



Island Site, Radcliffe

Hydraulic Modelling Technical Note

November 2020



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Glossary

Principal technical terms and abbreviations are included in the Glossary Table below, please note that this list is not exhaustive.

Term	Definition
1D (Model)	1-Dimensional model typically built using watercourse cross-section survey data to represent the watercourse and adjacent floodplain
2D (Model)	2-Dimensional model typically built using LiDAR and site specific topographic data to represent the wider floodplain
1D-2D (Model)	Combination of 1D and 2D model (i.e. typically a representation of the watercourse and floodplain)
AEP	Annual Exceedance Probability (i.e. The probability that a storm event will occur in any given year, e.g. a 100 year return period refers to there being a probability of 1 in 100 that a storm event will occur in any given year)
BL	Blockage Scenario Model Simulation
DEV	Proposed Site Layout Model
EA	Environment Agency (England)
EXG	Existing Site Layout Model
FFL	Finished Floor Level
HMR or TN	Hydraulic Modelling Report or Technical Note
LiDAR	Light Detection and Ranging (i.e. Ground elevation data)
MIT or OPT	Flood Mitigation Option Modelling
Model Inflow	This is the volume of water that is input into the model to generate the flood extents
NFC	Normal Flow Conditions (i.e. as surveyed conditions, typically with no structure blockage or breach of any defences)
NRW	Natural Resources Wales
SEPA	Scottish Environment Protection Agency
ST	Sensitivity Test

Introduction

Waterco has been commissioned to undertake a hydraulic modelling study of Crow Trees Farm Brook (CTFB), a tributary of the River Irwell culverted under a proposed development site (referred to hereon as 'Island Site') at Radcliffe, M26 2PR. The site is part of the adjacent East Lancashire Paper Mill (ELPM) Site which benefits from an outline planning approval. The purpose of this study is to provide indicative flood levels and outlines at the Island Site due to flood risk from CTFB.

It should be noted that the River Irwell (and potentially Bealey's Goit watercourse) pose a further source of fluvial flood risk to the site which is currently not simulated within in the CTFB model. The output from the 2018 ELPM site modelling (scheme 12168) of the River Irwell is briefly discussed in relation to this site.

A location plan and an aerial photograph of the site are included in Appendix A. The National Grid Reference (NGR) of the site is 379040 407390.

The site is brownfield, covering an area of 1.02ha. The site comprises hardstanding, derelict buildings, and is overgrown. The site is bordered by Howard Street and the A6053 to the north, Cock Clod Street to the east and Rectory Lane to the south and south-west.

A topographical survey of the wider ELPM site was undertaken in November 2016 and provided by the Client. The survey data is included in Appendix B for information. The survey shows existing site levels fall from north-east to south-west, from a level of approximately 67.17m AOD near the eastern site boundary to 63.97m AOD near the south-western site boundary.

The current EA Flood Maps for Planning (November 2020) for the site show food risk from both the CTFB and River Irwell watercourses. The flood maps show about one-half of the site area to be located within Flood Zone 3 – an area considered to be at relatively high risk of fluvial flooding with an annual probability of the flooding greater than 1% (1 in 100) AEP (annual exceedance probability). Approximately 16% of the site area is located within Flood Zone 2 – an area considered to be at medium risk of fluvial flooding with an annual probability of the flooding between 1% and 0.1% (1 in 1000) AEP. The remaining site area is located within Flood Zone 1 – an area considered to be at low risk of fluvial flooding with an annual probability of the flooding lower than 0.1% (1 in 1000) AEP. An extract of the current EA Flood Zones is included in Appendix C for reference. The EA Historical Flood Map included in Appendix C shows no records of past flooding at the site.

It is understood that the current CTFB flood zones are based on the outputs of a detailed EA 1D/2D¹ ISIS-TUFLOW model built in 2016. To provide an improved site-specific assessment of fluvial flood risk from CTFB the existing 1D/2D hydraulic model has been updated to include topographical survey of site. Additional model updates such as inclusion of the direct flood risk from the River Irwell have not been completed as part of this study. It is likely that a more detailed site-specific assessment of flood risk at the site, which is outside the current scope of this study, will be required in the future if Planning approval is sought for the

¹ A 1D/2D hydrodynamic model is comprised of a 1-Dimensional (1D) river network model (based on surveyed river cross-sections) coupled with a 2-Dimensional (2D) Digital Terrain Model (DTM) of the potential floodplain (created from LiDAR).

development.

This brief Technical Note summarises the updates made to the current EA CTFB model and provides hydraulic model outputs which will inform Master Planning of the Island Site. This document does not constitute a detailed Hydraulic Modelling Report, rather it provides an outline of the works completed along with a brief review of project outputs.

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Modelling Assessment

A copy of the current EA CTFB model has been sourced and used as the base for this study.

The latest version(s) of hydraulic modelling software Flood Modeller Pro (FMP – previously ISIS) and TUFLOW available at the start of the project have been used for all simulations; 4.6 and 2020-01-AB respectively.

To investigate the fluvial flood risk from CTFB at the site during the existing (EXG) scenario, a range of fluvial events have been simulated; namely the 5% (1 in 20), 1% (1 in 100) and 0.1% (1 in 1000) AEP events. The impact of future climate change (CC) has also been investigated during the 1% AEP event by increasing flows by 35% (CC1) and 70% (CC2). The flow data within the current EA model was calculated by Capita AECOM in 2016. The inflow data and storm duration used have been briefly reviewed and are considered suitable for use for the purposes of this study. Therefore, no change has been made to the current EA model hydrology.

A review of the 1D network reach and the 2D TUFLOW domain was carried out to confirm the extent adequately covers the proposed development site.

The existing 1D FMP model network of CTFB starts 140m south of Withins Reservoir (NGR 378700 408680, Node ref: CROT01_01777) and ends at the watercourse's confluence with the River Irwell (NGR 379065 407230, Node ref: CROT01_DS). Approximately 1.75km of the watercourse has been modelled.

The EA 1D model cross-sections have been reviewed and updated where required to include panel markers to improve conveyance curves.

A Head-Time (HT) boundary condition has been applied as the 1D model downstream boundary condition. In the current EA Model, a constant stage value of 58m AOD has been applied as the downstream boundary level. In this study a constant stage value of 61.2m AOD corresponding to 50% AEP event maximum water level in the River Irwell has been applied. The River Irwell water levels have been extracted from the EA Bury South model (2017) at the River Irwell 1D model node IRWE4_0000u.

During model testing, sensitivity of the downstream boundary stage value on flood risk at the site has been completed through additional simulations. The River Irwell maximum water levels of 61.96m AOD, 62.36m AOD, 62.49m AOD and 63.13m AOD corresponding to the 10% AEP, 5% AEP, 4% AEP and 1% AEP events respectively have been tested as the downstream boundary stage values. Model outputs from these simulations are discussed further below.

No other changes have been made to the 1D model data, including boundary locations, lateral inflow locations and hydrographs, structure representation, Manning's n roughness etc.

The 2D TUFLOW domain has been constructed from 1m LiDAR data (flown in 2016 and downloaded in 2020) and site-specific topographical survey data. The extent of the linked 1D/2D model domain is presented in Appendix D.

The 2D model cell size has been unchanged from the EA model and set as 2m. Existing TUFLOW z-shape features used to represent the bank elevations, parapet levels, canal levels and to correct minor LiDAR

filtering errors were kept unchanged from the EA model and utilised.

OS MasterMap data (provided with the current EA model) has been used to classify land use and assign Manning's n roughness coefficients throughout the floodplain. The coefficient values have been unchanged from the EA model.

Head-Discharge (HQ) downstream boundary condition applied in the existing EA 2D model has been replaced by a 2D HT boundary condition. A constant stage value of 61.2m AOD corresponding to 50% AEP event water level in the River Irwell has been applied similar to the 1D model.

No further changes have been made to the 2D domain or boundaries.

The A6053 Cross Lane Culvert (Model Ref: CROT01_00270; NGR 379020 407490) is considered potentially critical to flooding at the site given its proximity to the site and potential to block. To investigate flood risk at the site in the event of a blockage of this structure, blockage scenario simulation has been performed and detailed in Table 3. Due to the small size of the culvert structure opening, a 100% blockage has been investigated. FMP does not allow representation of 100% blockage, hence a 99.9% blockage has been specified using an IED file.

Table 1 - Blockage Scenario Simulation

Scenario Ref	Structure	Fluvial Event	% Blockage	Model Ref
BL1	A6053 Cross Lane Culvert	1% AEP + 35% CC	100%	BL1-99.9

During model testing an additional blockage scenario investigating a lower percentage culvert blockage of 80% has been completed as a sensitivity test to understand the impact of the culvert on flood risk at the site. The results of this test have not been mapped but discussed briefly in the Results section further below.

No other sensitivity tests have been carried out as part of this study. We recommend that further sensitivity testing is carried out, should the scheme progress beyond feasibility.

Summary of Results

This section of the report documents the results obtained from the primary simulations and blockage scenarios for the EXG site.

Maximum flood depth, velocity and hazard mapping has been provided for each primary simulation in Appendix E. Flood hazard ratings have been calculated in accordance with DEFRA document 'FD2320: Flood Risks to People' and EA guidance document 'Supplementary Note on Flood Hazard Ratings and Thresholds'.

In addition to the mapping, calculated maximum water levels were extracted at each node along the 1D network model and compared for each simulation. A table of this data has been provided in Appendix F. Maximum water level data has also been extracted across the site in the 2D domain for the all the AEP events, and represented in Appendix G.

Detailed below is a summary of the flood mechanisms for the simulated events, which is to be read in conjunction with the above detailed information.

EXG Simulations

The results of the hydraulic modelling show the development site to experience flooding during all the simulated flood events. The extent of flooding on the site increases from the lower to the higher AEP events. Some portions of the site near the eastern and western site boundaries, which are at a higher ground elevation, remains flood free during all the simulated events.

During all the simulated events, floodwater is shown to exceed Crow Trees Farm Brook channel capacity upstream of the A6053 Cross Lane Culvert and overtop the road. From here floodwater flows south and enters the site via the northern site boundary causing low-lying areas of the site to experience flooding. Floodwater continues to flow south and exits the site via the southern site boundary to discharge into the River Irwell.

The 2018 ELPM site modelling results show the Island Site experiences flooding in the southwest of the site during the 1% AEP + 35%CC event as a result of the River Irwell and / or Bealey's Goit overtopping their banks. Figure 1 shows an extract of the results.

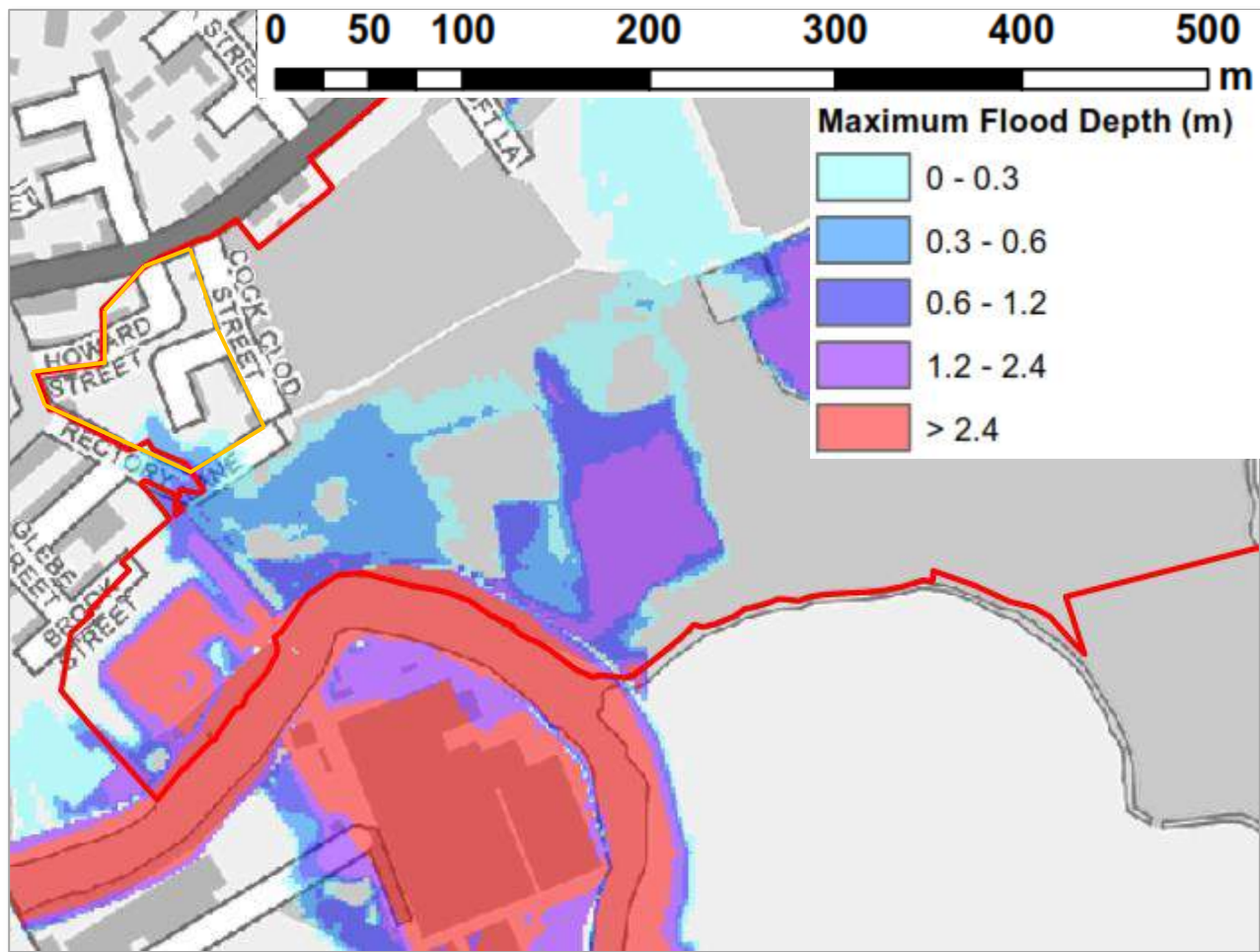


Figure 1 Extract from ELPM scheme. 1% AEP event plus 35% climate change allowance, existing site scenario. The orange line shows the approximate site boundary of the Island Site, and the red line the ELPM site boundary.

Blockage Scenario Simulation

Model outputs from the 1%AEP + 35%CC event, BL1 blockage scenario (100% blockage of A6053 Cross Lane Culvert) show the flood extents on the site are similar but slightly larger than the unblocked scenario extents. The flood depths on the site are also shown to increase by up to 150mm relative to the unblocked scenario. The flood risk associated with the blockage can be attributed to the significantly reduced flow capacity of the culvert, leading to additional water levels and spilling upstream of the structure.

A sensitivity test investigating a lower percentage (80%) blockage of culvert showed that the flood depths on the site increase by up to 120mm relative to the unblocked scenario.

The downstream boundary sensitivity tests simulated had mixed results, the simulation corresponding to the 10% AEP event water level in the River Irwell showed negligible impact on flood risk at the site relative to the current EA model results. However, the other simulations corresponding to 5% AEP, 4% AEP and 1% AEP event water levels in the River Irwell were found to be unstable with the simulations crashing or results having major instabilities. We recommend further investigation into the model stability is carried and that agreement with the EA is sorted regarding the model set-up at downstream boundary or whether the CTFB

model be combined with the River Irwell model.

Model Flood Extents versus EA Flood Zones

A comparison of modelled flood extents versus current EA Flood Zones on the site show that the flood extents are similar. The modelled 1% AEP event flood extents almost match with the EA FZ3 outline, whereas the modelled 0.1% AEP event flood extents are slightly smaller compared to the EA FZ2 outline on the site. The minor differences can be attributed to the site-specific model updates carried out as part of this study.

Recommendations

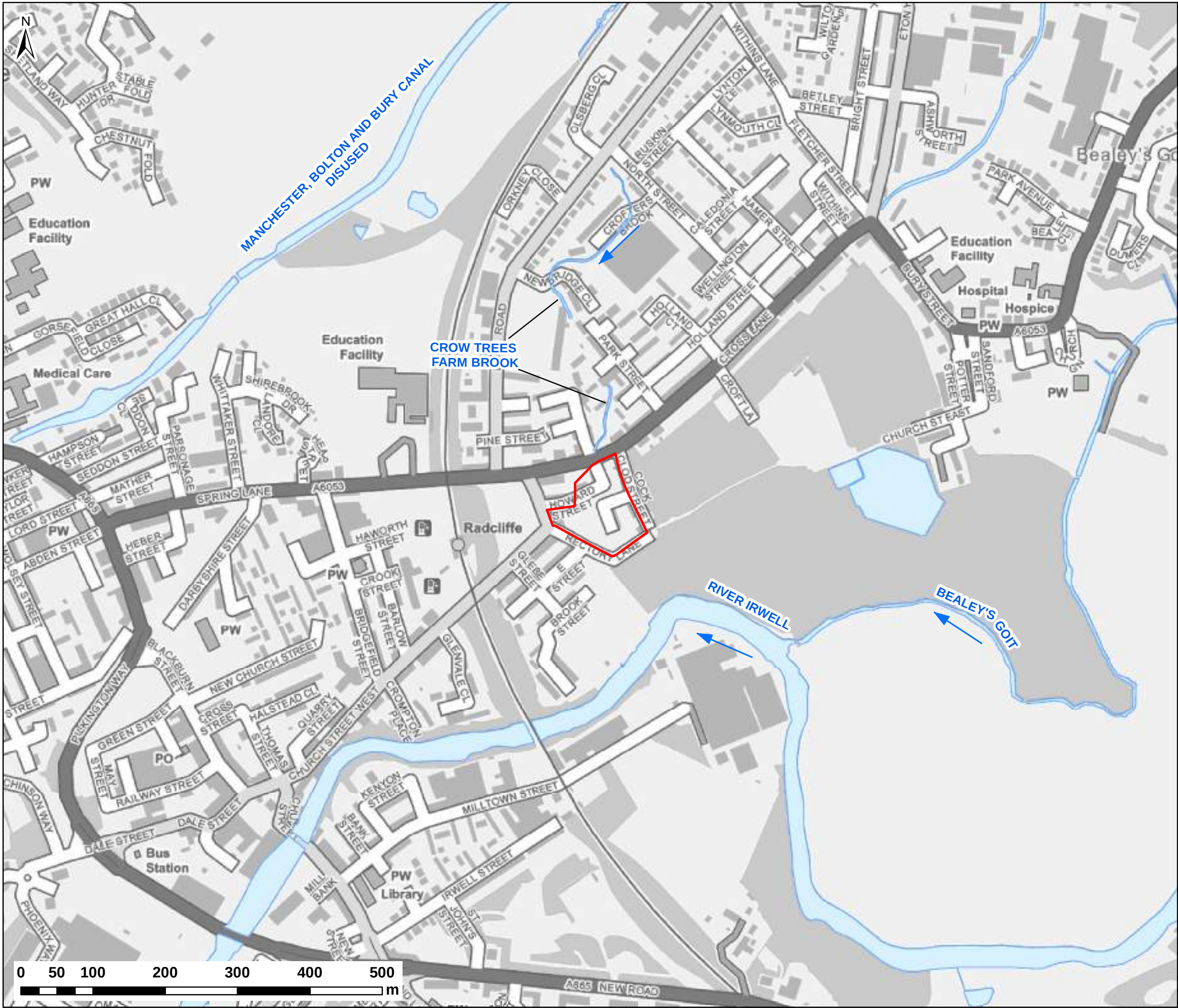
The outputs from the updated EA Crow Trees Farm Brook hydraulic model and associated technical note should be used to inform the Master Planning of the site. If Planning approval is sought for the development in the future, it is recommended that additional works are carried out for a detailed site-specific assessment of flood risk. We highly recommend liaison with the EA to confirm all modelling requirements for Planning Approval. A detailed modelling methodology should be submitted to the EA to confirm (but not limited to):

- The model extents and boundary conditions. The CTFB model includes the River Irwell water levels as downstream boundary condition. The model could be updated to include representation of the River Irwell and Bealey's Goit to assess the direct flood risk from the River Irwell at the site.
- Watercourse inflows and required AEP events. If the CTFB and the River Irwell model are to be combined, or the CTFB model is extended to include a truncated section of the Irwell, it is likely that variable storm durations for the two river catchments will have to be simulated for different AEP events.
- Blockage locations. There are several culverts along the CTFB watercourse and Bealey's Goit which could impact flooding at the site if blocked and so may be a requirement of the EA to investigate such blockages.

Further recommendations for additional modelling include:

- Sensitivity testing of key model parameters such as roughness coefficients, inflows and downstream boundary conditions.
- Investigation into the model stability to understand why some of the downstream sensitivity runs crashed, as this could be a sign of poor overall model performance.

Appendix A Location Plan & Aerial Image



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

-  Site Boundary
-  Watercourses / Water Bodies



CLIENT:



www.waterco.co.uk

SCHEME:

**ISLAND SITE,
RADCLIFFE**

PLOT TITLE:

LOCATION PLAN

PLOT STATUS:

FINAL

DATE:

04/11/2020

DRAWN:

VJ

CHECKED:

SB

APPROVED:

DH

PLOT SCALE @ A3:

1:5,000

(UNLESS STATED OTHERWISE)

PLOT NAME:

13478-Location_Plan

REV:

-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

CLIENT:

A TESTA
1984
COMPANY

www.waterco.co.uk

SCHEME:

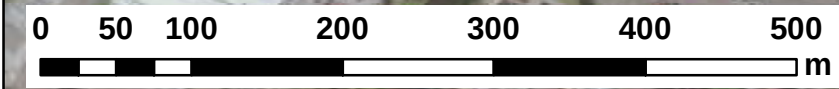
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RADCLIFFE**

PLOT TITLE:

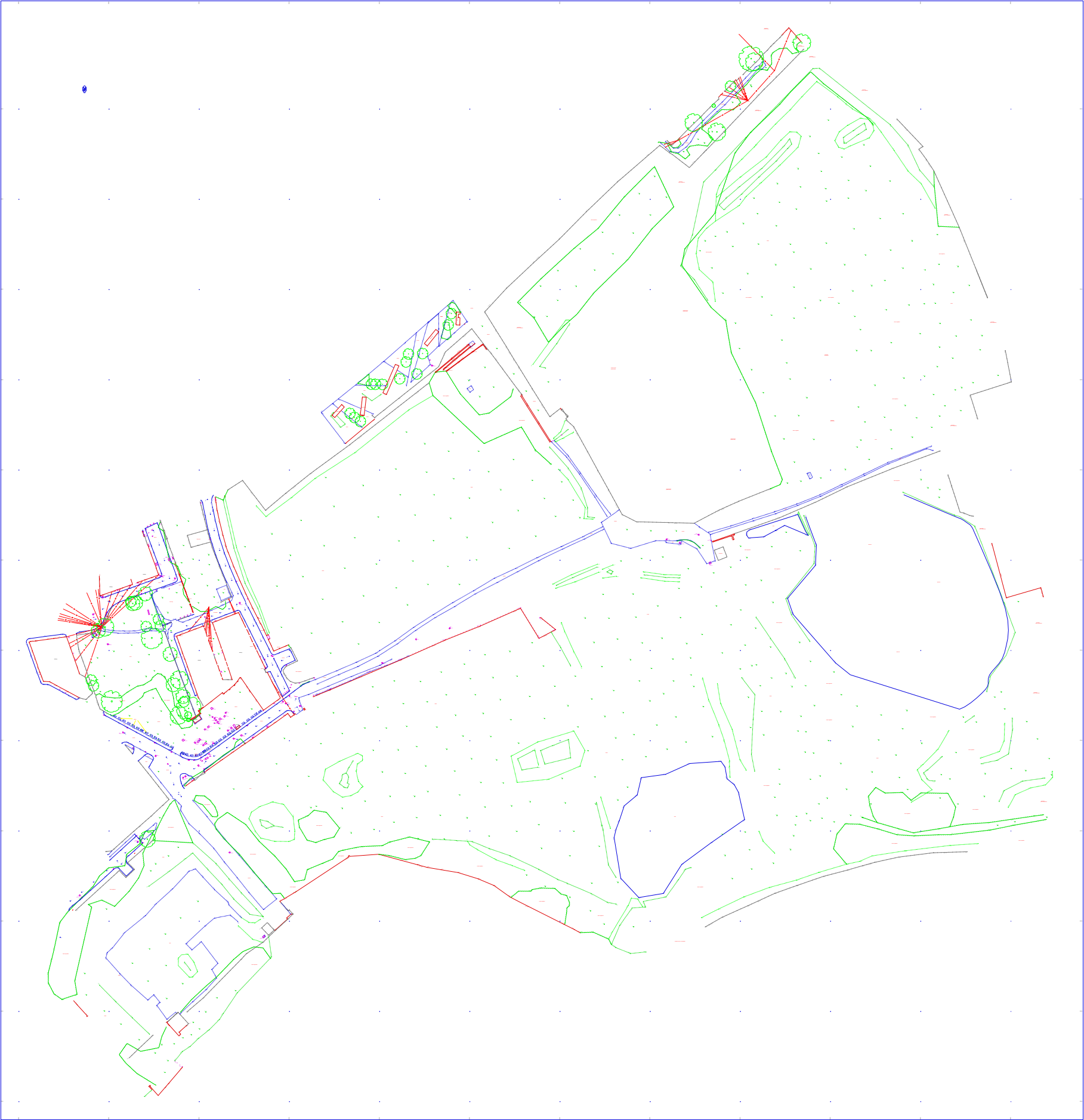
AERIAL PLAN

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FINAL			03/11/2020
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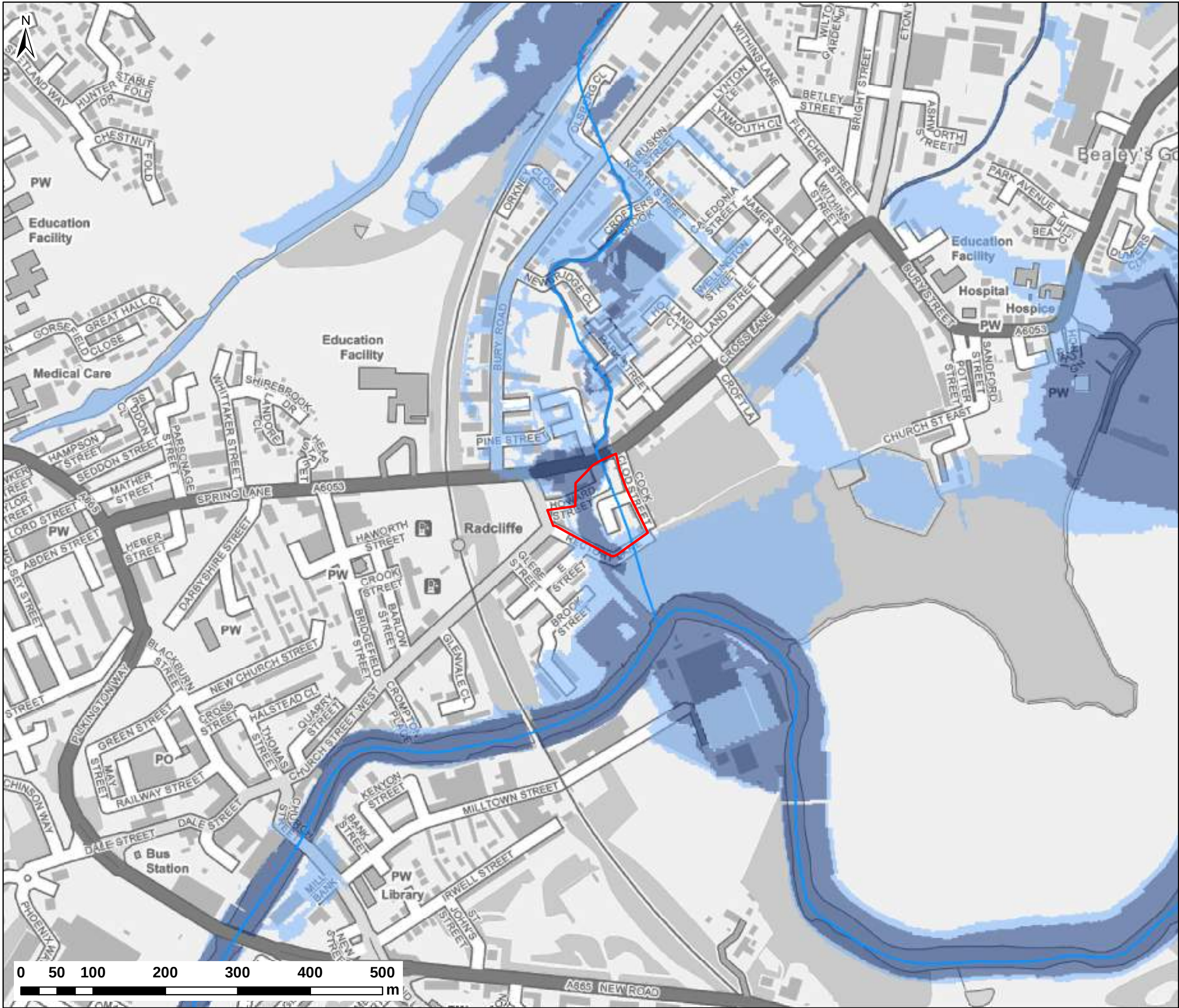
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13478-Aerial_Plan		-



Appendix B Survey Data



Appendix C EA Flood Maps



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

- Site Boundary
- EA Main Rivers
- EA Flood Zone 3
- EA Flood Zone 2



CLIENT:




www.waterco.co.uk

SCHEME:

**ISLAND SITE,
RADCLIFFE**

PLOT TITLE:

EA FLOOD MAP FOR PLANNING
DATA ACCESSED OCTOBER 2020

PLOT STATUS:		DATE:	
FINAL		03/11/2020	
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
VJ	SB	DH	1:5,000 (UNLESS STATED OTHERWISE)
PLOT NAME:			REV:
13478-EA_FZ_FM			-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

Historical Flood Map

CLIENT:

A TRUSTEES COMPANY

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SCHEME:

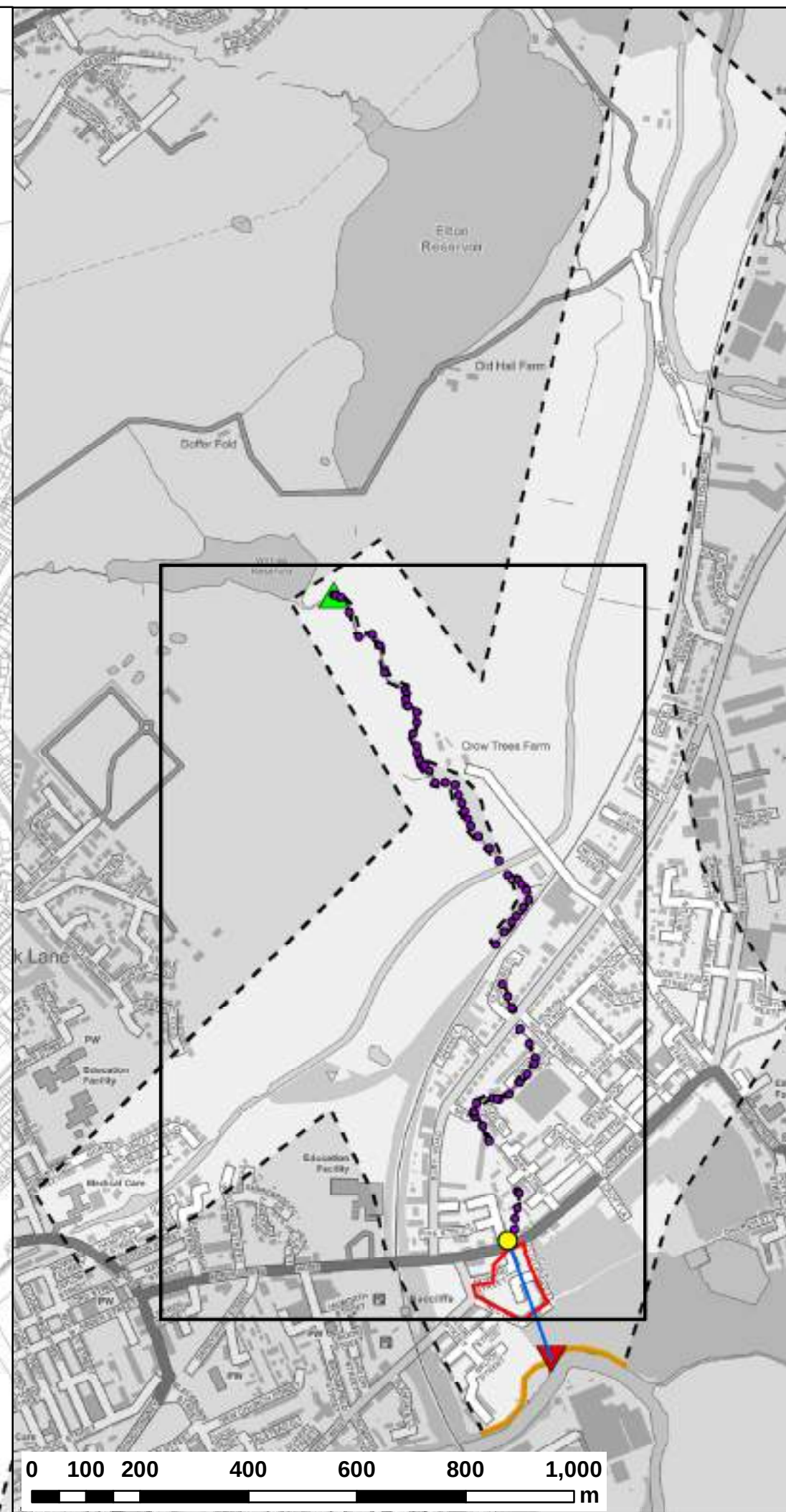
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RADCLIFFE**

PLOT TITLE:

EA HISTORICAL FLOOD MAP
DATA ACCESSED OCTOBER 2020

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PLOT NAME:			REV:
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Appendix D 1D/2D Model Extents



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

- Site Boundary
- Model Extent
- A6053 Culvert Blockage Location
- 1D Nodes
- 1D Model Inflow Location
- 1D Model Outflow Location
- Culvert Section
- 2D Downstream Boundary

CLIENT:

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SCHEME:

ISLAND SITE, RADCLIFFE

PLOT TITLE:

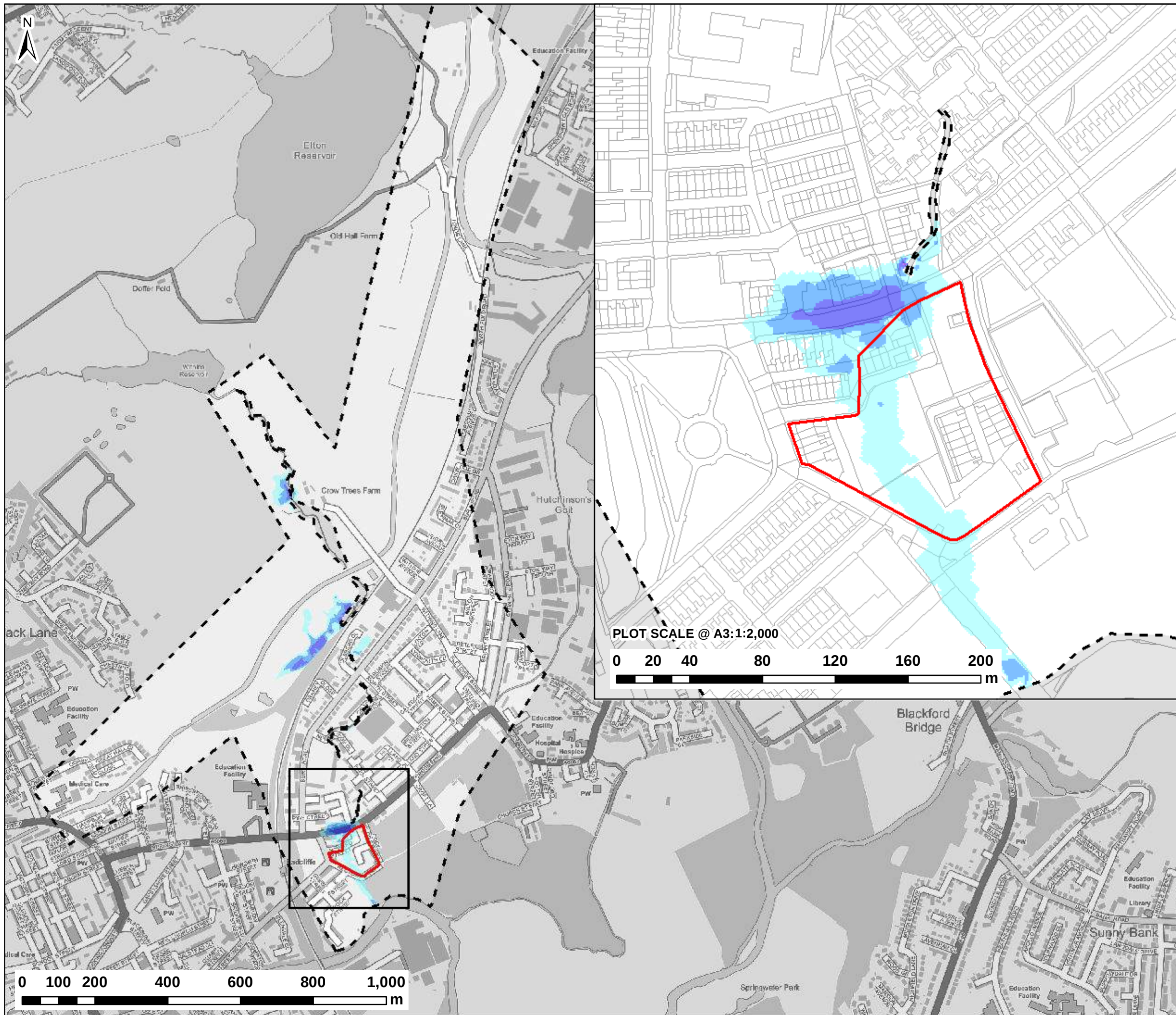
MODEL EXTENT

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Appendix E Flood Mapping



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary
Model Extent

Maximum Flood Depth (m)

0 - 0.3
0.3 - 0.6
0.6 - 1.2
1.2 - 2.4
> 2.4

CLIENT:
wyg
A TERRA TECH COMPANY

waterco
www.waterco.co.uk

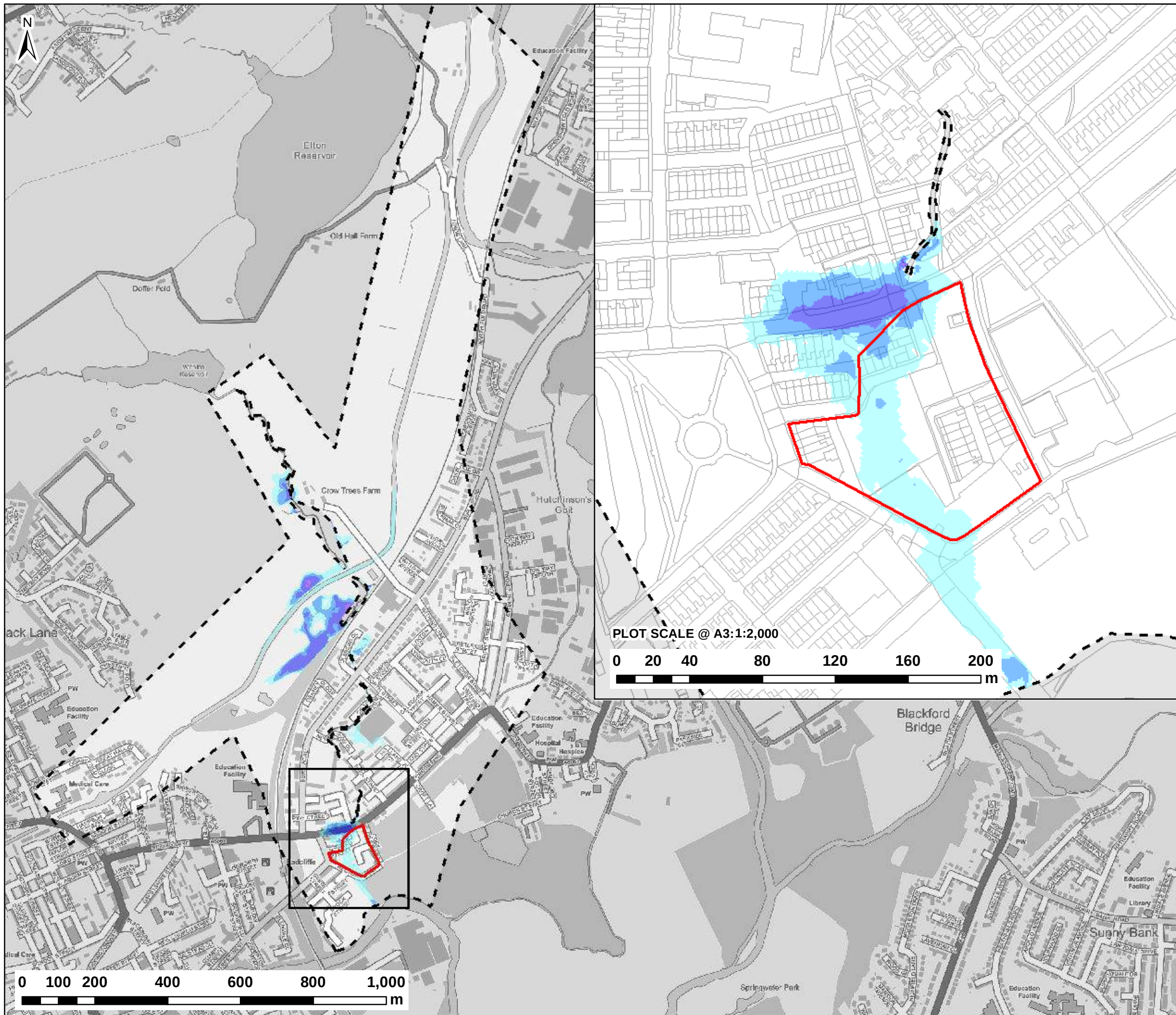
SCHEME:
ISLAND SITE,
RADCLIFFE

PLOT TITLE:
MAXIMUM FLOOD DEPTH
5% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS:
FINAL
DATE: 03/11/2020

DRAWN: VJ
CHECKED: SB
APPROVED: DH
PLOT SCALE @ A3: 1:10,000
(UNLESS STATED OTHERWISE)

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REV: -



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary
Model Extent

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4

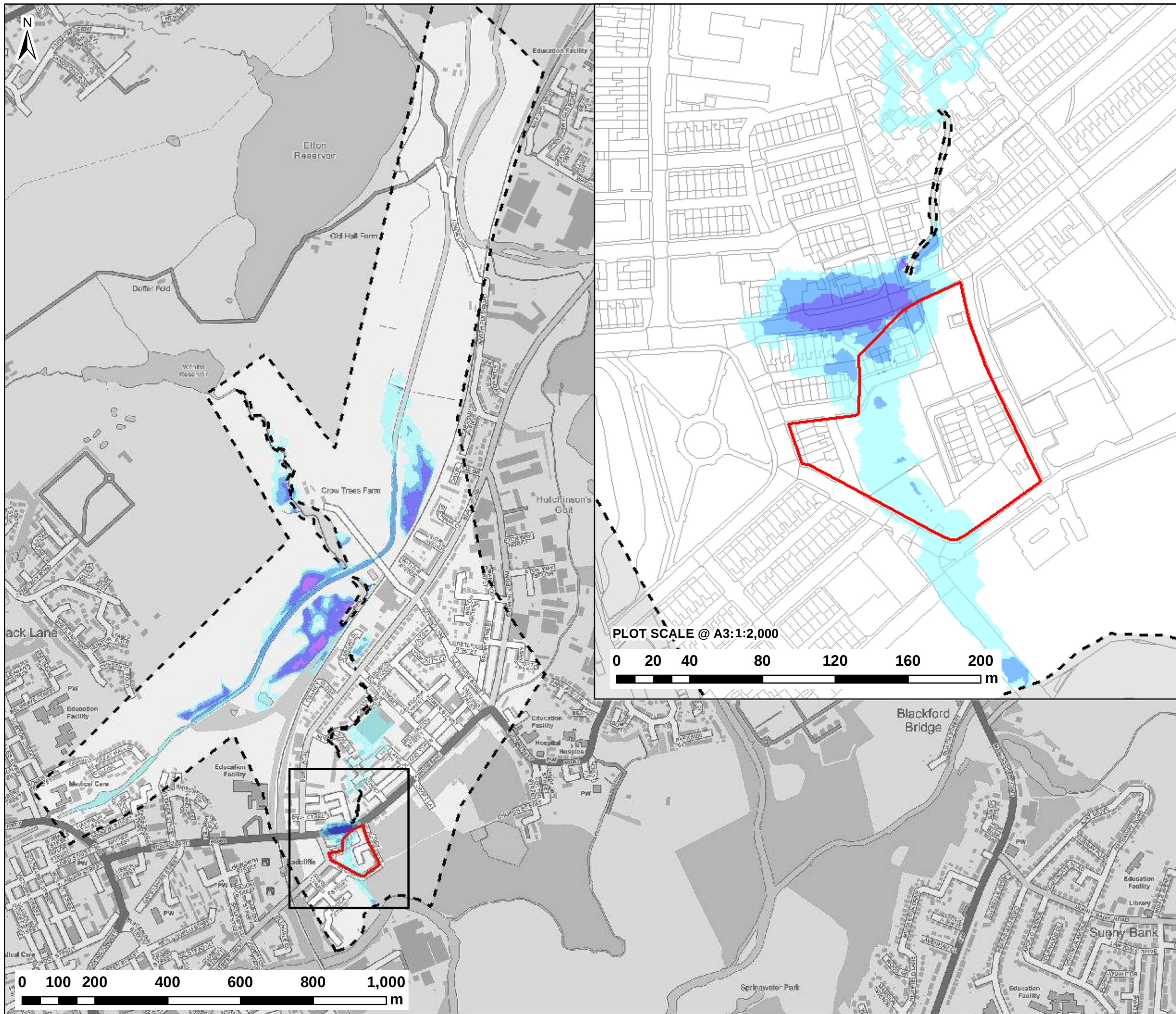
CLIENT: 


www.waterco.co.uk

SCHEME: **ISLAND SITE, RADCLIFFE**

PLOT TITLE: **MAXIMUM FLOOD DEPTH
1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS**

PLOT STATUS: FINAL		DATE: 03/11/2020	
DRAWN: VJ	CHECKED: SB	APPROVED: DH	PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)
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NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

Model Extent

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4

CLIENT:

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SCHEME:

ISLAND SITE, RADCLIFFE

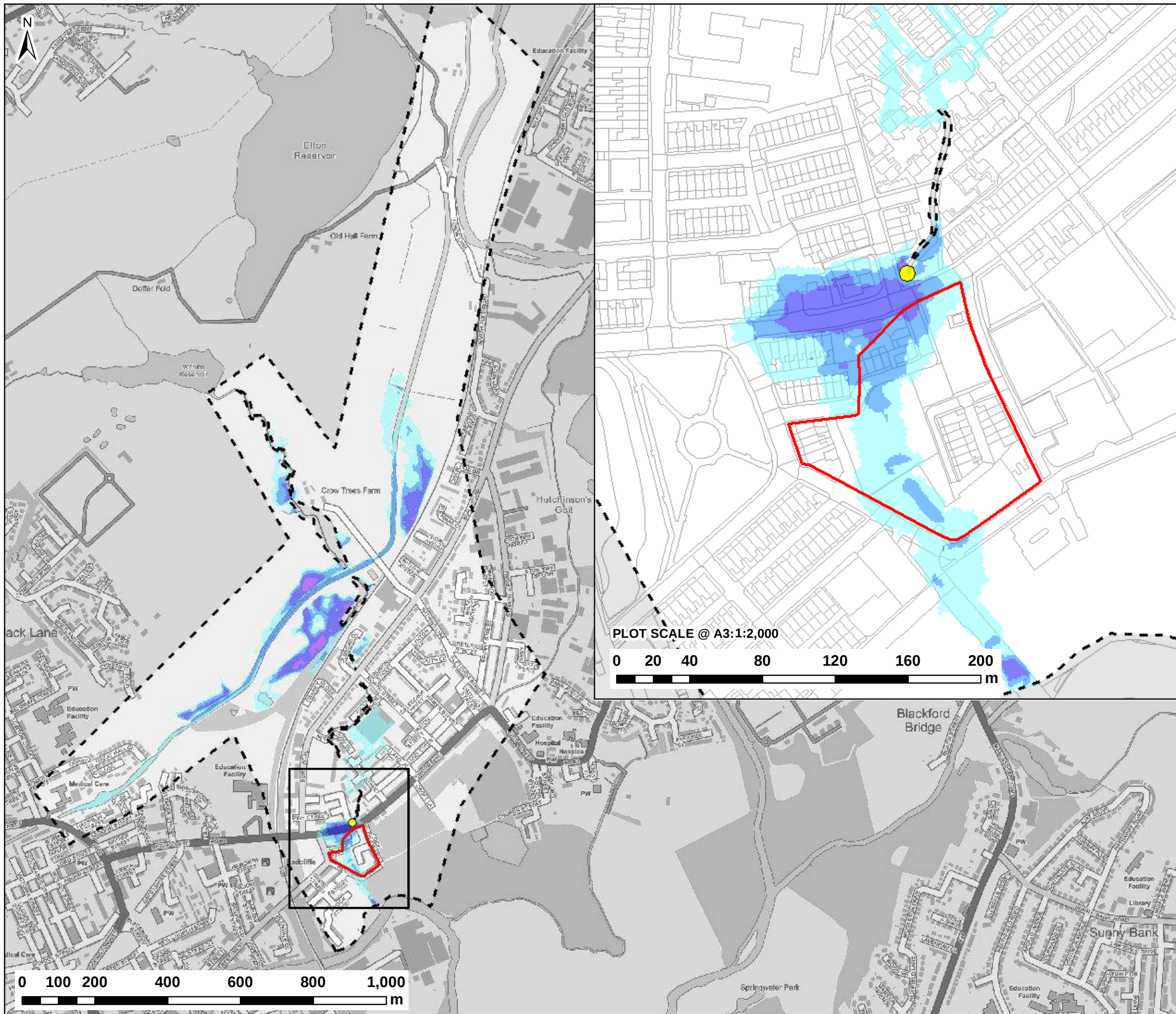
PLOT TITLE:

MAXIMUM FLOOD DEPTH
1% AEP + 35% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS: **FINAL** DATE: 03/11/2020

DRAWN: VJ CHECKED: SB APPROVED: DH PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)

PLOT NAME: 13478-CRT_Q100CC1_EXG_NFC_D REV: -



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

- Site Boundary
- Model Extent
- A6053 Culvert Blockage Location

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4

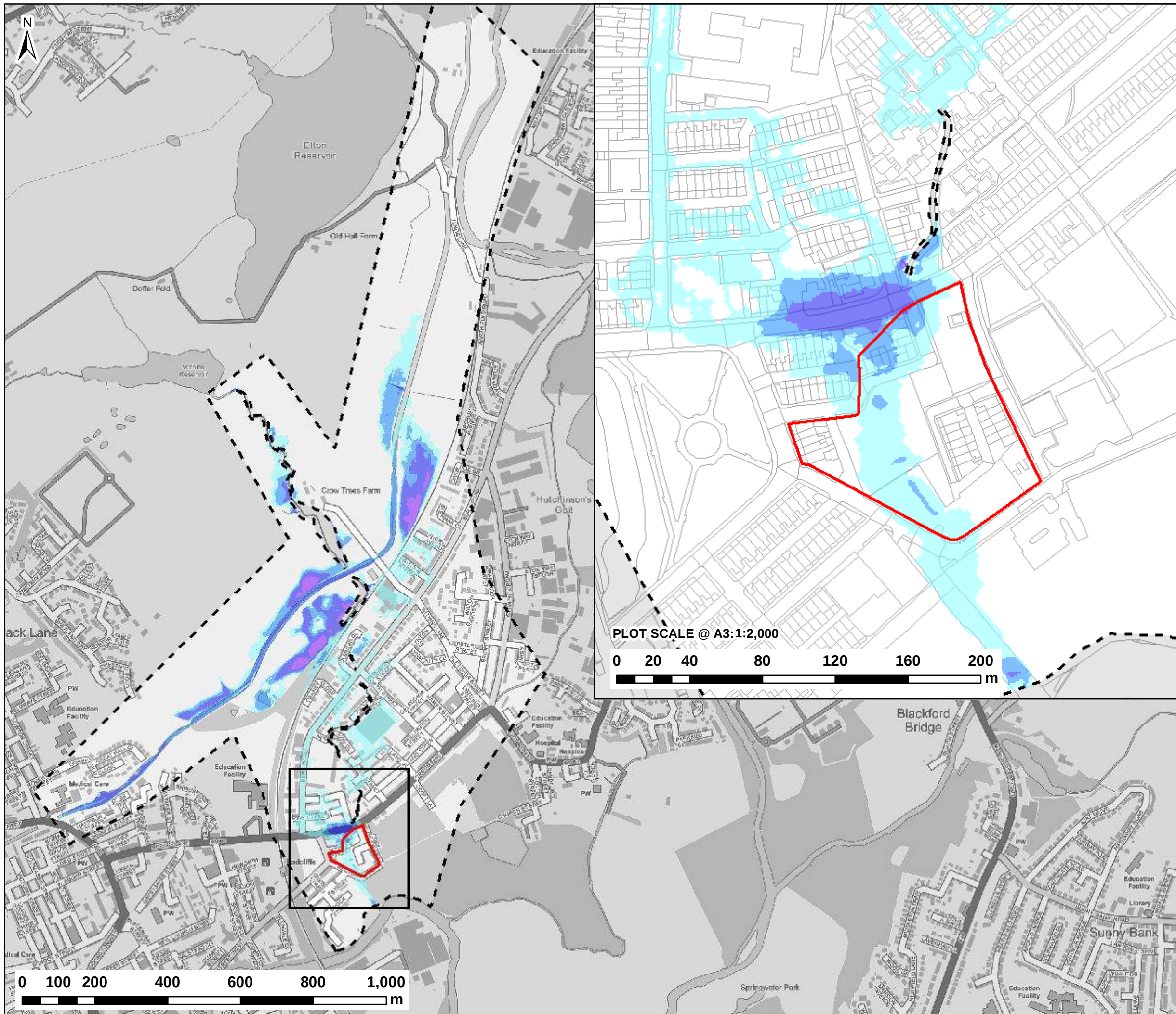
CLIENT: 


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SCHEME: **ISLAND SITE, RADCLIFFE**

PLOT TITLE: **MAXIMUM FLOOD DEPTH
1% AEP + 35% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
100% BLOCKAGE A6053 CULVERT**

PLOT STATUS: FINAL			DATE: 03/11/2020
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NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary
Model Extent

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4

CLIENT:
wyg
A TERRA TECH COMPANY

waterco
www.waterco.co.uk

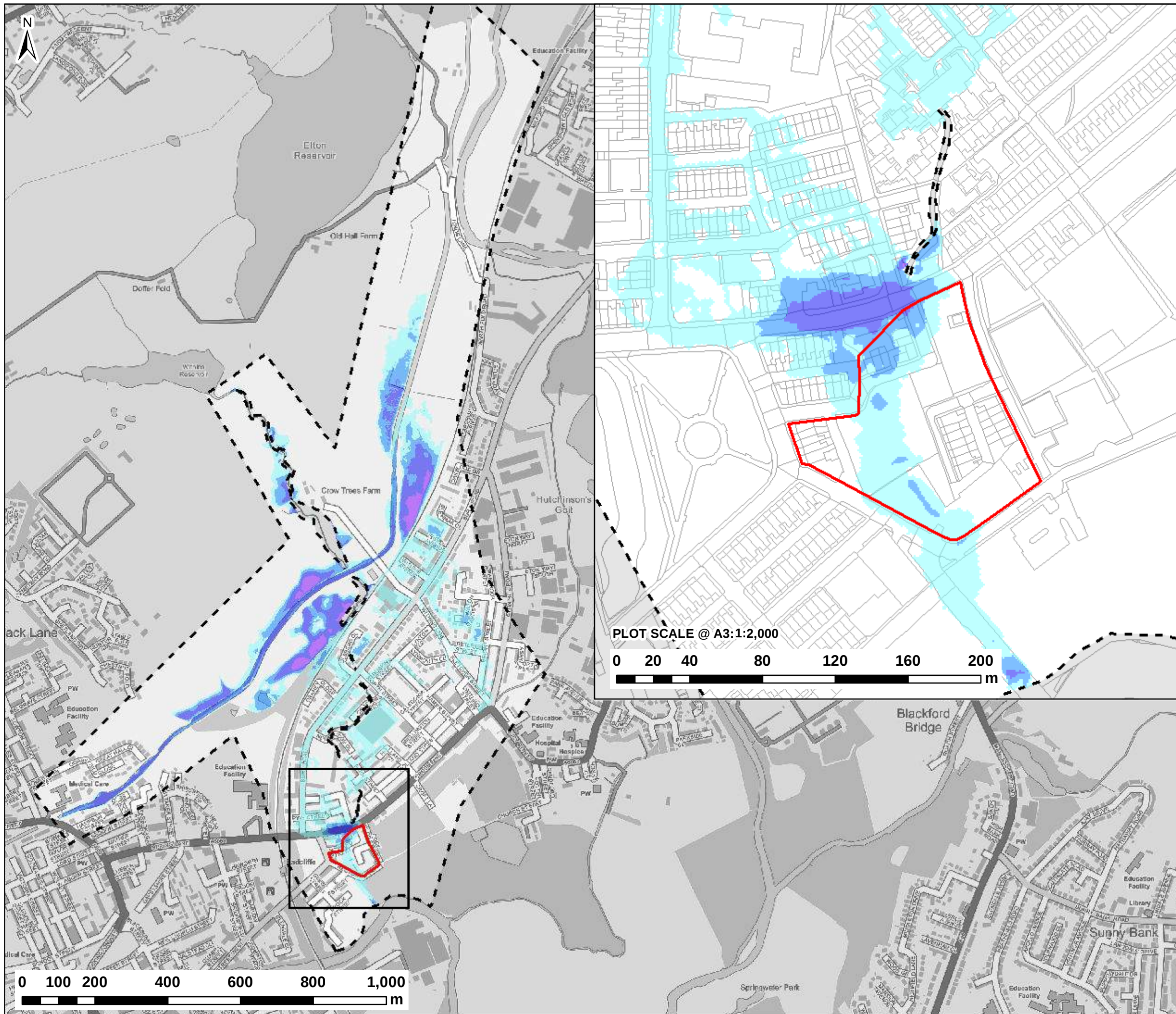
SCHEME:
ISLAND SITE,
RADCLIFFE

PLOT TITLE:
MAXIMUM FLOOD DEPTH
1% AEP + 70% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS: FINAL **DATE:** 03/11/2020

DRAWN: VJ	CHECKED: SB	APPROVED: DH	PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)
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NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary
Model Extent

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4

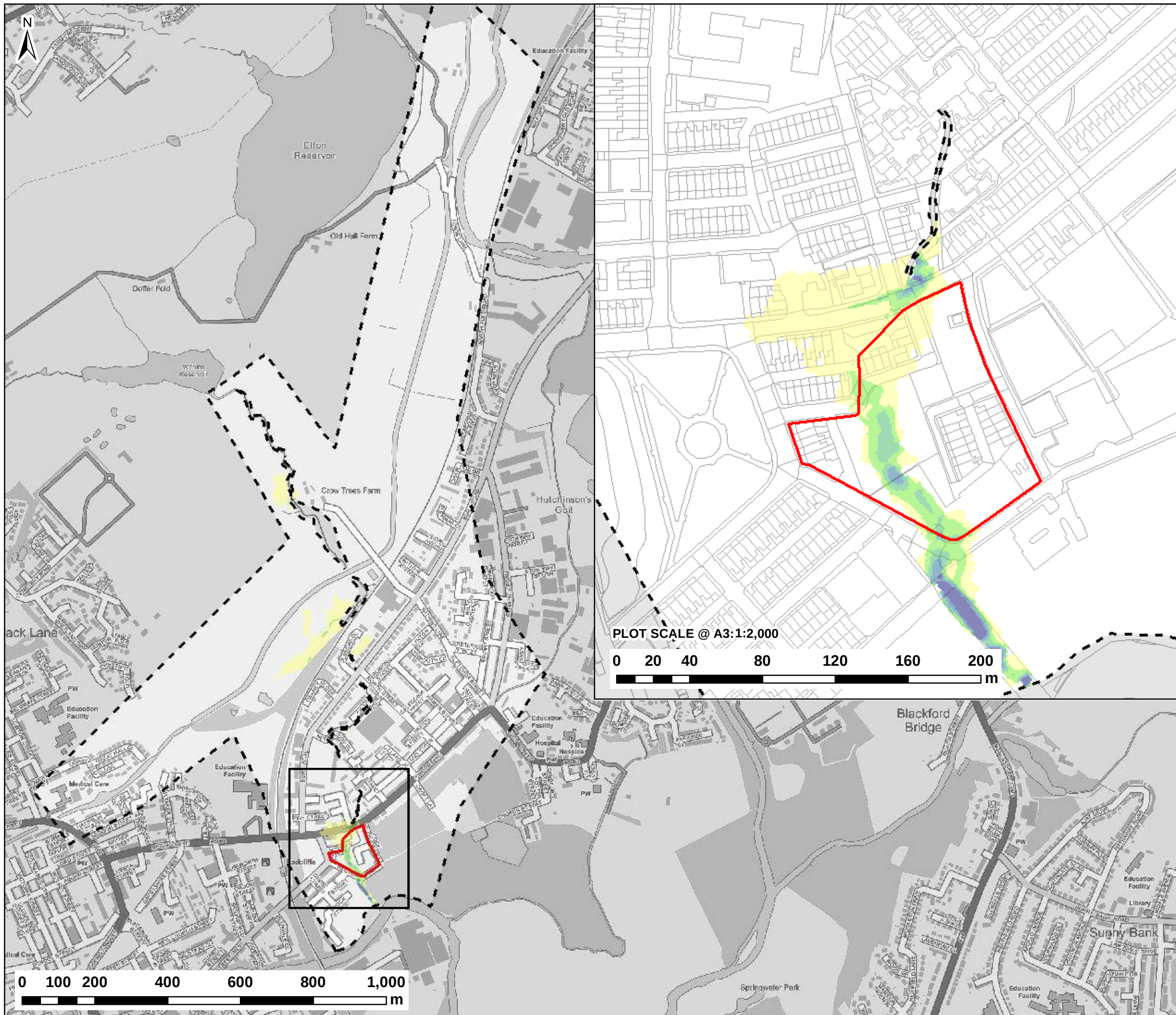
CLIENT: 


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SCHEME: **ISLAND SITE, RADCLIFFE**

PLOT TITLE: **MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS**

PLOT STATUS: FINAL			DATE: 03/11/2020
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PLOT NAME: 13478-CRT_Q1000_EXG_NFC_D			REV: -



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary
Model Extent

Maximum Velocity (m/s)

- < 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

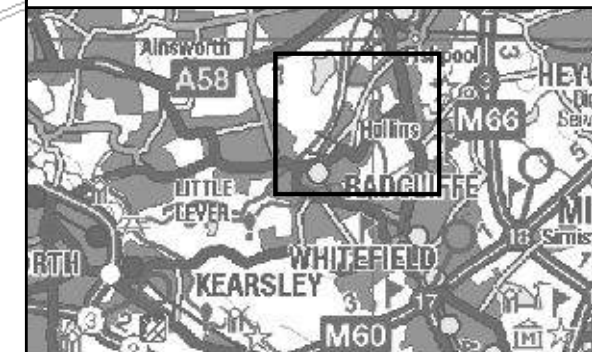
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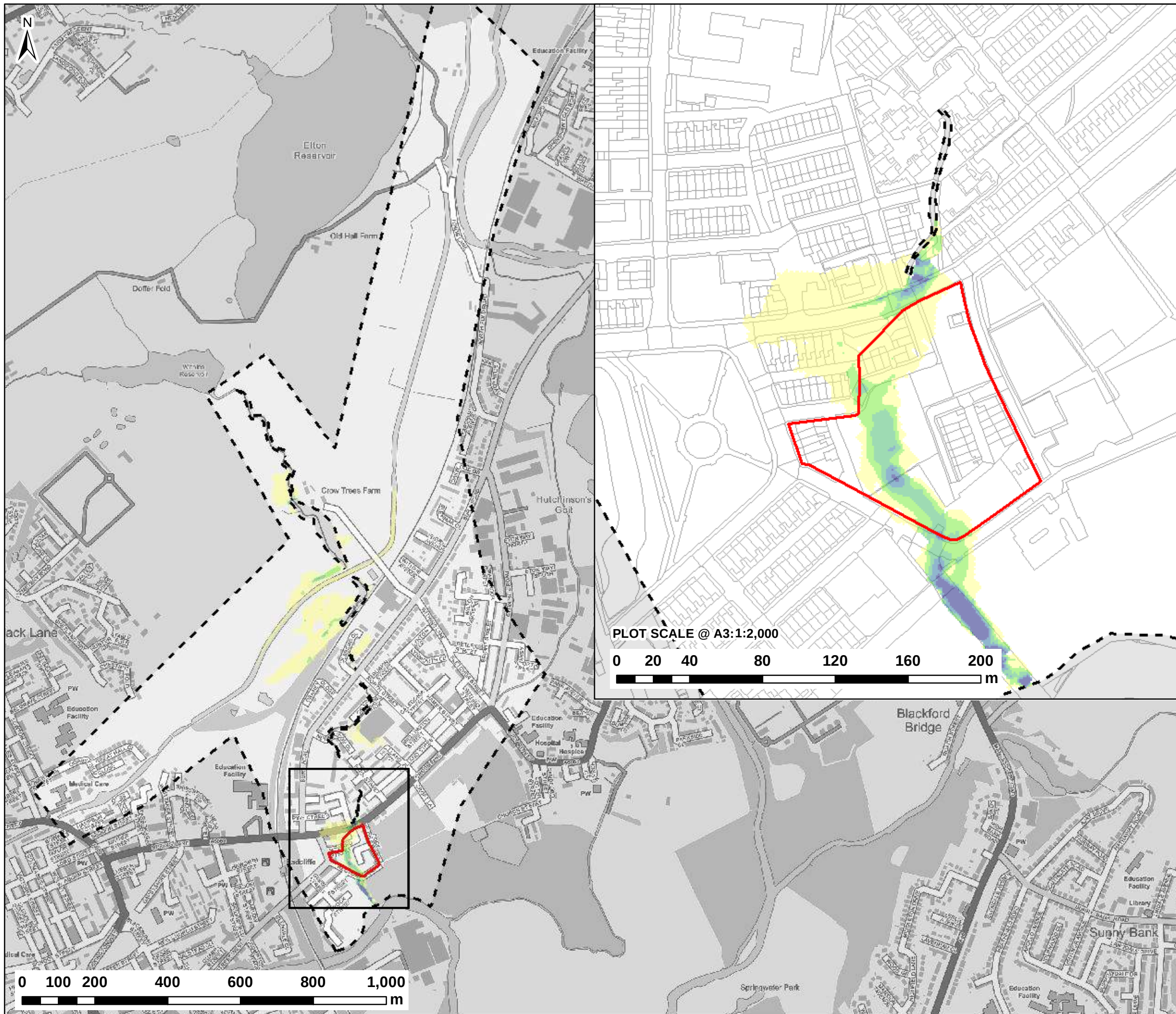

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SCHEME: **ISLAND SITE, RADCLIFFE**

PLOT TITLE: **MAXIMUM VELOCITY
5% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS**

PLOT STATUS: FINAL		DATE: 03/11/2020	
DRAWN: VJ	CHECKED: SB	APPROVED: DH	PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)
PLOT NAME: 13478-CRT_Q20_EXG_NFC_V			REV: -





NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

Model Extent

Maximum Velocity (m/s)

- < 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

CLIENT:

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SCHEME:

**ISLAND SITE,
RADCLIFFE**

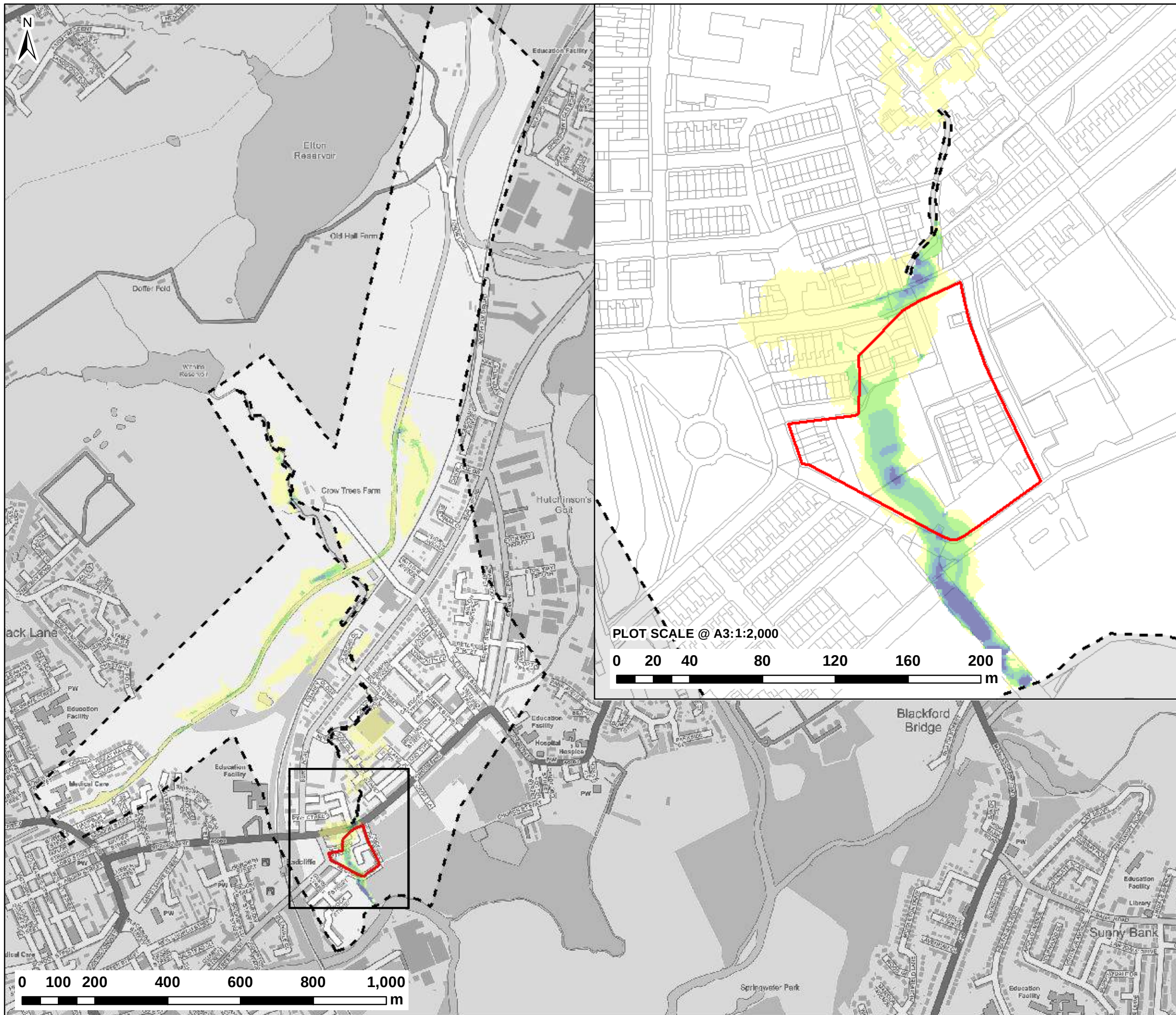
PLOT TITLE:

**MAXIMUM VELOCITY
1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS**

PLOT STATUS: **FINAL** DATE: 03/11/2020

DRAWN: VJ CHECKED: SB APPROVED: DH PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)

PLOT NAME: 13478-CRT_Q100_EXG_NFC_V REV: -



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

Model Extent

Maximum Velocity (m/s)

- < 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

CLIENT:

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SCHEME:

ISLAND SITE, RADCLIFFE

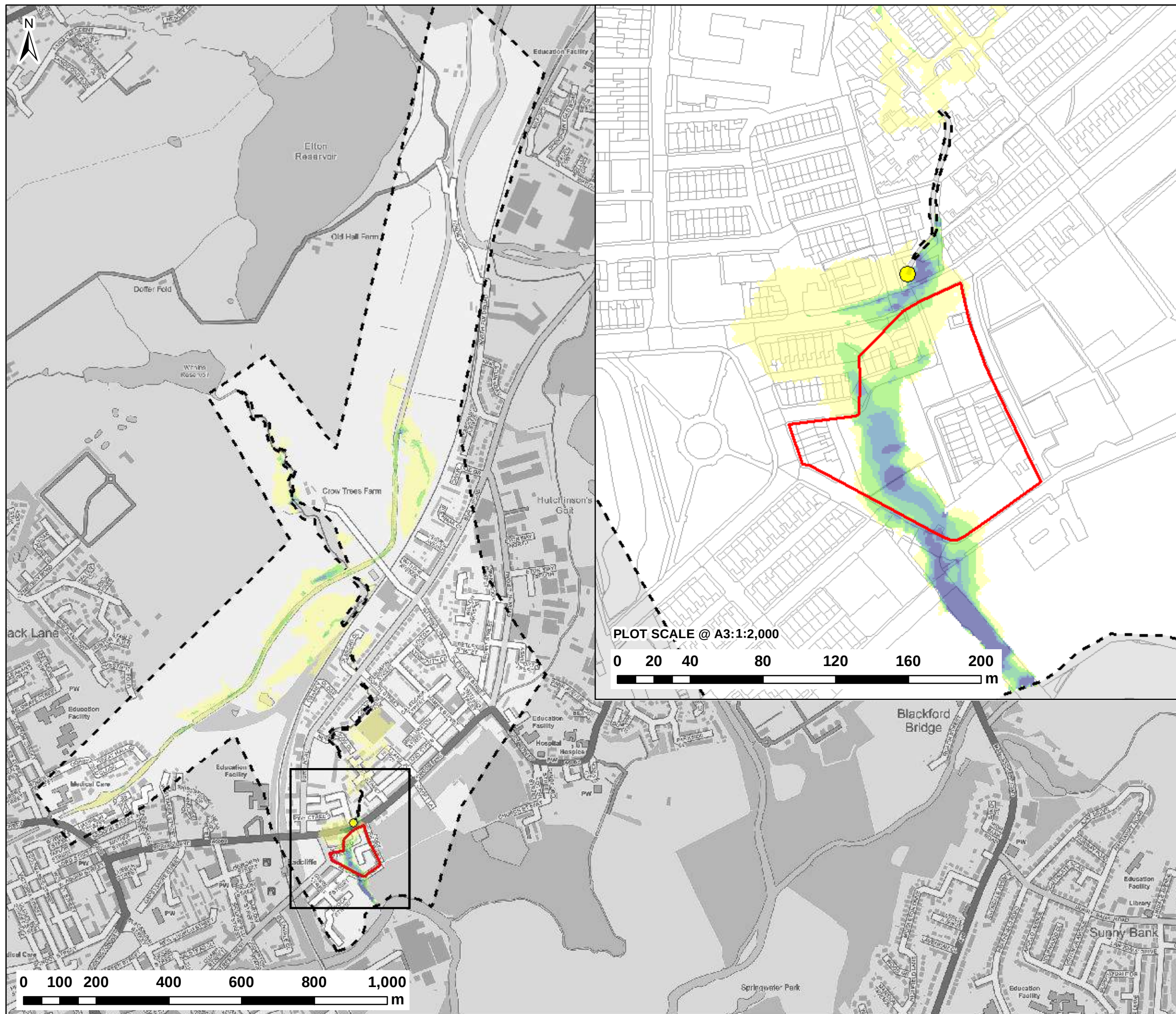
PLOT TITLE:

MAXIMUM VELOCITY
1% AEP + 35% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS: **FINAL** DATE: 03/11/2020

DRAWN: VJ CHECKED: SB APPROVED: DH PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)

PLOT NAME: 13478-CRT_Q100CC1_EXG_NFC_V REV: -



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

- Site Boundary
- Model Extent
- A6053 Culvert Blockage Location

Maximum Velocity (m/s)

- < 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

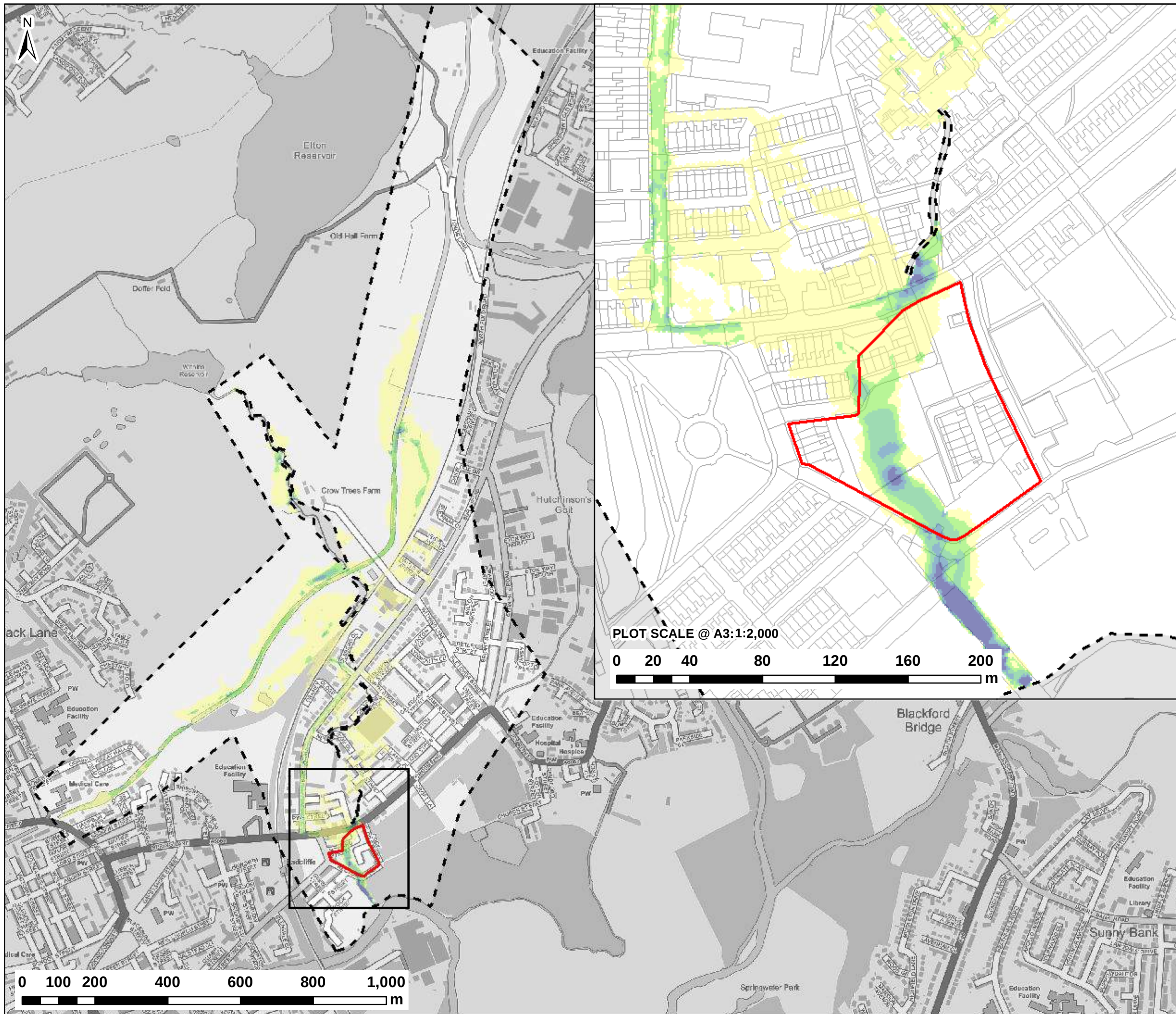
CLIENT: 


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SCHEME: **ISLAND SITE, RADCLIFFE**

PLOT TITLE: **MAXIMUM VELOCITY
1% AEP + 35% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
100% BLOCKAGE A6053 CULVERT**

PLOT STATUS: FINAL		DATE: 03/11/2020	
DRAWN: VJ	CHECKED: SB	APPROVED: DH	PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)
PLOT NAME: 13478-CRT_Q100CC1_EXG_BL1-99.9_V			REV: -



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

Model Extent

Maximum Velocity (m/s)

< 0.3

0.3 - 0.6

0.6 - 0.9

0.9 - 1.2

> 1.2

CLIENT:

A TRIMBLE TECH COMPANY

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SCHEME:

**ISLAND SITE,
RADCLIFFE**

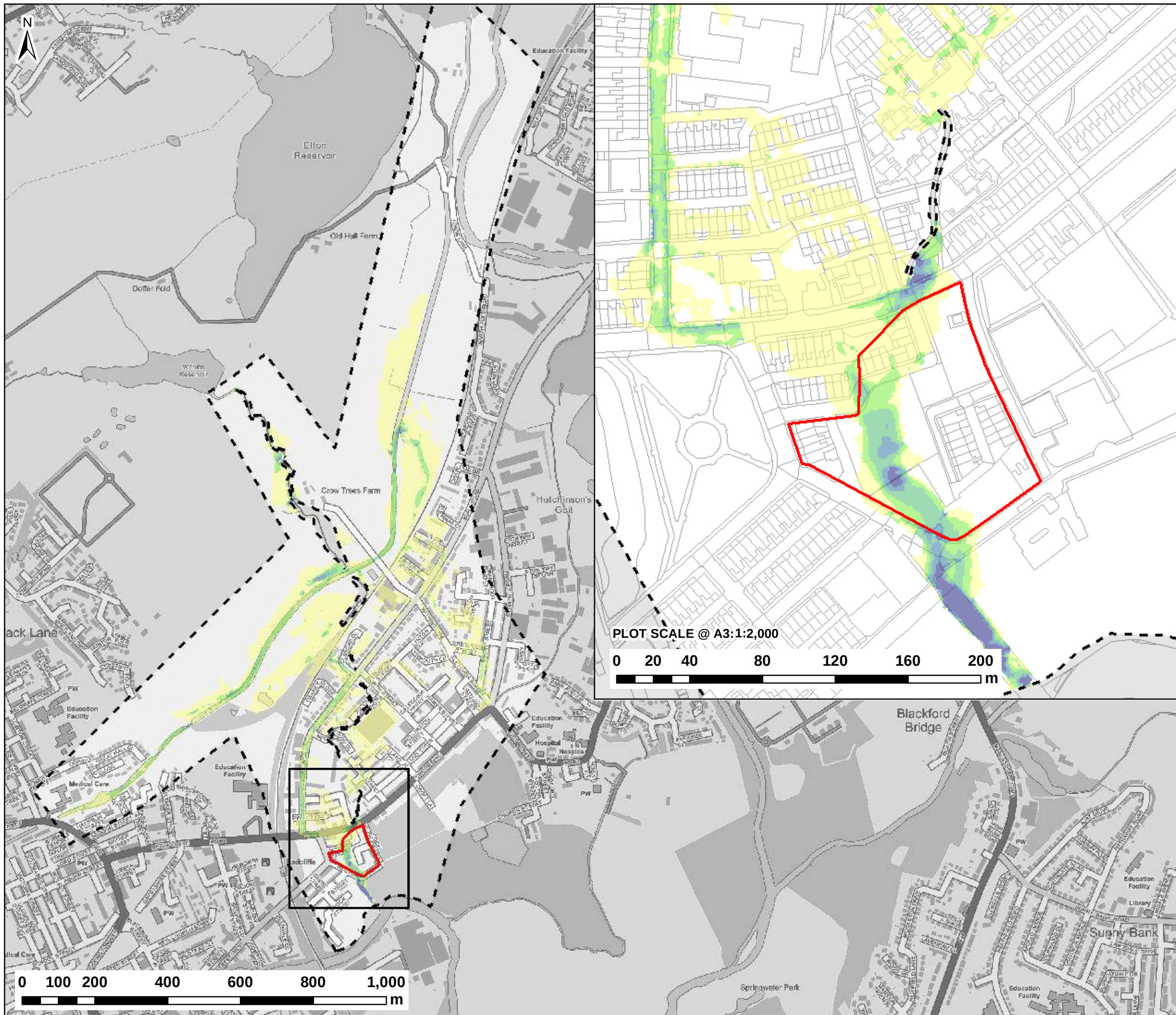
PLOT TITLE:

MAXIMUM VELOCITY
1% AEP + 70% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS:			DATE:
FINAL			03/11/2020

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
VJ	SB	DH	1:10,000
			(UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
13478-CRT_Q100CC2_EXG_NFC_V	-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

Model Extent

Maximum Velocity (m/s)

- < 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

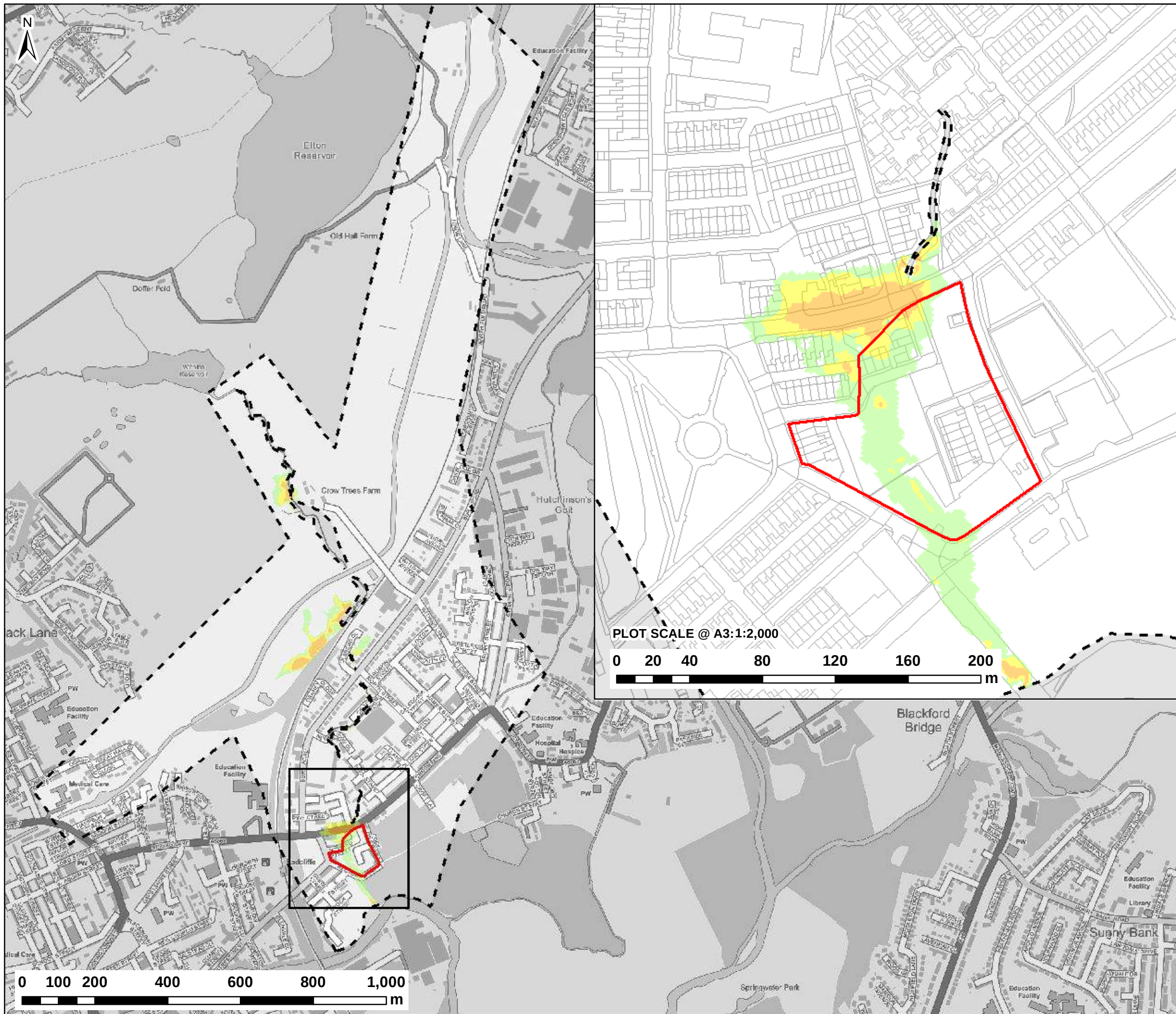
CLIENT: 


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SCHEME: **ISLAND SITE, RADCLIFFE**

PLOT TITLE: **MAXIMUM VELOCITY
0.1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS**

PLOT STATUS: FINAL			DATE: 03/11/2020
DRAWN: VJ	CHECKED: SB	APPROVED: DH	PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)
PLOT NAME: 13478-CRT_Q1000_EXG_NFC_V			REV: -



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

Model Extent

Maximum Flood Hazard Rating (FD2320)

< 0.75 (Caution)

0.75 - 1.25 (Danger for Some)

1.25 - 2 (Danger for Most)

> 2.0 (Danger for All)

CLIENT:

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SCHEME:

**ISLAND SITE,
RADCLIFFE**

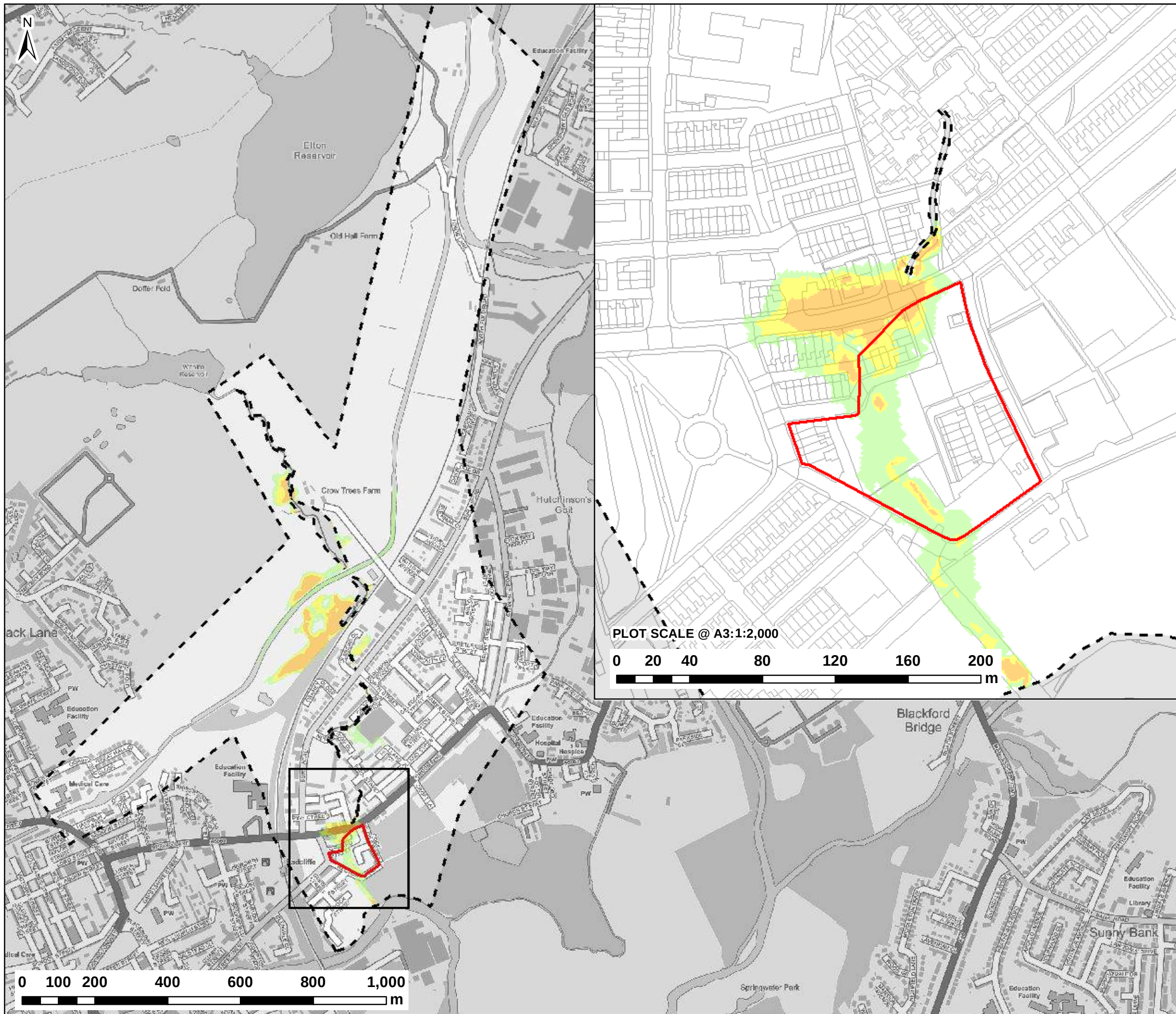
PLOT TITLE:

FLOOD HAZARD RATING
5% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS:			DATE:
FINAL			03/11/2020

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
VJ	SB	DH	1:10,000 (UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
13478-CRT_Q20_EXG_NFC_HZ	-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary

Model Extent

Maximum Flood Hazard Rating (FD2320)

< 0.75 (Caution)

0.75 - 1.25 (Danger for Some)

1.25 - 2 (Danger for Most)

> 2.0 (Danger for All)

CLIENT:





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SCHEME:

**ISLAND SITE,
RADCLIFFE**

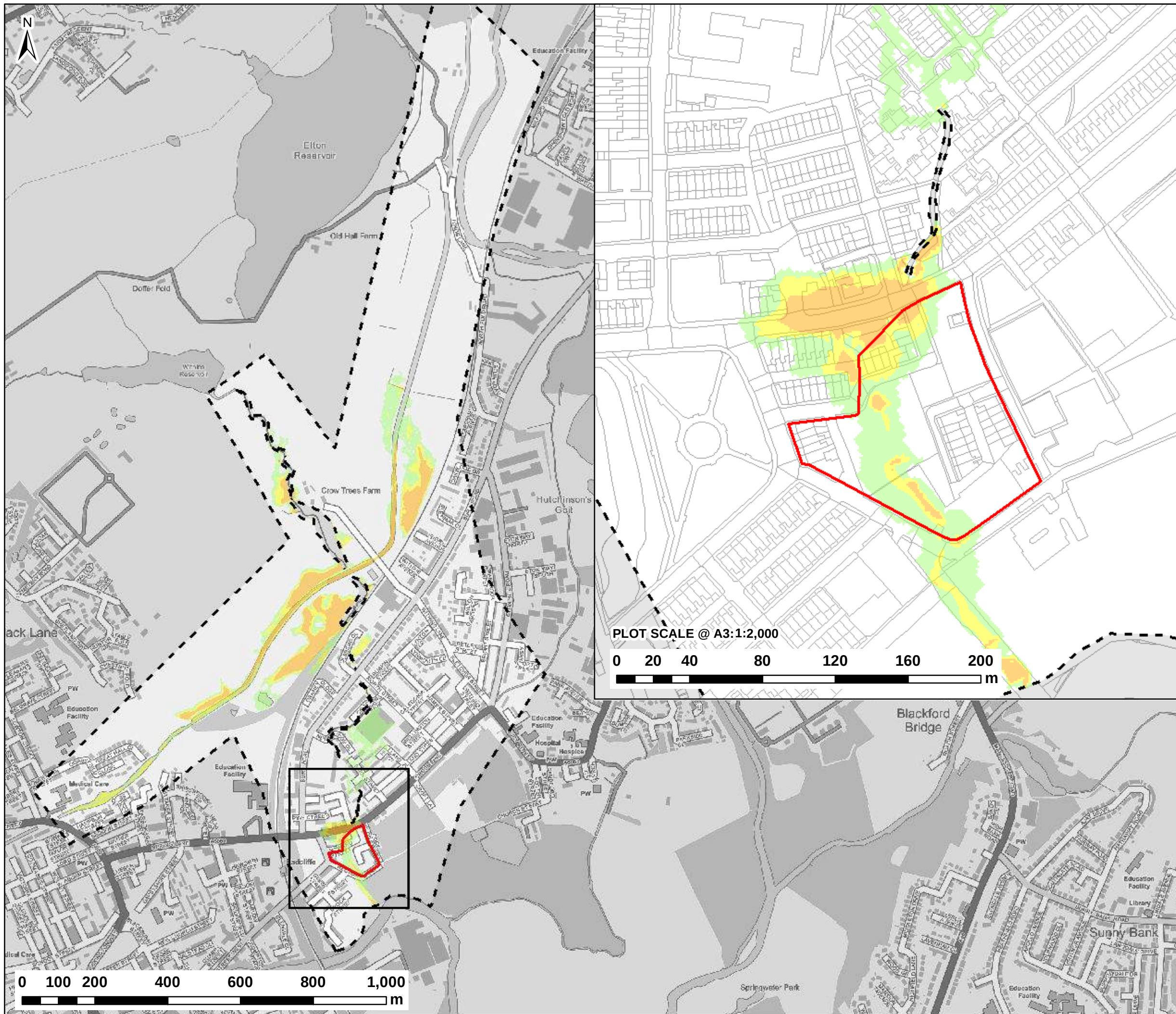
PLOT TITLE:

FLOOD HAZARD RATING
1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS:			DATE:
FINAL			03/11/2020

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
VJ	SB	DH	1:10,000 (UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
13478-CRT_Q100_EXG_NFC_HZ	-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary
Model Extent

Maximum Flood Hazard Rating (FD2320)

< 0.75 (Caution)
0.75 - 1.25 (Danger for Some)
1.25 - 2 (Danger for Most)
> 2.0 (Danger for All)

CLIENT: 


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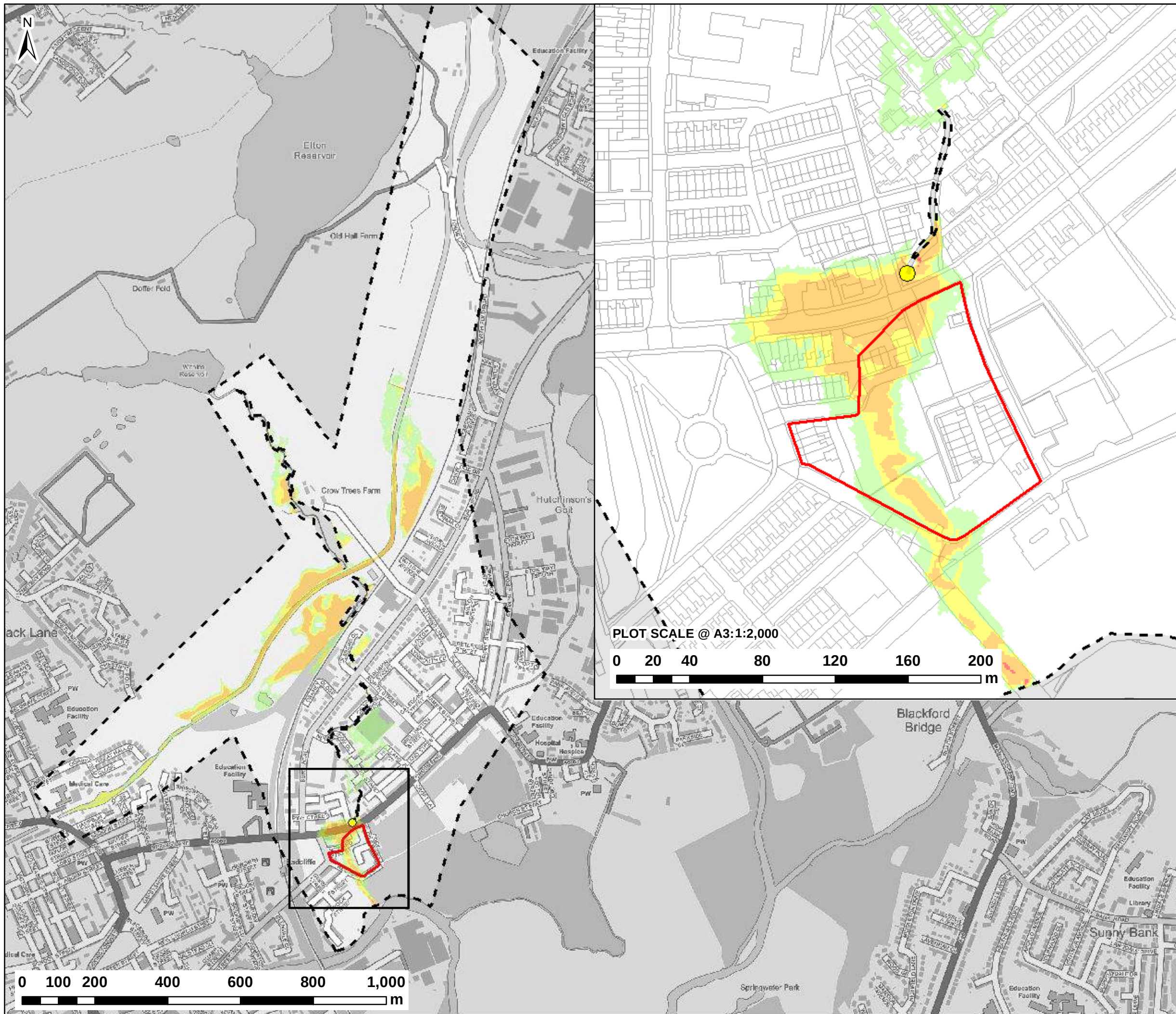
SCHEME:
**ISLAND SITE,
RADCLIFFE**

PLOT TITLE:
FLOOD HAZARD RATING
1% AEP + 35% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS: **FINAL** DATE: 03/11/2020

DRAWN: VJ CHECKED: SB APPROVED: DH PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)

PLOT NAME: 13478-CRT_Q100CC1_EXG_NFC_HZ REV: -



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

- Site Boundary
- Model Extent
- A6053 Culvert Blockage Location

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)

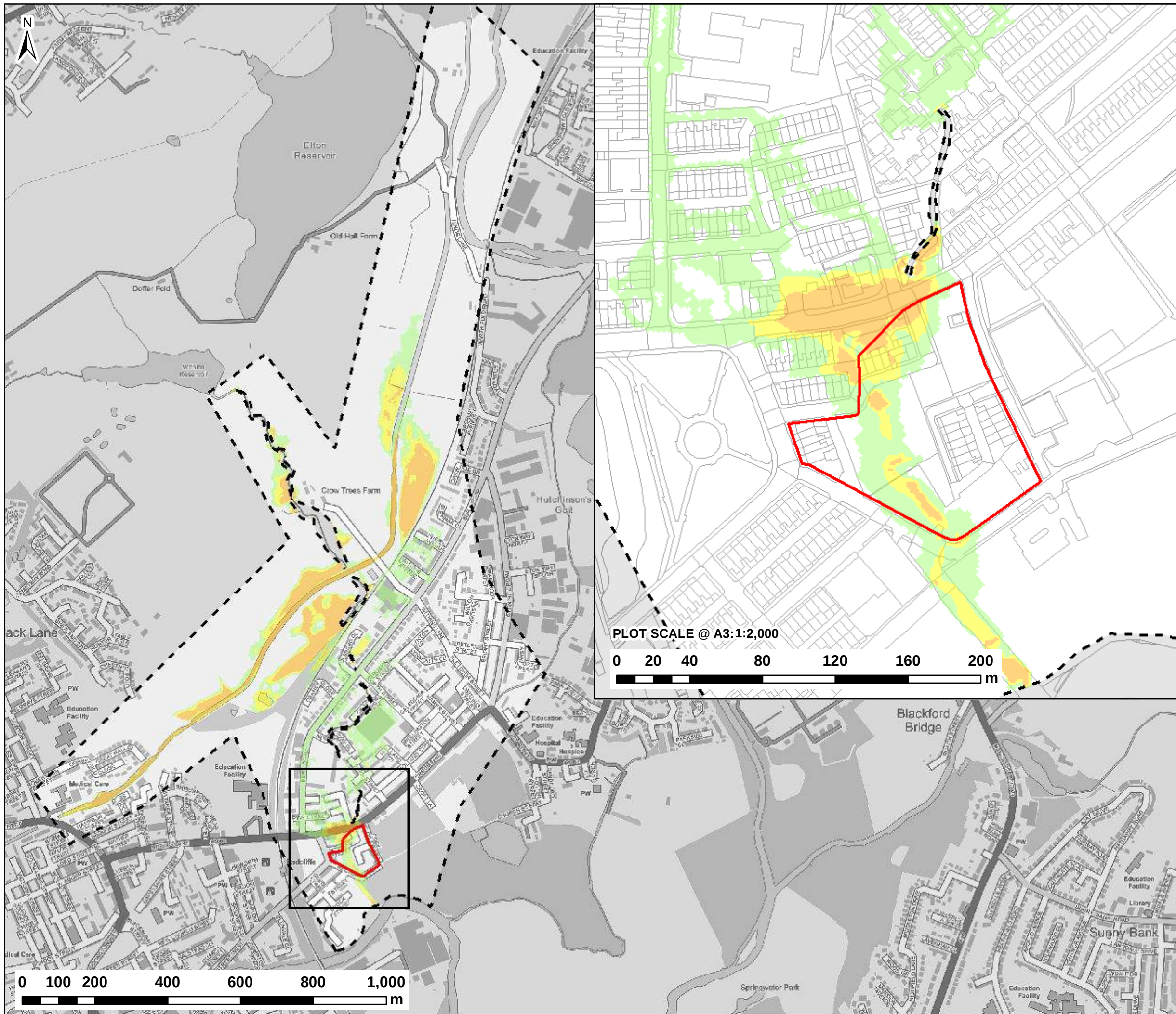
CLIENT: 


www.waterco.co.uk

SCHEME: **ISLAND SITE, RADCLIFFE**

PLOT TITLE: **FLOOD HAZARD RATING**
1% AEP + 35% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
100% BLOCKAGE A6053 CULVERT

PLOT STATUS: FINAL		DATE: 03/11/2020	
DRAWN: VJ	CHECKED: SB	APPROVED: DH	PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)
PLOT NAME: 13478-CRT_Q100CC1_EXG_BL1-99.9_HZ			REV: -



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary
Model Extent

Maximum Flood Hazard Rating (FD2320)

< 0.75 (Caution)
0.75 - 1.25 (Danger for Some)
1.25 - 2 (Danger for Most)
> 2.0 (Danger for All)

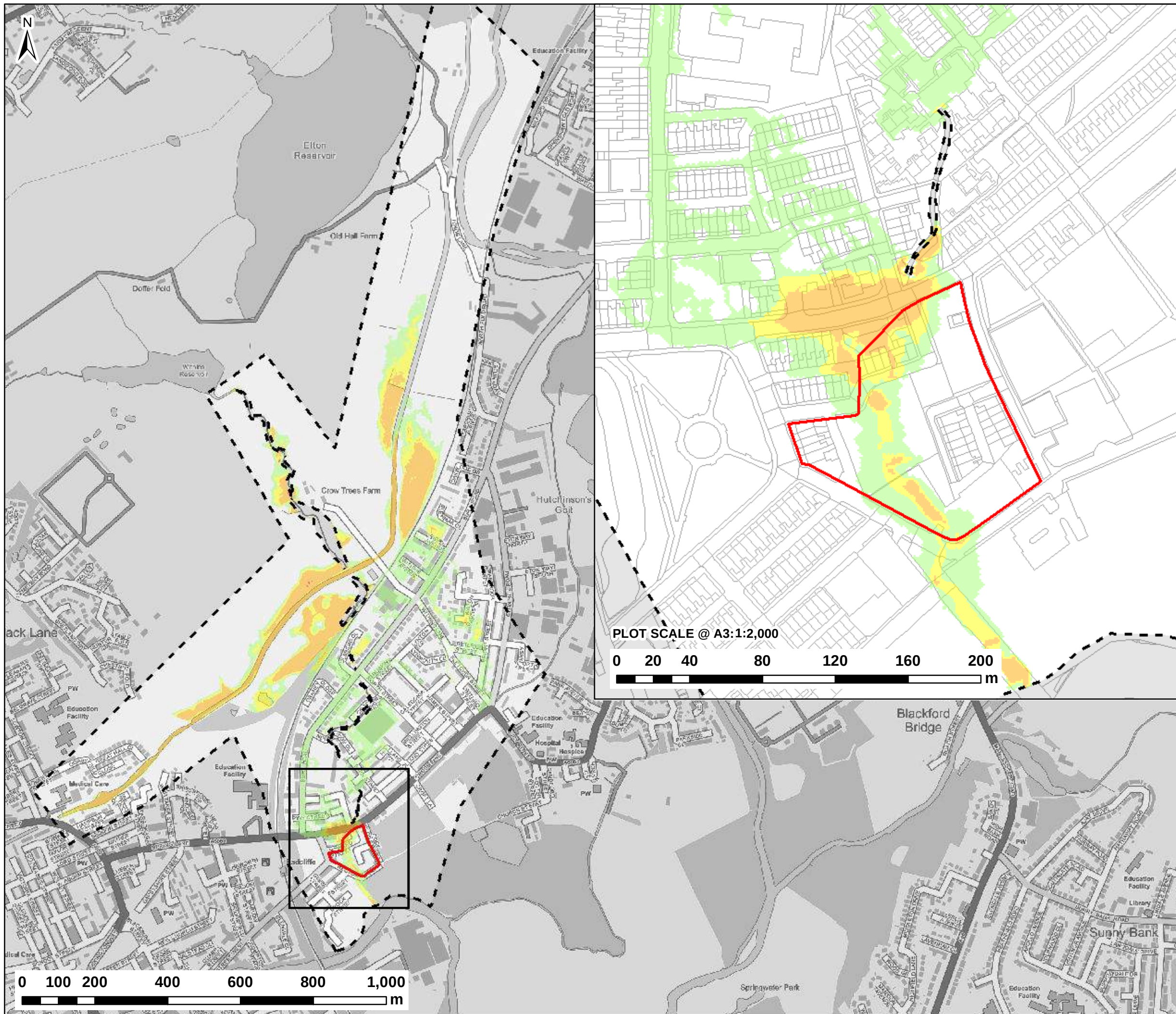
CLIENT:

www.waterco.co.uk

SCHEME: **ISLAND SITE, RADCLIFFE**

PLOT TITLE: **FLOOD HAZARD RATING**
1% AEP + 70% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS: FINAL		DATE: 03/11/2020	
DRAWN: VJ	CHECKED: SB	APPROVED: DH	PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)
PLOT NAME: 13478-CRT_Q100CC2_EXG_NFC_HZ			REV: -



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

Site Boundary
Model Extent

Maximum Flood Hazard Rating (FD2320)

< 0.75 (Caution)
0.75 - 1.25 (Danger for Some)
1.25 - 2 (Danger for Most)
> 2.0 (Danger for All)

CLIENT: 


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SCHEME: **ISLAND SITE, RADCLIFFE**

PLOT TITLE: **FLOOD HAZARD RATING
0.1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS**

PLOT STATUS: **FINAL** DATE: 03/11/2020

DRAWN: VJ CHECKED: SB APPROVED: DH PLOT SCALE @ A3: 1:10,000 (UNLESS STATED OTHERWISE)

PLOT NAME: 13478-CRT_Q1000_EXG_NFC_HZ REV: -

Appendix F Tabulated 1D Model Results

Normal Flow Condition Simulations

Date: 29-10-2020

Model Type: FMP-TUFLOW

FMP Build: 4.6

TUFLOW Build: 2020-01-AB

Normal Flow Condition Simulations - NFC

Model Ref	Event	DTM
Q20 EXG	5% AEP (1 in 20)	Existing Site Layout (EXG)
Q100 EXG	1% AEP (1 in 100)	
Q100CC1 EXG	1% AEP + 35% Climate Change (CC1)	
Q100CC2 EXG	1% AEP + 70% Climate Change (CC2)	
Q1000 EXG	0.1% AEP (1 in 1000)	

Notes:

1D/2D model build 005

EXG = Existing site layout

Nodes adjacent to site are highlighted in yellow

	Node Label	Notable Features	NORMAL FLOW CONDITIONS (NFC) - EXG SCENARIO				
			Q20	Q100	Q100CC1	Q100CC2	Q1000
			Q20-EXG-NFC (5% AEP)	Q100-EXG-NFC (1% AEP)	Q100CC1-EXG-NFC (1% AEP +35% CC)	Q100CC2-EXG-NFC (1% AEP +70% CC)	Q1000-EXG-NFC (0.1% AEP)
			(mAOD)	(mAOD)	(mAOD)	(mAOD)	(mAOD)
Crow Trees Farm Brook	CROT01_01777	Crow Trees Farm Brook Inflow Location	79.61	79.98	80.24	80.83	80.87
	CROT01_01776		79.58	79.95	80.21	80.91	81.01
	01776BU	Bridge downstream of the Withins Reservoir spillway	79.58	79.95	80.21	80.91	81.01
	01776BD		79.58	79.95	80.21	80.37	80.45
	01776SU		79.58	79.95	80.21	80.91	81.01
	01776SD		79.58	79.95	80.21	80.37	80.45
	CROT01_1776C		79.58	79.95	80.21	80.37	80.45
	CROT01_01766		79.54	79.90	80.22	80.42	80.49
	CROT01_1766C		78.87	79.08	79.25	79.41	79.48
	CROT01_01730		78.45	78.61	78.74	78.85	78.90
	CROT01_INT8		78.09	78.28	78.41	78.52	78.57
	CROT01_INT9		77.93	78.13	78.26	78.37	78.42
	CROT01_INT10		77.79	78.00	78.16	78.27	78.31
	CROT01_01629		77.70	77.91	78.07	78.17	78.22
	CROT01_INT7		77.31	77.63	77.88	78.00	78.04
	CROT01_01527		77.25	77.59	77.86	77.99	78.04
	CROT01_INT11		77.24	77.58	77.85	77.98	78.04
	CROT01_INT12		77.22	77.57	77.84	77.97	78.02
	CROT01_01518		77.19	77.54	77.82	77.95	78.01
	01518_IN	Culvert under a path upstream of Crow Trees Farm	77.19	77.54	77.82	77.95	78.01
	01518CU		77.09	77.33	77.52	77.64	77.69
	01507CD		77.07	77.31	77.50	77.62	77.67
	01507_OUT		76.84	76.93	77.03	77.17	77.24
	CROT01_01507		76.84	76.93	77.03	77.17	77.24
	CROT01_01505		76.82	76.91	77.00	77.15	77.22
	CROT01_INT30		76.82	76.90	76.96	77.01	77.03
	CROT01_INT31		76.82	76.89	76.94	76.99	77.01
	CROT01_01452		76.81	76.88	76.93	76.97	76.99
	CROT01_INT13		76.81	76.87	76.91	76.94	76.96
	CROT01_INT14		76.81	76.87	76.92	76.96	76.98
	CROT01_INT21		76.80	76.84	76.85	76.85	76.85
	CROT01_01383		76.81	76.88	76.94	76.98	77.01
	01383IN	Culvert under a footpath near to Crow Trees Farm	76.81	76.88	76.94	76.98	77.01
	01383CU		75.13	76.08	76.25	76.36	76.42
	01376CD		75.14	76.05	76.21	76.32	76.38
	01376OUT		75.14	76.05	76.21	76.32	76.38
	CROT01_01376		75.14	76.05	76.21	76.32	76.38
	CROT01_INT15		75.08	76.03	76.18	76.29	76.35
	CROT01_INT16		75.07	76.03	76.18	76.29	76.35
	CROT01_01327		75.07	76.04	76.18	76.29	76.35
	CROT01_INT17		75.07	76.04	76.18	76.29	76.35
	CROT01_INT18		75.07	76.03	76.18	76.29	76.35
	CROT01_INT19		75.07	76.03	76.18	76.29	76.35
	CROT01_INT32		75.07	76.03	76.18	76.29	76.35
	CROT01_INT20		75.07	76.03	76.18	76.29	76.35
	CROT01_INT33		75.07	76.03	76.18	76.29	76.35
	CROT01_01207		75.07	76.03	76.18	76.29	76.35
	CROT01_INT26		75.07	76.03	76.18	76.29	76.35
	CROT01_INT27		75.07	76.03	76.18	76.29	76.35
	CROT01_01124		75.06	76.03	76.18	76.29	76.35
	01124IN	Culvert under the Manchester Bury and Bolton Canal	75.06	76.03	76.18	76.29	76.35
	01124CU		74.25	74.83	74.93	75.02	75.08
	01092CD		73.21	73.35	73.49	73.55	73.58
	01092OUT		73.21	73.35	73.49	73.55	73.58
	CROT01_01092		73.21	73.35	73.49	73.55	73.58
	CROT01_01074		73.17	73.36	73.51	73.58	73.60
	01074BU	Bridge located between Manchester Bury and Bolton Canal and the Metrolink Line	73.17	73.36	73.51	73.58	73.60
	01074BD		72.89	73.34	73.50	73.57	73.59
	01074SU		73.17	73.36	73.51	73.58	73.60
	01074SD		72.89	73.34	73.50	73.57	73.59
CROT01_1074C	72.89		73.34	73.50	73.57	73.59	
CROT01_01071		72.86	73.33	73.49	73.57	73.59	
CROT01_INT34		72.88	73.33	73.49	73.56	73.59	
CROT01_INT35		72.89	73.33	73.49	73.56	73.59	
CROT01_01027		72.90	73.33	73.49	73.56	73.59	
CROT01_INT36		72.89	73.33	73.49	73.56	73.59	
CROT01_INT37		72.89	73.33	73.49	73.56	73.59	
CROT01_INT4		72.89	73.33	73.49	73.56	73.59	
CROT01_INT5		72.89	73.33	73.49	73.56	73.59	
CROT01_INT6		72.89	73.33	73.49	73.56	73.59	
CROT01_00926		72.89	73.33	73.49	73.56	73.59	
00926IN	Culvert under the Metrolink Line	72.89	73.33	73.49	73.56	73.59	
00926CU		72.49	72.83	72.95	73.01	73.02	
00926CUin1		72.33	72.63	72.73	72.79	72.80	
00926CUin2		72.15	72.41	72.50	72.54	72.55	
00926CUin3		71.96	72.16	72.23	72.27	72.28	
00926CUin4		71.73	71.88	71.93	71.96	71.97	
00850CD		71.48	71.55	71.58	71.59	71.60	
00850OUT		71.48	71.55	71.58	71.59	71.60	
CROT01_00850		71.48	71.55	71.58	71.59	71.60	
CROT01_00827		71.45	71.54	71.57	71.59	71.60	
00827BU	Small bridge south of Olsberg Close	71.45	71.54	71.57	71.59	71.60	
00827BD		71.16	71.29	71.35	71.38	71.40	
00827SU		71.45	71.54	71.57	71.59	71.60	
00827SD		71.16	71.29	71.35	71.38	71.40	
CROT01_0827C		71.16	71.29	71.35	71.38	71.40	
CROT01_08004		71.05	71.20	71.27	71.31	71.33	
CROT01_0804C		70.92	71.14	71.21	71.26	71.28	
CROT01_08000		70.86	71.08	71.16	71.21	71.23	

Hydraulic Model Results - Island Site, Radcliffe



1D FMP Model Results - Maximum Water Levels (mAOD)

Normal Flow Condition Simulations

Date: 29-10-2020
Model Type: FMP-TUFLOW
FMP Build: 4.6
TUFLOW Build: 2020-01-AB

Normal Flow Condition Simulations - NFC

Model Ref	Event	DTM
Q20 EXG	5% AEP (1 in 20)	Existing Site Layout (EXG)
Q100 EXG	1% AEP (1 in 100)	
Q100CC1 EXG	1% AEP + 35% Climate Change (CC1)	
Q100CC2 EXG	1% AEP + 70% Climate Change (CC2)	
Q1000 EXG	0.1% AEP (1 in 1000)	

Notes:

ID/2D model build 005
EXG = Existing site layout
Nodes adjacent to site are highlighted in yellow

Node Label	Notable Features	NORMAL FLOW CONDITIONS (NFC) - EXG SCENARIO				
		Q20	Q100	Q100CC1	Q100CC2	Q1000
		Q20-EXG-NFC (5% AEP) (mAOD)	Q100-EXG-NFC (1% AEP) (mAOD)	Q100CC1-EXG-NFC (1% AEP + 35% CC) (mAOD)	Q100CC2-EXG-NFC (1% AEP + 70% CC) (mAOD)	Q1000-EXG-NFC (0.1% AEP) (mAOD)
00800IN	Culvert under Bury Road	70.86	71.08	71.16	71.21	71.23
00800CU		70.50	70.59	70.62	70.64	70.66
00800CUin1		70.39	70.46	70.48	70.49	70.52
00800CUin2		70.25	70.31	70.34	70.36	70.39
00800CUin3		70.17	70.23	70.24	70.25	70.26
00762CD		70.09	70.14	70.15	70.16	70.17
00762OUT	Culvert under Crofters Brook	70.09	70.14	70.15	70.16	70.17
CROT01_00762		70.09	70.14	70.15	70.16	70.17
CROT01_INT25		69.93	69.99	70.02	70.06	70.08
CROT01_00700		69.86	69.92	69.95	69.99	70.00
00700IN		69.86	69.92	69.95	69.99	70.00
00700CU		69.82	69.87	69.90	69.93	69.95
00690CD	Culvert under Crofters Brook	69.79	69.84	69.88	69.91	69.93
00690OUT		69.72	69.76	69.80	69.83	69.84
CROT01_00690		69.72	69.76	69.80	69.83	69.84
CROT01_INT22		69.60	69.64	69.67	69.70	69.71
CROT01_INT23		69.52	69.57	69.59	69.61	69.62
CROT01_INT24		69.43	69.48	69.51	69.53	69.54
CROT01_00594	Small bridge at Windsor Court	69.40	69.46	69.48	69.51	69.52
CROT01_00592		69.43	69.48	69.51	69.53	69.54
00592BU		69.43	69.48	69.51	69.53	69.54
00592BD		69.37	69.43	69.45	69.48	69.49
00592SU		69.43	69.48	69.51	69.53	69.54
00592SD		69.37	69.43	69.45	69.48	69.49
CROT01_0592C	Bridge at Newbridge Close	69.37	69.43	69.45	69.48	69.49
CROT01_00583		69.20	69.25	69.29	69.33	69.34
CROT01_00551		69.11	69.18	69.23	69.27	69.29
CROT01_00537		69.03	69.10	69.16	69.20	69.22
00537BU		69.03	69.10	69.16	69.20	69.22
00537BD		69.03	69.10	69.16	69.20	69.22
00537SU	Metal access bridge	69.03	69.10	69.16	69.20	69.22
00537SD		69.03	69.10	69.16	69.20	69.22
CROT01_0537C		69.03	69.10	69.16	69.20	69.22
CROT01_00526		68.95	69.03	69.09	69.14	69.16
CROT01_00504		68.79	68.85	68.90	68.94	68.96
00504BLU		68.79	68.85	68.90	68.94	68.96
00504BLD	Culvert from Station Works to Hoyles Court	68.75	68.81	68.86	68.89	68.91
CROT01_0504C		68.75	68.81	68.86	68.89	68.91
CROT01_00476		68.70	68.76	68.81	68.84	68.86
CROT01_0476C		68.03	68.09	68.13	68.16	68.18
CROT01_00474		68.08	68.15	68.20	68.24	68.26
00474IN		68.08	68.15	68.20	68.24	68.26
00474CU	Bridge near Hoyles Court and Gingham Court	67.86	67.89	67.91	67.93	67.94
00474CUin1		67.20	67.24	67.26	67.28	67.30
00474CUin2		66.59	66.64	66.68	66.71	66.73
00367CD		66.22	66.29	66.35	66.38	66.40
00367OUT		66.22	66.29	66.35	66.38	66.40
CROT01_00367		66.22	66.29	66.35	66.38	66.40
CROT01_00365	A6053 Cross Lane Culvert	66.22	66.29	66.35	66.38	66.40
00365BU		66.22	66.29	66.35	66.38	66.40
00365BD		66.22	66.29	66.35	66.38	66.40
00365SU		66.22	66.29	66.35	66.38	66.40
00365SD		66.22	66.29	66.35	66.38	66.40
CROT01_00363		66.22	66.29	66.35	66.38	66.40
CROT01_INT1	Crow Trees Farm Brook Outflow Location	66.18	66.24	66.29	66.32	66.33
CROT01_INT2		66.17	66.23	66.28	66.30	66.32
CROT01_INT3		66.15	66.19	66.21	66.21	66.21
CROT01_00274		66.18	66.25	66.30	66.33	66.34
CROT01_00270		66.18	66.25	66.30	66.33	66.34
00270BL		66.18	66.25	66.30	66.33	66.34
00270IN	A6053 Cross Lane Culvert	66.18	66.25	66.30	66.33	66.34
00270CU		64.41	64.41	64.41	64.41	64.41
00270CUin1		63.69	63.69	63.69	63.69	63.69
00270CUin2		62.98	62.98	62.98	62.98	62.98
00270CUin3		62.25	62.25	62.25	62.25	62.25
00270CUin4		61.58	61.58	61.58	61.58	61.58
00270CUin5	A6053 Cross Lane Culvert	61.21	61.21	61.21	61.21	61.21
00270CUin6		61.22	61.22	61.22	61.22	61.22
00020CD		61.22	61.23	61.23	61.23	61.23
00020OR		61.20	61.20	61.20	61.20	61.20
CROT01_DS		61.20	61.20	61.20	61.20	61.20

Hydraulic Model Results - Island Site, Radcliffe



1D FMP Model Results - Maximum Water Levels (mAOD)

Blockage Scenarios

Date: 29-10-2020

Model Type: FMP-TUFLOW

FMP Build: 4.6

TUFLOW Build: 2020-01-AB

Blockage Scenarios

Model Ref	Details	Event	DTM
Q100CC1 BL1-99.9	100% Blockage of A6053 Cross Lane Culvert	Q100CC1	Existing Site Layout (EXG)

Notes:

1D/2D model build 005
BL = Blockage Scenarios
Nodes adjacent to site are highlighted in yellow

Node Label	Notable Features	NFC	BLOCKAGE SCENARIOS-EXG
		Q100CC1-EXG-NFC (1% AEP+ 35%CC) (mAOD)	BL1-99.9 Q100CC1-EXG-BL1-99.9 (1% AEP + 35% CC) (mAOD)
CROT01_01777	Crow Trees Farm Brook Inflow Location	80.24	80.24
CROT01_01776		80.21	80.21
01776BU	Bridge downstream of the Withins Reservoir spillway	80.21	80.21
01776BD		80.21	80.21
01776SU		80.21	80.21
01776SD		80.21	80.21
CROT01_1776C		80.21	80.21
CROT01_01766		80.22	80.22
CROT01_1766C		79.25	79.25
CROT01_01730		78.74	78.74
CROT01_INT8		78.41	78.41
CROT01_INT9		78.26	78.26
CROT01_INT10		78.16	78.16
CROT01_01629		78.07	78.07
CROT01_INT7		77.88	77.88
CROT01_01527		77.86	77.86
CROT01_INT11		77.85	77.85
CROT01_INT12		77.84	77.84
CROT01_01518		77.82	77.82
01518_IN	Culvert under a path upstream Crow Trees Farm	77.82	77.82
01518CU		77.52	77.52
01507CD		77.50	77.50
01507_OUT		77.03	77.03
CROT01_01507		77.03	77.03
CROT01_01505		77.00	77.00
CROT01_INT30		76.96	76.96
CROT01_INT31		76.94	76.94
CROT01_01452		76.93	76.93
CROT01_INT13		76.91	76.91
CROT01_INT14		76.92	76.92
CROT01_INT21		76.85	76.85
CROT01_01383		76.94	76.94
01383IN	Culvert under a path near Crow Trees Farm	76.94	76.94
01383CU		76.25	76.25
01376CD		76.21	76.21
01376OUT		76.21	76.21
CROT01_01376		76.21	76.21
CROT01_INT15		76.18	76.18
CROT01_INT16		76.18	76.18
CROT01_01327		76.18	76.18
CROT01_INT17		76.18	76.18
CROT01_INT18		76.18	76.18
CROT01_INT19		76.18	76.18
CROT01_INT32		76.18	76.18
CROT01_INT20		76.18	76.18
CROT01_INT33		76.18	76.18
CROT01_01207		76.18	76.18
CROT01_INT26		76.18	76.18
CROT01_INT27		76.18	76.18
CROT01_01124		76.18	76.18
01124IN	Culvert under the Manchester Bury and Bolton Canal	76.18	76.18
01124CU		74.93	74.93
01092CD		73.49	73.48
01092OUT		73.49	73.48
CROT01_01092		73.49	73.48
CROT01_01074		73.51	73.51
01074BU	Bridge located between Manchester Bury and Bolton Canal and the Metrolink Line	73.51	73.51
01074BD		73.50	73.49
01074SU		73.51	73.51
01074SD		73.50	73.49
CROT01_1074C		73.50	73.49

Hydraulic Model Results - Island Site, Radcliffe



1D FMP Model Results - Maximum Water Levels (mAOD)

Blockage Scenarios

Date: 29-10-2020

Model Type: FMP-TUFLOW

FMP Build: 4.6

TUFLOW Build: 2020-01-AB

Blockage Scenarios

Model Ref	Details	Event	DTM
Q100CC1 BL1-99.9	100% Blockage of A6053 Cross Lane Culvert	Q100CC1	Existing Site Layout (EXG)

Notes:

1D/2D model build 005
BL = Blockage Scenarios
Nodes adjacent to site are highlighted in yellow

Node Label	Notable Features	NFC	BLOCKAGE SCENARIOS-EXG
		Q100CC1-EXG-NFC (1% AEP+ 35%CC) (mAOD)	BL1-99.9
			Q100CC1-EXG-BL1-99.9 (1% AEP + 35% CC) (mAOD)
CROT01_01071		73.49	73.49
CROT01_INT34		73.49	73.49
CROT01_INT35		73.49	73.49
CROT01_01027		73.49	73.49
CROT01_INT36		73.49	73.49
CROT01_INT37		73.49	73.49
CROT01_INT4		73.49	73.49
CROT01_INT5		73.49	73.49
CROT01_INT6		73.49	73.49
CROT01_00926		73.49	73.49
00926IN		73.49	73.49
00926CU		72.95	72.95
00926CUIn1		72.73	72.74
00926CUIn2		72.50	72.50
00926CUIn3		72.23	72.23
00926CUIn4		71.93	71.93
00850CD		71.58	71.58
00850OUT		71.58	71.58
CROT01_00850		71.58	71.58
CROT01_00827		71.57	71.57
00827BU		71.57	71.57
00827BD		71.35	71.35
00827SU		71.57	71.57
00827SD		71.35	71.35
CROT01_0827C		71.35	71.35
CROT01_00804		71.27	71.27
CROT01_0804C		71.21	71.21
CROT01_00800		71.16	71.16
00800IN		71.16	71.16
00800CU		70.62	70.62
00800CUIn1		70.48	70.48
00800CUIn2		70.34	70.34
00800CUIn3		70.24	70.24
00762CD		70.15	70.15
00762OUT		70.15	70.15
CROT01_00762		70.15	70.15
CROT01_INT25		70.02	70.02
CROT01_00700		69.95	69.95
00700IN		69.95	69.95
00700CU		69.90	69.90
00690CD		69.88	69.88
00690OUT		69.80	69.80
CROT01_00690		69.80	69.80
CROT01_INT22		69.67	69.67
CROT01_INT23		69.59	69.59
CROT01_INT24		69.51	69.51
CROT01_00594		69.48	69.48
CROT01_00592		69.51	69.51
00592BU		69.51	69.51
00592BD		69.45	69.45
00592SU		69.51	69.51
00592SD		69.45	69.45
CROT01_0592C		69.45	69.45
CROT01_00583		69.29	69.29
CROT01_00551		69.23	69.23
CROT01_00537		69.16	69.16
00537BU		69.16	69.16
00537BD		69.16	69.16
00537SU		69.16	69.16
00537SD		69.16	69.16
CROT01_0537C		69.16	69.16

Crow Trees Farm Brook

Hydraulic Model Results - Island Site, Radcliffe



1D FMP Model Results - Maximum Water Levels (mAOD)

Blockage Scenarios

Date: 29-10-2020

Model Type: FMP-TUFLOW

FMP Build: 4.6

TUFLOW Build: 2020-01-AB

Blockage Scenarios

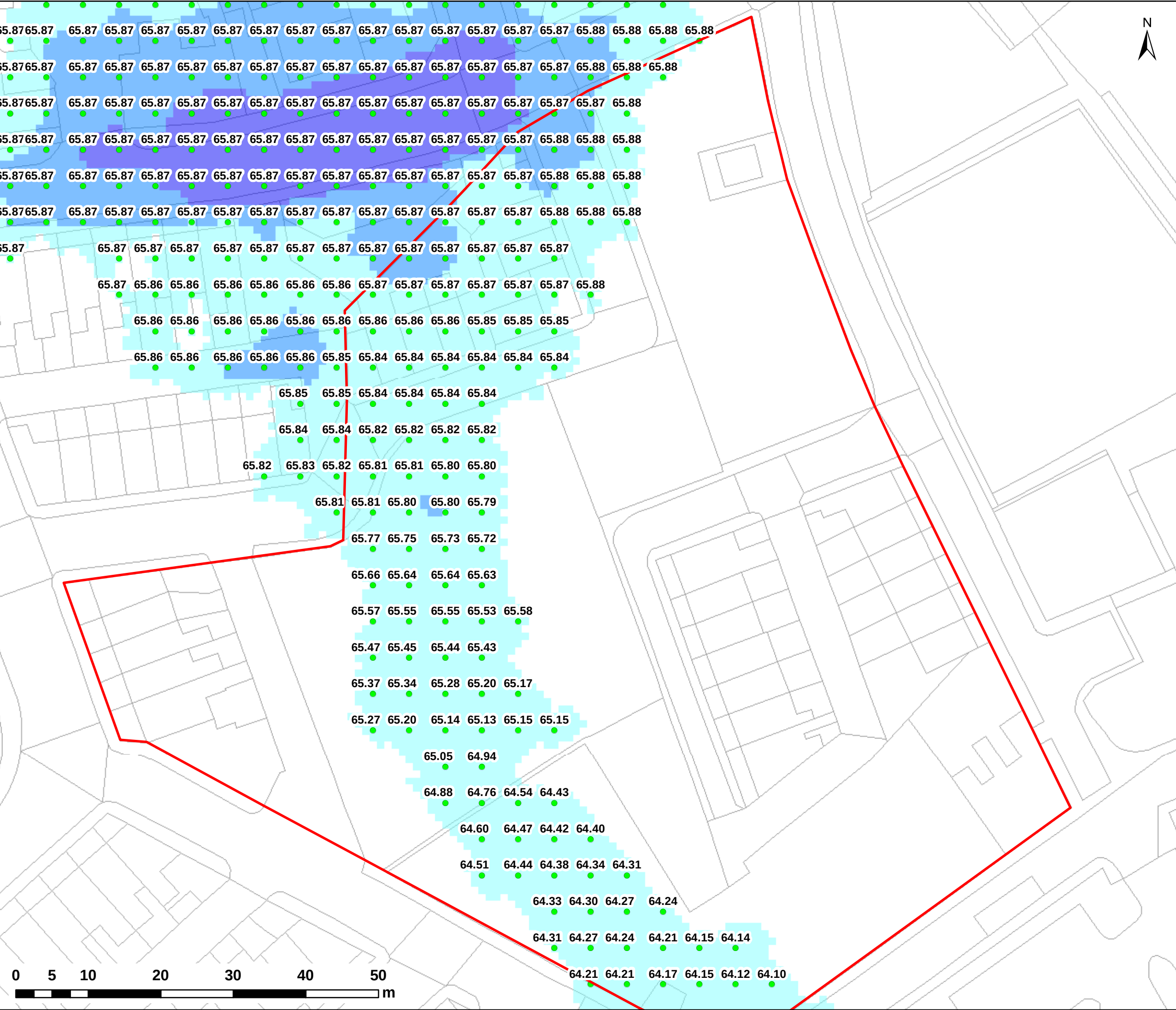
Model Ref	Details	Event	DTM
Q100CC1 BL1-99.9	100% Blockage of A6053 Cross Lane Culvert	Q100CC1	Existing Site Layout (EXG)

Notes:

1D/2D model build 005
BL = Blockage Scenarios
Nodes adjacent to site are highlighted in yellow

Node Label	Notable Features	NFC	BLOCKAGE SCENARIOS-EXG
			BL1-99.9
		Q100CC1-EXG-NFC (1% AEP+ 35%CC) (mAOD)	Q100CC1-EXG-BL1-99.9 (1% AEP + 35% CC) (mAOD)
CROT01_00526		69.09	69.09
CROT01_00504		68.90	68.90
00504BLU	Metal access bridge	68.90	68.90
00504BLD		68.86	68.86
CROT01_0504C		68.86	68.86
CROT01_00476		68.81	68.81
CROT01_0476C		68.13	68.13
CROT01_00474		68.20	68.20
00474IN	Culvert from Station Works to Hoyles Court	68.20	68.20
00474CU		67.91	67.91
00474CUIn1		67.26	67.26
00474CUIn2		66.68	66.72
00367CD		66.35	66.47
00367OUT		66.35	66.47
CROT01_00367		66.35	66.47
CROT01_00365		66.35	66.48
00365BU	Bridge near Hoyles Court and Gingham Court	66.35	66.48
00363BD		66.35	66.48
00365SU		66.35	66.48
00363SD		66.35	66.48
CROT01_00363		66.35	66.48
CROT01_INT1		66.29	66.44
CROT01_INT2		66.28	66.43
CROT01_INT3		66.21	66.32
CROT01_00274		66.30	66.45
CROT01_00270		66.30	66.45
00270BL	A6053 Cross Lane Culvert (BL1)	66.30	66.45
00270IN		66.30	64.72
00270CU		64.41	64.18
00270CUIn1		63.69	63.47
00270CUIn2		62.98	62.77
00270CUIn3		62.25	62.04
00270CUIn4		61.58	61.38
00270CUIn5		61.21	61.21
00270CUIn6		61.22	61.20
00020CD		61.23	61.20
00020OR		61.20	61.20
CROT01_DS	Crow Trees Farm Brook Outflow Location	61.20	61.20

Appendix G Maximum Water Level Mapping



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE
2) MAXIMUM WATER LEVELS HAVE BEEN RESAMPLED AT A 5m HORIZONTAL RESOLUTION

LEGEND

Site Boundary

Water Level Points (m AOD)

Maximum Flood Depth (m)

0 - 0.3

0.3 - 0.6

0.6 - 1.2

1.2 - 2.4

> 2.4

CLIENT:

www.waterco.co.uk

SCHEME:

**ISLAND SITE,
RADCLIFFE**

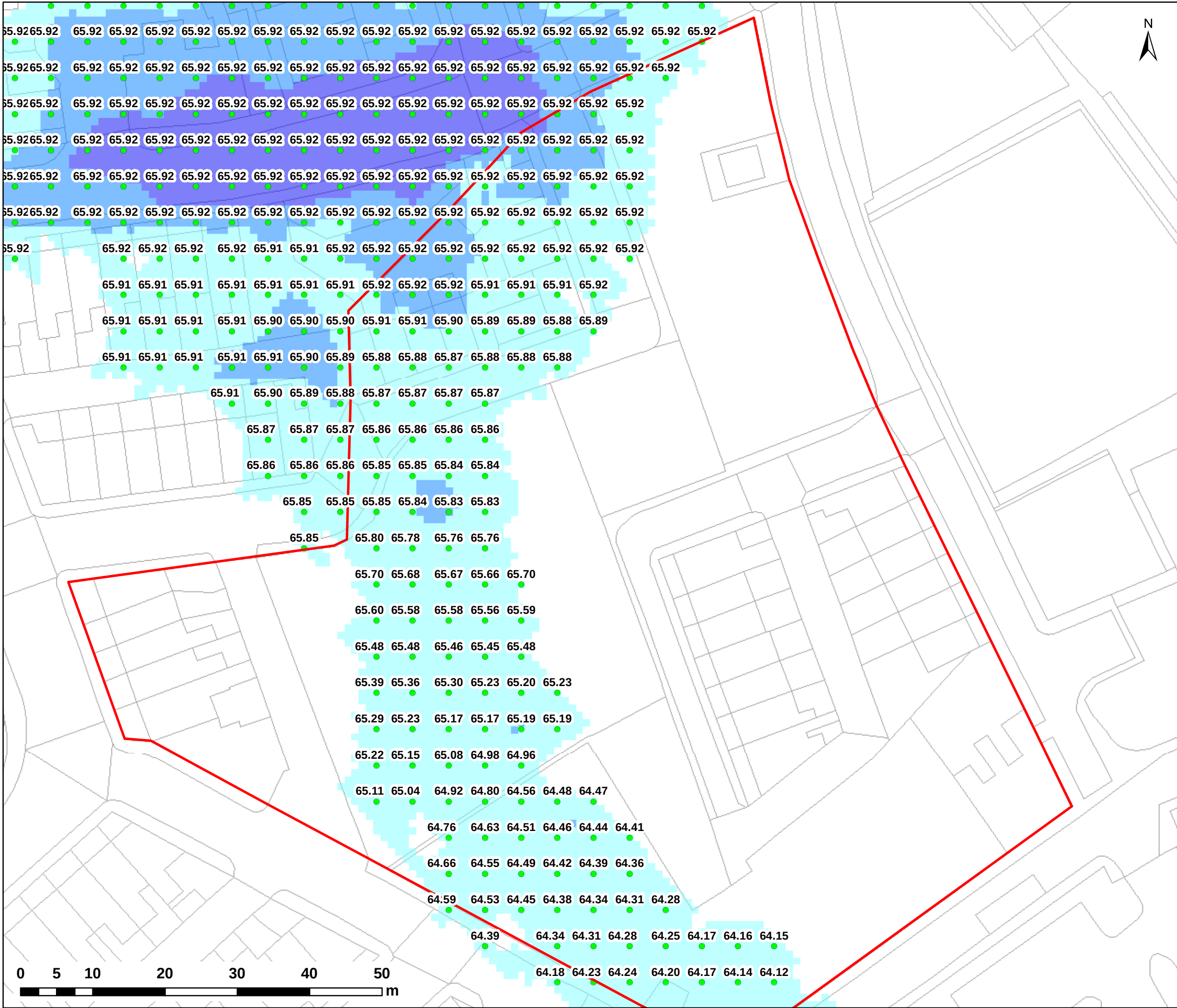
PLOT TITLE:

MAXIMUM WATER LEVELS
5% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS:			DATE:
FINAL			03/11/2020

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
VJ	SB	DH	1:500
			(UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
13478-CRT_Q20_EXG_NFC_WL	-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE
2) MAXIMUM WATER LEVELS HAVE BEEN RESAMPLED AT A 5m HORIZONTAL RESOLUTION

LEGEND

Site Boundary

Water Level Points (m AOD)

Maximum Flood Depth (m)

0 - 0.3

0.3 - 0.6

0.6 - 1.2

1.2 - 2.4

> 2.4

CLIENT:

A TRINA TECH COMPANY

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SCHEME:

**ISLAND SITE,
RADCLIFFE**

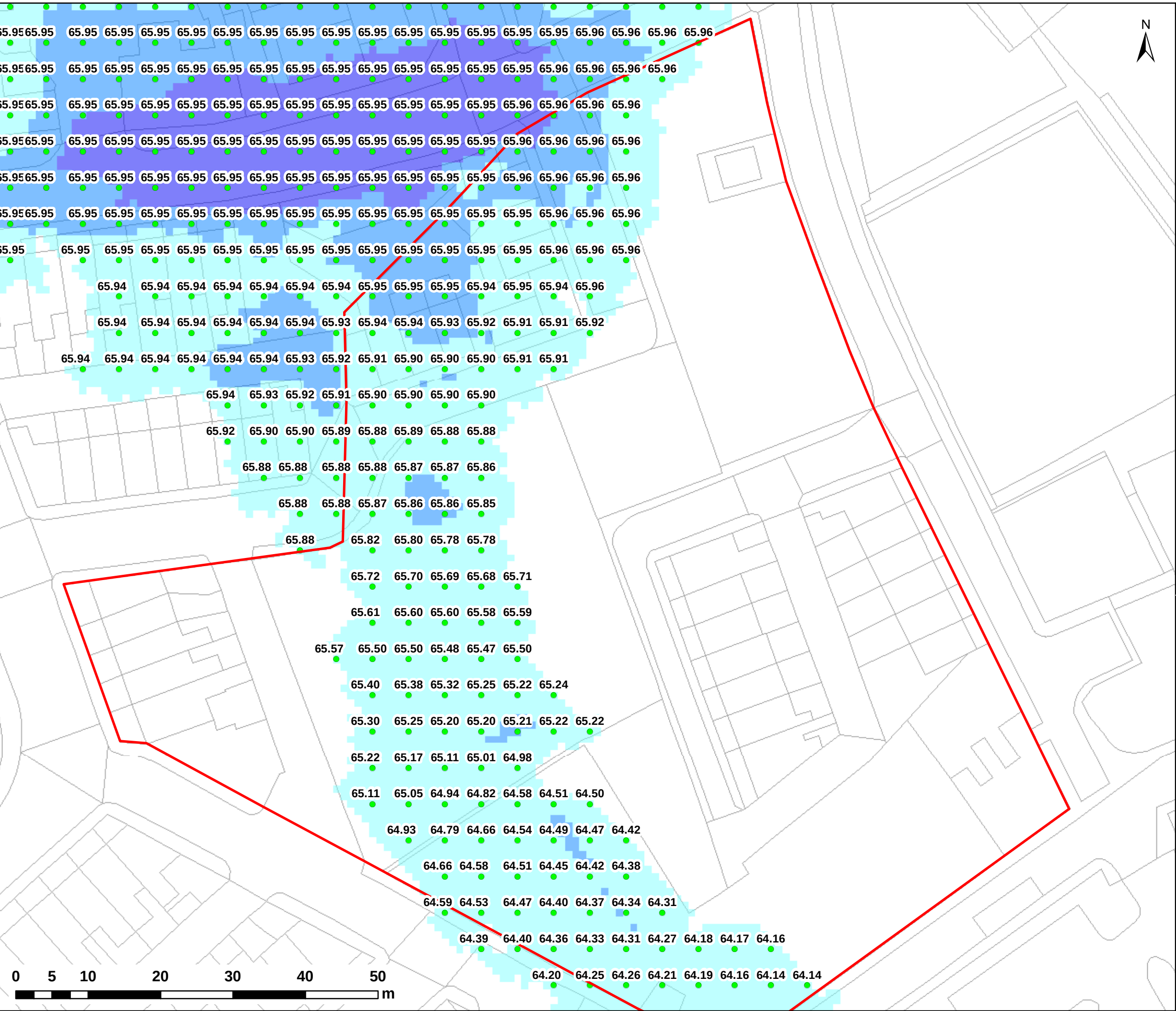
PLOT TITLE:

MAXIMUM WATER LEVELS
1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS:			DATE:
FINAL			03/11/2020

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
VJ	SB	DH	1:500
			(UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
13478-CRT_Q100_EXG_NFC_WL	-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE
2) MAXIMUM WATER LEVELS HAVE BEEN RESAMPLED AT A 5m HORIZONTAL RESOLUTION

LEGEND

Site Boundary

Water Level Points (m AOD)

Maximum Flood Depth (m)

0 - 0.3

0.3 - 0.6

0.6 - 1.2

1.2 - 2.4

> 2.4

CLIENT:

www.waterco.co.uk

SCHEME:

**ISLAND SITE,
RADCLIFFE**

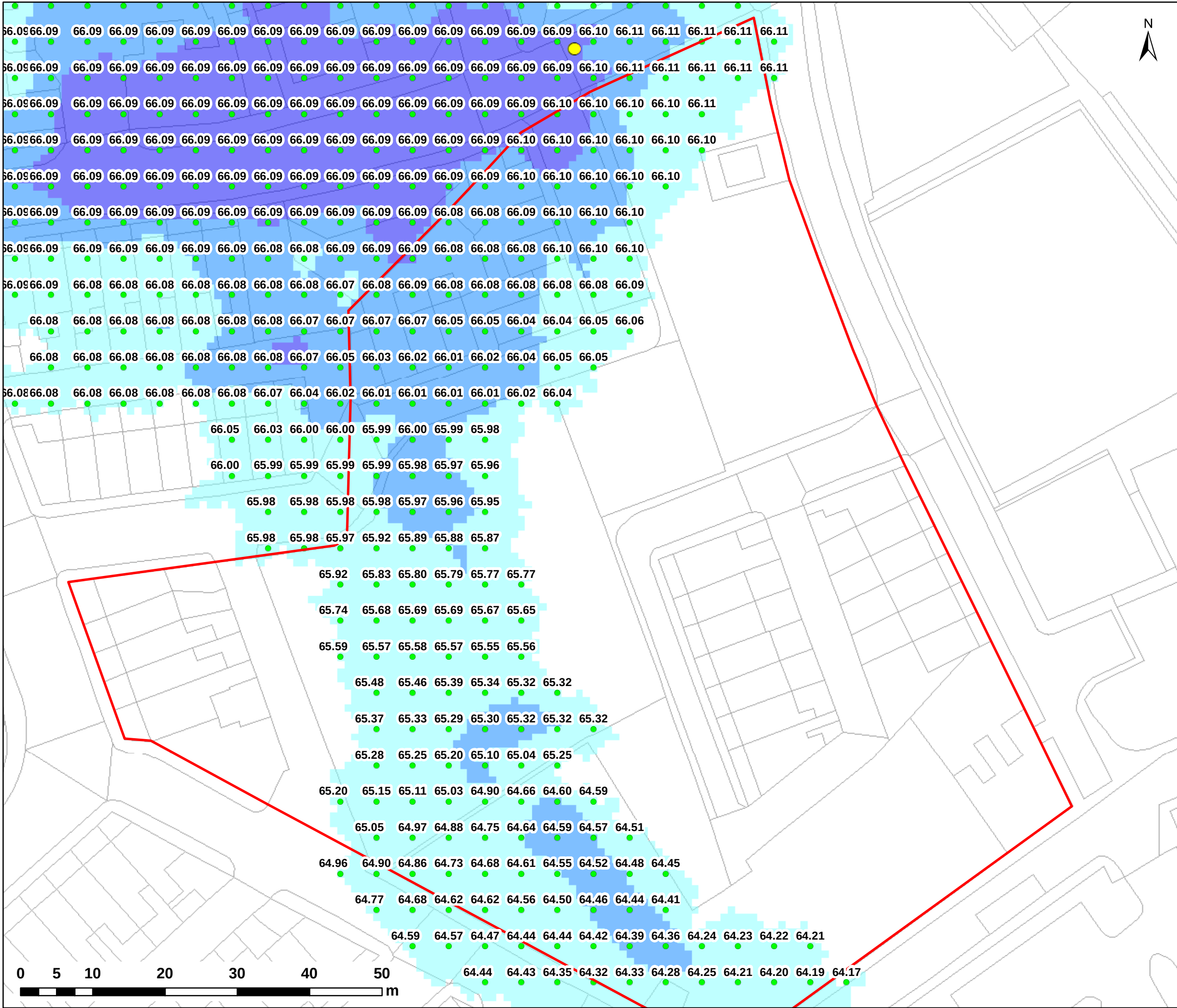
PLOT TITLE:

MAXIMUM WATER LEVELS
1% AEP + 35% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS:			DATE:
FINAL			03/11/2020

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
VJ	SB	DH	1:500
			(UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
13478-CRT_Q100CC1_EXG_NFC_WL	-



NOTES:
 1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE
 2) MAXIMUM WATER LEVELS HAVE BEEN RESAMPLED AT A 5m HORIZONTAL RESOLUTION

LEGEND

- Site Boundary
- Water Level Points (m AOD)
- A6053 Culvert Blockage Location

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:



www.waterco.co.uk

SCHEME:

**ISLAND SITE,
RADCLIFFE**

PLOT TITLE:

MAXIMUM WATER LEVELS
 1% AEP + 35% CC FLUVIAL EVENT
 EXISTING SITE LAYOUT (EXG)
 100% BLOCKAGE A6053 CULVERT

PLOT STATUS:

FINAL

DATE:

03/11/2020

DRAWN:

VJ

CHECKED:

SB

APPROVED:

DH

PLOT SCALE @ A3:

1:500

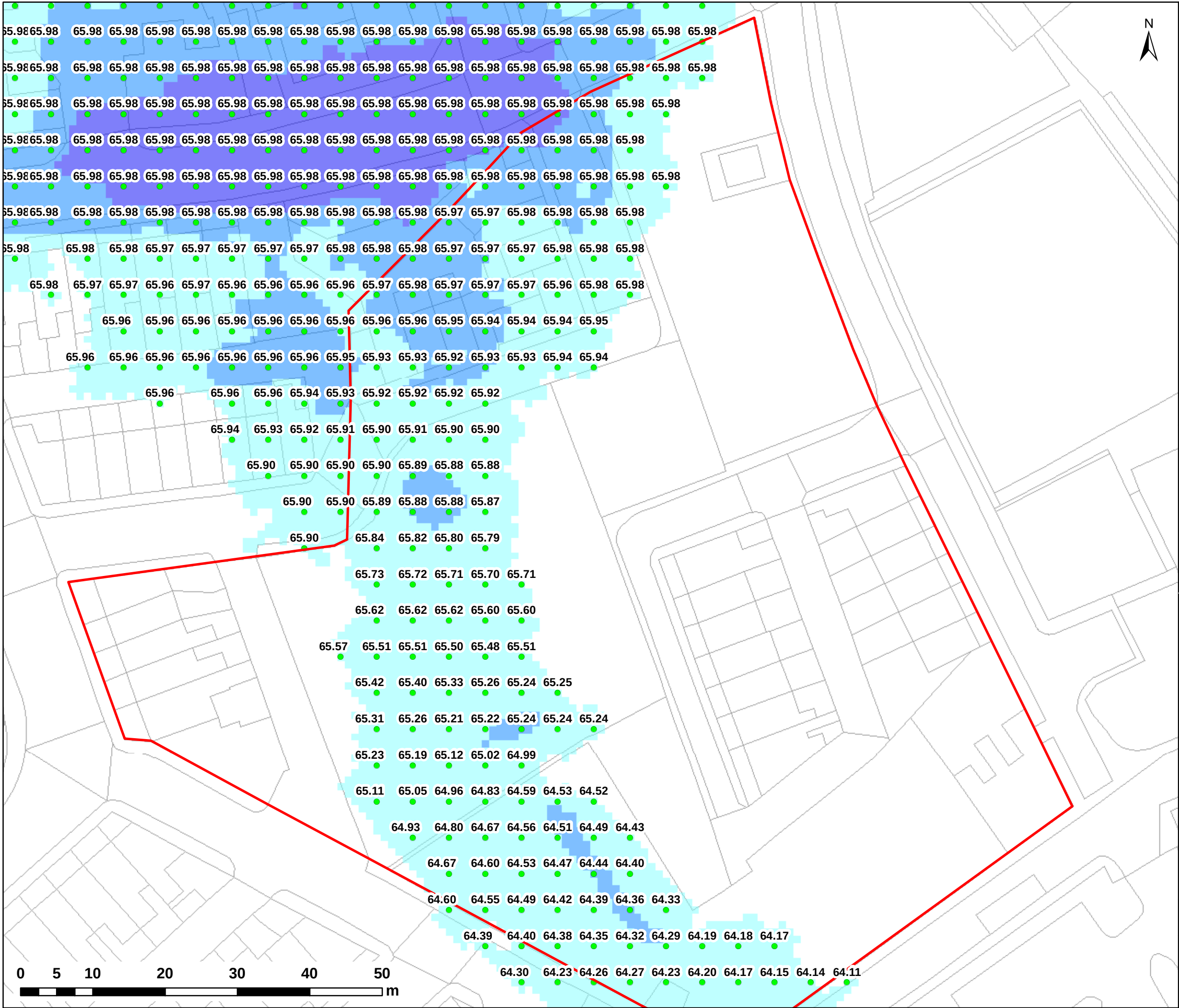
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PLOT NAME:

13478-CRT_Q100CC1_EXG_BL1-99.9_WL

REV:

-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE
2) MAXIMUM WATER LEVELS HAVE BEEN RESAMPLED AT A 5m HORIZONTAL RESOLUTION

LEGEND

Site Boundary

Water Level Points (m AOD)

Maximum Flood Depth (m)

0 - 0.3

0.3 - 0.6

0.6 - 1.2

1.2 - 2.4

> 2.4

CLIENT:

A TERN TECH COMPANY

www.waterco.co.uk

SCHEME:

**ISLAND SITE,
RADCLIFFE**

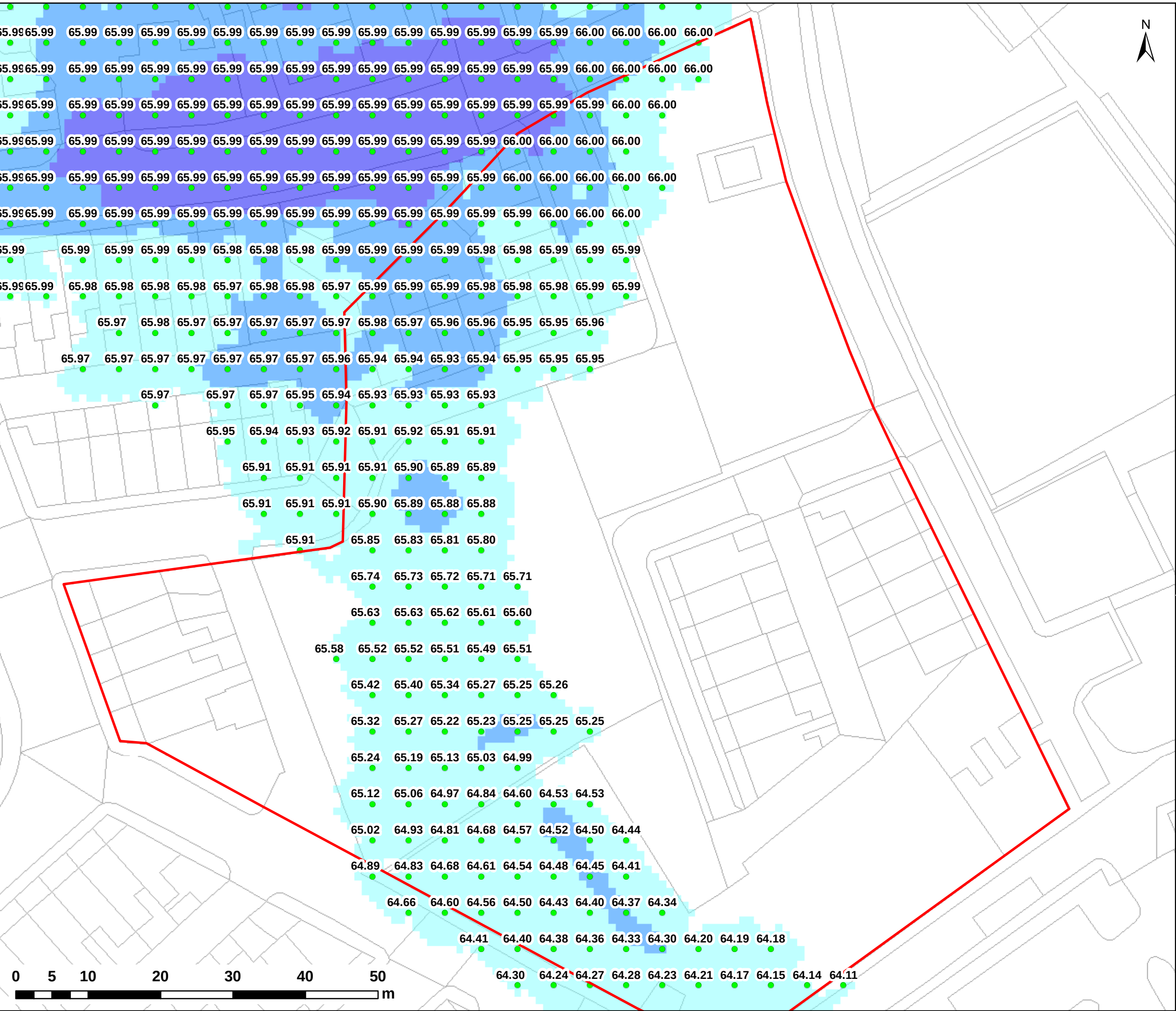
PLOT TITLE:

MAXIMUM WATER LEVELS
1% AEP + 70% CC FLUVIAL EVENT
EXISTING SITE LAYOUT (EXG)
NORMAL FLOW CONDITIONS

PLOT STATUS:			DATE:
FINAL			03/11/2020

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
VJ	SB	DH	1:500
			(UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
13478-CRT_Q100CC2_EXG_NFC_WL	-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES
ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE
2) MAXIMUM WATER LEVELS HAVE BEEN RESAMPLED
AT A 5m HORIZONTAL RESOLUTION

LEGEND

-  Site Boundary
 -  Water Level Points (m AOD)
- Maximum Flood Depth (m)**
-  0 - 0.3
 -  0.3 - 0.6
 -  0.6 - 1.2
 -  1.2 - 2.4
 -  > 2.4



CLIENT:			
			
		www.waterco.co.uk	
SCHEME:		ISLAND SITE, RADCLIFFE	
PLOT TITLE:		MAXIMUM WATER LEVELS 0.1% AEP FLUVIAL EVENT EXISTING SITE LAYOUT (EXG) NORMAL FLOW CONDITIONS	
PLOT STATUS:		FINAL	DATE: 03/11/2020
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
VJ	SB	DH	1:500 (UNLESS STATED OTHERWISE)
PLOT NAME:			REV:
13478-CRT_Q1000_EXG_NFC_WL			-