Malachy Walsh and Partners

Consulting Engineers

Cork | Tralee | Limerick | London

Kilcumber Bridge 110 kV Sub-Station

Flood Risk Assessment

on behalf of
Cloncant Renewable Energy Limited

Project	Document	Revision	Issue	Prepared	Checked	Date
21280	6004	A	**Final**	Sean Doyle	Paddy Curran	January 2021

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List of Abbreviations

RFRA	Regional Flood Risk Assessment
SFRA	Strategic Flood Risk Assessment
FRA	Flood Risk Assessment
CFRAM	Catchment Flood Risk and Management
SUDS	Sustainable Urban Drainage Systems
WSL	Water Surface Level
AEP	Annual Exceedance Probability
MRFS	Mid-Range Future Scenario

1 General

1.1 Introduction

This Flood Risk Assessment (FRA) report has been prepared in respect of a proposed 110 kV substation at Ballykilleen, Edenderry, County Offaly. The proposed development site is located on the southwest side of the R401 regional road and directly opposite the Bord na Móna Edenderry Power Station. The purpose of the development is to facilitate the electrical connection of the permitted Cushaling wind farm to the Eirgrid transmission grid. The site, which is 6 kilometres south of Edenderry, is shown in Figure 1 below.

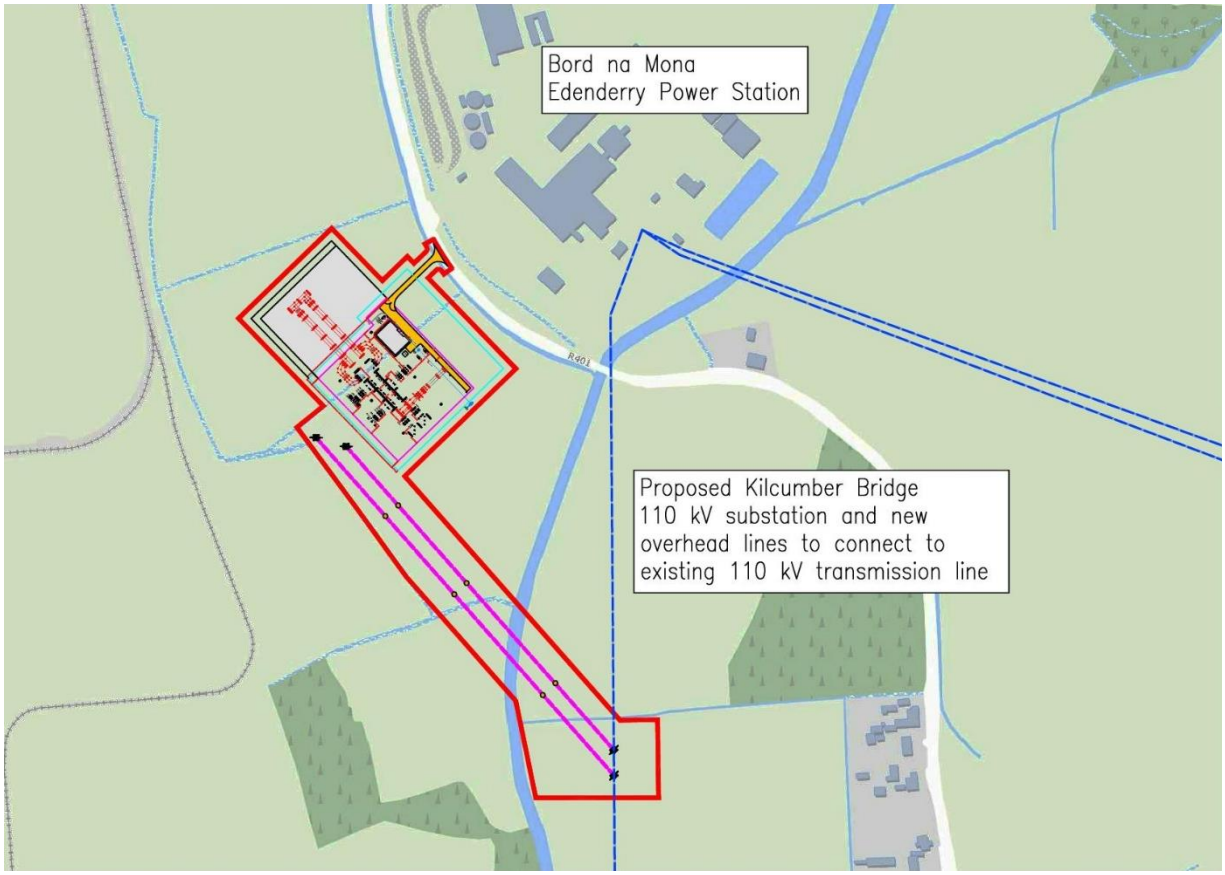

Figure 1 – Site Location and Layout[1]

1.2 Objectives

The purpose of this report is to establish the flood risk associated with the proposed development and, if appropriate, to recommend mitigation measures to prevent any increase in flood risk within or outside the site.

The report has been prepared in the context of *The Planning System and Flood Risk Management – Guidelines for Planning Authorities, November 2009*, published by the Office of Public Works and the Department of Environment, Heritage and Local Government. Flood Risk Assessments are carried out at different scales by different organisations. The hierarchy of assessment types are Regional (RFRA), Strategic (SFRA) and Site-specific (FRA). This report is site-specific.

The report also considers the policy and requirements for flood risk assessment set out in the current Offaly County Development Plan 2014-2020, specifically Volume 1 Section 8.17 and the SFRA.

[1] Map reproduced from Ordnance Survey Ireland by permission of the Government, licence number EN 00115720.

1.3 Site Description

The site is currently used as agricultural grassland. The development proposal includes a substation building, external electrical equipment mounted on concrete plinths, and electrical transmission pylons. There is an existing Cushaling – Mount Lucas 110 kV power line running south from the Cushaling 110kV substation, across the R401 and through the land on the east side of the Figile River. The proposed substation will connect to this power line via a pair of new power lines running southeast from the substation compound.

1.4 Methodology

The Flood Risk Management Guidelines document outlines three stages in the assessment of flood risk as follows:

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

This report includes all three stages of assessment.

2 Flood Risk Identification (Stage 1)

Possible sources of flood risk were identified by

- Walkover survey of the site;
- Topographical survey of the site;
- Aerial photography of the site and surrounding area;
- Examination of available information on the OPW website (https://www.floodinfo.ie).

The OSI historical 25" maps for the area indicate some locations on both sides of the Figile River near the site as being liable to floods (Figure 2 – OSI historic 25" map below).

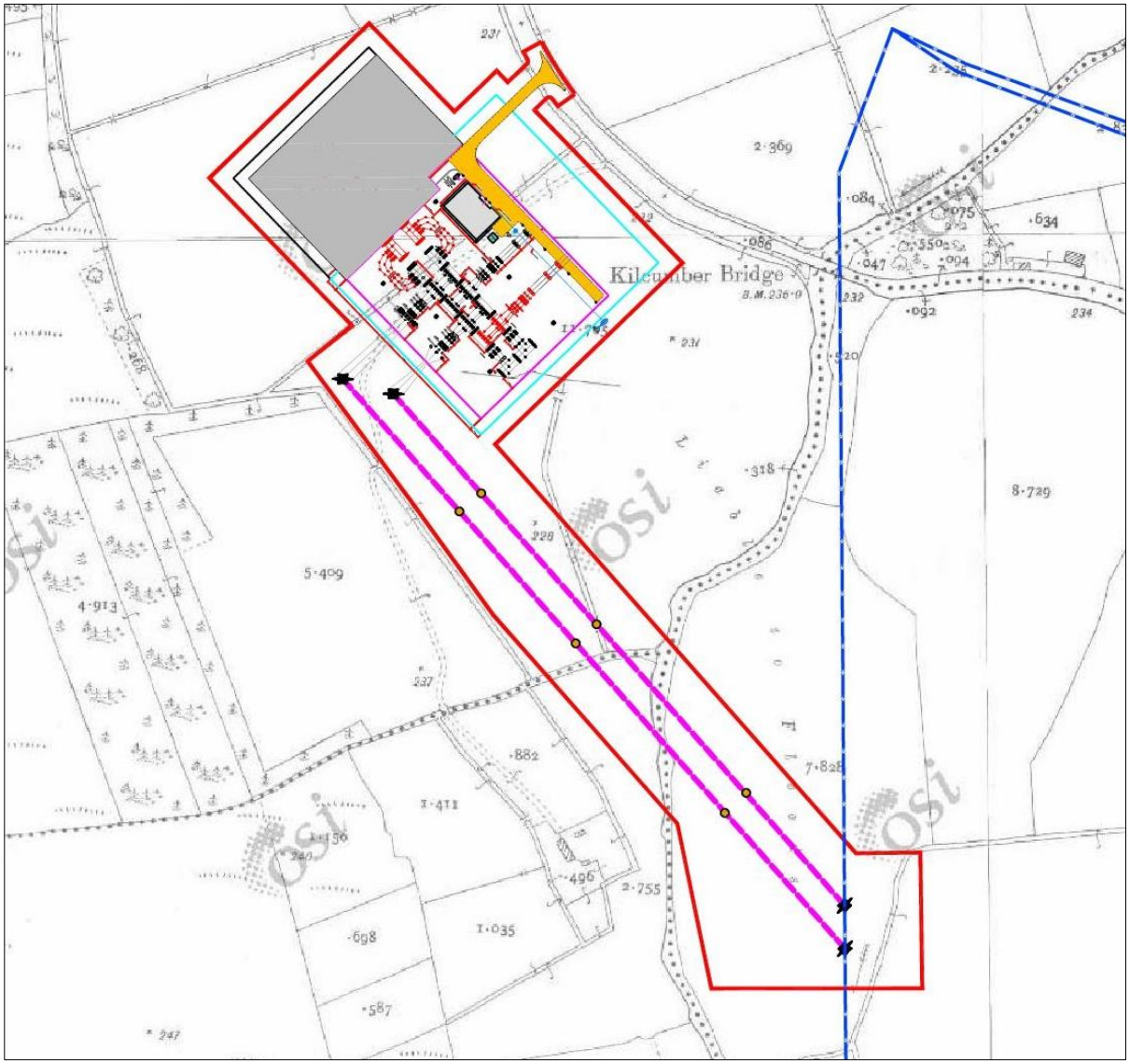

Figure 2 – OSI historic 25" map[2]

[2] Map reproduced from Ordnance Survey Ireland by permission of the Government, licence number EN 00115720.

Figure **3** below shows the OPW Past Flood Events obtained from *https://www.floodinfo.ie*. There are flood events recorded at several locations around Edenderry and at Clonbulloge to the south. There are no recorded flood events in the vicinity of the proposed site.

Figure **3** also shows the Flood Zones for the area. The site is outside the blue areas and therefore in Flood Zone C.

The Figile River is a drained channel and responsibility for its maintenance lies with the Local Authority. The OPW maps show the site as being *Benifited Lands* due to the Figile drainage scheme.

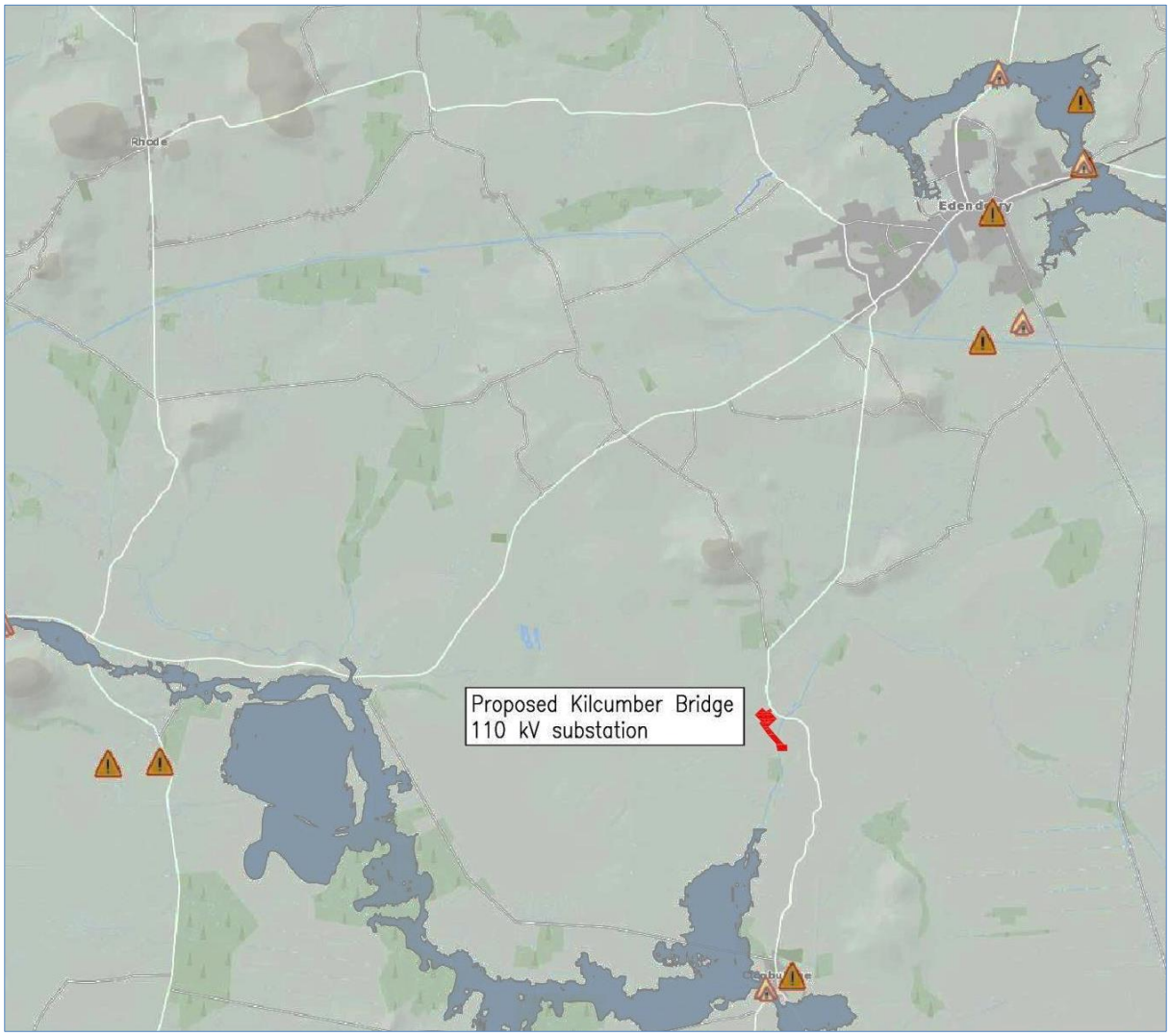

Figure 3 – OPW Past Flood Events and Flood Zones

3 Initial Flood Risk Assessment (Stage 2)

The purpose of the Initial Flood Risk Assessment is to ensure that all the relevant flood risk sources are identified to determine if a Stage 3 Detailed Flood Risk Assessment is required and if so that they can be addressed appropriately.

3.1 Flooding sources

Potential sources of flooding and their relevance to the flood risk to the site are outlined in the following sub-sections.

3.1.1 River flooding

River flooding occurs when the capacity of a river channel is exceeded and water flows onto the adjacent land or flood plain. The Stage 1 assessment identified that the area to the east of the site adjacent to the river was liable to flooding in the past. This may no longer the case because of the drainage scheme which is maintained by the Local Authority. However, because of the proximity of the proposed site to the river it will be necessary establish a design flood level on which to base the minimum surface level of the substation compound and floor level of the buildings. For this reason, it will be necessary to complete a Stage 3 - Detailed Flood Risk Assessment.

3.1.2 Overland flow

Overland or pluvial flow occurs when rainfall intensity exceeds the infiltration capacity of the ground. The excess water flows overland to the nearest watercourse or results in ponding in low areas or upstream of physical obstructions. It is most likely to occur following periods of sustained rainfall when the ground surface becomes saturated. Overland flow can also occur due to river flooding where the overbank flow from a point upstream runs across the site before returning to the river channel further downstream. This type of flooding is not uncommon and can occur where there is no direct risk from an adjacent or nearby river channel. There is no evidence that this type of flooding occurs within the proposed site. Any risk of such an event can be mitigated by ensuring that buildings and equipment are set at an appropriate level relative to the existing ground.

3.1.3 Estuarial flooding

Estuarial or tidal flooding occurs when the peak flow in a river coincides with extreme high tides resulting in abnormally high water surface levels in the lower reaches of a river channel. The Figile River at this location is remote from the coast and is above the 60 metre OS contour. Tidal effects do not have to be considered for this site.

3.1.4 Groundwater flooding

Groundwater flooding occurs when the water table rises to the level of the ground surface due to rainfall and flows out over the surface. This is normally associated with karst bedrock. Groundwater flooding occurs relatively slowly and poses a low hazard to people. The risk of groundwater flooding is considered to be negligible at this location.

3.1.5 Summary of flood risks

The potential for flooding of the site is low. However, a Stage 3 - Detailed Flood Risk Assessment will be carried out to determine the appropriate construction level for the development and to confirm the flood zoning for the site.

3.2 Appraisal of availability and adequacy of existing information

Table 1 below includes a summary list of existing information and the availability and adequacy of the data.

Information	Availability	Adequacy/Comments
Flow data for the Figile River	Yes	Information available from the OPW FSU web portal.
Topographical survey of proposed substation site	Yes	The survey includes the subject site and an adequate length of the adjacent river reach and relevant structures.
Aerial photography of the site and surrounding area.	Yes	Aerial photography from Bing maps.

Table 1 – Availability and adequacy of existing information

As indicated in the table above, sufficient information exists in relation to the site which can be used in a Stage 3 flood risk assessment. This involves the development of a hydraulic model of the river channel and determination of design flow rates for current and future climate scenarios.

3.3 Flood zone mapping

The OPW flood maps indicate that the site is in Flood Zone C and hence suitable for all types of development from a flood risk perspective. The hydraulic analysis of the river adjacent to the site will be used to verify this.

3.4 Requirements for a Stage 3 FRA

A Stage 3 detailed flood risk assessment will be carried out to provide a quantitative appraisal of the potential flood risk to the site and to examine the potential impact of the development on flood risk elsewhere. The assessment focuses on the risk of flooding from the Figile River since this is the only source that has been identified as a potential risk to the site. The other possible sources of flooding are of low or zero risk.

4 Detailed Flood Risk Assessment (Stage 3)

4.1 Flow calculations

The Figile River runs in a southerly direction a short distance to the east of the proposed substation. The catchment area at the site 81.09 km^2. Flow rates were determined using the OPW Flood Studies Update (FSU) Web Portal. The growth factors were calculated using both a General Extreme Value (GEV) and an Extreme Value Type 1 (EV1) distribution with the latter giving the most onerous value for return periods greater that the median value.

The OPW FSU output is included in Appendix B.

The flow rates in m^3/second for different flood return periods are shown in Table 2. The flow rate on which the design flood level is based is the 1% AEP (1 in 100 year return period) flow rate with a 20% increase to allow for the possible effects of future climate change as discussed in Section 4.4 of this report. The Q_{100} and $Q_{1,000}$ flow rates are used to confirm the flood zoning for the site.

Statistical Distribution	Q_{med}	Q_{100}	Q_{100} + 20%	$Q_{1,000}$
EV1	10.15	24.83	29.80	32.84
GEV	10.15	24.26	29.11	31.41

Table 2 – Flow Rates (m^3/second)

The full catchment area is shown in Figure 4.

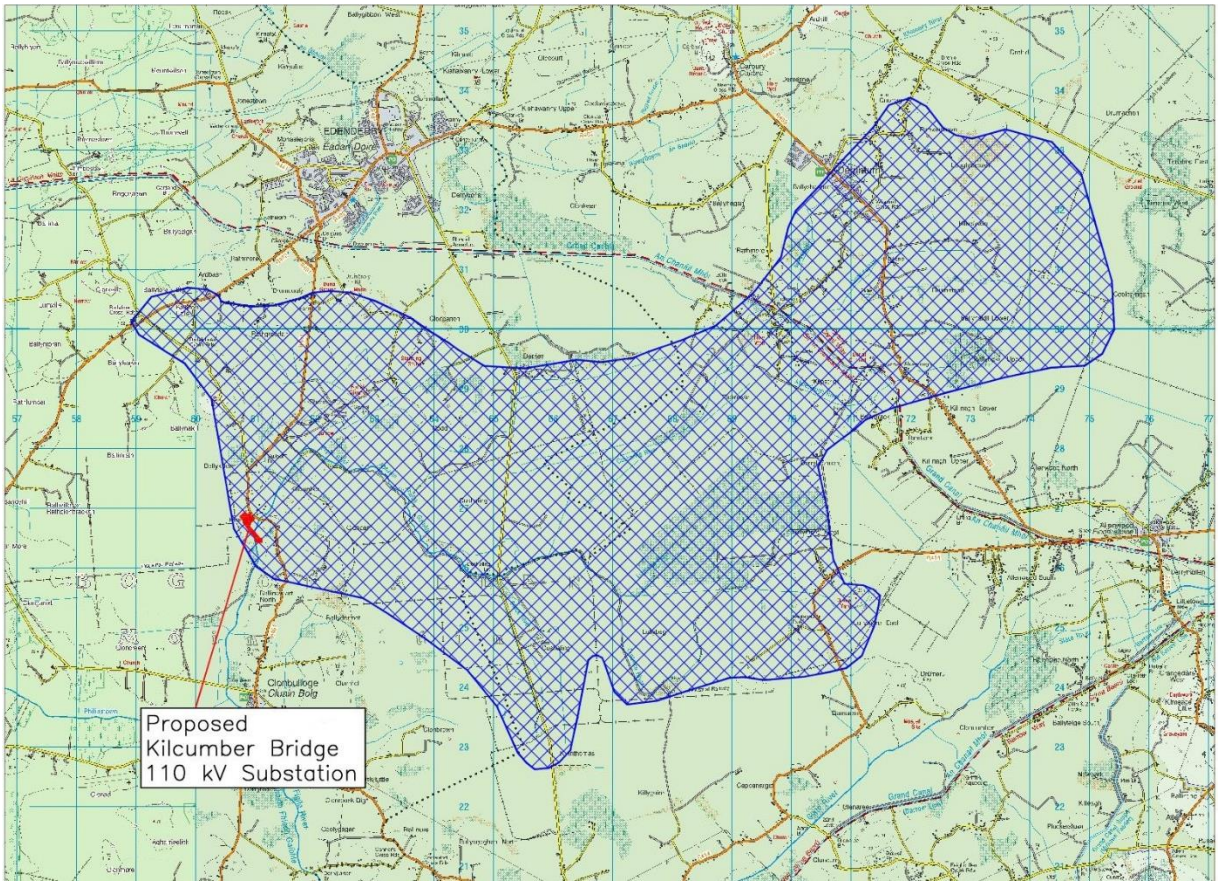

Figure 4 – Catchment at Kilcumber Bridge[3]

[3] Map reproduced from Ordnance Survey Ireland by permission of the Government, licence number EN 00115719.

4.2 Hydraulic model

The hydraulic analysis was carried out using HEC-RAS 1D modelling to determine the water surface profile of the Figile River adjacent to the site. The analysis is based on steady flow conditions using the flow rates calculated above.

A topographical survey of the river channel and overbank areas was carried out over a 1,000 metre length of the river reach starting at the downstream face of Kilcumber Bridge. A total of 11 sections were surveyed at average intervals of 100 metres. This information was used to create a 1D hydraulic model using HEC-RAS river modelling software. The cross sections are numbered from downstream to upstream with the section names corresponding to the distance from the downstream boundary. The sections are plotted in HEC-RAS from left to right facing downstream.

There is a low single span bridge about 800 metres downstream of Kilcumber Bridge (model River Station 193). This was included in the topographical survey and incorporated into the hydraulic model. Photographs of this bridge are shown below.

Manning friction coefficients of 0.033 and 0.060 were used for the channel and overbank areas, respectively. The downstream boundary condition was taken as a water surface gradient of 0.001 to correspond with the overall channel slope. Flow velocities are low at all flow rates resulting in sub-critical flow throughout under steady flow conditions.

Photograph 1 - downstream bridge facing east

Photograph 2 - downstream bridge facing upstream

4.3 Results of Analysis

4.3.1 Flood levels

The analysis indicates that the low bridge at River Station 193 restricts the flow at flow rates above 14 m^3/second. At higher flow rates the afflux increases the water surface level upstream as far as Kilcumber Bridge and beyond. This increases the flood risk between both bridges and changes the flood zone extents locally.

The calculated flood level at the site for a 1% AEP flood event including a 20% climate change factor is 67.10 mOD. Construction levels should be based on this value with an appropriate freeboard for each element of the development.

The water surface profiles from the HEC-RAS hydraulic model are shown in Figure 6 to Figure 8 in Appendix A.

4.3.2 Flood zones

The Flood Risk Management Guidelines document defines three flood zone types as follows:

Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);

Flood Zone B - where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1,000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and

Flood Zone C - where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1,000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

The flood zones are defined without taking the effects of future climate change into account.

Table 3.1 of the Guidelines lists the vulnerability classes for different types of development and states that development types not listed should be considered on their own merits. Electrical substations are included in the highly vulnerable development class and must be sited in Flood Zone C. Construction of a substation in Flood Zones A or B would require a Justification Test in accordance with Chapter 5 of the Guidelines.

The pylons for the 110 kV electrical connection are not vulnerable to flooding and are therefore appropriate in all Flood Zones. A Justification Test is not required for any element of the proposed development.

The flood zones adjacent to the site based on the hydraulic analysis are shown in Figure 5 below.

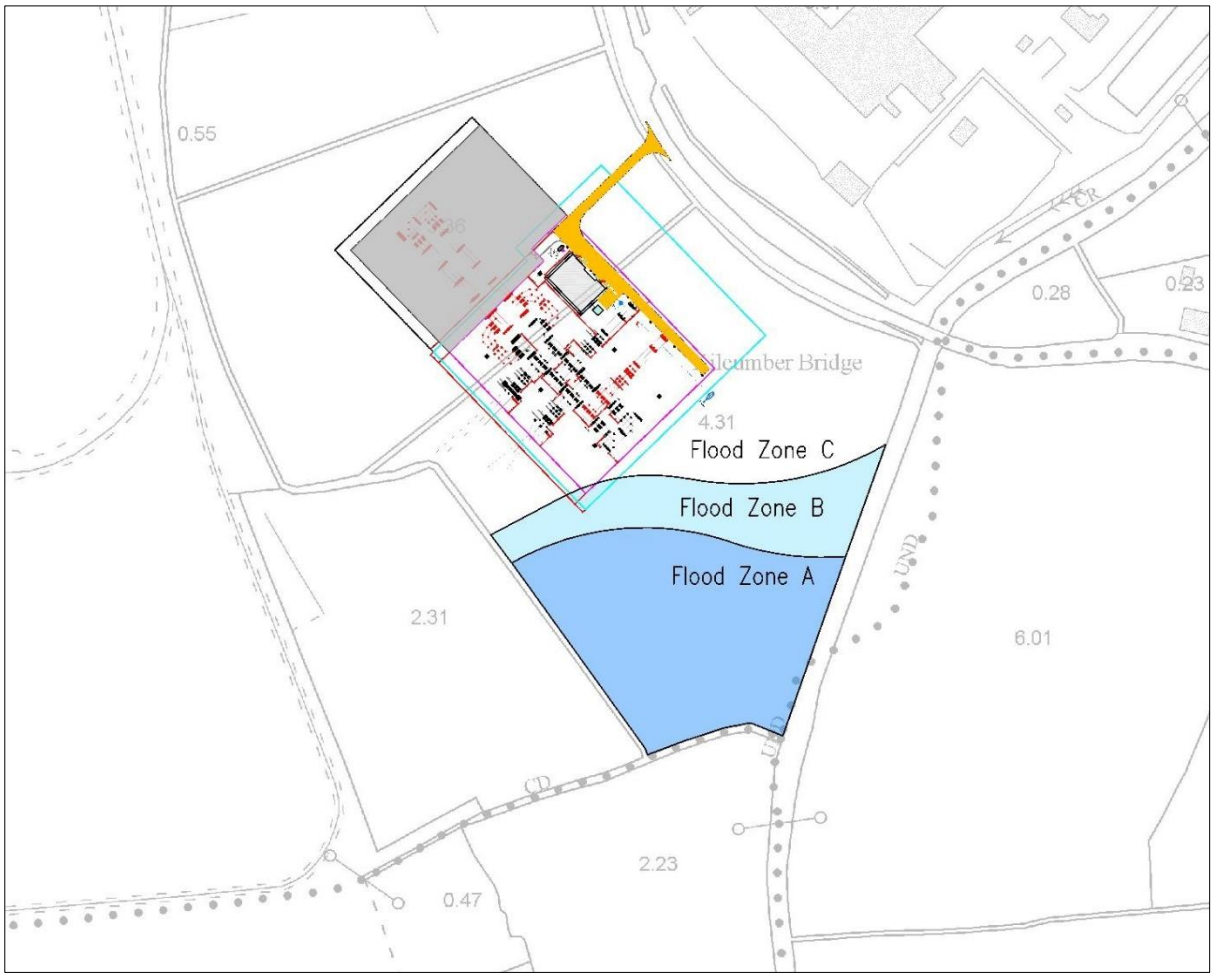

Figure 5 – Flood Zones (Flood zone C covers all areas not in zone A or B)

4.3.3 Potential impacts of flooding elsewhere

With the exception of the pylons for 110 kV overhead line all construction will be in Flood Zone C. The volume of flood plain storage displaced by the pylons will be negligible. The proposed development will, therefore, not increase flood risk within or outside the site.

4.4 Climate change

The Inter-Governmental Panel on Climate Change (IPCC), 4th assessment report Climate Change 2007 concluded that warming of the climate is unequivocal. Subsequent IPCC reports have reiterated this conclusion. Increases in rainfall and particularly in rainfall intensity are expected to occur in the future with a consequent increase in flood risk generally. For the mid-range future climate scenario (MRFS) it is recommended that the flow rate is increased by a factor of 20% to year 2100.

5 Summary and Conclusions

This flood risk assessment established the flood zoning for the site. The electrical substation is located in Flood Zone C and the pylons for the electrical connection to the external grid are in Flood Zones A and B. The substation and overhead line are appropriate for the respective flood zones in which they are to be located in accordance with the Flood Risk Management Guidelines.

Existing ground levels at the site range from 66.8 to 68 mOD. Construction levels should be based on a design flood level of 67.10 mOD. Freeboard needs to be added to this design flood level that is appropriate to each element of the proposed development.

The proposed development will not increase flood risk within or outside the site.

6 References

Offaly County Council County Development Plan 2014-2020

The Planning System and Flood Risk Management – Guidelines for Planning Authorities, Office of Public Works and the Department of Environment, Heritage and Local Government, November 2009.

OPW *Planning and Development Flood Policy*, published on www.flooding.ie

OPW *Flood Plans and Flood Maps* on www.floodinfo.ie

National Preliminary Flood Risk Assessment (NFRA) Report, Office of Public Works, August 2011.

Ireland and the IPCC 4th Assessment Report, Irish Committee on Climate Change, 2007.

Appendix A
- HEC-RAS model water surface profiles

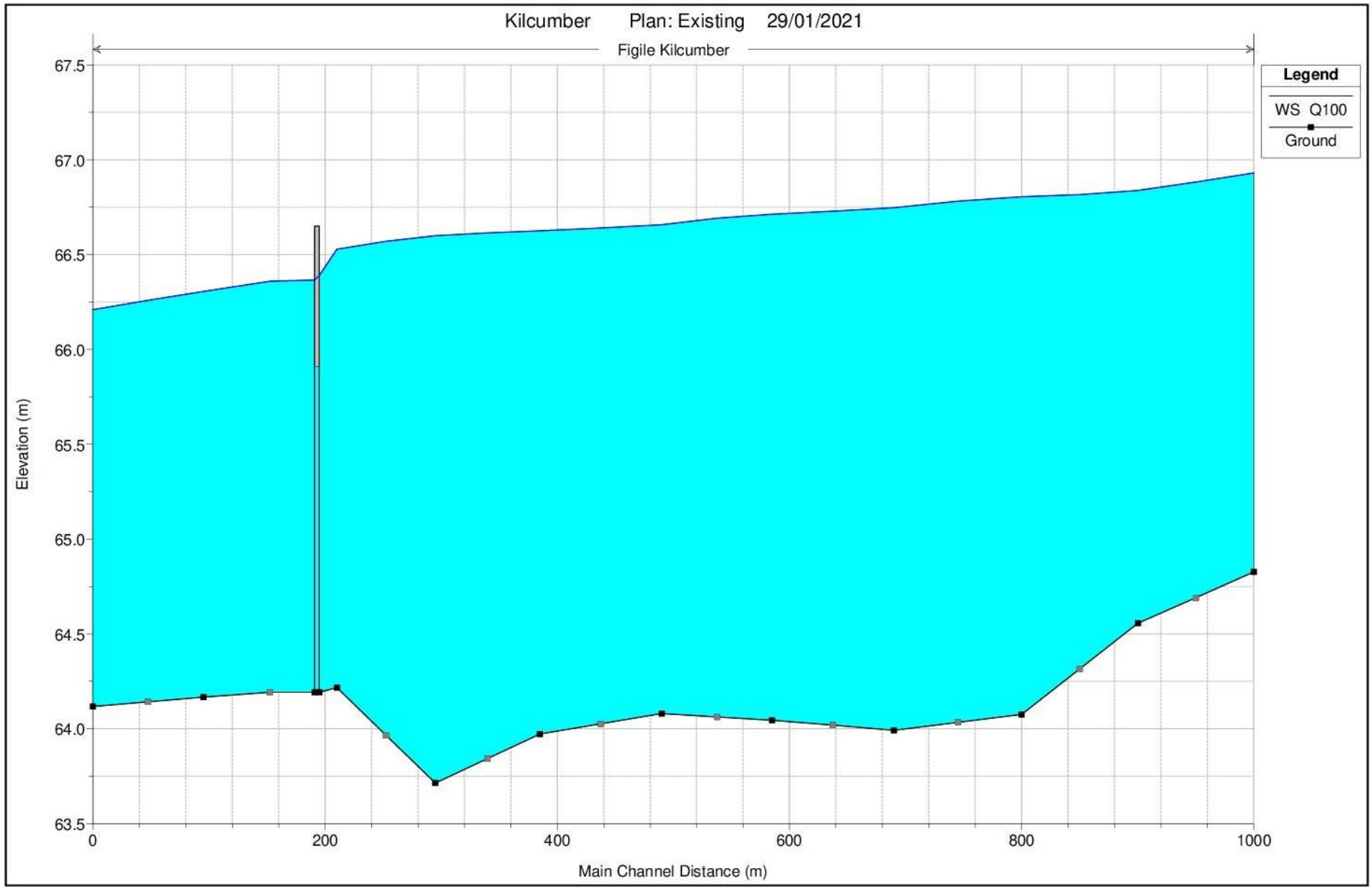

Figure 6 – HEC-RAS water surface profile for 1% AEP flood

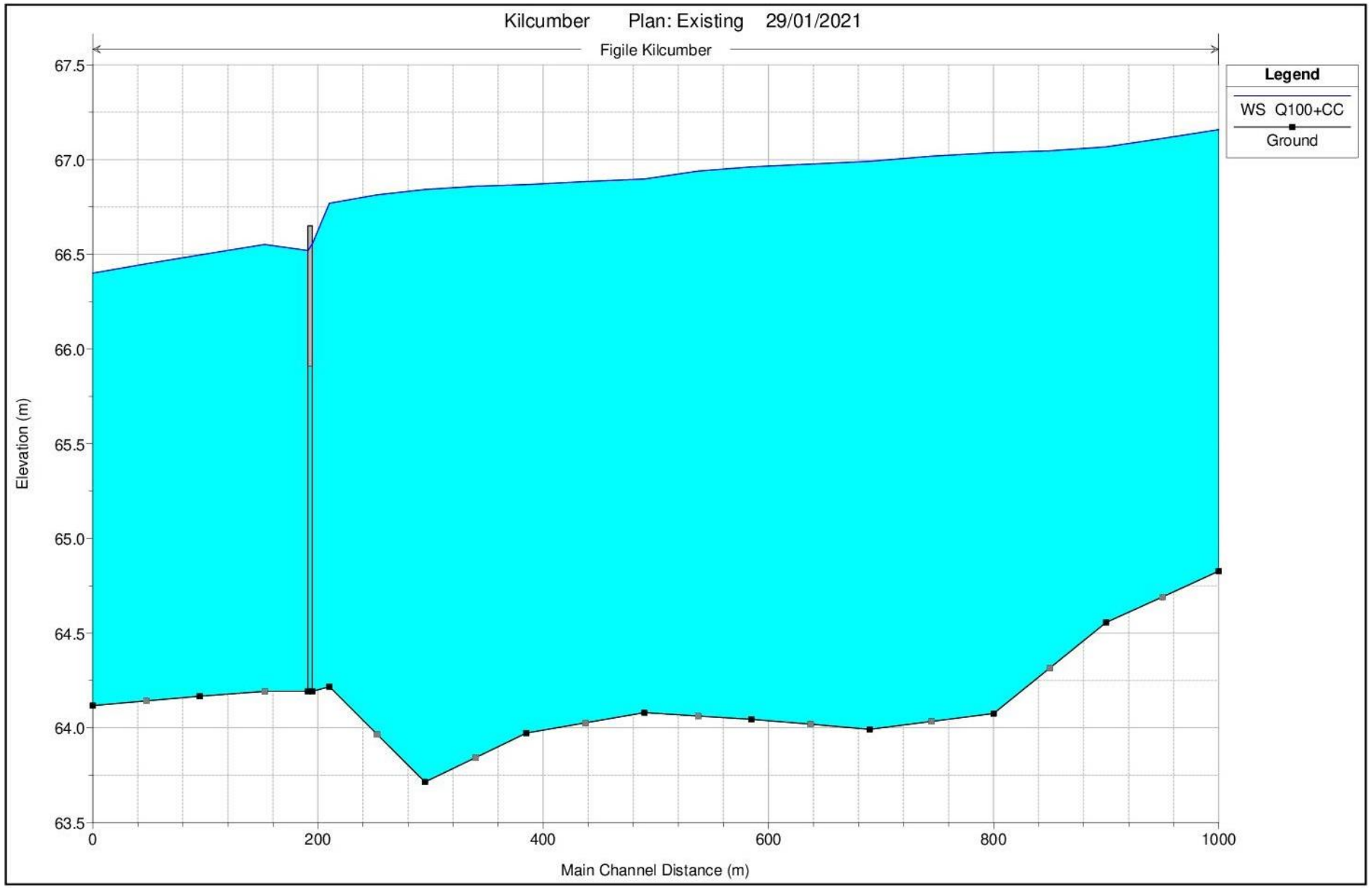

Figure 7 – HEC-RAS water surface profile for 1% AEP flood including climate change

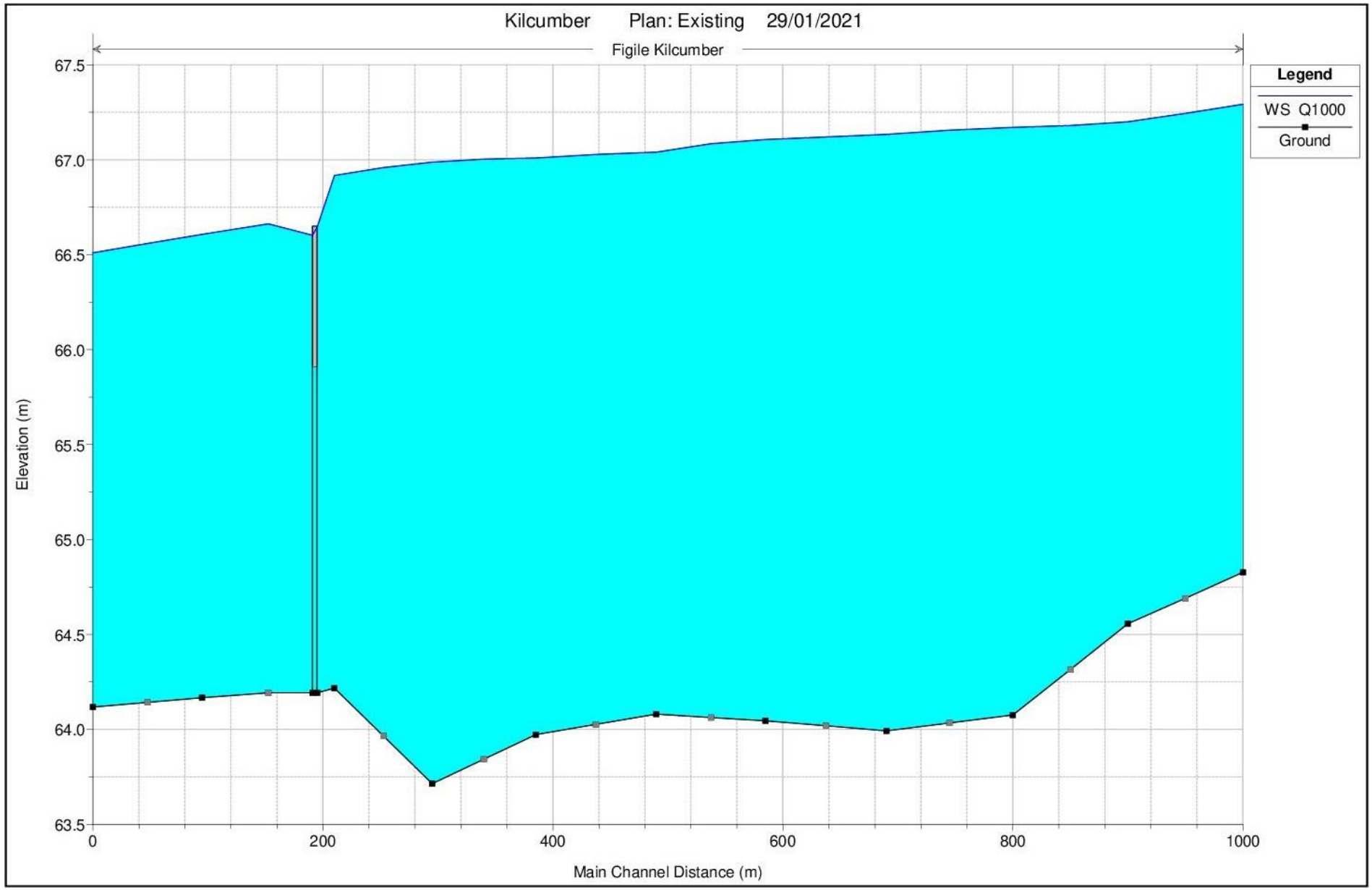

Figure 8 – HEC-RAS water surface profile for 0.1% AEP flood

Appendix B
-OPW FSU output

Flood Estimation Report #11641 (Kilcumber)

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Subject site

Attributes

Name	Unit	Value
Coordinate [X]		660969.718317111
Coordinate [Y]		726109.371440844
Distance	km	0.634846879914829
Station Number		14_1831_4
Location		
Water Body		
Catchment		
Hydrometric Area		
Organisation		
FSU Rating Classification		
Drainage works	year	
Contributing Catchment Area	km^2	81.089
Center Northing	m	227990
Center Easting	m	267130
Northing	m	226081
Easting	m	261032
A-Max series gap in years	year	
A-Max series number of years	year	
A-Max series number of usable years	year	
A-Max series end year	year	
A-Max series start year	year	
FARL		1
ALLUV		0.0077
PEAT		0.5967
FOREST		0.0673
PASTURE		0.3556
S1085	m/km	1.03608
MSL	km	18.763
DRAIND	km/km^2	0.783
ALTBAR		78.9
NETLEN	km	63.514
T4		
T3		

SAAPE	mm	514.24
T2		
ARTDRAIN2		0
ARTDRAIN		0.016
TAYSLO		0.205886
STMFRQ		47
BFISOIL		0.419877438
SAAR	mm	829.98
RWSEG_CD		14_1831
TOP_RWSEG		
Bankfull		
HGF	m^3/s	
MAF	m^3/s	
FAI		0.3314
FLATWET		0.58
URBEXT		0.0015
HGF/QMED		
centroidx3857		-778524.310246443
centroidy3857		7038303.24640949
x3857		-788779.40289965
y3857		7035293.22126785

Pivotal site

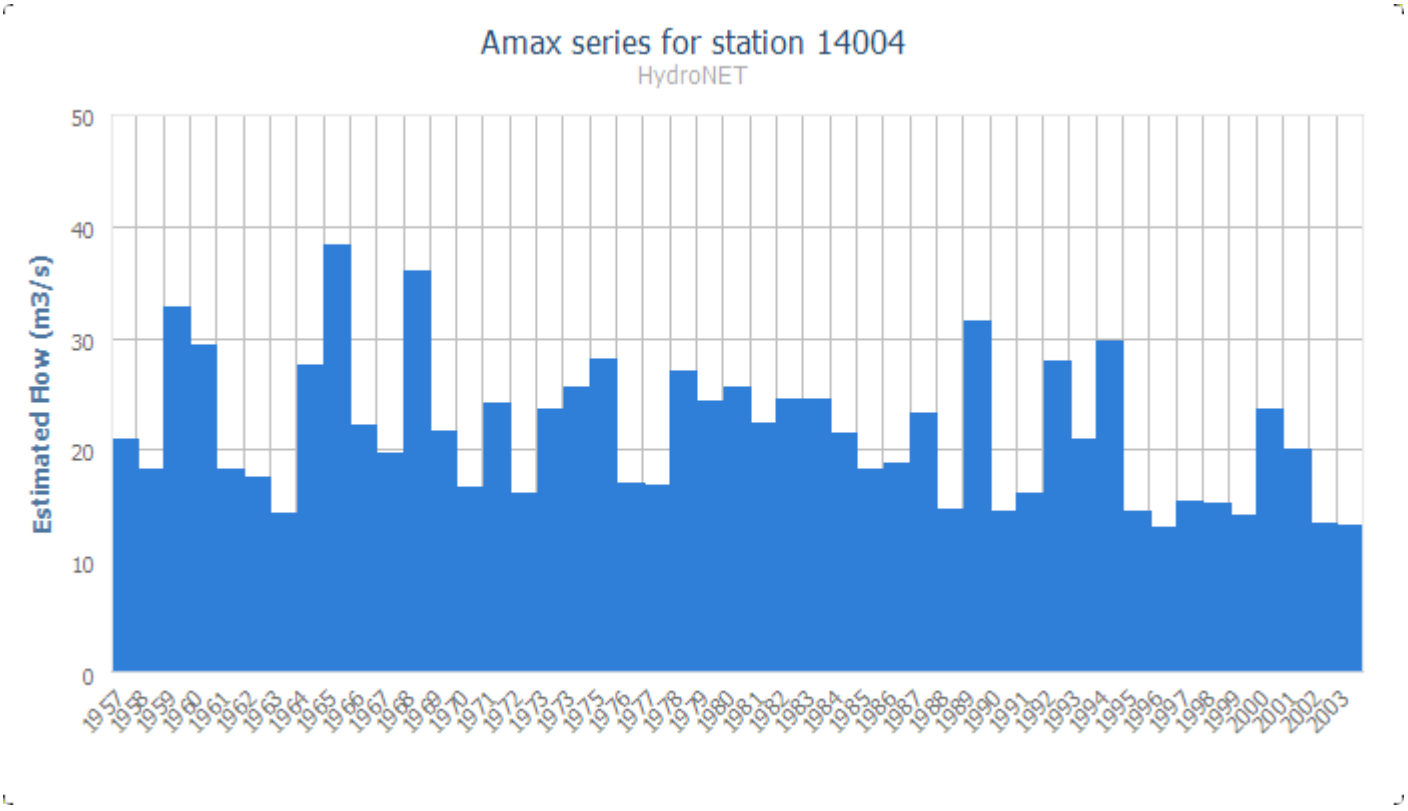
Attributes

Name	Unit	Value
Coordinate [X]		660927.713028632
Coordinate [Y]		723533.926572038
Station Number		14004
Location		CLONBULLOGE
Water Body		FIGILE
Catchment		Barrow
Hydrometric Area		14
Organisation		OPW
FSU Rating Classification		A1
Drainage works	year	No
Contributing Catchment Area	km^2	268.8505
Center Northing	m	227571
Center Easting	m	258386
Northing	m	223505
Easting	m	260990
A-Max series gap in years	year	0
A-Max series number of years	year	47
A-Max series number of usable years	year	47
A-Max series end year	year	2003
A-Max series start year	year	1957
FARL		0.999
ALLUV		0.0086
PEAT		0.3957
FOREST		0.0679
PASTURE		0
S1085	m/km	0.64373
MSL	km	24.695
DRAIND	km/km^2	0.597
ALTBAR		0
NETLEN	km	160.496
T4		0.074290548094429
T3		0.14782706002051
SAAPE	mm	508.2
T2		0.16359541378291
ARTDRAIN2		0
ARTDRAIN		0.0092
TAYSLO		0.174473
STMFRQ		115
BFISOIL		0.537
SAAR	mm	838.67
RWSEG_CD		14_996
TOP_RWSEG		14_1867
Bankfull		N/A
HGF	m^3/s	34
MAF	m^3/s	21.5
FAI		0.25
FLATWET		0.59
URBEXT		0.0032
HGF/QMED		1.6152087944182
x3857		-788904.424325122
y3857		7030986.33962624

centroidx3857		-793740.825076675
centroidy3857		7038189.89221268
Distance	km	15.2169370358358

Map

Amax Series Chart



QMED Estimates

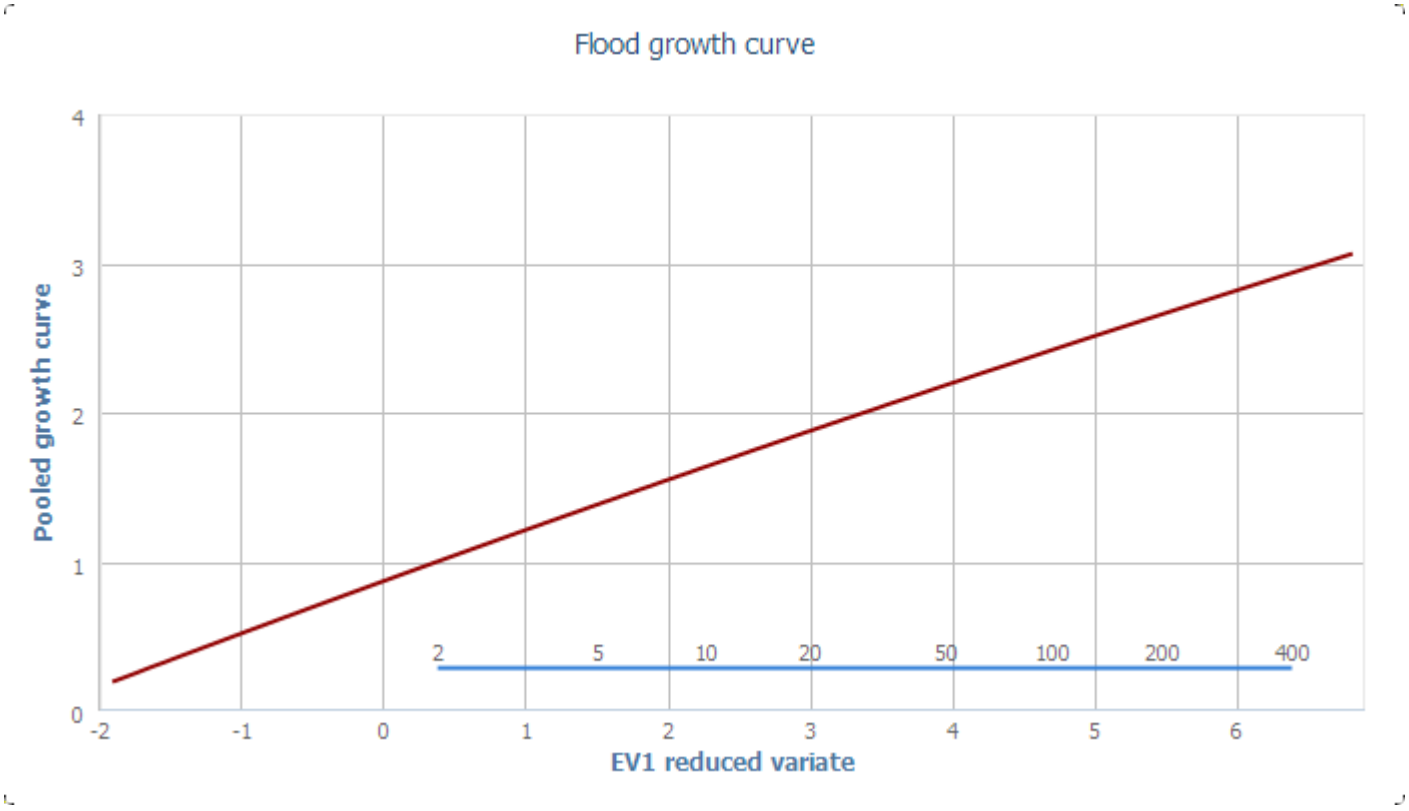
Subject rural QMED	10.17
Subject urban QMED	10.2
Pivotal gauged QMED	21.05
Pivotal adjustment factor QMED	1
Subject adjusted QMED	**10.15**

Pooling Group

Station	Amax years
08003 FIELDSTOWN	18
08007 ASHBOURNE	15
08008 BROADMEADOW	25
06033 CONEYBURROW BR.	25
36031 LISDARN	30
11001 BOLEANY	33
08011 DULEEK D/S	23
09001 LEIXLIP	25
08009 BALHEARY	15
15003 DININ BR.	50

07033 VIRGINIA HATCHERY	25
08012 BALLYBOGHIL	19
24004 BRUREE	52
24022 HOSPITAL	20
14004 CLONBULLOGE	47
25005 SUNVILLE	46
06031 CURRALHIR	18
09010 WALDRONS BRIDGE	19

Selected Flood Growth Curve



Pooled growth curve	EV1 reduced variate
0.19	-1.92
0.25	-1.75
0.29	-1.66
0.31	-1.6
0.33	-1.55
0.34	-1.51
0.36	-1.47
0.37	-1.44
0.38	-1.41
0.39	-1.38
0.4	-1.35
0.41	-1.33
0.41	-1.31
0.42	-1.29
0.43	-1.27
0.43	-1.25
0.44	-1.23
0.45	-1.21
0.45	-1.2
0.46	-1.18
0.46	-1.16
0.47	-1.15
0.48	-1.13
0.48	-1.12
0.48	-1.11
0.49	-1.09
0.49	-1.08
0.5	-1.07
0.5	-1.06

0.51	-1.04
0.51	-1.03
0.52	-1.02
0.52	-1.01
0.52	-1
0.53	-0.99
0.53	-0.98
0.53	-0.97
0.54	-0.96
0.54	-0.94
0.55	-0.93
0.55	-0.93
0.55	-0.92
0.56	-0.91
0.56	-0.9
0.56	-0.89
0.57	-0.88
0.57	-0.87
0.57	-0.86
0.58	-0.85
0.58	-0.84
0.58	-0.83
0.58	-0.83
0.59	-0.82
0.59	-0.81
0.59	-0.8
0.6	-0.79
0.6	-0.78
0.6	-0.78
0.6	-0.77
0.61	-0.76
0.61	-0.75
0.61	-0.74
0.62	-0.74
0.62	-0.73
0.62	-0.72
0.62	-0.71
0.63	-0.71
0.63	-0.7
0.63	-0.69
0.63	-0.68
0.64	-0.68
0.64	-0.67
0.64	-0.66
0.64	-0.66
0.65	-0.65
0.65	-0.64
0.65	-0.63
0.65	-0.63
0.66	-0.62
0.66	-0.61
0.66	-0.61
0.66	-0.6
0.67	-0.59
0.67	-0.59
0.67	-0.58
0.67	-0.57

0.68	-0.57
0.68	-0.56
0.68	-0.55
0.68	-0.55
0.68	-0.54
0.69	-0.54
0.69	-0.53
0.69	-0.52
0.69	-0.52
0.7	-0.51
0.7	-0.5
0.7	-0.5
0.7	-0.49
0.7	-0.48
0.71	-0.48
0.71	-0.47
0.71	-0.47
0.71	-0.46
0.72	-0.45
0.72	-0.45
0.72	-0.44
0.72	-0.44
0.72	-0.43
0.73	-0.42
0.73	-0.42
0.73	-0.41
0.73	-0.41
0.73	-0.4
0.74	-0.39
0.74	-0.39
0.74	-0.38
0.74	-0.38
0.74	-0.37
0.75	-0.37
0.75	-0.36
0.75	-0.35
0.75	-0.35
0.75	-0.34
0.76	-0.34
0.76	-0.33
0.76	-0.33
0.76	-0.32
0.76	-0.31
0.77	-0.31
0.77	-0.3
0.77	-0.3
0.77	-0.29
0.77	-0.29
0.78	-0.28
0.78	-0.27
0.78	-0.27
0.78	-0.26
0.78	-0.26
0.79	-0.25
0.79	-0.25
0.79	-0.24
0.79	-0.24

0.79	-0.23
0.8	-0.22
0.8	-0.22
0.8	-0.21
0.8	-0.21
0.8	-0.2
0.81	-0.2
0.81	-0.19
0.81	-0.19
0.81	-0.18
0.81	-0.17
0.81	-0.17
0.82	-0.16
0.82	-0.16
0.82	-0.15
0.82	-0.15
0.82	-0.14
0.83	-0.14
0.83	-0.13
0.83	-0.13
0.83	-0.12
0.83	-0.11
0.84	-0.11
0.84	-0.1
0.84	-0.1
0.84	-0.09
0.84	-0.09
0.84	-0.08
0.85	-0.08
0.85	-0.07
0.85	-0.07
0.85	-0.06
0.85	-0.06
0.86	-0.05
0.86	-0.04
0.86	-0.04
0.86	-0.03
0.86	-0.03
0.87	-0.02
0.87	-0.02
0.87	-0.01
0.87	-0.01
0.87	0
0.87	0
0.88	0.01
0.88	0.01
0.88	0.02
0.88	0.03
0.88	0.03
0.89	0.04
0.89	0.04
0.89	0.05
0.89	0.05
0.89	0.06
0.9	0.06
0.9	0.07
0.9	0.07

0.9	0.08
0.9	0.08
0.9	0.09
0.91	0.1
0.91	0.1
0.91	0.11
0.91	0.11
0.91	0.12
0.92	0.12
0.92	0.13
0.92	0.13
0.92	0.14
0.92	0.14
0.93	0.15
0.93	0.16
0.93	0.16
0.93	0.17
0.93	0.17
0.93	0.18
0.94	0.18
0.94	0.19
0.94	0.19
0.94	0.2
0.94	0.2
0.95	0.21
0.95	0.22
0.95	0.22
0.95	0.23
0.95	0.23
0.96	0.24
0.96	0.24
0.96	0.25
0.96	0.25
0.96	0.26
0.97	0.27
0.97	0.27
0.97	0.28
0.97	0.28
0.97	0.29
0.97	0.29
0.98	0.3
0.98	0.3
0.98	0.31
0.98	0.32
0.98	0.32
0.99	0.33
0.99	0.33
0.99	0.34
0.99	0.34
0.99	0.35
1	0.36
1	0.36
1	0.37
1	0.37
1	0.38
1.01	0.38
1.01	0.39

1.01	0.4
1.01	0.4
1.01	0.41
1.02	0.41
1.02	0.42
1.02	0.42
1.02	0.43
1.02	0.44
1.03	0.44
1.03	0.45
1.03	0.45
1.03	0.46
1.03	0.47
1.04	0.47
1.04	0.48
1.04	0.48
1.04	0.49
1.04	0.49
1.05	0.5
1.05	0.51
1.05	0.51
1.05	0.52
1.05	0.52
1.06	0.53
1.06	0.54
1.06	0.54
1.06	0.55
1.06	0.56
1.07	0.56
1.07	0.57
1.07	0.57
1.07	0.58
1.08	0.59
1.08	0.59
1.08	0.6
1.08	0.6
1.08	0.61
1.09	0.62
1.09	0.62
1.09	0.63
1.09	0.64
1.09	0.64
1.1	0.65
1.1	0.66
1.1	0.66
1.1	0.67
1.11	0.67
1.11	0.68
1.11	0.69
1.11	0.69
1.11	0.7
1.12	0.71
1.12	0.71
1.12	0.72
1.12	0.73
1.13	0.73
1.13	0.74

1.13	0.75
1.13	0.75
1.14	0.76
1.14	0.77
1.14	0.77
1.14	0.78
1.14	0.79
1.15	0.79
1.15	0.8
1.15	0.81
1.15	0.82
1.16	0.82
1.16	0.83
1.16	0.84
1.16	0.84
1.17	0.85
1.17	0.86
1.17	0.87
1.17	0.87
1.18	0.88
1.18	0.89
1.18	0.89
1.18	0.9
1.19	0.91
1.19	0.92
1.19	0.92
1.19	0.93
1.2	0.94
1.2	0.95
1.2	0.95
1.2	0.96
1.21	0.97
1.21	0.98
1.21	0.98
1.21	0.99
1.22	1
1.22	1.01
1.22	1.01
1.22	1.02
1.23	1.03
1.23	1.04
1.23	1.05
1.23	1.05
1.24	1.06
1.24	1.07
1.24	1.08
1.25	1.09
1.25	1.1
1.25	1.1
1.25	1.11
1.26	1.12
1.26	1.13
1.26	1.14
1.27	1.15
1.27	1.15
1.27	1.16
1.27	1.17

1.28	1.18
1.28	1.19
1.28	1.2
1.29	1.21
1.29	1.22
1.29	1.23
1.3	1.23
1.3	1.24
1.3	1.25
1.3	1.26
1.31	1.27
1.31	1.28
1.31	1.29
1.32	1.3
1.32	1.31
1.32	1.32
1.33	1.33
1.33	1.34
1.33	1.35
1.34	1.36
1.34	1.37
1.34	1.38
1.35	1.39
1.35	1.4
1.35	1.41
1.36	1.42
1.36	1.43
1.36	1.44
1.37	1.45
1.37	1.46
1.38	1.47
1.38	1.48
1.38	1.49
1.39	1.51
1.39	1.52
1.39	1.53
1.4	1.54
1.4	1.55
1.41	1.56
1.41	1.57
1.41	1.59
1.42	1.6
1.42	1.61
1.43	1.62
1.43	1.63
1.43	1.65
1.44	1.66
1.44	1.67
1.45	1.68
1.45	1.7
1.46	1.71
1.46	1.72
1.46	1.74
1.47	1.75
1.47	1.76
1.48	1.78
1.48	1.79

1.49	1.81
1.49	1.82
1.5	1.83
1.5	1.85
1.51	1.86
1.51	1.88
1.52	1.89
1.52	1.91
1.53	1.93
1.53	1.94
1.54	1.96
1.54	1.97
1.55	1.99
1.55	2.01
1.56	2.02
1.57	2.04
1.57	2.06
1.58	2.08
1.58	2.09
1.59	2.11
1.6	2.13
1.6	2.15
1.61	2.17
1.61	2.19
1.62	2.21
1.63	2.23
1.63	2.25
1.64	2.27
1.65	2.29
1.66	2.31
1.66	2.34
1.67	2.36
1.68	2.38
1.69	2.41
1.69	2.43
1.7	2.46
1.71	2.48
1.72	2.51
1.73	2.53
1.74	2.56
1.75	2.59
1.76	2.62
1.77	2.65
1.78	2.68
1.79	2.71
1.8	2.74
1.81	2.77
1.82	2.81
1.83	2.84
1.84	2.88
1.85	2.92
1.87	2.96
1.88	3
1.89	3.04
1.91	3.09
1.92	3.13
1.94	3.18

1.96	3.23
1.97	3.29
1.99	3.34
2.01	3.4
2.03	3.46
2.05	3.53
2.07	3.6
2.1	3.68
2.13	3.77
2.16	3.86
2.19	3.96
2.22	4.07
2.26	4.19
2.31	4.34
2.36	4.5
2.42	4.7
2.5	4.95
2.6	5.28
2.75	5.78
3.06	6.8

Adopted Growth Factors

Return Period	Growth Factor	Design Peak Flow (m^3/s)
1.3	0.74	7.51
2	1	10.15
5	1.39	14.11
10	1.63	16.54
20	1.87	18.98
30	2	20.3
50	2.17	22.02
100	2.39	24.25
200	2.61	26.49
500	2.89	29.33
1000	3.1	31.46

Hydrograph Width Estimation Summary

Hydrograph summary is not available for this report because the hydrograph was not transferred to the subject site.

Hydrograph Plots

Hydrographs are not available for this report because module 3 was not finished.

IBIDEM Plots and Tables

No IBIDEM plots were saved by the user.

Audit Trail Report #11641 (Kilcumber)

User ID:	sean.doyle@mwp.ie
Name:	Doyle, Sean
Company:	Malachy Walsh and Partners
Address:	
Report date & time:	29-01-2021 01:20
Start of Calculation:	19-01-2021 22:00

Decisions made by the user:

Decision	User comment	System information	Date
2.1 Subject site accepted	N/A	Location 14004	20-01-2021 15:21
2.9 Single site analysis accepted	N/A		20-01-2021 15:21
2.11 Pooling group accepted	N/A	Pooled group accepted with the following stations: [08011, 09001, 24002, 06013, 14011, 07006, 16004, 15001, 25021, 06025, 11001, 08008, 26019, 25016, 16001] and distribution: EV1	20-01-2021 15:22
2.13 Module 2 finalized	N/A	Finished combined analysis using distribution: EV1 and weight: 0.5.	20-01-2021 15:22
2.1 Subject site accepted	N/A	Location 14_1831_4	20-01-2021 15:29

2.4 Pivotal site accepted	Reason for accepting: The subject site is within this pivotal site Reason for ignoring warnings:	Station: 14004 CLONBULLOGE The user has been notified that 14 candidates where either hydrologically or geographically closer to the subject site than the chosen pivotal site. The user has accepted to reject these sites in preference of the chosen pivotal site.	20-01-2021 15:30
2.8 QMED data transfer performed	N/A		20-01-2021 15:30
2.11 Pooling group accepted	N/A	Pooled group accepted with the following stations: [08003, 08007, 08008, 06033, 36031, 11001, 08011, 09001, 08009, 15003, 07033, 08012, 24004, 24022, 14004, 25005, 06031, 09010] and distribution: EV1	20-01-2021 15:30
2.13 Module 2 finalized	N/A	Finished pooled analysis with the following distribution selected: EV1.	20-01-2021 16:03
2.8 QMED data transfer performed	N/A		25-01-2021 17:03
2.11 Pooling group accepted	N/A	Pooled group accepted with the following stations: [08003, 08007, 08008, 06033, 36031, 11001, 08011, 09001, 08009, 15003, 07033, 08012, 24004, 24022, 14004, 25005, 06031, 09010] and distribution: EV1	25-01-2021 17:03
2.8 QMED data transfer performed	N/A		28-01-2021 17:45
2.11 Pooling group accepted	N/A	Pooled group accepted with the following stations: [08003, 08007, 08008, 06033, 36031, 11001, 08011, 09001, 08009, 15003, 07033, 08012, 24004, 24022, 14004, 25005, 06031, 09010] and distribution: EV1	28-01-2021 17:45
2.13 Module 2 finalized	N/A	Finished pooled analysis with the following distribution selected: GEV.	28-01-2021 17:47