GEO-ENVIRONMENTAL CONSULTING ENGINEERS

bEk Enviro Ltd
Suite One | No 3 Mitton Road Business Park
Mitton Road | Whalley | Lancashire | BB7 9YE
01254 377622
mbuckley@bekenviro.co.uk | bekenviro.co.uk

EXTRACTION OF SLATE FROM MINERAL-WORKING DEPOSITS
ABERLLEFENNI SLATE QUARRY, MACHYNLLETH SY20 9SB

FLOOD CONSEQUENCES ASSESSMENT

Prepared for:
WINCILATE WELSH SLATE

Report Ref: BEK-RB20011-1
March 2022 (Revised December 2022)

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

bEk Enviro Ltd
Suite One | No 3 Mitton Road Business Park
Mitton Road | Whalley | Lancashire | BB7 9YE
01254 377622
mbuckley@bekenviro.co.uk | bekenviro.co.uk

Project Quality Assurance Information Sheet

SITE	**EXTRACTION OF SLATE FROM MINERAL-WORKING DEPOSITS ABERLLEFENNI SLATE QUARRY, MACHYNLLETH SY20 9SB**
REPORT TITLE	**FLOOD CONSEQUENCES ASSESSMENT**
REPORT STATUS	PLANNING
REPORT NO	BEK-RB20011-1
DATE	March 2022 Revised December 2022
PREPARED FOR	Wincilate Welsh Slate, Aberllefenni Slate Quarries Machynlleth Powys SY20 9RU
PREPARED BY	**BEK ENVIRO LIMITED** Suite One No 3 Mitton Road Business Park Mitton Road Whalley Lancashire BB7 9YE
AUTHOR	**Richard Broun** BSc (Hons) CEng MICE FCIHT
CHECKED	**David Emmott** BSc (Hons) MSc MIEnvSci CEnv
AUTHORISED	**Michael Buckley** BSc (Hons) MSc MIEnvSci CEnv
CONTACT	richard@bekenviro.co.uk www.bekenviro.co.uk Office: 01254 377622 Mobile: 07836 568911

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

bEk Enviro Ltd
Suite One | No 3 Mitton Road Business Park
Mitton Road | Whalley | Lancashire | BB7 9YE
01254 377622
mbuckley@bekenviro.co.uk | bekenviro.co.uk

EXTRACTION OF SLATE FROM MINERAL WORKING DEPOSITS ABERLLEFENNI SLATE QUARRY, MACHYNLLETH SY20 9SB
FLOOD CONSEQUENCES ASSESSMENT

PROJECT NO: **RB20011**

REPORT REF: **BEK-RB20011-1**

DATE: **March 2022 (Revised December 2022)**

REVISION STATUS / HISTORY

Rev	Date	Issue / Comment	Prepared	Checked
00	10.03.2022	Draft report to Client	RCTB	
01	18.12.2022	For Planning	RCTB	

GENERAL REPORT LIMITATIONS

BEK Enviro Limited (BEK) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and BEK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by BEK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

No part of this report may be copied or duplicated without the express permission of BEK and the party for whom it was prepared. Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

Unless explicitly agreed otherwise, in writing, this report has been prepared under BEK's standard Terms and Conditions as included within our proposal to the Client.

The report needs to be considered in the light of the BEK proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

CONTENTS

1.0 INTRODUCTION

1.1 Purpose

1.1.1 This report records the results of a Flood Consequences Assessment in support of a planning application for the extraction of slate from mineral-working deposits at Aberllefenni Slate Quarry, Machynlleth SY20 9SB.

1.1.2 The assessment, which has been undertaken at the instruction of the owners of the site, has been prepared in accordance with the Planning Policy Wales Technical Advice Note 15 (TAN 15): Development and Flood Risk, which was issued by the Welsh Assembly Government in July 2004.

2.0 EXISTING SITE USAGE / PROPOSED DEVELOPMENT

2.1 Location

2.1.1 Aberllefenni Slate Quarry is located to the north of the village of Aberllefenni, near Corris, OS Grid Reference E 276860, N 310060. The site is crossed by the Afon Llefenni which flows from north-east to south-west into a pond adjacent to the class 3 road and subsequently into the Afon Dulas.

2.1.2 Natural Resources Wales' (NRW's) indicative assessment of flooding shows that the site is partially within Flood Zones 2 & 3 with the remainder in Flood Zone 1. See **Figure 1** below.

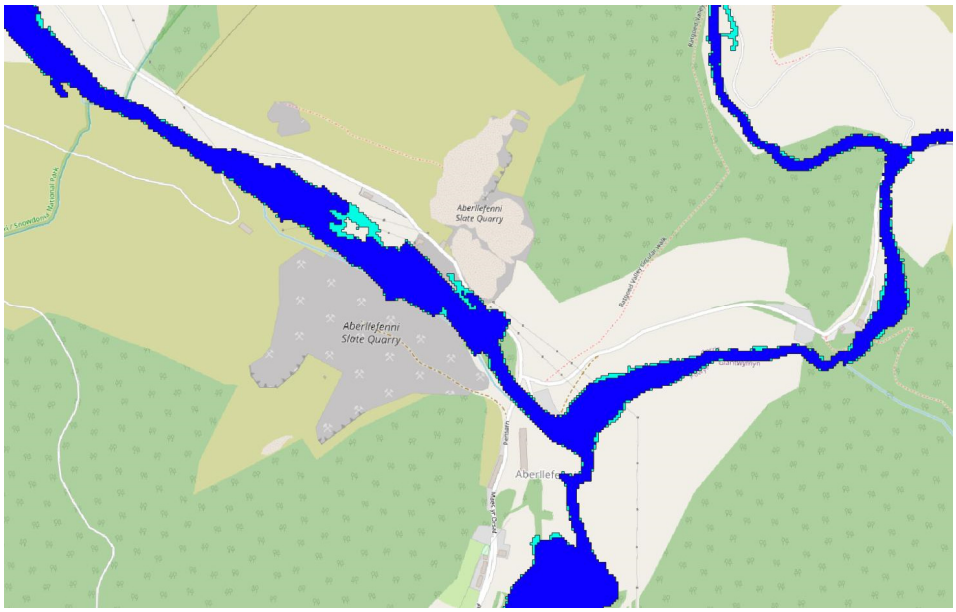


Figure 1: Site Location partially within Flood Zones 2 & 3

2.1.3 The Flood Zones are defined as follows:

Flood Zone 1: low probability and comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%). (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3).

Flood Zone 2: medium probability and comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%). (Land shown in light blue on the Flood Map).

Flood Zone 3: high probability and comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%). (Land shown in dark blue on the Flood Map).

2.0 EXISTING SITE USAGE / PROPOSED DEVELOPMENT (continued)

2.2 Development Advice Map (DAM) Classification

2.2.1 The site is partially within **Zone C2:** defined by TAN 15 as "areas of the flood plain without flood defences" (land shown in BLUE on the DAM map) and partially in **Zone B:** "considered [by TAN 15] to be areas known to have been flooded in the past evidenced by sedimentary deposits" (land shown YELLOW on the DAM map). See **Figure 2** below.

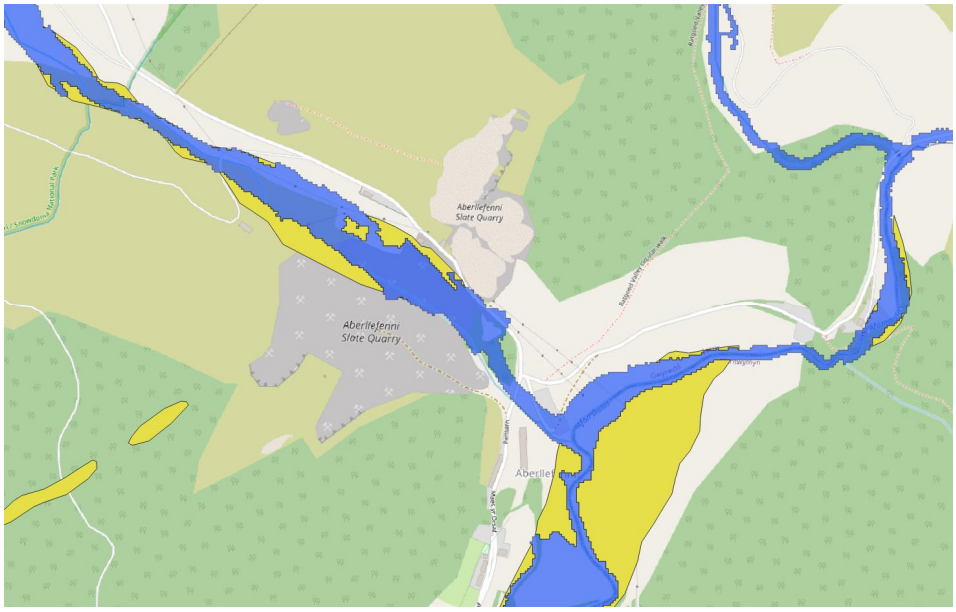


Figure 2: Site Location partially within Flood Zones 2 & 3

2.3 Existing Site Levels

2.3.1 Ground levels within the site range from approximately 115m AOD in the valley floor to 310m AOD at the summit of the existing tips. See **Figure 3** below.

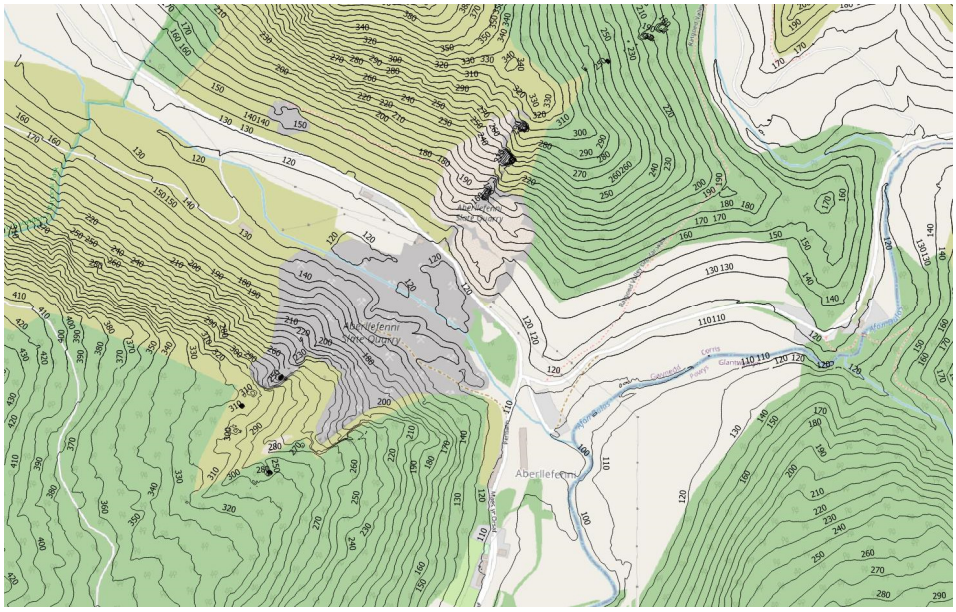


Figure 3: Existing Ground Levels within the Site (based on LiDAR data)

2.0 EXISTING SITE USAGE / PROPOSED DEVELOPMENT (continued)

2.4 Existing Pedestrian / Vehicular Access Routes

2.4.1 Pedestrian and vehicular access to and from the site is via a minor road (Maes Yr Orsaf / Pensarn) which leads from the village of Corris to the south-west and from the A487 (towards Dolgellau) to the north.

2.5 Estimated Flood Levels

2.5.1 The extent of flooding which results from various storm events has been predicted by a hydraulic model compiled by Civil Engineering Solutions (CES) in response to concerns raised by NRW. This matter is discussed in greater detail below.

2.6 Existing Classification / Use

2.6.1 "Less Vulnerable Development" as defined by Section 5 TAN 15.

2.6.2 The site currently comprises mineral extraction site.

2.7 Proposed Classification / Use

2.7.1 "Less Vulnerable Development" as defined by Section 5 TAN 15.

2.7.2 The owners of the land wish to removal slate waste material from the mineral working deposits in the Valley Floor tip (hatched light blue) and the Southern tip (hatched green). They also wish to use part of the Crushing yard (hatched orange) for the processing of slate waste material, which is currently not permitted on this part of the site. See **Figure 4** below.

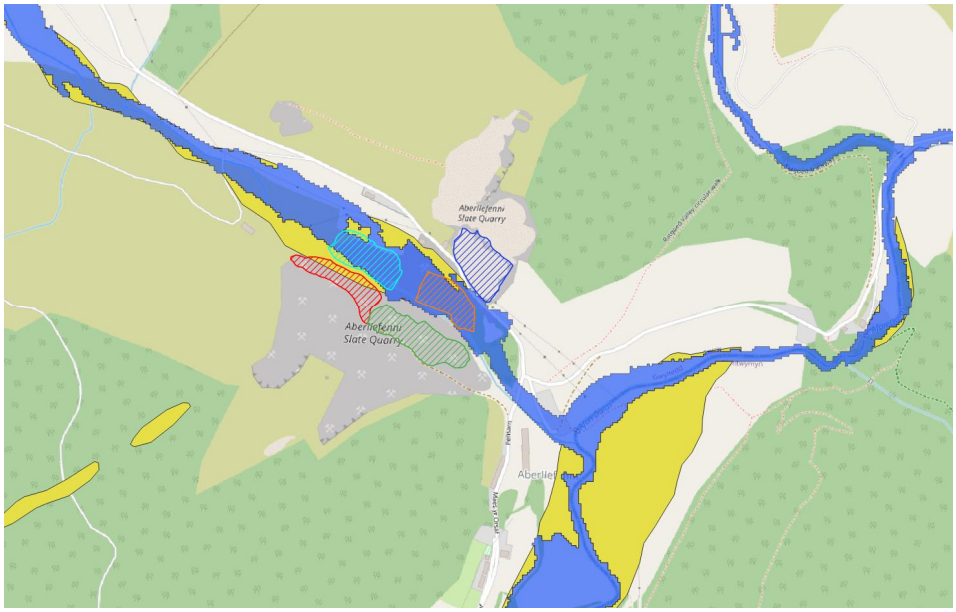


Figure 4: Areas of Proposed Mineral Extraction

2.7.3 The Southern Tip is outside of areas shown to be at risk of flooding whereas the Valley Floor Tip and Crushing Yard are partially within Zone C2 (without significant flood defence infrastructure) and Zone B (areas known to have been flooded in the past).

2.0 EXISTING SITE USAGE / PROPOSED DEVELOPMENT (continued)

2.7 Proposed Classification / Use (continued)

2.7.4 The intention would be to continue the crushing and screening of slate waste in the crushing yard. The other areas would only be used for storage. A 1.0m high bund will be provided to screen the crushing yard from residential receptors.

2.8 Justification for Proposed Development

2.8.1 Section 6 of TAN 15 sets out "tests" for justifying the location of the development.

2.8.2 It is considered that the proposals contribute to the local economy by reworking previously developed land.

2.8.3 The potential consequences of a flooding event in terms of the criteria contained in Sections 5 & 7 and Appendix 1 of TAN 15 are considered below.

3.0 EXISTING DEFENCES

3.1 Type / Distance from Proposed Development Site

3.1.1 The Flood Risk Assessment Wales Map shows that there are no defences between the site and the Afon Llefenni.

3.1.2 As part of previous consultations NRW have expressed concern that *"the slate heaps in their existing size and state [could] act as a throttle for flood flows from the Afon Llefenni. Their removal could impact on flows and flow routes downstream if the proposed bund were to be overtopped or was breached."*

3.1.3 It is possible therefore that the principal flood risk associated with the proposed mineral extraction is to the downstream settlement rather than to the works themselves.

3.2 Potential Methods of Flooding

3.2.1 The potential methods of flooding are considered to be as follows:

- Extreme storm events.
- Increase in fluvial levels due to global warming / climate change.
- Increased risk to the downstream settlement due to the removal of mineral deposits.

4.0 FLOOD RISK ANALYSIS

4.1 Fluvial Inundation

4.1.1 In order to determine the extent and nature of the existing and proposed flood risk, the owners of the site have commissioned Civil Engineering Solutions (CES) of Dolgellau, Gwynedd to prepare a hydraulic model to identify and quantify overland flood risks both before and after the mineral extraction. A copy of CES' Pluvial Flood Modelling Summary Report is provided in support of this Flood Consequences Assessment.

4.1.2 The methodology used to compile the model is described in Section 3.4 of this reports as follows:

"A TuFLOW fluvial flood model simulation of the "Existing" site geometry was prepared. The model is based on LiDAR baseline topographic information [which was evidently last flown in 2007] with updates utilizing site specific survey data provided by the client. The "Proposed" model uses the same baseline flow and topography as the "Existing" model simulation with modified topography to represent removal and reprofiling of stockpiles, where identified within data provided by the client's surveyor.

Catchment generated flows have been assessed at the downstream limits of the subject site and applied as an inflow hydrograph at the head of the model. This represents a slight overestimate of flows for the upper parts of the model, but this soon diminishes over a relatively short model reach.

Point Object (PO) lines were specified at various locations through the model to record flow passing key points of interest. The most significant of which were referenced A and H. These identify flow into the proposed development site and flow just downstream of the lower reaches of the development area.

Three model simulations were undertaken for both the "Existing" and "Proposed" model topography, with varying flow rates to inform the Flood Consequence Assessment (being undertaken by others). These represent the:

- *100-year return period event.*
- *100-year with a 30% allowance for climate change. And*
- *1000-year storm event.*

Model runs was simulated using the TuFLOW HPC solver (2020-10-AA-iSP-w64). Maximum predicted flood depth and velocity grids have been processed from the modelling simulations with the 100yCCy and 1000y event outputs".

4.2 Global Warming / Climate Change

4.2.1 Climate change predictions currently used by NRW are based on the FCDPAG3 scenario.

4.2.2 Welsh Government require proposals to be tested against the 100-year (1.0% AEP) + climate change fluvial event (in this case +30%) and the 1,000-year (0.1%) event. These scenarios are considered by the hydraulic model.

4.0 FLOOD RISK ANALYSIS (continued)

4.3 Conclusions of Hydraulic Modelling Report

4.3.1 The conclusions of the hydraulic modelling report are stated in Section 3.4 as follows with graphs illustrating the results included on page 7 (reproduced in **Appendix A** of this FCA Report):

"A review of output information recorded by the PO lines [A & H] has indicated there is no discernible change in peak flow or duration resulting from the proposed removal of the stockpiles. PO node H is downstream of the proposed works [and the result] demonstrates no third-party detriment and post development water levels are identical to predevelopment levels.

Point Object nodes C, D, E & F show a changing of water levels as expected. The change in level is due to the development proposals. It's important to note that the expected water levels are impacting the site only, and no third parties".

4.3.2 Appendix C of the CES report includes plans showing the predicted flood depths of the "Existing" and "Proposed" scenarios for the Q1000, Q100CC and Q100 fluvial events (reproduced in **Appendix A** of this FCA Report). These show that flood depths in excess of 1.5m are predicted across the site.

4.4 Emergency Access & Egress

4.4.1 Even for the worst-case scenario predicted by the CES report, an emergency access / egress route will exist for both vehicles and pedestrians via Maes Yr Orsaf / Pensarn toward A487 to the north and Corris to the south-west.

5.0 PROPOSED MITIGATION MEASURES

5.1 General

5.1.1 The development proposals involve the removal slate waste material from the mineral working deposits in the Valley Floor tip (hatched light blue) and the Southern tip (hatched green). The Crushing yard (hatched orange) will be used for the processing of the slate waste material, which is currently not permitted on this part of the site.

5.1.2 Although parts of the development will be within **Zones B & C2**, it is considered that no special measures are required to minimise the impact of any future inundation of the site during events more severe than the criteria set out in TAN 15. However, in accordance with good site management plant and machinery should be located away from high flood risk areas.

5.2 Emergency Access / Evacuation

5.2.1 The site lies partially within the NRW Flood Alert Area. It is recommended that the owners of the site should sign up to any warning service and, in the event of extreme events, occupants of the site should be required to follow NRW advice.

6.0 SUMMARY

6.1 General

6.1.1 This Flood Consequences Assessment indicates that part of the site is within an area which is at risk of flooding during extreme fluvial conditions.

6.1.2 Consideration has been given to the justification for developing the site, in view of the potential flood risk and it has been concluded that the tests set out in Sections 5 and 7 and Appendix 1 of TAN 15 can be satisfied.

6.1.3 The consequences of any future flooding have been assessed and mitigation measures incorporated into the development proposals to reduce the impact of any future inundation in the vicinity of the site. The extent of these works is detailed in **Section 5.0** of this report.

For **BEK ENVIRO LTD**
December 2022

APPENDIX A

Extracts from CES' Pluvial Flood Modelling Summary Report

MasterMap Code	Manning's value	Description
10123	0.035	Footpaths
10167	0.040	Railways
10172	0.030	Roads tracks and paths
10183	0.035	Roadside paths
10203	0.010	Tidal water
10217	0.040	Unclassified land
10185	0.080	Structures
10054	0.050	Land steps
10210	0.010	Water general
10096	0.035	Slopes
10119	0.035	Steps
10193	0.080	Pylon

3.4 TuFLOW Fluvial model simulations.

A TuFLOW fluvial flood model simulation of the "Existing" site geometry was prepared. The model is based on LiDAR baseline topographic information with updates utilizing site specific survey data provided by the client. The "Proposed" model uses the same baseline flow and topography as the "Existing" model simulation with modified topography to represent removal and reprofiling of stockpiles, where identified within data provided by the client's surveyor.

Catchment generated flows have been assessed at the downstream limits of the subject site and applied as an inflow hydrograph at the head of the model. This represents a slight overestimate of flows for the upper parts of the model, but this soon diminishes over a relatively short model reach.

Point Object (PO) lines were specified at various locations through the model to record flow passing key points of interest. The most significant of which were referenced A and H. These identify flow into the proposed development site and flow just downstream of the lower reaches of the development area.

Three model simulations were undertaken for both the "Existing" and "Proposed" model topography, with varying flow rates to inform the Flood Consequence Assessment (being undertaken by others). These represent the:

- 100-year return period event.
- 100-year with a 30% allowance for climate change. and
- 1000-year storm event.

Model runs was simulated using the TuFLOW HPC solver (2020-10-AA-iSP-w64). Maximum predicted flood depth and velocity grids have been processed from the modelling simulations with the 100yCCy and 1000y event outputs presented in Appendix C.

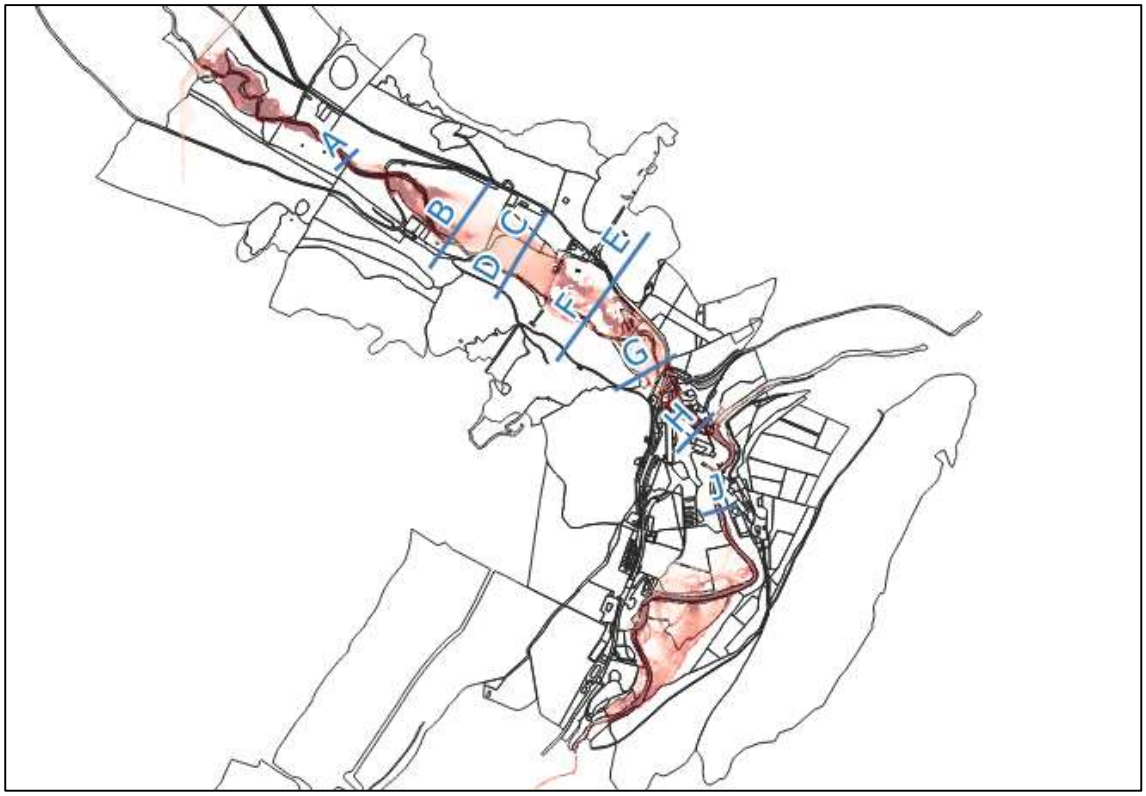


Figure 3: Point Object Location Plan

A review of output information recorded by the PO lines has indicated there is no discernible change in peak flow or duration resulting from the proposed removal of the stockpiles. This is evidenced by graphing the output information in Microsoft Excel. For the purposes of this study, the 100yCC flow outputs are presented below.

Please note, the jaggedness of the outputs is due to TuFLOW' s HPC module. The software program sets a variable 'timestep' dependent on the model's stability. Due to the terrain models provided by the client for the 'existing' and 'proposed' scenarios, the flood modelling software has reduced timesteps, when appropriate resulting in a small 'lag' of water during the simulation.

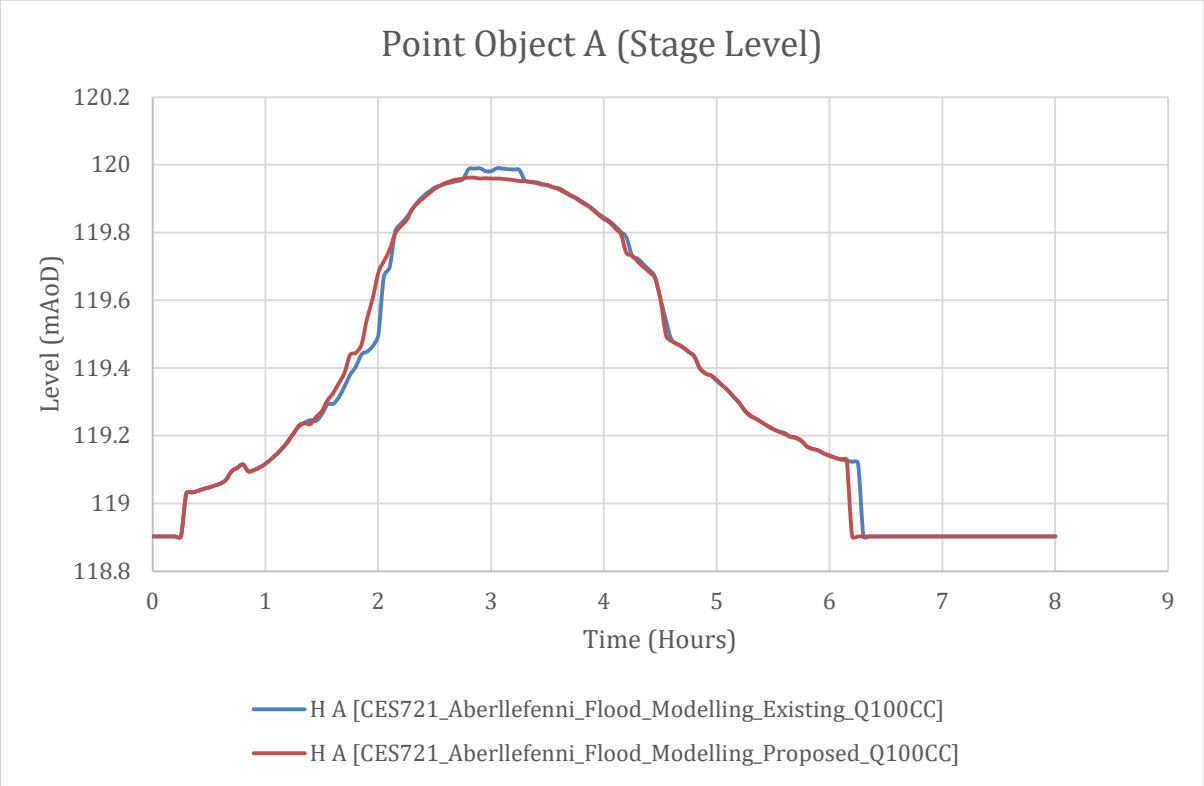


Figure 4: 100yCC - Predicted Maximum Stage Level PO A

Figure 4 identifies the water level experienced upstream of the development proposals remain

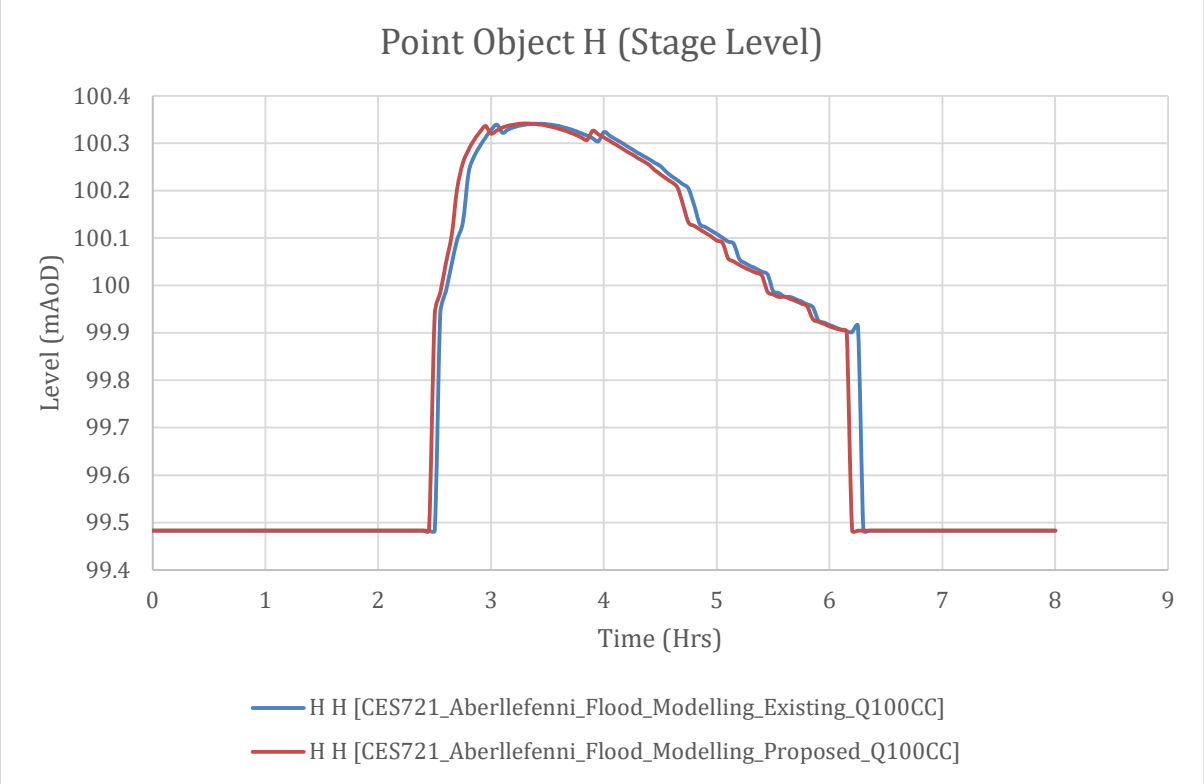


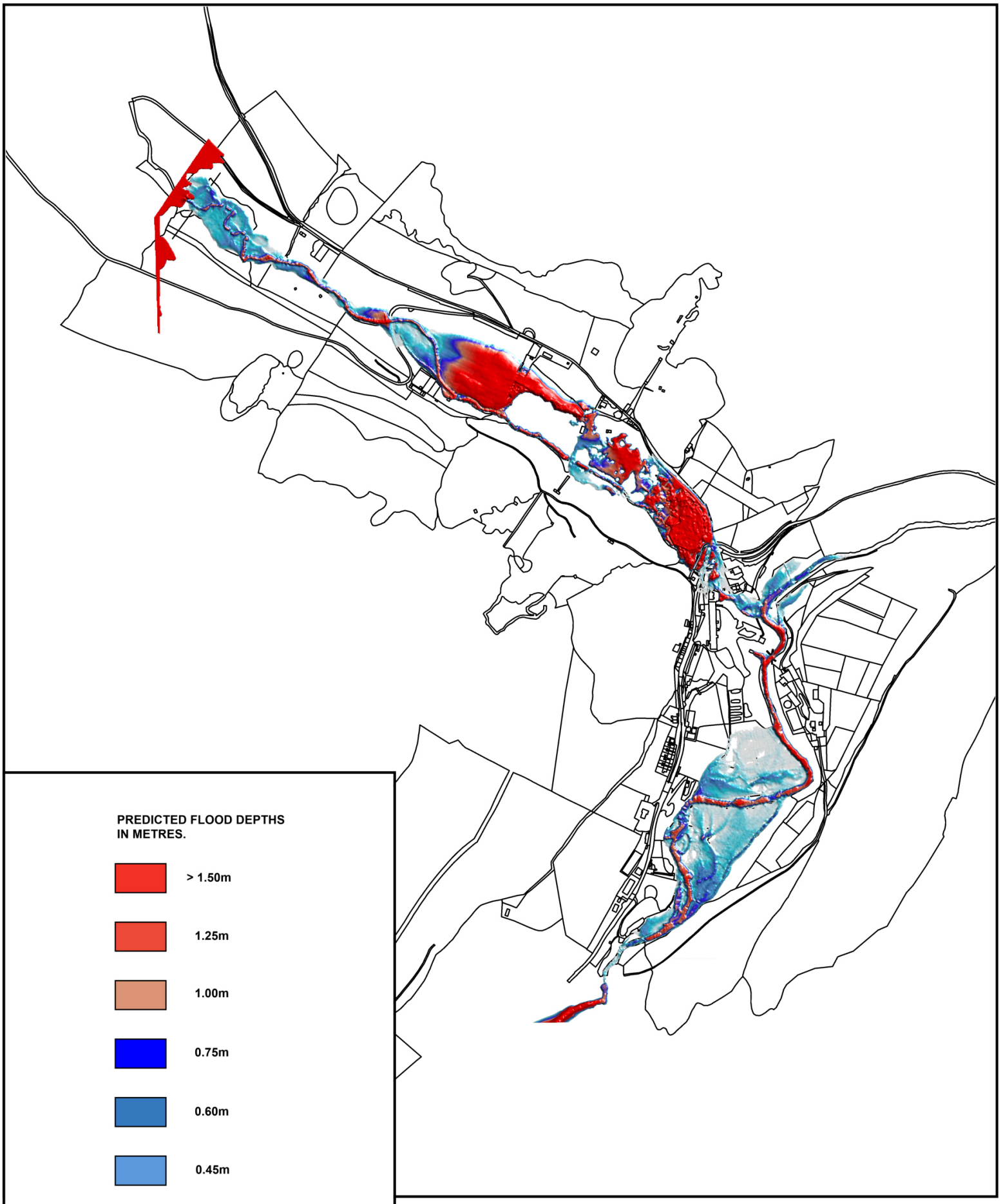
Figure 5: 100yCC - Predicted Maximum Stage Level PO H

PO node H is downstream of the proposed works. Point Object H (Figure 5) demonstrates no third-party detriment and post development water levels are identical to predevelopment levels.

Point Object nodes C, D, E&F show a changing of water levels as expected. The change in level is due to the development proposals. Its important to note that the expected water levels are impacting the site only, and no third parties.

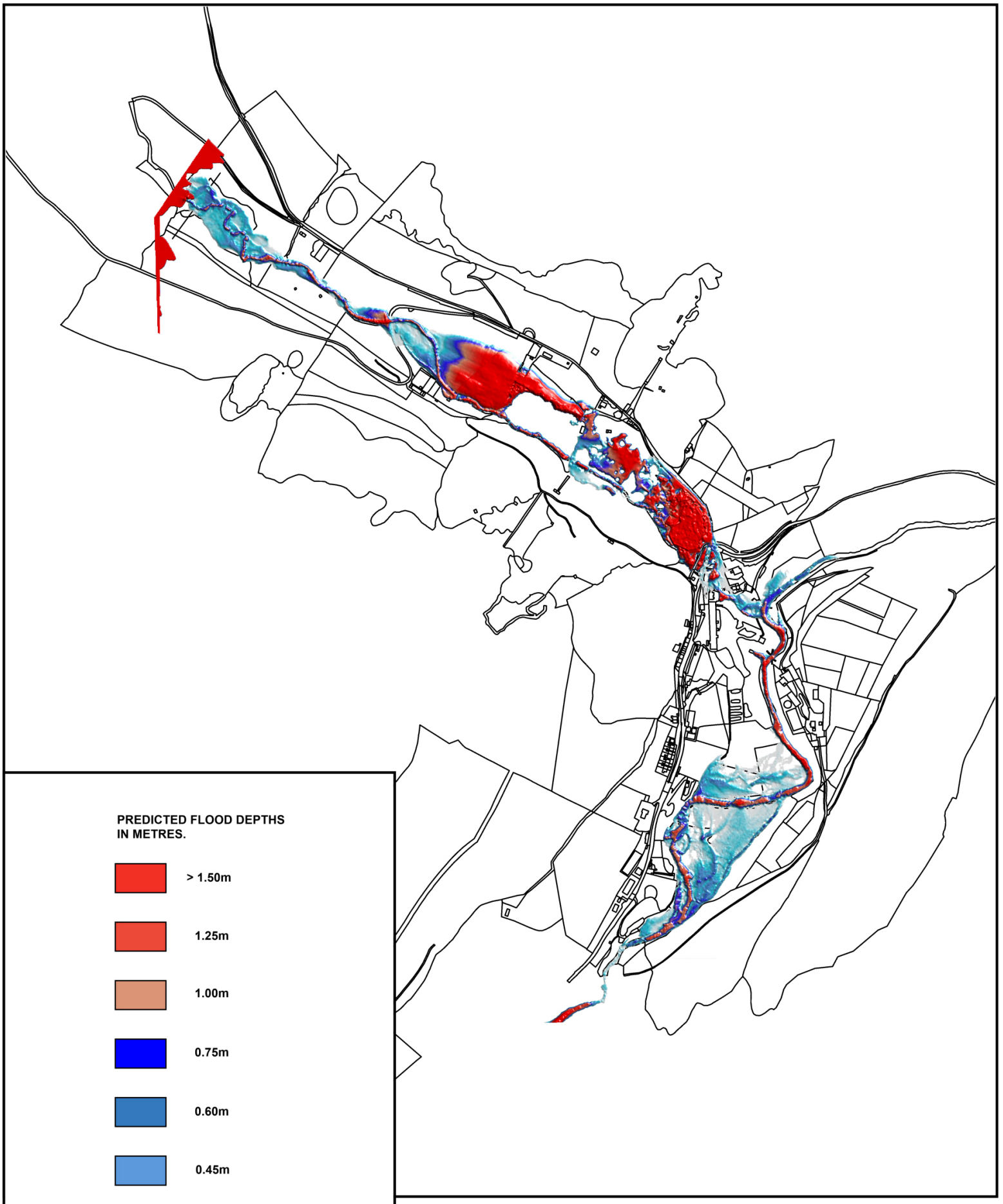
CIVIL ENGINEERING SOLUTIONS

APPENDIX C: HYDRAULIC FLOOD MODELLING OUTPUTS



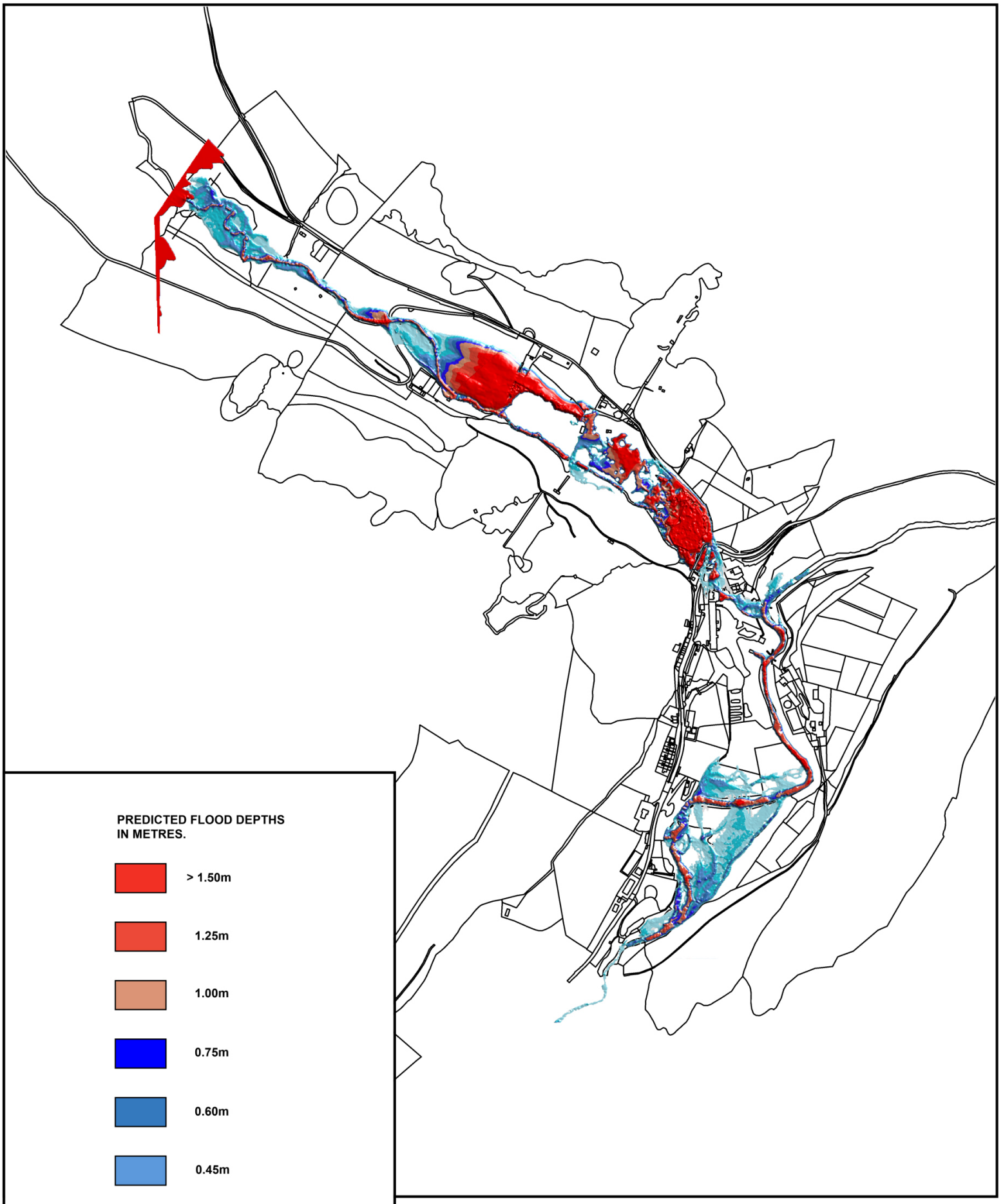
CES721 Aberllefenni

Maximum Depth - Q1000 Fluvial Event Existing



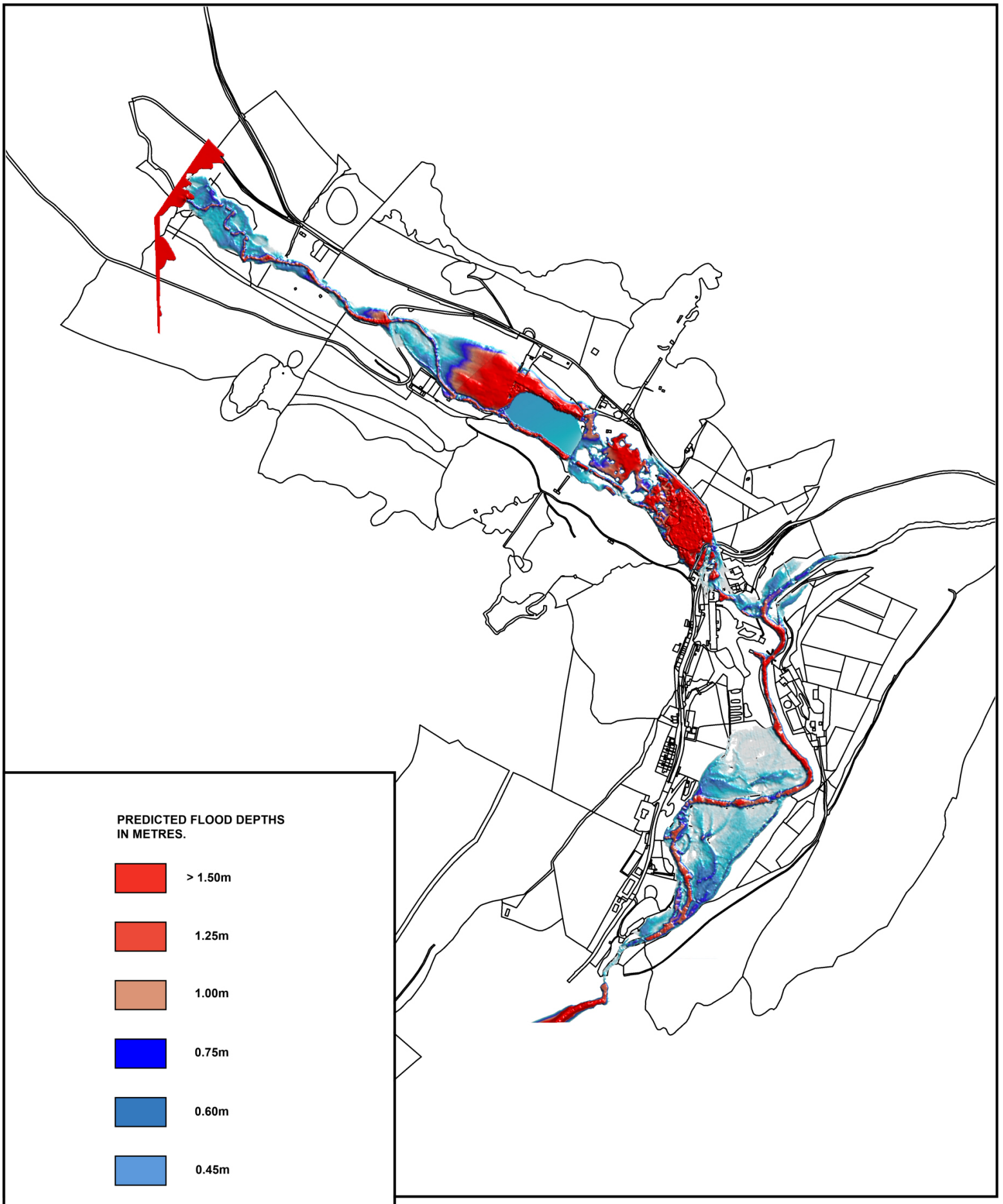
CES721 Aberllefenni

Maximum Depth - Q100CC Fluvial Event Existing



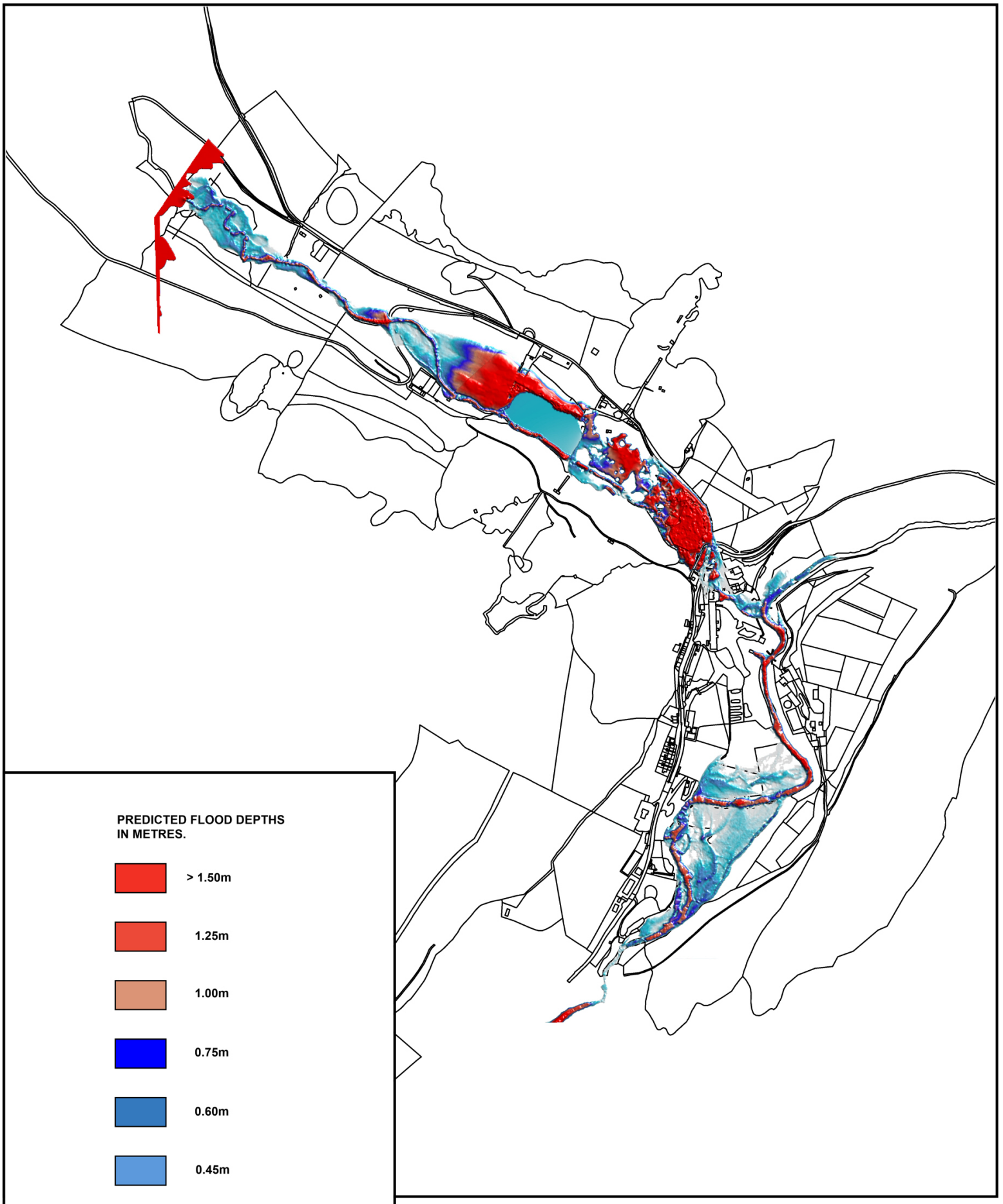
CES721 Aberllefenni

Maximum Depth - Q100 Fluvial Event Existing



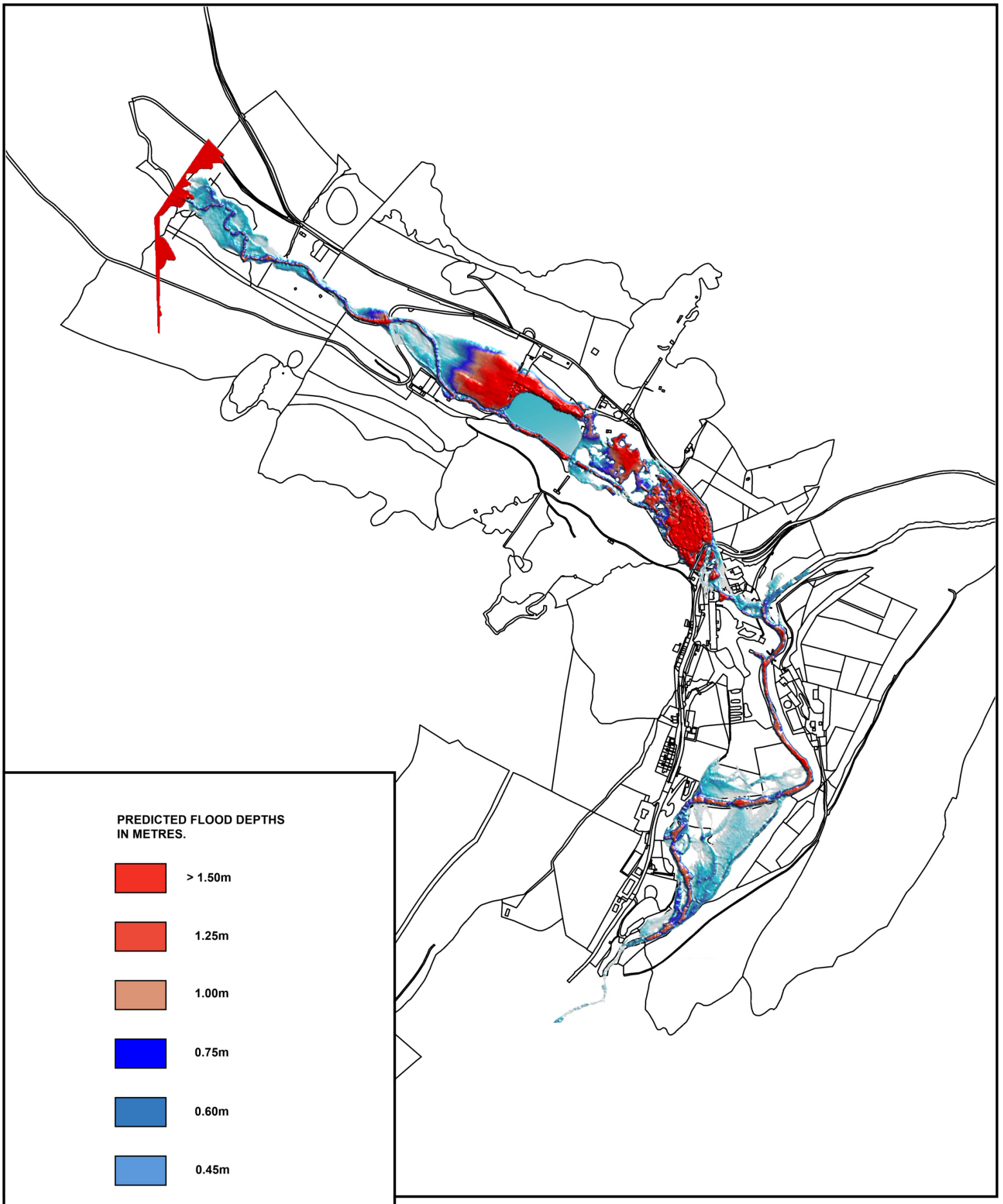
CES721 Aberllefenni

Maximum Depth - Q1000 Fluvial Event Proposed



CES721 Aberllefenni

Maximum Depth - Q100CC Fluvial Event Proposed



CES721 Aberllefenni

Maximum Depth - Q100 Fluvial Event Proposed

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

Suite One | No 3 Mitton Road Business Park | Mitton Road | Whalley | Lancashire | BB7 9YE
Office: 01254 377622 Mobile: 07906 753583 mbuckley@bekenviro.co.uk www.bekenviro.co.uk