-specific flood risk assessment has concluded that the entire development footprint is located within Flood Zone C, mitigation measures have been considered and included within the proposed development where necessary, to mitigate the risk of pluvial flooding to and from the site.

4.1.1 Finished Floor Levels

The lowest proposed Finished Floor Level on the northern boundary adjacent to the River Boyne is at 19.25mOD, well above any potential coastal flood levels. The topographic gradient across the site minimises any natural accumulation or ponding of water on-site, however Finished Floor Levels across the site retain a minimum freeboard of at least 150mm above surrounding hard surfaces including the road network.

4.1.2 Surface Water Run-Off

It is proposed to store excess storm water up to the 1 in 100-year storm event within 4 No. underground storage systems, one per surface water catchment. The attenuation storage will normally be dry and will only fill up during storm events. The stormwater will then be released after the storm, at a controlled rate via the hydrobrake manholes.

The total capacity of the attenuation storage is 4,521 m^3. This is sufficient storage capacity to store water from the critical 100-year storm for the subject site with 20% climate change allowed for in the calculations.

Any flows from the system in design exceedance events will be directed along roads and into greenfield space adjacent to the outfalls, reducing any residual risk to dwellings. Further details are provided in the accompanying Site Drainage report produced by Waterman Moylan.

4.1.3 Access

Access to the site is located directly from Rathmullan Road and is located within Flood Zone C. Whilst historical flooding is noted on Rathmullan Road from poor stormwater drainage further to the east, the road provides access from three separate directions to the site, ensuring safe access and egress from flood risk.

4.1.4 Third Party Impacts

As the site is wholly contained within Flood Zone C and the surface water drainage system appropriately attenuates stormwater from the site, there is no increased flood risk to third parties from this development

5 Conclusion

JBA Consulting has undertaken a detailed Site-Specific Flood Risk Assessment for the proposed site development in Rathmullan Co. Dublin. The site is currently a greenfield site located on the western fringe of Drogheda, Co. Meath. It is situated south of the River Boyne between the M1 Motorway and Rathmullan Road. No historic flooding has been identified within the site boundary.

A portion of the site is currently incorrectly classified as Flood Zone A/B, due to the outdated catchment conditions represented within the Eastern CFRAMs flood modelling and mapping. This CFRAM study does not reflect the interception of the former un-named watercourse and incorporation of its flows into the M1 motorway surface water drainage network.

From reviewing available sources of flooding, including the flood extent and depth maps produced as part of the Eastern CFRAM, the proposed development is at low risk of flooding and should be classified as Flood Zone C.

This recommendation has been communicated to the OPW who have now noted the mapping of this area as requiring review and potential update, following the additional information provided within this assessment.

The proposed development consists of a Strategic Housing Development on residential zoned lands west of Drogheda town centre. The accommodation provided on the site consists of;

- 661 residential units with a crèche and retail unit.

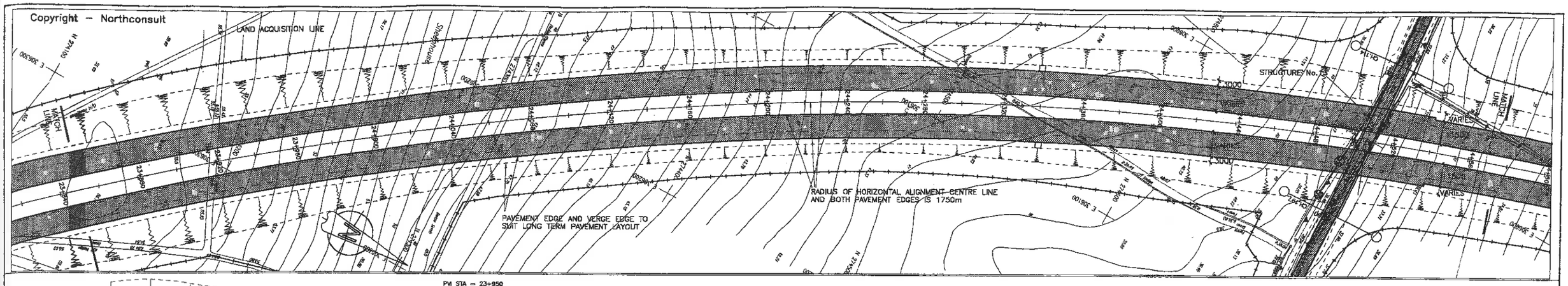
The proposed estate road levels around the site range from 18.73 to 36.50 m OD Malin and proposed finished floor levels range between 19.25 to 36.50 m OD Malin. Finished Floor Levels across the site retain a minimum freeboard of at least 150mm above surrounding hard surfaces including the road network. Surface water will be managed through the use of underground attenuation tanks and controlled discharge.

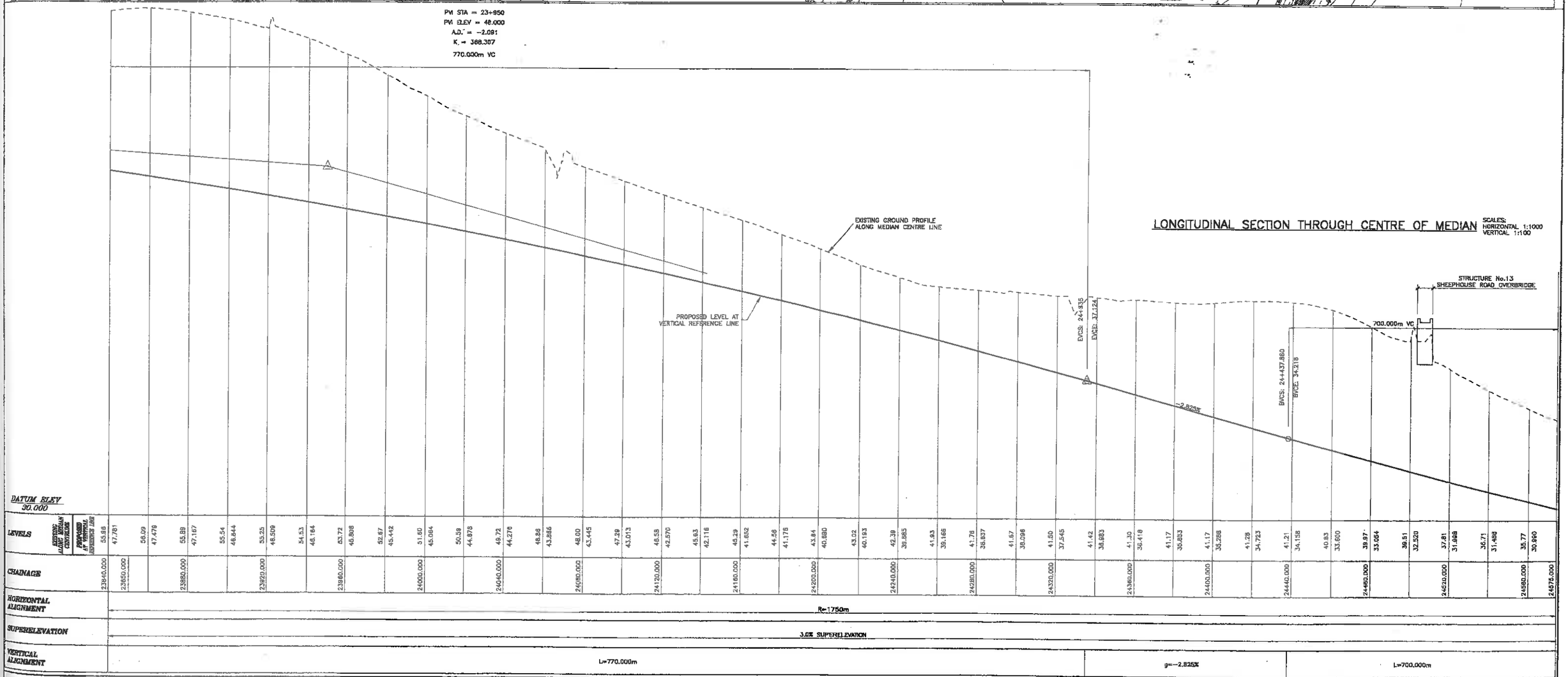
The main access for the site will be provided via a new 4 arm signalised junction with arms linking the Rathmullan Road (East), the Rathmullan Road (West) the proposed site access and the local access road to the south of the signalised junction. A second access into the housing development is proposed via a new priority junction to the south of the site onto the existing local access road.

The Flood Risk Assessment was undertaken in accordance with 'The Planning System and Flood Risk Management' guidelines and confirm that the development can manage risk in agreement with the core principles contained within.

Appendices

A Appendix – Northern Motorway Project Drainage Layout





LONGITUDINAL SECTION THROUGH CENTRE OF MEDIAN

SCALES:
HORIZONTAL 1:1000
VERTICAL 1:100

Project Title:

NORTHERN MOTORWAY PROJECT
GORMANSTON TO MONASTERBOICE

Origin: Roughan & O' Donovan Consulting Engineers

Client:
Meath County Council
Meath County Council
Northern Motorway Project Office
County Engineer
Mr. Oliver Perians B.E., C.Eng., F.I.E.I.
Project Engineer
Mr. Charles McCarthy B.E., M.I.E.I.

Consulting Engineer: **Northconsult**

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Rev.	Date	Description	Appr.
A	–	NOT USED	
B	–	NOT USED	
C	AUG.'99	MINOR REVISIONS	GPS
D	1/5/00	CONSTRUCTION ISSUE	GPS

Rev.	Date	Description	Appr.

Contract Title: Contract No. 7 : Road Contract South Of Boyne River CH.11300 To CH.24600

Drawing Title: Motorway Road Layout Sheet 19 CH.23850 To CH.24575

Status: Construction

Designed:	GPS	File Name:	971891041	Drawing Nr.	Rev
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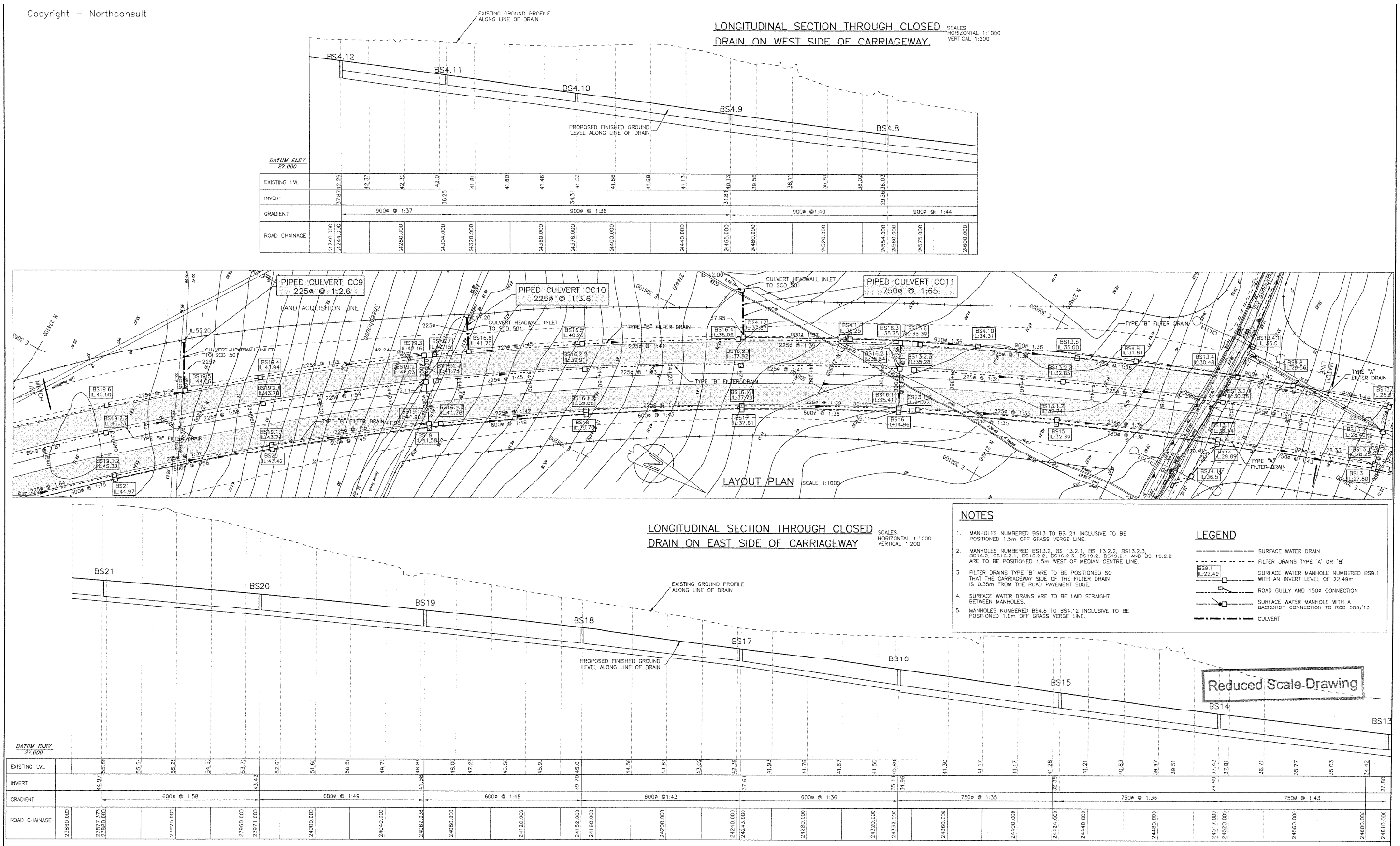
Approved:	GPS	Scale:	1 : 1000		
Checked:	GPS	Date:	03-08-98		



NOTES

1. MANHOLES NUMBERED BS13 TO BS 21 INCLUSIVE TO BE POSITIONED 1.5m OFF GRASS VERGE LINE.
2. MANHOLES NUMBERED BS13.2, BS 13.2.1, BS 13.2.2, BS13.2.3, BS16.2, BS16.2.1, BS16.2.2, BS16.2.3, BS19.2, BS19.2.1 AND BS 19.2.2 ARE TO BE POSITIONED 1.5m WEST OF MEDIAN CENTRE LINE.
3. FILTER DRAINS TYPE 'B' ARE TO BE POSITIONED SO THAT THE CARRIAGEWAY SIDE OF THE FILTER DRAIN IS 0.35m FROM THE ROAD PAVEMENT EDGE.
4. SURFACE WATER DRAINS ARE TO BE LAID STRAIGHT BETWEEN MANHOLES.
5. MANHOLES NUMBERED BS4.8 TO BS4.12 INCLUSIVE TO BE POSITIONED 1.0m OFF GRASS VERGE LINE.

LEGEND

- SURFACE WATER DRAIN
- FILTER DRAINS TYPE 'A' OR 'B'
- BS9.1 IL:22.49 — SURFACE WATER MANHOLE NUMBERED BS9.1 WITH AN INVERT LEVEL OF 22.49m
- ROAD GULLY AND 150ø CONNECTION
- SURFACE WATER MANHOLE WITH A BACKDROP CONNECTION TO RCD 500/13
- CULVERT

Reduced Scale Drawing

Project Title: NORTHERN MOTORWAY PROJECT
GORMANSTON TO MONASTERBOICE

Origin: Roughan & O' Donovan Consulting Engineers

Client: **Meath County Council**

Meath County Council
Northern Motorway Project Office

County Engineer
Mr. Oliver Perkins B.E., C.Eng., F.I.E.I.

Project Engineer
Mr. Charles McCarthy B.E., M.I.E.I.

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Rev.	Date	Description	Appr.
C	Aug. 99	Minor Revisions	GPS
D	1.5.00	Construction Issue	GPS

Contract Title: Contract No. 7 : Road Contract South Of Boyne River CH.11300 To CH.24800

Drawing Title: Drainage Layout Sheet 19 CH.23850 To CH.24575

Status: CONSTRUCTION

Designed:	J.H.R	File Name:	971891132	Drawing Nr.	Rev
Drawn:	S.K.			7RD 1132	D
Approved:	GPS	Scale:	As Shown		
Checked:	J.H.R	Date:	30-3-99		

B Appendix – Understanding Flood Risk

Flood risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood risk can be expressed in terms of the following relationship:

Flood Risk = Probability of Flooding x Consequences of Flooding

B.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period (in years. A 1% AEP flood has a 1 in 100 chance of occurring in any given year. In his report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can be helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval and is the terminology which will be used throughout this report.

Table: Conversion between return periods and annual exceedance probabilities

Return period (years)	Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

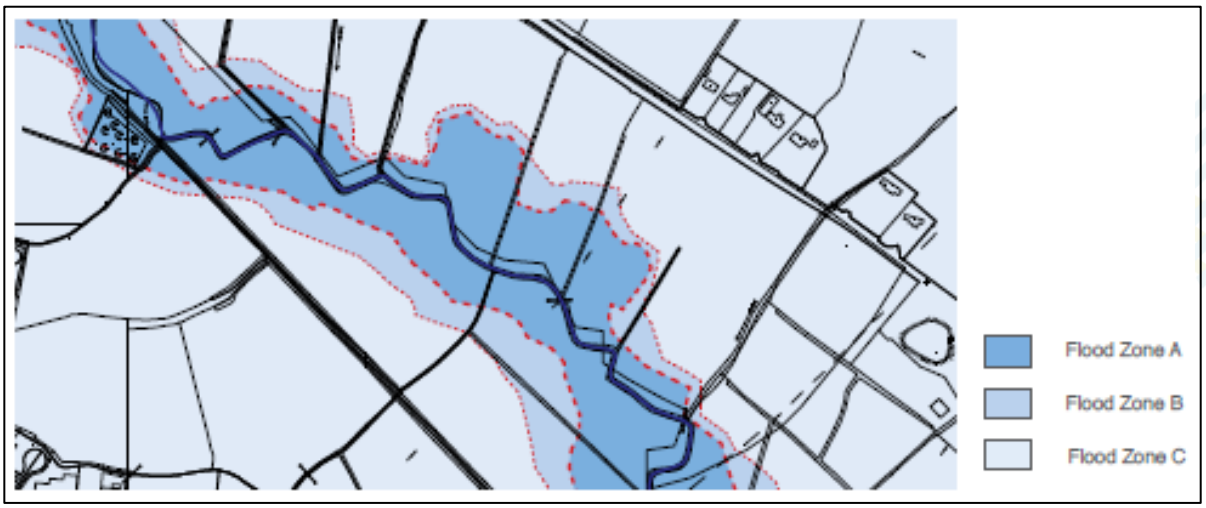
B.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purposes of the Planning Guidelines, there are 3 types of levels of flood zones, A, B and C.

Zone	Description
Flood Zone A	Where the probability of flooding is highest; greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/tidal flooding.
Flood Zone B	Moderate probability of flooding; between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/tidal.
Flood Zone C	Lowest probability of flooding; less than 0.1% from both rivers and coastal/tidal.

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences due to overtopping or breach and that there may be no guarantee that the defences will be maintained in perpetuity.

Figure: Indicative Flood Zones (OPW & DoEHLG 2009)



B.3 Consequences of Flooding

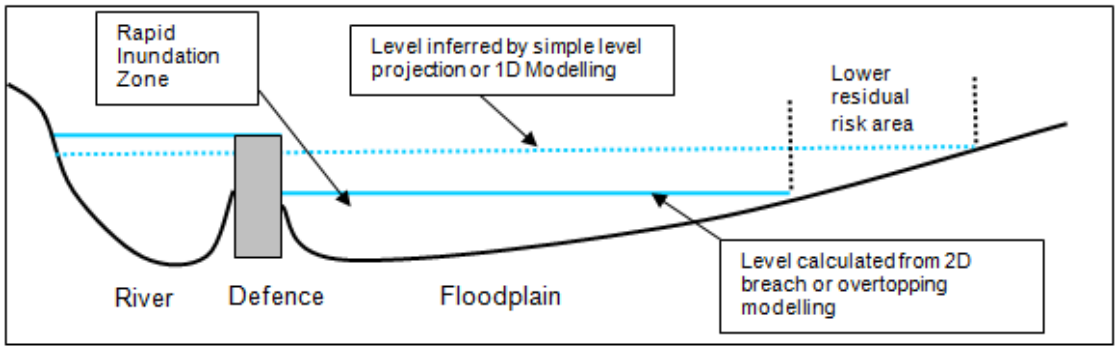
Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow. Rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc.)

The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on the type of development, which are detailed in the Guidelines, and are summarised as:

- **Highly vulnerable**, including residential properties, essential infrastructure and emergency service facilities;
- **Less Vulnerable**, such as retail and commercial and local transport infrastructure, such as changing rooms.
- **Water compatible, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.**
-

B.4 Residual Risk

The presences of flood defences, by their very nature, hinder the movement of flood water across the floodplain and prevent flooding unless river levels rise above the defence crest level or a breach occurs. This is known as residual risk:



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