Report No: 16/008.01
Revision: 01
Dated: 5th July 2016

Kirklees College Dewsbury Learning Village Dewsbury

Flood Risk Assessment

Client:

Kirklees College
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Manchester Road
Huddersfield
West Yorkshire
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REVISION HISTORY

Revision	Date	Details
00	9th May 2016	First issue
01 Draft	4th July 2016	Revised site layout
01 Final	5th July 2016	Amendments to Section 7 and Appendices; updated site layout plan.

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APPENDICES

LIST OF FIGURES

ABBREVIATIONS

AEP: Annual exceedance probability

AOD: Above Ordnance Datum

CCA: Climate change allowance

MBC: Metropolitan Borough Council

SFRA: Strategic Flood Risk Assessment

1.0 INTRODUCTION

1.1. JOC Consultants Ltd is instructed by KPP Architects on behalf of Kirklees College, (the Client), to prepare this flood risk assessment report for the development of the proposed Dewsbury Learning Village. The development is the subject of a planning application to Kirklees Metropolitan Borough Council.

1.2. Since the first edition of this report was issued in May 2016, there have been further discussions with the Environment Agency and the proposed layout of the development has been amended. This revision of the FRA reflects the recent changes to the design.

1.3. References in this report to “the site” are references to the site to which the planning application applies. Specific references to sources of information used in the report are shown in square brackets and are listed in section 9. Figures 1 to 7 are presented immediately following page 19 and the appendices follow thereafter.

1.4. In the preparation of this FRA, JOC Consultants Ltd has relied on information provided by statutory authorities and by the Client’s architect and accepts no liability for its accuracy or adequacy or for the consequences of any changes to or re-assessment of this data in the future.

1.5. This report is prepared specifically for the Client for the purpose of the aforementioned planning application and the report may not be used for any purpose other than for the purpose for which it was commissioned, and it may not be assigned to any third party without our written permission.

2.0 OBJECTIVES

2.1. The objectives of this flood risk assessment are to:

1. establish whether the site is likely to be affected by current or future flooding from any source;
2. establish whether the proposed development will increase flood risk elsewhere; and
3. recommend, as appropriate, measures for managing flood risk.

3.0 PLANNING POLICY ON FLOOD RISK

3.1 National Policy

3.1.1. National Planning Policy in relation to flood risk is set out in the National Planning Policy Framework (NPPF) [1] and the Technical Guidance thereto [2].

3.2 Local Policy

3.2.1. Local policy is defined in the saved policies of the Kirklees Unitary Development Plan [3] revised in September 2007.

3.2.2. Local policy on development and flood risk is informed by the Calder Valley Strategic Flood Risk Assessment (SFRA), [4]. Reference to the SFRA is made in subsequent sections of this report.

3.3 Planning Practice Guidance

3.3.1. In addition to national and local policy, the Planning Practice Guidance for Flood Risk and Coastal Change [5] provides advice to planning authorities to assist them when considering planning applications in areas at risk of flooding. This report has been prepared with reference to that guidance.

4.0 LOCATION AND DESCRIPTION OF THE SITE

4.1. The site, which was previously developed as a supermarket with a car park is situated in Dewsbury, between Halifax Road and Bradford Road, as shown outlined in red on the map extract in Figure 1. The NGR coordinates at the approximate centre of the site are: 424360E, 422138N.

4.2. The total site area amounts to approximately 0.99ha.

4.3. Batley Beck enters the site from the north in open channel close to the north-east corner and then flows in culvert through the eastern part of the site from north to south, leaving the site close to the south-east corner. The beck is designated as a Main River watercourse and is therefore regulated by the Environment Agency. The topographical survey shows the top of the wall at the entrance to the culvert to be 42.75m AOD. Upstream of the entrance to the culvert, the beck is contained within a stone wall, 1.2m high on the right bank, and by an existing building wall on the left bank, (see Appendix A). The beck reverts to open channel to the east of Bradford Road, as shown in Figure 1.

4.4. The topographical survey shows the site elevation to vary between 43.88m AOD and 42.51m AOD. Bradford Road and Halifax Road fall towards the south and the south-east, respectively. Commercial Road falls from Bradford Road to a low point of 43.06m AOD close to the Batley Beck crossing, and then rises to its junction with Halifax Road, at an elevation of 54.12m AOD.

4.5. The ground surface at the site is mostly impermeable comprising concrete and tar macadam areas and derelict floor surfaces of the former building. There are minor fringes of permeable ground comprising bushes and grass along the south-east boundary and adjacent to Bradford Road.

4.6. Satellite photographs show the site to have been occupied by a building with a large car park in 2002. By 2009 however, this use appears to have ceased and the site has remained derelict since then. The building was located in the western part of the site with the car park to the east.

4.7. The site currently discharges surface water to Batley Beck as shown in the historic drainage plan reproduced in Appendix B. It is understood that the drainage system has continued to function since the supermarket was demolished.

4.8. The site is situated in an Environment Agency Flood Warning Area, as shown on the Environment Agency website.

5.0 THE PROPOSED DEVELOPMENT

5.1. Kirklees College wishes to bring together the faculties of the college in Dewsbury onto a single site and, to this end, a single building is proposed with outside teaching areas, vehicle parking and scope for future expansion. The development will include permeable landscaped areas amounting to approximately 0.24ha.

5.2. The proposed site layout plan is provided in Appendix C and full details of the development are included with the planning application documents.

5.3. The development is classified as **More Vulnerable** in accordance with Table 2 of the NPPF Technical Guidance.

6.0 FLOOD RISK

6.1 Data collection and consultations

6.1.1. The data provided by the Environment Agency in response to our enquiries is reproduced in Appendix D and is discussed in the following sections.

6.1.2. A site meeting with the Environment Agency was held on 25th May 2016 to discuss the implications of the development on floodplain storage. The note of the meeting is provided in Appendix E, but as the proposed site layout was subsequently amended, the development will not affect floodplain storage.

6.1.3. Kirklees MBC, as Lead Local Flood Authority was also consulted and its response is reproduced in Appendix F.

6.2 Existing flood defences

6.2.1. The Environment Agency Asset Defence Map shows the site to be protected by high ground adjacent to the right bank of Batley Beck (asset number 48237) and by the culvert (asset number 27833). No details are provided to indicate the standard of protection provided by these assets.

6.3 History of Flooding

6.3.1. In its email dated 4th May 2016, the Environment Agency confirmed that it has no records of historic flooding at the site.

6.3.2. Kirklees MBC also confirmed, in its email dated 5th May 2016, that there are no recorded incidents of flooding at the site, but advised that its records only cover the past 15 years.

6.3.3. In view of the presence of Batley Beck on the site, it is highly likely that some flooding will have affected the site in the past.

6.4 Risk of tidal or fluvial flooding

6.4.1. The site is not in an area at risk of flooding from tidal sources.

6.4.2. The Environment Agency flood map shows the eastern half of the site to be in flood zone 3. This defines the area where the annual probability of flooding is 1% or greater. The western half is in flood zone 1. This is consistent with the SFRA Figure B 2-1 which confirms the eastern half of the site to be in flood zone 3a. No part of the site is in the functional floodplain, zone 3b.

6.4.3. Predicted flood levels from the 2015 Batley Beck model are included in the Environment Agency data in Appendix D. The model node immediately upstream of the culvert is EA123129BAT0917, as shown on the Node Point Map. (This node is described as EA123129**5**BAT0917 on the accompanying data sheet). The flood levels at this location are shown in Table 6.1 below. These are the results of the 'defended' case which simulates existing conditions.

6.4.4. The relationship between flood level and return period is shown in Figure 2. Normally, this would appear as a reasonably straight line in the logarithmic scale and so the result is somewhat surprising. This may be due to hydraulic instability at the entrance to the culvert, but it should be checked in the model by the Environment Agency.

Table 6.1: Modelled flood levels at node EA123129BAT0917 (defended case)

Return Period years	Flood level m AOD	Return Period years	Flood level m AOD
2	40.48	50	42.40
5	40.73	75	43.00
10	40.92	100	43.28
20	41.25	200	43.52
30	41.96	1000	43.76
		100 CCA	43.53

6.4.5. The SFRA Flood Depths Map at Figure C 2-1 shows no depth of flooding from a 1% AEP event with a 1.33% standard of flood defence. The standard of defence is the level at which the onset of flooding occurs which, at the site, is the top of the culvert wall which is 42.75m AOD. The return period at which this flood level occurs is approximately 63 years, as shown in Figure 2. It is possible that a lower overtopping threshold may exist upstream of the site, but any overland flow would have to cross Commercial Road, which is higher than 43.0m AOD. The annual probability of fluvial flooding at the site is therefore approximately 1.6%.

6.4.6. The Flood Map shows the present day 1% AEP flood outline which, according to the model is 43.32m AOD (in the undefended case), assuming no significant gradient across the water surface which in this case would be unlikely. The Flood Map shows the flood outline to extend westwards to the footprint of the former building on the site. This footprint also appears on the topographical survey plan where the ground level is around 43.8m AOD. There is therefore a discrepancy of approximately 0.5m between the position of the flood outline and the modelled flood level. The flood outline however will be less accurate than the modelled flood level as it is plotted to a broad scale, so the modelled level should provide the more reliable estimate.

6.4.7. The minimum site ground level is 42.51m AOD, next to the Batley Beck culvert wall. A depth of 0.77m is therefore predicted at this location resulting from a 1% AEP flood event. This occurs in a relatively small area and the depth diminishes as the site rises towards the south and west.

6.4.8. In the 0.1% AEP event, a flood level of 43.76m AOD is predicted. This would affect the site up to the footprint of the former building. At the minimum ground level, a depth of 1.25m would occur in this event.

Loss of floodplain storage

6.4.9. As it is proposed to locate the college building within the flood zone 1 area, with only vehicle parking in flood zones 2 and 3, there will be no loss of floodplain storage.

6.5 Risk of surface water flooding

Risk to the site

6.5.1. The Environment Agency surface water flood map shows the entire site to be within the area that would be affected by the 1 in 1000 rainfall event. The annual probability of this event is 0.1% or less. The risk increases in the eastern part of the site which is affected by the 1% AEP and the 3.33% AEP events.

Effect of the development on flood risk

6.5.2. The development will reduce the impermeable area by approximately 25% by introducing additional soft landscaped areas. This will reduce the surface water run-off volume compared with existing conditions by approximately 18%, as shown in Figures 3 and 4 for the 3.3% and 1% AEP events respectively and also in Tables G1 to G4 in Appendix G. The development will not therefore increase surface water flood risk elsewhere.

6.6 Risk of sewer flooding

6.6.1. There is no evidence of sewer flooding in the area and the absence of records of flooding at the site suggests that the risk of this type of flooding is low. At times of fluvial flooding however, floodwaters may emerge from the local sewerage system resulting in overland flow.

6.7 Risk of groundwater flooding

6.7.1. Groundwater flooding of land occurs when the water table rises above the ground surface or enters basements and is typically associated with permeable rock such as chalk. This type of flooding is unlikely to affect the site. Any rise in the water table would be intercepted by the Batley Beck which would have a draw-down effect. This risk is therefore assessed to be negligible.

6.8 Risk of flooding from reservoirs and canals

6.8.1. The Environment Agency flood map for reservoirs shows the site to be in an area that would be affected due to the uncontrolled release of water from Stancliffe Reservoir which is approximately 2.13km to the NW of the site. The reservoir is owned and operated by Yorkshire Water Services. The depth of potential flooding is indicated to be between 0.3m and 2m in the vicinity of Batley Beck but most of the site is unaffected. The likelihood of this type of flooding is stated to be ‘extremely unlikely’ as reservoir dams are subject to regular statutory inspection by qualified reservoir engineers.

6.8.2. The site is not at risk from the uncontrolled release of water from any canal.

6.9 Effects of climate change

6.9.1. The impact of climate change must be assessed over the lifetime of the development. The Planning Practice Guidance at paragraph 026 states that the lifetime of non-residential development depends on its characteristics and planners *‘should use their experience within their locality’* to assess a realistic lifetime. For an educational establishment such as that proposed, a design life of 30 years would be reasonable.

6.9.2. For the purposes of this assessment, climate change effects are therefore considered up to the year 2046. New guidance on the application of climate change allowances was issued in February 2016 and updated on 12th April 2016 [6]. The guidance provides the anticipated changes to peak river flow and rainfall intensity (as well as sea level rise and wind speed which are not relevant to this FRA) for different scenarios of carbon dioxide emissions over future epochs up to 2115. Climate change allowances are provided for each river basin district in England and as the site is situated within the Humber river basin district, the following allowances apply to the period 2040 to 2069:

Peak river flow allowances

6.9.3. As the development is classified as More Vulnerable and is partly in flood zone 3a, the Higher Central and Upper End allowances should be used to assess the range of climate change effects, in accordance with the new guidance. The allowances applicable to the Humber river basin district in the period 2040 to 2069 as shown in Table 6.2 below.

Table 6.2: Total percentage change in peak river flow in the period 2040 - 2069		
River Basin District	Allowance Category	Climate change effect
HUMBER	Upper end	30%
	Higher central	20%

6.9.4. At 2046, climate change is anticipated to increase peak river flow rates in the Humber river basin district by 20% to 30%. The modelled 1% AEP flood level of 43.53m AOD including climate change is likely to have been based on a 20% increase in flow rate as the modelling preceded the new climate change guidance. The modelled flood data shows the flow rate to increase from 26.043m^3/s in the present day 100 year event to 26.173m^3/s with climate change effects (denoted incorrectly in the Environment Agency data as the 101 return period event). This is an increase of only 0.5% but is most probably due to loss of flow into floodplain storage upstream. Assuming the input hydrograph to the model was increased by 20% to simulate climate change effects then, by extrapolation, a 30% increase would result in a flow rate of 26.238m^3/s at node EA123129BAT0917.

6.9.5. A plot of the flow rate -v- flood level is shown in Figure 5, from which it is evident, (assuming the modelled data to be correct), that a 30% increase in the input flow hydrograph, resulting in a flow rate of 28.238m^3/s, would have no effect on flood level at node EA123129BAT0917. The model data appears anomalous however and it is recommended that the Environment Agency reviews its data.

Peak rainfall intensity

6.9.6. Current climate change guidance requires the Central and Upper End allowances to be used when assessing the effects of increases to peak rainfall intensities. The allowances apply across the whole of England and are shown in Table 6.3 for the period 2040 to 2069.

Table 6.3: Total percentage change in peak rainfall intensity in the period 2040 - 2069	
Allowance Category	Climate change effect
Upper end	20%
Central	10%

6.9.7. The effects of climate change on surface water run-off are shown in Figures 6 and 7 for the 3.3% and 1% AEP events respectively, based on the Central and Upper End allowances.

6.10 Appropriate land use

6.10.1. As the application site is partly within flood zone 3a, the proposed development is an appropriate land use in accordance with Table 3 of the NPPF Technical Guidance subject to satisfying the requirements of the Exception Test. The development must also pass the Sequential Test.

6.10.2. The Sequential Test and the Exception Test are the subject of our report number 16/008.02, which shows that there are no suitable alternative sites in a lower risk flood zone. The report also shows that the development satisfies the two criteria of the Exception Test.

7.0 FLOOD RISK MANAGEMENT

7.1 Fluvial flood risk

7.1.1. A minimum finished floor level of 43.88m AOD is recommended for the development. This will provide freeboard of 600mm above the 1% AEP flood level and 350mm above the 1% AEP flood level including climate change. This floor level will also be 170mm above the modelled 0.1% AEP flood level.

7.1.2. Safe access and egress to and from the site will be possible via Commercial Road and Halifax Road. This route is above 44.00m AOD and the ground level at the site entrance in Commercial Road is approximately 44.0m AOD so access and egress would not be impeded during a flood.

7.1.3. The site is situated in a flood warning area and it is recommended that Kirklees College registers with the Environment Agency flood warning service in order to receive automated flood warnings.

7.1.4. A flood response action plan should be prepared with a statement of measures to be taken in the event of an anticipated flood and details of the safe evacuation route. This should be discussed with the emergency planning officer of Kirklees MBC.

7.2 Surface water flood risk

7.2.1. It is unlikely that ground conditions will be suitable for infiltration drainage, due to a potentially high water table and the proximity of buildings. It is therefore recommended that surface water from the development is collected and discharged to Batley Beck via a sustainable drainage system, in accordance with Kirklees MBC policy and national guidance.

7.2.2. The non-statutory technical standards for sustainable drainage systems recommend:

- *Peak run off rate of the 1 in 1 year and 1 in 100 years rainfall events from developments on previously developed sites should be as close as reasonably practicable to the greenfield run off rates for the same events and must not exceed the run off rates from the previous development for the same events*;

- *Run-off volume from developments on previously developed sites generated by the 1 in 100 years 6 hour event should be as close as reasonably practicable to the greenfield run-off volume for the same event and must not exceed the volume from the previous development.*

7.2.3. Surface water from the site however was discharged to Batley Beck, as stated in 4.7 above. The brownfield peak flow rate from the site is estimated by the Modified Rational Method of the Wallingford Procedure to be 91 l/s (see Appendix H). It is therefore proposed to discharge surface water from the development at a rate not exceeding 63 l/s, which represents a 30% reduction of the existing estimated peak flow rate. The preliminary estimate of the required attenuation storage for the 3.3% and 1% AEP events, based on the average of the Higher Central and Upper End climate change allowances would be $34.0m^3$ and $101.5m^3$ respectively, (see Appendix G: Tables G5 to G8 and Figures 6 and 7).

7.2.4. It is recommended that a detailed drainage design is prepared and submitted to the Council for approval prior to construction. This recommendation can be secured by an appropriately worded planning condition.

7.2.5. It is also recommended that outfalls from the site are fitted with non-return valves in order to prevent ingress from Batley Beck. When water levels in the beck are high the site drainage system may become 'flood-locked' and the effect of this should be considered in the detailed design.

7.2.6. In the event that any surface water flooding occurs at the site, the recommendations in section 7.1 above would be sufficient to protect against this risk.

7.3 Residual flood risk

7.3.1. Residual flood risk is that which remains after the flood risk management measures have been implemented. The freeboard recommended for the finished floor level will help to mitigate the risks associated with inaccuracies in flood prediction and uncertainties in future climate change effects.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

8.1.1. The use of the site as a non-residential educational establishment places the site in the 'More Vulnerable' category, in accordance with Table 2 of the NPPF Technical Guidance.

8.1.2. The site is at risk of fluvial flooding from Batley Beck but is protected by a wall at the entrance to the culvert in which the beck flows across the site, which provides a standard of defence of approximately 1 in 63 years.

8.1.3. The Environment Agency Flood Map shows approximately the eastern half of the site to be in flood zone 3, assuming no flood defences and SFRA Flood Zone Map confirms the site to be in flood zone 3a. No part of the site is in the functional floodplain.

8.1.4. The 2015 Batley Beck model predicts a 1% AEP flood level of 43.28m AOD, taking into account existing conditions. The minimum of 42.51m AOD occurs adjacent to Batley Beck culvert and in a 1% AEP event, a depth of flooding of 0.77m at this location is to be expected. The 0.1% AEP flood level is predicted to be 43.76m AOD, resulting in a depth of 1.25m at the minimum ground level. This would affect a relatively small area and the depth diminishes as the site rises towards the south and west.

8.1.5. The development will not result in any floodplain storage as the proposed college building will be situated in the flood zone 1 area of the site.

8.1.6. The risk of surface water flooding increases from ‘Low’ in the western part of the site, where the risk is between 0.1% and 1%, to ‘Medium’ in the eastern part where the risk is between 1% and 3.3%.

8.1.7. The development will reduce surface water run-off volume by approximately 18% compared with existing conditions, owing to a reduction in the impermeable area of 25%.

8.1.8. The risk of sewer flooding is generally low. At times of fluvial flooding however, floodwaters may emerge from the local sewerage system resulting in overland flow.

8.1.9. The risk of ground water flooding is negligible.

8.1.10. The site is potentially at risk of flooding resulting from an uncontrolled release of water from Stancliffe reservoir. This type of flooding is extremely unlikely as reservoir dams are subject to regular statutory inspection by qualified reservoir engineers.

8.1.11. The site is not at risk from an uncontrolled release of water from any canal.

8.1.12. The effects of climate change over the next 30 years are expected to increase peak river flow rates in the Humber river basin district by between 20% and 30%, depending on carbon dioxide emissions over that period. As flood levels increase however, more of the flow enters storage in the floodplain upstream of the site and this greatly reduces the effect of climate change on flood levels within the site itself.

8.1.13. As the development is partly situated in flood zone 3a and is classified as More Vulnerable, the Sequential Test and, if necessary, the Exception Test must be applied in accordance with the NPPF. These matters have been addressed in our report number 16/008.02 which shows that there are no suitable alternative sites in a lower risk flood zone and that the development satisfies the two criteria of the Exception Test.

8.1.14. The flood risk management recommendations in section 7 above will reduce flood risk from all sources to an acceptable level in accordance with current guidance.

8.2 Recommendations

8.2.1. It is recommended that the flood risk management measures stated in section 7 of this report are implemented in the design and operation of the development. These measures can be secured by appropriately worded planning conditions.

9.0 REFERENCES

1. National Planning Policy Framework. Department for Communities and Local Government. March 2012.

2. Technical Guidance to the National Planning Policy Framework. Department for Communities and Local Government. March 2012.

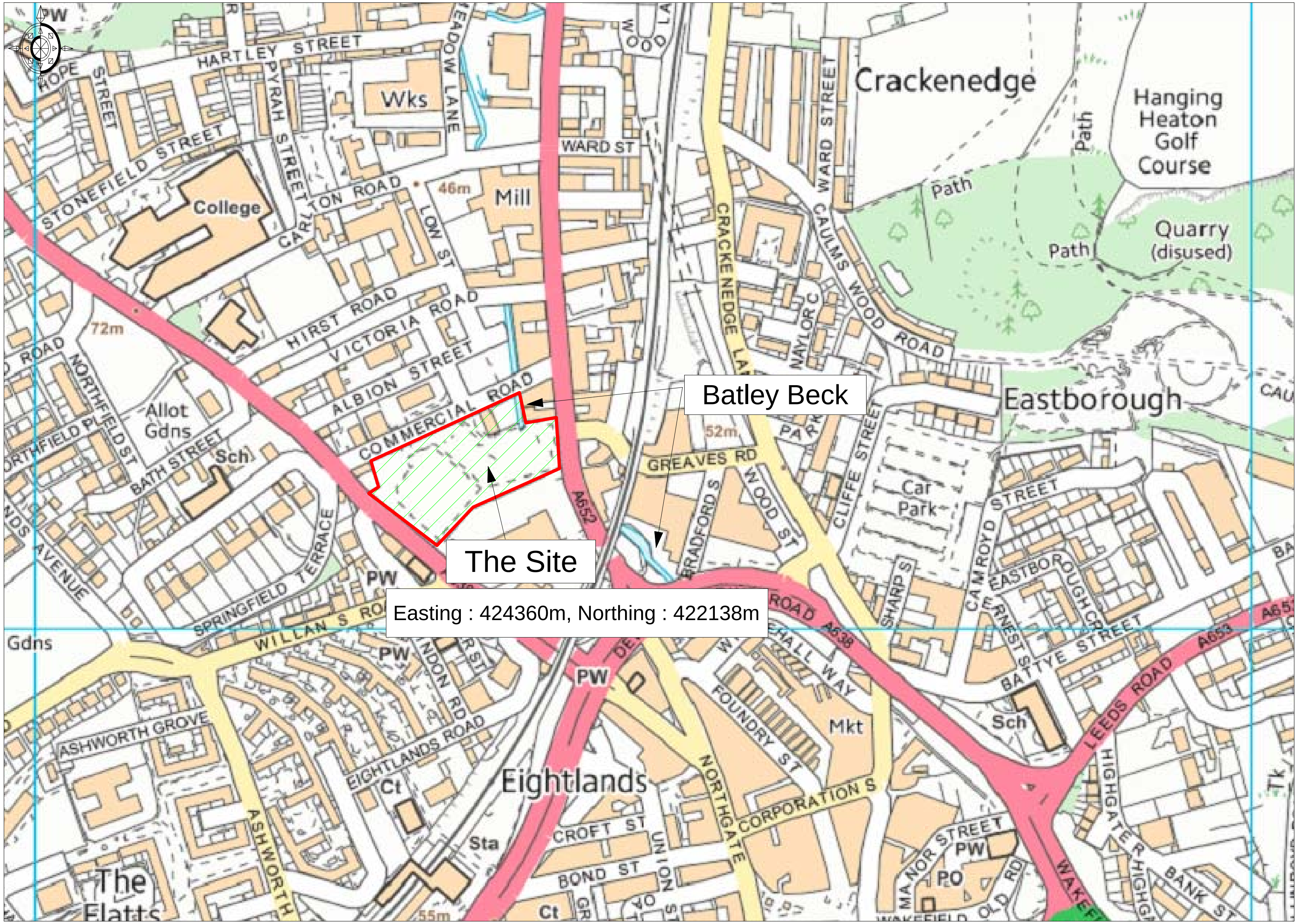
3. Kirklees MBC Unitary Development Plan, revised September 2007.

4. Calder Valley Strategic Flood Risk Assessment. Calderdale, Kirklees and Wakefield Councils, November 2008.

5. Planning Practice Guidance: Flood Risk and Coastal Change. Updated 15th April 2015. Department for Communities and Local Government.

6. Flood risk assessments: climate change allowances. Environment Agency, 19th February 2016, updated 12th April 2016.

Kirklees College - Dewsbury Site



Promap®

Figure 1: Location Plan

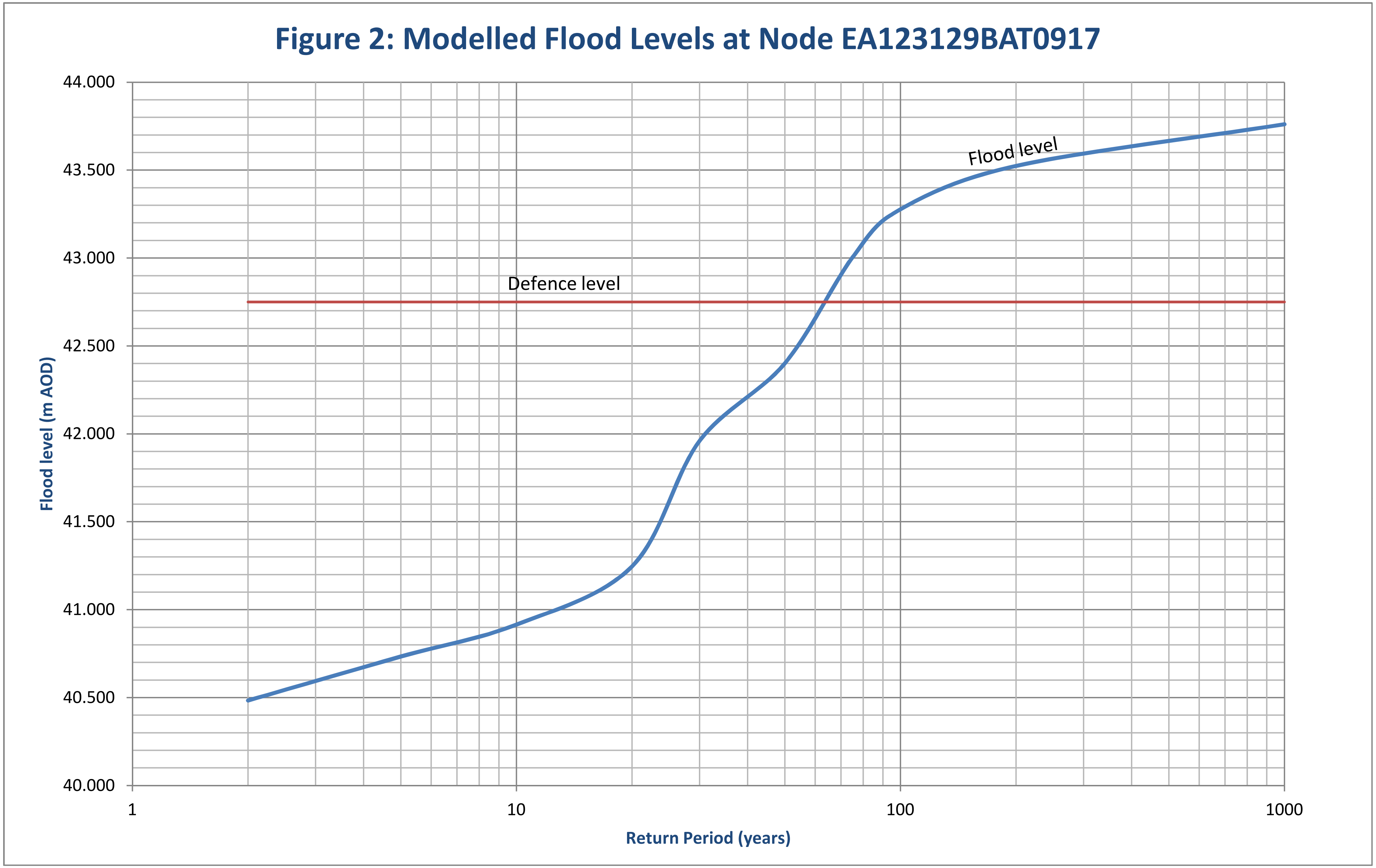
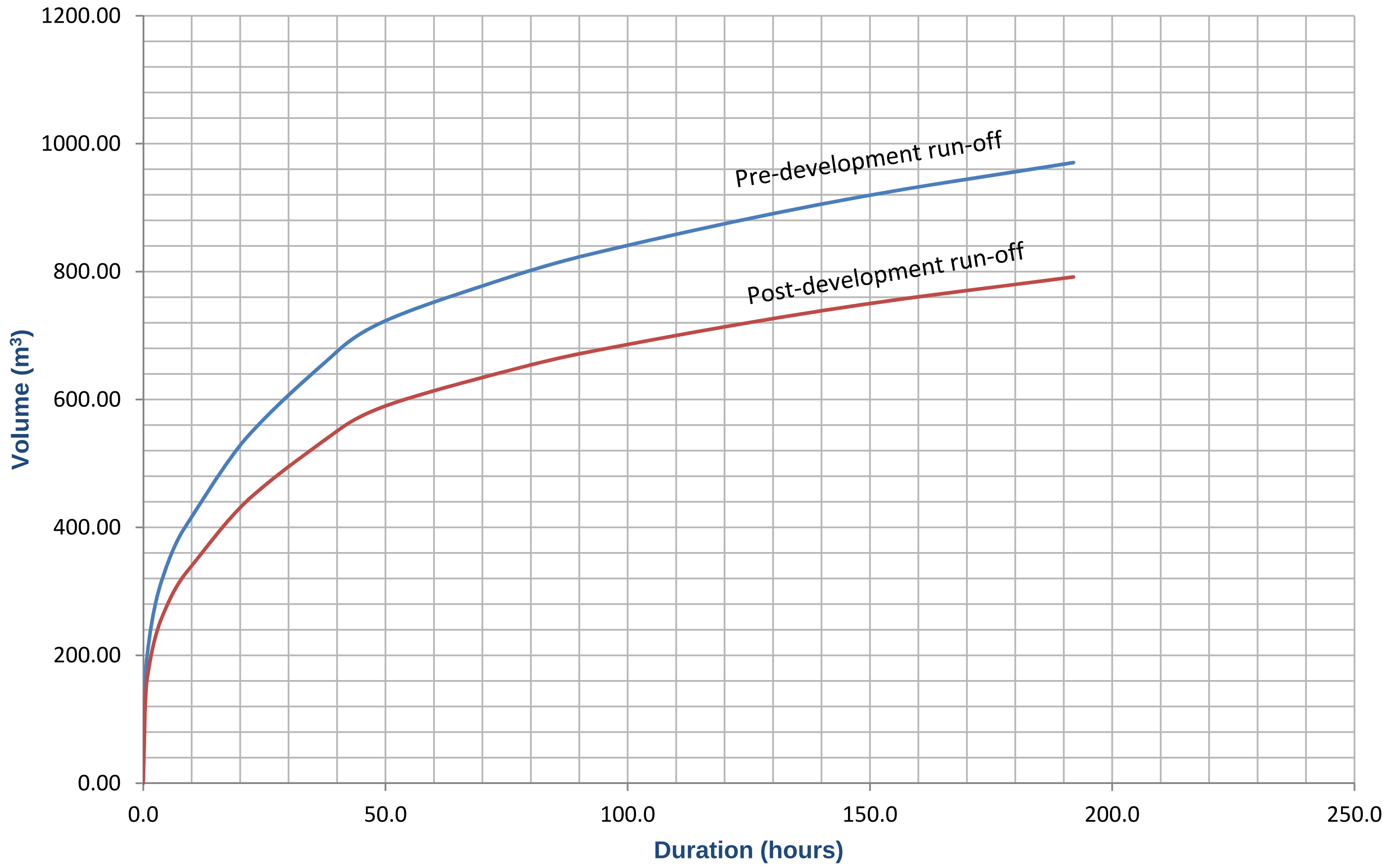


Figure 2: Modelled Flood Levels at Node EA123129BAT0917
44.000
43.500
43.000
42.500
42.000
41.500
41.000
40.500
40.000
Flood level (m AOD)
Flood level
Defence level
1
10
100
1000
Return Period (years)

Figure 3: Effect of the development on rapid response surface water run-off
(3.3% A.E.P event)



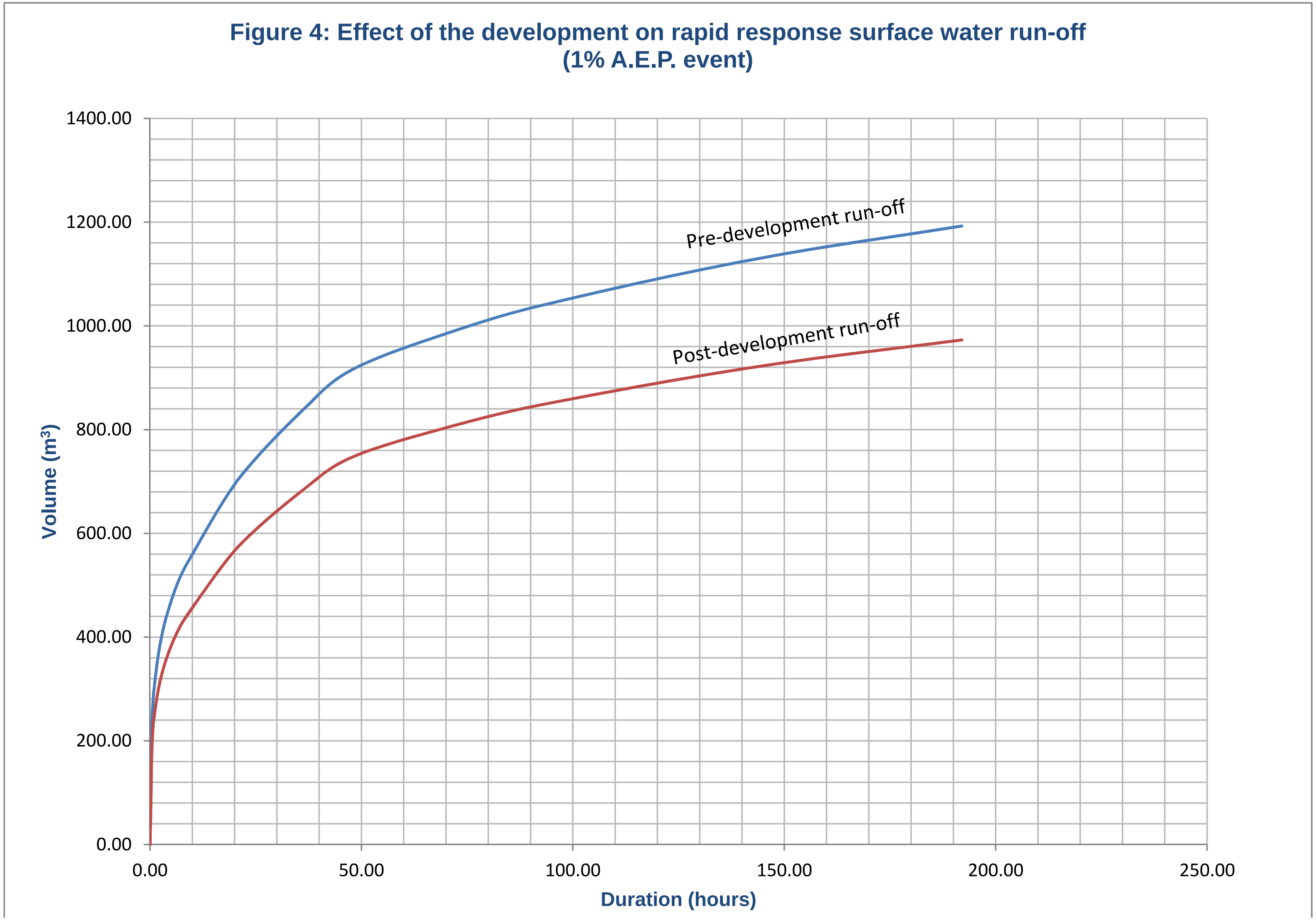


Figure 4: Effect of the development on rapid response surface water run-off
(1% A.E.P. event)
Pre-development run-off
Post-development run-off
Volume (m³)
Duration (hours)
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
0.00
50.00
100.00
150.00
200.00
250.00

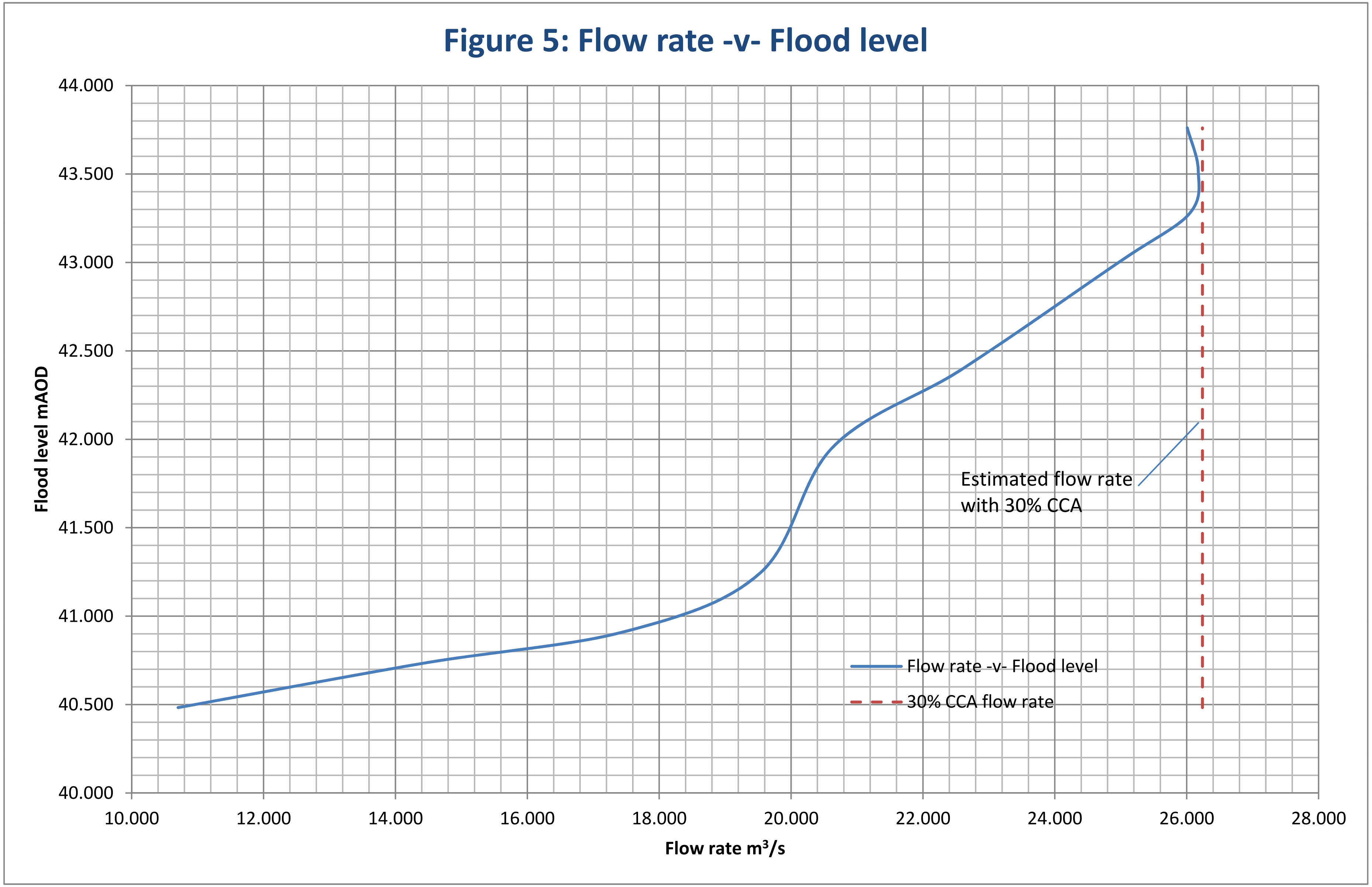


Figure 5: Flow rate -v- Flood level
44.000
43.500
43.000
42.500
42.000
41.500
41.000
40.500
40.000
Flood level mAOD
10.000
12.000
14.000
16.000
18.000
20.000
22.000
24.000
26.000
28.000
Flow rate m³/s
Estimated flow rate
with 30% CCA
Flow rate -v- Flood level
30% CCA flow rate

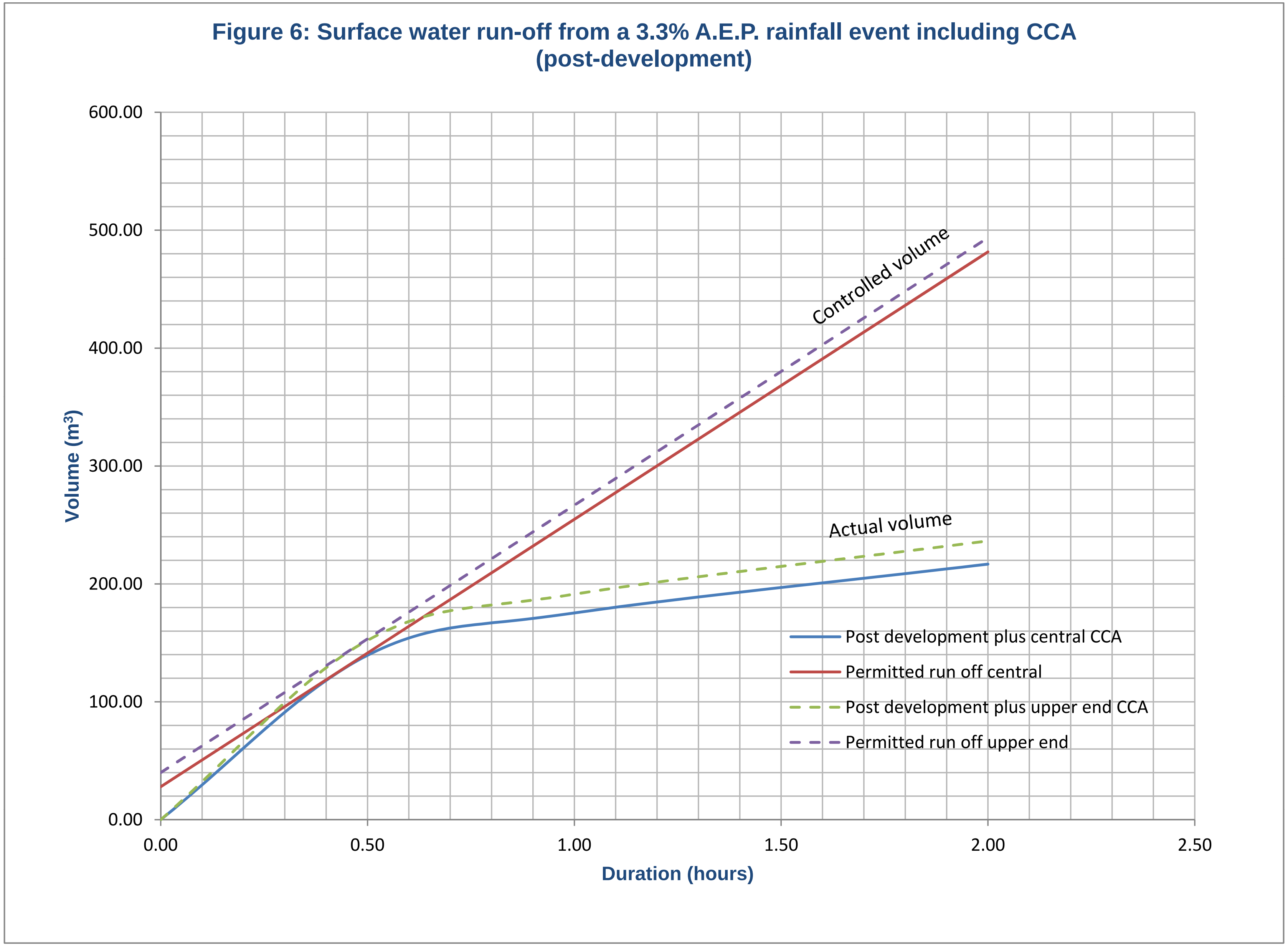


Figure 6: Surface water run-off from a 3.3% A.E.P. rainfall event including CCA
(post-development)
Volume (m³)
600.00
500.00
400.00
300.00
200.00
100.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
Duration (hours)
Controlled volume
Actual volume
Post development plus central CCA
Permitted run off central
Post development plus upper end CCA
Permitted run off upper end

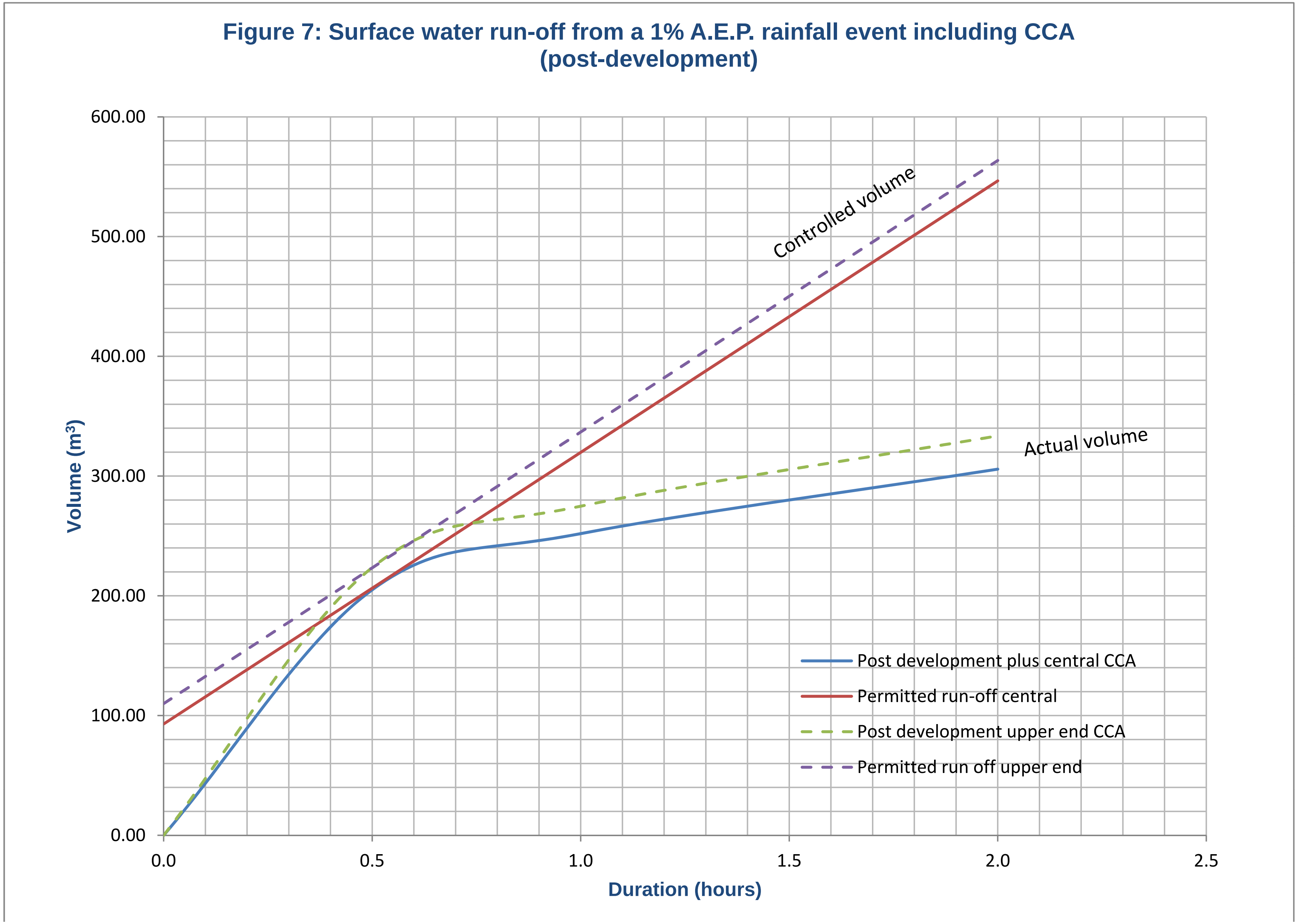


Figure 7: Surface water run-off from a 1% A.E.P. rainfall event including CCA
(post-development)
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Volume (m³)
0.0
0.5
1.0
1.5
2.0
2.5
Duration (hours)
Controlled volume
Actual volume
Post development plus central CCA
Permitted run-off central
Post development upper end CCA
Permitted run off upper end

APPENDIX A

Topographical Survey Plan

KPP ARCHITECTS
KILMARTIN PLOWMAN & PARTNERS LIMITED

REV	DRAWN	DATE	DESCRIPTION
.	.	.	.

KPP ARCHITECTS
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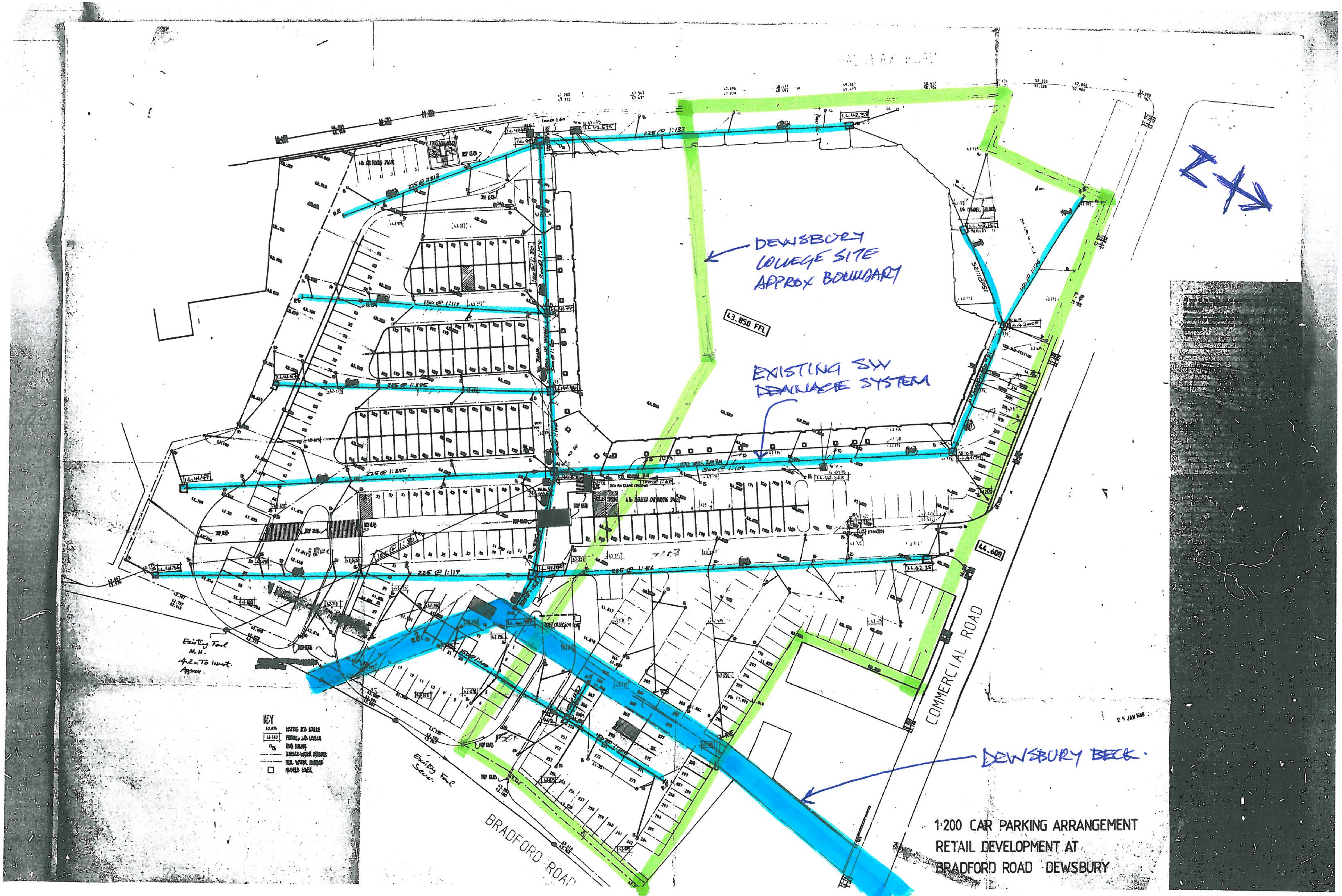
PROJECT TITLE: KIRKLEES COLLEGE DEWSBURY

TITLE: EXISTING SITE PLAN

STATUS	-	SCALE	1:500 @ A2	DRAWN	JR
FILE	P:\PROJECTS2\ -			DATE	12.02.16
PROJECT	2045	DRAWING	1001	REVISION	-

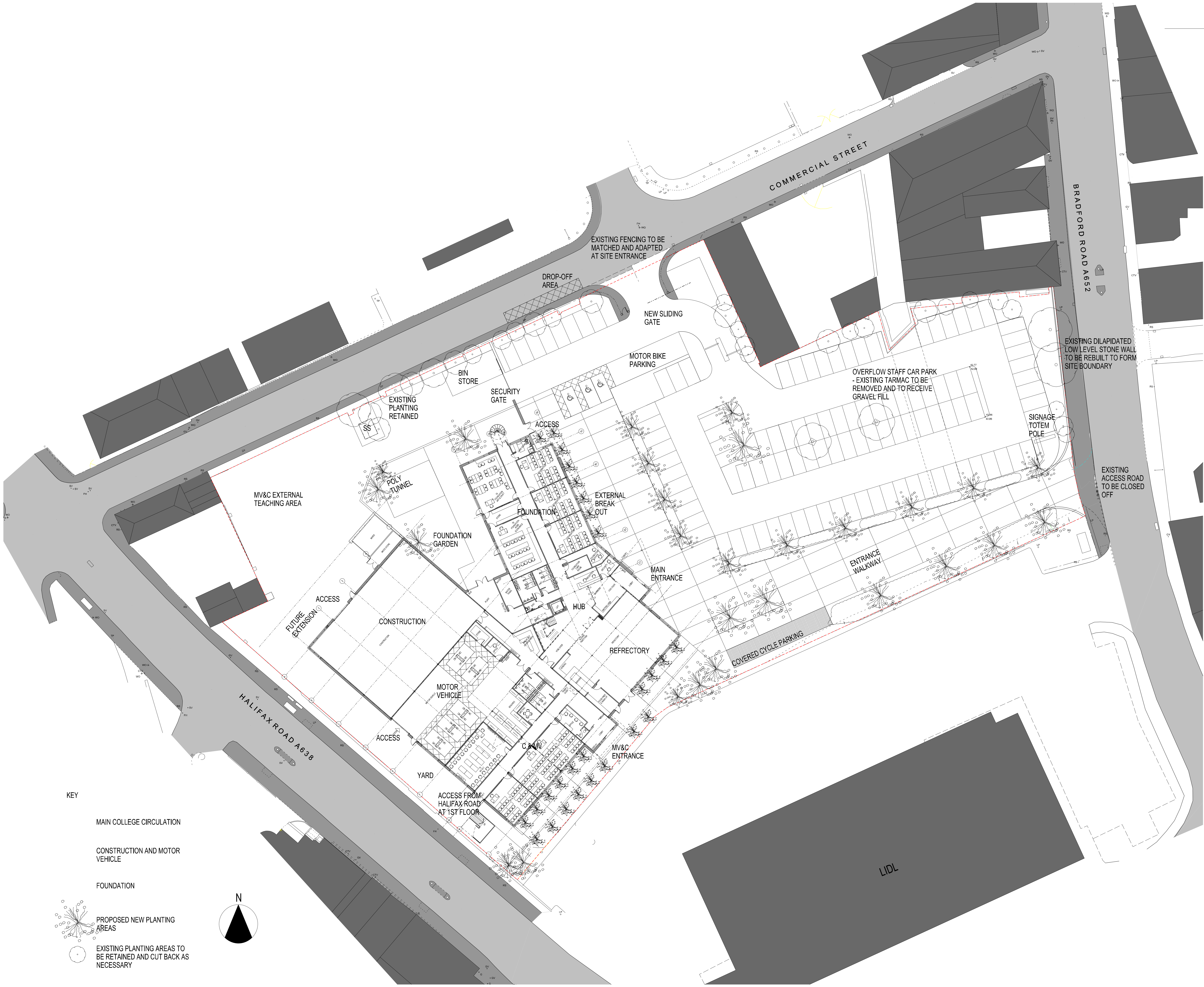
APPENDIX B

Historic drainage plan


DEWSBURY COLLEGE SITE APPROX BOUNDARY
EXISTING SW DRAINAGE SYSTEM
DEWSBURY BECK.
43.850 FFL
44.600
225 @ 1:133
150 @ 1:118
225 @ 1:295
225 @ 1:285
225 @ 1:118
300 @ 1:108
COMMERCIAL ROAD
BRADFORD ROAD
Existing Foul M.H. 4.2m To Invert Approx.
Existing Foul Sew.
KEY
2 5 JAN 1988
1:200 CAR PARKING ARRANGEMENT
RETAIL DEVELOPMENT AT
BRADFORD ROAD DEWSBURY

APPENDIX C

Site layout plan



KPP ARCHITECTS
KILMARTIN PLOWMAN & PARTNERS LIMITED

REV	DRAWN	DATE	DESCRIPTION
-	-	-	-

KPP ARCHITECTS
KILMARTIN PLOWMAN & PARTNERS LIMITED

LODGE HOUSE 12 TOWN STREET
HORSFORTH LEEDS LS18 4RJ
T : 0113 239 0460 F : 0113 239 0475
E : architects@kpp-leeds.co.uk
W : www.kpp-leeds.co.uk

PROJECT TITLE: KIRKLEES COLLEGE DEWSBURY LEARNING VILLAGE

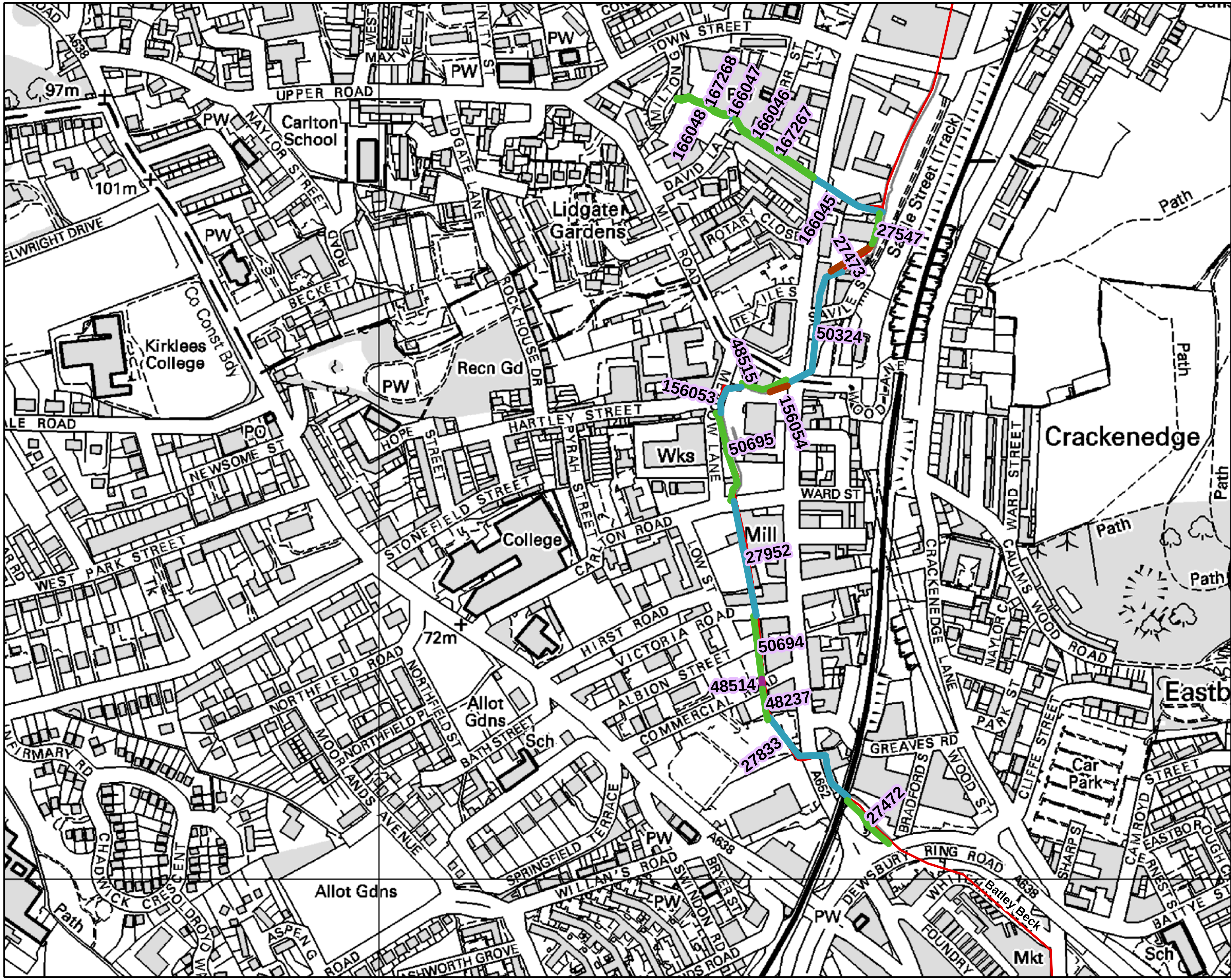
TITLE: PROPSOSED SITE PLAN

STATUS	-	SCALE	1:500 @ A2	DRAWN	-
FILE	P:\PROJECTS2\ -			DATE	-
PROJECT	2045	DRAWING	2001	REVISION	-

APPENDIX D

Environment Agency flood data

Asset Defence Map for Kirklees College, Dewsbury   Date Created: 03/05/16   RFI: 5119



Environment Agency

www.environment-agency.gov.uk

Scale: 1:4,000

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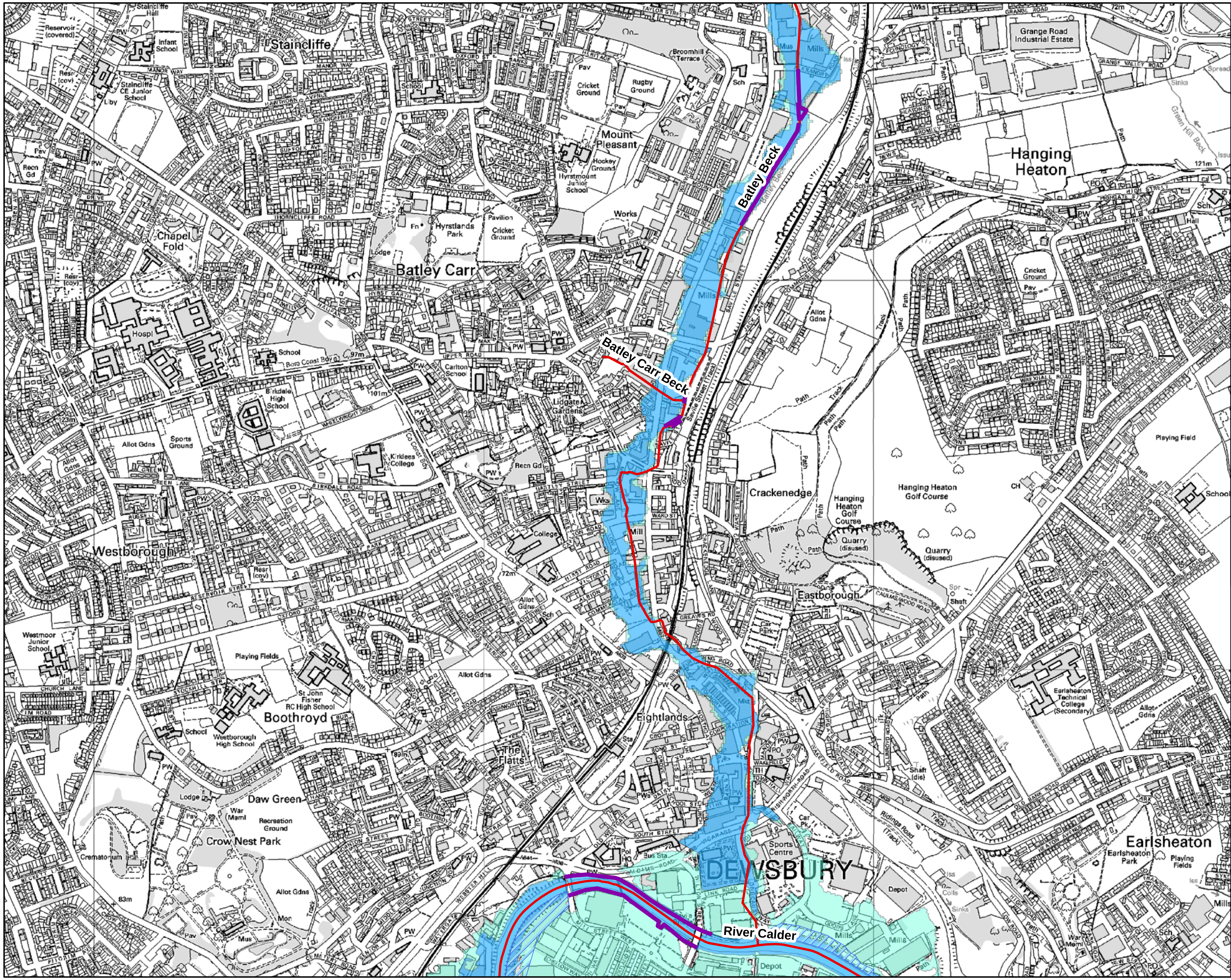
LEGEND

Defences

- bridge abutment
- high ground
- simple culvert
- wall
- Main River

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Flood Map for Planning for Kirklees College, Dewsbury   Date Created: 03/05/16   RFI: 5119



Environment Agency

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Scale: 1:10,000

N
W E
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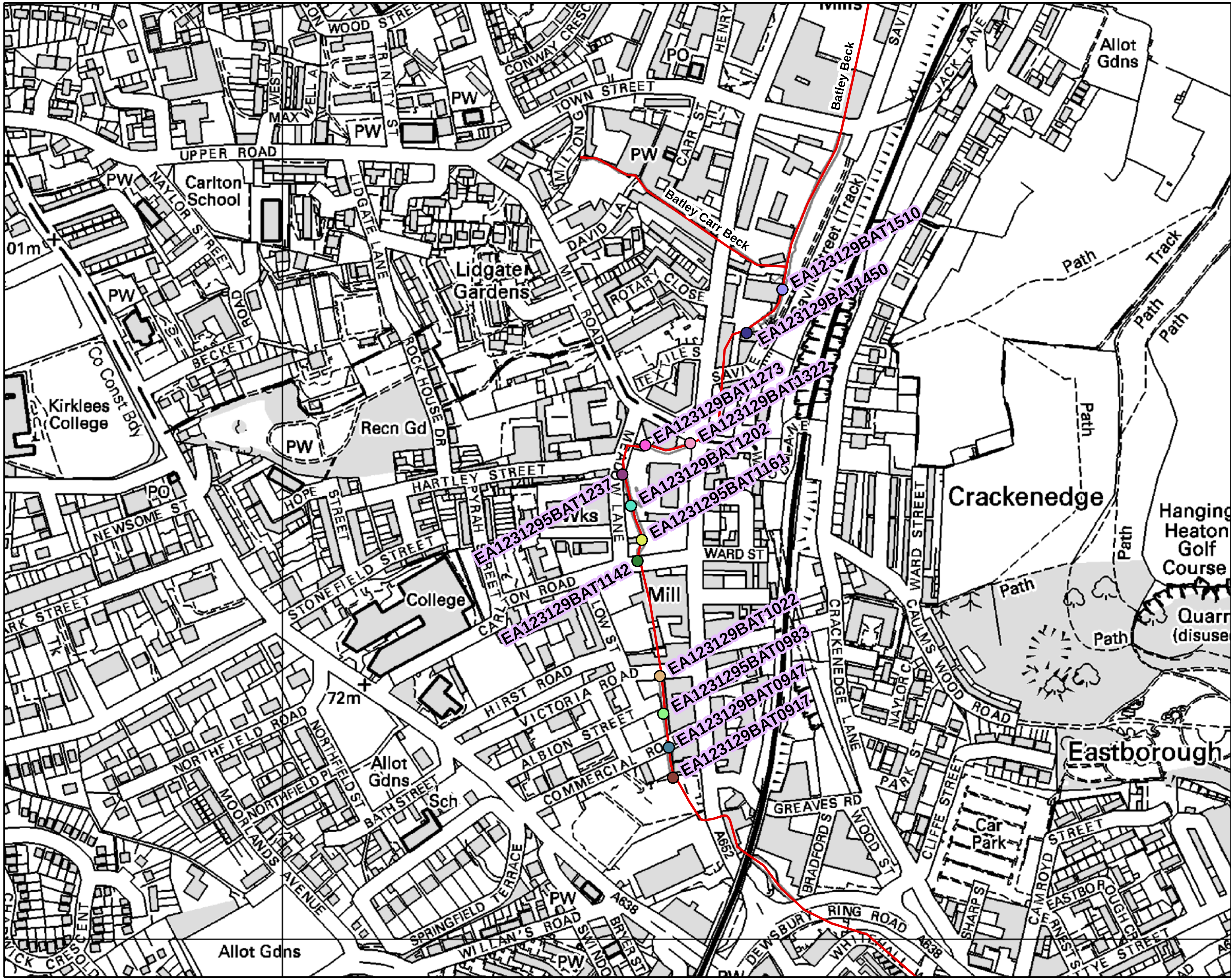
LEGEND

- Main River
- Flood Map Flood Defences
- Flood Storage Areas
- Flood Zone 3 (FZ3)
- Flood Zone 2 (FZ2)

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Node Point Map for Kirklees College, Dewsbury   Date Created: 03/05/16   RFI: 5119



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N E S W

LEGEND

Node Point ID

- EA1231295BAT0983
- EA1231295BAT1161
- EA1231295BAT1237
- EA123129BAT0917
- EA123129BAT0947
- EA123129BAT1022
- EA123129BAT1142
- EA123129BAT1202
- EA123129BAT1273
- EA123129BAT1322
- EA123129BAT1450
- EA123129BAT1510
- Main River

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Node Point Information
RFI: 5119

2015 Batley Beck Model - Defended Scenario Results (Level - mAOD, Flow - m^3/s)

	Return Period											
	2		5		10		20		30		50	
Node Point	Max Level	Max Flow	Max Level	Max Flow	Max Level	Max Flow	Max Level	Max Flow	Max Level	Max Flow	Max Level	Max Flow
EA1231295BAT1510	44.526	9.384	44.975	12.592	45.318	15.258	45.775	16.815	45.877	16.793	45.941	16.912
EA1231295BAT1450	44.116	9.383	44.503	12.59	44.806	15.256	45.405	16.824	45.524	16.797	45.623	16.85
EA1231295BAT1322	42.824	10.35	43.365	13.952	43.827	16.913	44.14	18.824	44.255	19.023	44.413	18.895
EA1231295BAT1273	42.736	10.433	43.293	14.057	43.755	17.045	44.07	18.962	44.195	19.183	44.36	19.185
EA1231295BAT1237	42.514	10.622	42.825	14.293	43.053	17.344	43.193	19.288	43.322	19.617	43.509	19.767
EA1231295BAT1202	42.266	10.621	42.568	14.294	42.785	17.345	42.922	19.289	43.008	19.983	43.238	20.354
EA1231295BAT1161	41.956	10.621	42.229	14.295	42.411	17.346	42.541	19.291	42.67	20.088	42.985	20.75
EA1231295BAT1142	41.884	10.621	42.171	14.296	42.359	17.348	42.496	19.292	42.642	20.513	42.944	21.274
EA1231295BAT1022	41.551	10.622	41.769	14.305	41.939	17.366	42.059	19.367	42.239	20.521	42.656	21.38
EA1231295BAT0983	41.233	10.705	41.461	14.41	41.647	17.496	41.792	19.5	42.151	20.627	42.641	22.482
EA1231295BAT0947	40.891	10.705	41.065	14.41	41.219	17.501	41.448	19.553	41.992	20.632	42.418	22.526
EA1231295BAT0917	40.483	10.705	40.733	14.412	40.915	17.502	41.246	19.583	41.96	20.644	42.401	22.61

	Return Period									
	75		100		101		200		1000	
Node Point	**Max Level**	**Max Flow**	**Max Level**	**Max Flow**	**Max Level**	**Max Flow**	**Max Level**	**Max Flow**	**Max Level**	**Max Flow**
EA1231295BAT1510	46.07	16.658	46.14	16.607	46.266	16.768	46.262	16.764	46.478	16.061
EA1231295BAT1450	45.83	16.579	45.915	16.615	46.069	16.827	46.066	16.803	46.325	15.907
EA1231295BAT1322	44.8	18.899	44.893	18.85	45.03	18.685	45.026	18.677	45.242	18.313
EA1231295BAT1273	44.769	19.319	44.864	19.373	45.002	19.468	44.999	19.456	45.222	19.873
EA1231295BAT1237	44.044	19.901	44.149	19.955	44.274	20.05	44.272	20.038	44.488	20.455
EA1231295BAT1202	43.943	20.649	44.076	20.776	44.206	21.131	44.203	21.116	44.41	21.99
EA1231295BAT1161	43.802	21.208	43.993	21.569	44.127	22.142	44.125	22.126	44.317	22.804
EA1231295BAT1142	43.782	21.835	43.995	22.208	44.159	22.934	44.156	22.911	44.375	23.889
EA1231295BAT1022	43.433	21.894	43.705	22.201	43.885	22.928	43.882	22.904	44.084	23.88
EA1231295BAT0983	43.37	24.711	43.713	24.244	43.9	24.097	43.897	24.092	44.109	23.718
EA1231295BAT0947	43.012	24.741	43.405	24.381	43.685	24.253	43.681	24.253	43.89	24.295
EA1231295BAT0917	43.003	24.977	43.277	26.043	43.528	26.173	43.524	26.174	43.761	26.009

2015 Batley Beck Model - Undefended Scenario Results (Level - mAOD, Flow - m^3/s)

	Return Period											
	2		5		10		20		30		50	
Node Point	Max Level	Max Flow	Max Level	Max Flow	Max Level	Max Flow	Max Level	Max Flow	Max Level	Max Flow	Max Level	Max Flow
EA1231295BAT1510	44.527	9.392	44.975	12.587	45.315	15.229	45.646	16.59	45.796	16.684	45.873	16.587
EA1231295BAT1450	44.117	9.39	44.502	12.585	44.803	15.227	45.264	16.592	45.441	16.68	45.546	16.648
EA1231295BAT1322	42.826	10.358	43.367	13.947	43.823	16.884	44.068	18.497	44.198	18.88	44.354	18.696
EA1231295BAT1273	42.739	10.44	43.294	14.051	43.751	17.017	43.998	18.586	44.137	19.015	44.3	18.912
EA1231295BAT1237	42.517	10.63	42.826	14.288	43.052	17.317	43.158	18.829	43.283	19.334	43.464	19.432
EA1231295BAT1202	42.267	10.629	42.569	14.288	42.784	17.319	42.885	18.829	43.066	19.337	43.262	19.44
EA1231295BAT1161	41.956	10.628	42.229	14.29	42.41	17.32	42.501	18.83	42.713	19.619	42.992	20.358
EA1231295BAT1142	41.885	10.628	42.171	14.291	42.359	17.321	42.455	18.831	42.569	20.884	42.869	22.194
EA1231295BAT1022	41.551	10.63	41.769	14.3	41.938	17.338	42.02	18.839	42.122	20.891	42.524	22.306
EA1231295BAT0983	41.233	10.713	41.461	14.405	41.646	17.47	41.738	18.956	41.97	20.969	42.496	22.446
EA1231295BAT0947	40.892	10.712	41.064	14.405	41.218	17.476	41.385	18.958	41.819	20.972	42.273	22.544
EA1231295BAT0917	40.483	10.712	40.732	14.406	40.914	17.475	41.15	18.962	41.773	20.978	42.249	22.659

	Return Period					
	75		100		101	
Node Point	**Max Level**	**Max Flow**	**Max Level**	**Max Flow**	**Max Level**	**Max Flow**
EA1231295BAT1510	46.069	16.536	46.128	16.526	46.228	16.726
EA1231295BAT1450	45.825	16.579	45.896	16.609	46.008	16.798
EA1231295BAT1322	44.776	18.581	44.829	18.51	44.879	18.328
EA1231295BAT1273	44.748	18.931	44.818	18.955	44.895	19.085
EA1231295BAT1237	44.047	19.513	44.164	19.537	44.302	19.666
EA1231295BAT1202	43.904	20.079	44.056	19.976	44.193	20.375
EA1231295BAT1161	43.913	20.578	44.058	19.852	44.178	19.865
EA1231295BAT1142	43.756	24.014	44.015	23.612	44.178	23.636
EA1231295BAT1022	43.356	24.01	43.739	23.608	43.918	23.63
EA1231295BAT0983	43.308	25.029	43.75	24.668	43.915	24.583
EA1231295BAT0947	42.924	25.05	43.465	24.739	43.701	24.669
EA1231295BAT0917	42.914	25.212	43.318	26.335	43.545	26.225

Surface Water Map Kirklees College, Dewsbury

Legend

- Flood Extent 1 in 30
- Flood Extent 1 in 100
- Flood Extent 1 in 1000
- OS Traditional Maps

0 120 240 360
Metres

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Contact: enquiries@environment-agency.gov.uk 03708 506506

APPENDIX E

Note of site meeting with the Environment Agency on 25th May 2016

KIRKLEES COLLEGE, COMMERCIAL ROAD, DEWSBURY

NOTE OF SITE MEETING HELD AT 2PM ON WEDNESDAY 25 MAY 2016

1.0 PRESENT:

Christian Merriman (CM) - Environment Agency

Gary Cliff (GC) - Environment Agency

Lisa Killick (LK) - Environment Agency

Kevin Tyldesley (KT) - WML Consulting Ltd

Adrian Vernon (AV) - WML Consulting Ltd

Richard Lockey (RL) - KPP Architects

John O'Connor (JOC) - JOC Consultants Ltd

2.0 PURPOSE OF THE MEETING

2.1. The meeting was called to discuss the implications of the development on floodplain storage.

3.0 FLOODPLAIN STORAGE

3.1. JOC explained that the FRA had shown that the floodplain storage at the site was likely to have no significant effect on flood levels because flood levels were attenuated by upstream storage which has the effect of reducing the flow rate in the extreme event (1 in 1000 years event). The small loss of floodplain to the building footprint would not therefore affect flood levels in the wider area.

3.2. CM produced a map showing the actual floodplain outline in the 1 in 100 years event, taking into account the culvert and the overtopping threshold of the culvert wall. This showed the area of the floodplain to be restricted to a relatively small margin adjacent to the line of Batley Beck as it passes through the site in culvert. A check on flood depth had shown this to be not greater than 100mm.

3.3. CM questioned why the building could not be located in the flood zone 1 part of the site. RL explained that the planning authority had requested that the main college building be located as close to the Bradford Road boundary as possible. The presence of the culvert had influenced the final position of the building. To the rear of the main college building, in the flood zone 1 area, is a subsidiary building and space for future extension of the college to create a 6th form annex. It was not therefore feasible to locate the main building further west, in the flood zone 1 area.

3.4. The Environment Agency personnel indicated that, as there was no practicable opportunity to create compensation flood storage within the site and as the effect of the building footprint in the (defended) 1 in 100 years flood outline would be insignificant, the development proposal would not meet with an objection from the Environment Agency in relation to loss of floodplain storage.

3.5. AV explained that the building would need to intrude into the standard 8m margin adjacent to the culvert, leaving a clear 4m width for maintenance access. CM said this was unlikely to be a problem but justification would need to be provided when the application is made in due course for consent under the Environmental Permitting Regulations.

3.6. RL questioned whether a future expansion of an upper floor level over the line of the culvert would be likely to be allowed. CM said this would depend on being able to demonstrate that maintenance of the culvert, including excavation for replacement, would be feasible.

END OF MEETING NOTE

APPENDIX F

Kirklees MBC email dated 5th May 2016

John O'Connor

From: Tom Ghee [Tom.Ghee@kirklees.gov.uk]
Sent: 05 May 2016 15:46
To: 'John O'Connor'
Cc: Paul Farndale
Subject: RE: Kirklees College, Dewsbury
Attachments: Developer Advice.pdf; WYCA Developer SuDS.pdf

John,
I've checked our records and the council has no recorded flood incidents within the site. Please note that our records only extend to the last 15 years or so. The EA may also hold records relating to flooding from Dewsbury Beck.

I have no records or knowledge of drainage problems in the vicinity of the site.

The Council has a general drainage design guide for developers (attached). This has recently been augmented by a developers guide to the use of SuDS (attached), resulting from the recent change to legislation to encourage SuDS through planning. We would expect the usual drainage hierarchy of disposal to be used. Whilst I accept that infiltration SuDS may be limited due to groundwater levels and ground suitability, the option of surface level SuDS would be encouraged.

regards

Tom Ghee
Group Engineer,
Flood Management and PROW

Kirklees COUNCIL

01484 221000

tom.ghee@kirklees.gov.uk | www.kirklees.gov.uk

Investment & Regeneration Service, Civic Centre 3, Market Street, Huddersfield, HD1 1WG

Do you really need to print this e-mail...?

From: John O'Connor [mailto:jocconsultants@btconnect.com]
Sent: 05 May 2016 11:48
To: Tom Ghee
Subject: Kirklees College, Dewsbury

Tom,

As discussed on the phone just now, we are preparing a FRA for the new Kirklees College site between Halifax Road and Bradford Road, Dewsbury, as shown on the attached location plan. I would be grateful if you could let me have the following information:

- details of any historic flooding known to the Council at or in the vicinity of the site;

- details of any drainage problems known to the Council in the area;
- details of any special requirements of the Council in respect of development and flood risk.

Your earliest response will be appreciated.

Regards,

John O'Connor

joc consultants ltd
Park Farm House
Leathley Lane
Leathley
Otley
LS21 2JU

Tel/fax: 0113 284 2838

www.jocconsultants.co.uk

APPENDIX G

Surface water run-off calculations: Tables G1 to G8

Table G1: Rapid response run-off from 3.3% A.E.P. rainfall event: existing condition							
Duration	Rainfall	Area (m^2)			Volume (m^3)		
	at Site	Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume
hours	mm						
		C_v	SPR HOST				
		84.0%	21.0%				
0.0	0.0	0.99	0.00	0.99	0.00	0.00	0.00
0.5	20.2	0.99	0.00	0.99	167.98	0.00	167.98
1.0	25.4	0.99	0.00	0.99	211.23	0.00	211.23
2.0	31.4	0.99	0.00	0.99	261.12	0.00	261.12
3.0	35.5	0.99	0.00	0.99	295.22	0.00	295.22
4.0	38.6	0.99	0.00	0.99	321.00	0.00	321.00
6.0	43.5	0.99	0.00	0.99	361.75	0.00	361.75
8.0	47.2	0.99	0.00	0.99	392.52	0.00	392.52
12.0	52.9	0.99	0.00	0.99	439.92	0.00	439.92
18.0	61.1	0.99	0.00	0.99	508.11	0.00	508.11
24.0	67.6	0.99	0.00	0.99	562.16	0.00	562.16
36.0	77.9	0.99	0.00	0.99	647.82	0.00	647.82
48.0	86.1	0.99	0.00	0.99	716.01	0.00	716.01
72.0	94.1	0.99	0.00	0.99	782.54	0.00	782.54
96.0	100.3	0.99	0.00	0.99	834.09	0.00	834.09
144.0	109.6	0.99	0.00	0.99	911.43	0.00	911.43
192.0	116.7	0.99	0.00	0.99	970.48	0.00	970.48

Table G2: Rapid response run-off from 1% A.E.P. rainfall event: existing condition							
Duration	Rainfall	Area (m^2)			Volume (m^3)		
	at Site	Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume
hours	mm						
		Cv 84.0%	SPR HOST 21.0%				
0.00	0.0	0.99	0.00	0.99	0.00	0.00	0.00
0.50	29.7	0.99	0.00	0.99	246.99	0.00	246.99
1.00	36.5	0.99	0.00	0.99	303.53	0.00	303.53
2.00	44.3	0.99	0.00	0.99	368.40	0.00	368.40
3.00	49.4	0.99	0.00	0.99	410.81	0.00	410.81
4.00	53.3	0.99	0.00	0.99	443.24	0.00	443.24
6.00	59.3	0.99	0.00	0.99	493.14	0.00	493.14
8.00	63.8	0.99	0.00	0.99	530.56	0.00	530.56
12.00	70.7	0.99	0.00	0.99	587.94	0.00	587.94
18.00	80.6	0.99	0.00	0.99	670.27	0.00	670.27
24.00	88.4	0.99	0.00	0.99	735.13	0.00	735.13
36.00	100.6	0.99	0.00	0.99	836.59	0.00	836.59
48.00	110.2	0.99	0.00	0.99	916.42	0.00	916.42
72.0	119.1	0.99	0.00	0.99	990.44	0.00	990.44
96.0	125.8	0.99	0.00	0.99	1046.15	0.00	1046.15
144.0	135.9	0.99	0.00	0.99	1130.14	0.00	1130.14
192.0	143.4	0.99	0.00	0.99	1192.51	0.00	1192.51

Table G3: Rapid response run-off from 3.3% A.E.P. rainfall event: post development condition								
Duration	Rainfall	Area (m^2)			Volume (m^3)			
hours	at Site mm	Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume	% increase in run-off volume
		Cv 84.0%	SPR HOST 21.0%					
0.0	0.0	0.75	0.24	0.99	0.00	0.00	0.00	
0.5	20.2	0.75	0.24	0.99	126.75	10.28	137.03	-18%
1.0	25.4	0.75	0.24	0.99	159.38	12.93	172.31	-18%
2.0	31.4	0.75	0.24	0.99	197.03	15.99	213.01	-18%
3.0	35.5	0.75	0.24	0.99	222.76	18.07	240.83	-18%
4.0	38.6	0.75	0.24	0.99	242.21	19.65	261.86	-18%
6.0	43.5	0.75	0.24	0.99	272.95	22.15	295.10	-18%
8.0	47.2	0.75	0.24	0.99	296.17	24.03	320.20	-18%
12.0	52.9	0.75	0.24	0.99	331.94	26.93	358.87	-18%
18.0	61.1	0.75	0.24	0.99	383.39	31.11	414.50	-18%
24.0	67.6	0.75	0.24	0.99	424.18	34.41	458.59	-18%
36.0	77.9	0.75	0.24	0.99	488.81	39.66	528.46	-18%
48.0	86.1	0.75	0.24	0.99	540.26	43.83	584.09	-18%
72.0	94.1	0.75	0.24	0.99	590.46	47.90	638.36	-18%
96.0	100.3	0.75	0.24	0.99	629.36	51.06	680.42	-18%
144.0	109.6	0.75	0.24	0.99	687.72	55.80	743.51	-18%
192.0	116.7	0.75	0.24	0.99	732.27	59.41	791.68	-18%

Table G4: Rapid response run-off from 1% A.E.P. rainfall event: post development condition

Duration	Rainfall	Area (m^2)			Volume (m^3)			
	at Site	Impervious	Pervious	Total	Impervious	Pervious	Run-off	% increase
hours	mm	Area (ha)	Area (ha)	Area (ha)	Area	Area	Volume	in run-off volume
		C_v 84.0%	C_v 21.0%					
0.00	0.0	0.75	0.24	0.99	0.00	0.00	0.00	
0.50	29.7	0.75	0.24	0.99	186.36	15.12	201.48	-18%
1.00	36.5	0.75	0.24	0.99	229.03	18.58	247.61	-18%
2.00	44.3	0.75	0.24	0.99	277.97	22.55	300.53	-18%
3.00	49.4	0.75	0.24	0.99	309.98	25.15	335.12	-18%
4.00	53.3	0.75	0.24	0.99	334.45	27.13	361.58	-18%
6.00	59.3	0.75	0.24	0.99	372.10	30.19	402.28	-18%
8.00	63.8	0.75	0.24	0.99	400.33	32.48	432.81	-18%
12.00	70.7	0.75	0.24	0.99	443.63	35.99	479.62	-18%
18.00	80.6	0.75	0.24	0.99	505.75	41.03	546.78	-18%
24.00	88.4	0.75	0.24	0.99	554.69	45.00	599.70	-18%
36.00	100.6	0.75	0.24	0.99	631.24	51.21	682.46	-18%
48.00	110.2	0.75	0.24	0.99	691.48	56.10	747.58	-18%
72.00	119.1	0.75	0.24	0.99	747.33	60.63	807.96	-18%
96.00	125.8	0.75	0.24	0.99	789.37	64.04	853.41	-18%
144.00	135.9	0.75	0.24	0.99	852.75	69.18	921.93	-18%
192.00	143.4	0.75	0.24	0.99	899.81	73.00	972.81	-18%

Table G5: Post-development rapid response run-off from impervious area (3.3% A.E.P. rainfall including central CCA)									
Duration hours	Rainfall at Site mm	Area (m^2)			Volume (m^3)			Controlled run off m^3	Tangent m^3
		Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume		
		C_v 84.0%	C_v 0.0%					Controlled rate (l/s) 63.0	
0.00	0.0	0.75	0.24	0.99	0.00	0.00	0.00	0.00	28.00
0.50	22.2	0.75	0.24	0.99	139.43	0.00	139.43	113.40	141.40
1.00	27.9	0.75	0.24	0.99	175.32	0.00	175.32	226.80	254.80
2.00	34.5	0.75	0.24	0.99	216.73	0.00	216.73	453.60	481.60
3.00	39.1	0.75	0.24	0.99	245.03	0.00	245.03	680.40	708.40
4.00	42.5	0.75	0.24	0.99	266.43	0.00	266.43	907.20	935.20
6.00	47.9	0.75	0.24	0.99	300.25	0.00	300.25	1360.80	1388.80
8.00	51.9	0.75	0.24	0.99	325.79	0.00	325.79	1814.40	1842.40
12.00	58.2	0.75	0.24	0.99	365.13	0.00	365.13	2721.60	2749.60
18.00	67.2	0.75	0.24	0.99	421.73	0.00	421.73	4082.40	4110.40
24.00	74.4	0.75	0.24	0.99	466.59	0.00	466.59	5443.20	5471.20
36.00	85.7	0.75	0.24	0.99	537.69	0.00	537.69	8164.80	8192.80
48.00	94.7	0.75	0.24	0.99	594.29	0.00	594.29	10886.40	10914.40
72.00	103.5	0.75	0.24	0.99	649.50	0.00	649.50	16329.60	16357.60
96.00	110.3	0.75	0.24	0.99	692.30	0.00	692.30	21772.80	21800.80
144.00	120.6	0.75	0.24	0.99	756.49	0.00	756.49	32659.20	32687.20
192.00	128.4	0.75	0.24	0.99	805.50	0.00	805.50	43545.60	43573.60
								Total Storage Requirement (m^3)	28.00

Table G6: Post-development rapid response run-off from impervious area (3.3% A.E.P. rainfall including upper end CCA)									
Duration	Rainfall	Area (m^2)			Volume (m^3)			Controlled run off	Tangent
	at Site	Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)	Impervious Area	Pervious Area	Run-off Volume	m^3	
hours	mm								m^3
		C_v Impervious	C_v 0.0%					Controlled rate (l/s) 63.0	
0.0	0.0	0.75	0.24	0.99	0.00	0.00	0.00	0.00	40.00
0.5	24.2	0.75	0.24	0.99	152.10	0.00	152.10	113.40	153.40
1.0	30.5	0.75	0.24	0.99	191.26	0.00	191.26	226.80	266.80
2.0	37.7	0.75	0.24	0.99	236.43	0.00	236.43	453.60	493.60
3.0	42.6	0.75	0.24	0.99	267.31	0.00	267.31	680.40	720.40
4.0	46.3	0.75	0.24	0.99	290.65	0.00	290.65	907.20	947.20
6.0	52.2	0.75	0.24	0.99	327.54	0.00	327.54	1360.80	1400.80
8.0	56.6	0.75	0.24	0.99	355.40	0.00	355.40	1814.40	1854.40
12.0	63.5	0.75	0.24	0.99	398.32	0.00	398.32	2721.60	2761.60
18.0	73.3	0.75	0.24	0.99	460.07	0.00	460.07	4082.40	4122.40
24.0	81.1	0.75	0.24	0.99	509.01	0.00	509.01	5443.20	5483.20
36.0	93.5	0.75	0.24	0.99	586.57	0.00	586.57	8164.80	8204.80
48.0	103.3	0.75	0.24	0.99	648.31	0.00	648.31	10886.40	10926.40
72.0	112.9	0.75	0.24	0.99	708.55	0.00	708.55	16329.60	16369.60
96.0	120.4	0.75	0.24	0.99	755.23	0.00	755.23	21772.80	21812.80
144.0	131.5	0.75	0.24	0.99	825.26	0.00	825.26	32659.20	32699.20
192.0	140.0	0.75	0.24	0.99	878.72	0.00	878.72	43545.60	43585.60
								Total Storage Requirement (m^3)	40.00

Average: 34.00

Table G7: Post-development rapid response run-off from impervious area (1% A.E.P. rainfall including central CCA)

Duration	Rainfall	Area (m^2)			Volume (m^3)			Controlled run off	Tangent
	at Site	Impervious	Pervious	Total	Impervious	Pervious	Run-off		
hours	mm	Area (ha)	Area (ha)	Area (ha)	Area	Area	Volume	m^3	m^3
		C_v	C_v					Controlled rate (l/s)	
		84.0%	0.0%					63.0	
0.0	0.0	0.75	0.24	0.99	0.00	0.00	0.00	0.00	93.00
0.5	32.7	0.75	0.24	0.99	205.00	0.00	205.00	113.40	206.40
1.0	40.2	0.75	0.24	0.99	251.93	0.00	251.93	226.80	319.80
2.0	48.7	0.75	0.24	0.99	305.77	0.00	305.77	453.60	546.60
3.0	54.3	0.75	0.24	0.99	340.97	0.00	340.97	680.40	773.40
4.0	58.6	0.75	0.24	0.99	367.89	0.00	367.89	907.20	1000.20
6.0	65.2	0.75	0.24	0.99	409.31	0.00	409.31	1360.80	1453.80
8.0	70.2	0.75	0.24	0.99	440.37	0.00	440.37	1814.40	1907.40
12.0	77.8	0.75	0.24	0.99	487.99	0.00	487.99	2721.60	2814.60
18.0	88.7	0.75	0.24	0.99	556.32	0.00	556.32	4082.40	4175.40
24.0	97.2	0.75	0.24	0.99	610.16	0.00	610.16	5443.20	5536.20
36.0	110.7	0.75	0.24	0.99	694.37	0.00	694.37	8164.80	8257.80
48.0	121.2	0.75	0.24	0.99	760.63	0.00	760.63	10886.40	10979.40
72.0	131.0	0.75	0.24	0.99	822.06	0.00	822.06	16329.60	16422.60
96.0	138.4	0.75	0.24	0.99	868.31	0.00	868.31	21772.80	21865.80
144.0	149.5	0.75	0.24	0.99	938.02	0.00	938.02	32659.20	32752.20
192.0	157.7	0.75	0.24	0.99	989.79	0.00	989.79	43545.60	43638.60
								Total Storage Requirement (m^3)	93.00

Table G8: Post-development rapid response run-off from impervious area (1% A.E.P. rainfall including upper end CCA)

Duration	Rainfall	Area (m^2)			Volume (m^3)			Controlled run off	Tangent
	at Site	Impervious	Pervious	Total	Impervious	Pervious	Run-off		
hours	mm	Area (ha)	Area (ha)	Area (ha)	Area	Area	Volume	m^3	m^3
		C_v	C_v					Controlled rate (l/s)	
		Cv	0.0%					63.0	
0.0	0.0	0.75	0.24	0.99	0.00	0.00	0.00	0.00	110.00
0.5	35.6	0.75	0.24	0.99	223.63	0.00	223.63	113.40	223.40
1.0	43.8	0.75	0.24	0.99	274.84	0.00	274.84	226.80	336.80
2.0	53.2	0.75	0.24	0.99	333.57	0.00	333.57	453.60	563.60
3.0	59.3	0.75	0.24	0.99	371.97	0.00	371.97	680.40	790.40
4.0	64.0	0.75	0.24	0.99	401.34	0.00	401.34	907.20	1017.20
6.0	71.2	0.75	0.24	0.99	446.51	0.00	446.51	1360.80	1470.80
8.0	76.6	0.75	0.24	0.99	480.40	0.00	480.40	1814.40	1924.40
12.0	84.8	0.75	0.24	0.99	532.35	0.00	532.35	2721.60	2831.60
18.0	96.7	0.75	0.24	0.99	606.90	0.00	606.90	4082.40	4192.40
24.0	106.1	0.75	0.24	0.99	665.63	0.00	665.63	5443.20	5553.20
36.0	120.7	0.75	0.24	0.99	757.49	0.00	757.49	8164.80	8274.80
48.0	132.2	0.75	0.24	0.99	829.78	0.00	829.78	10886.40	10996.40
72.0	142.9	0.75	0.24	0.99	896.79	0.00	896.79	16329.60	16439.60
96.0	151.0	0.75	0.24	0.99	947.24	0.00	947.24	21772.80	21882.80
144.0	163.1	0.00	0.00	0.00	0.00	0.00	0.00	32659.20	32769.20
192.0	172.1	0.00	0.00	0.00	0.00	0.00	0.00	43545.60	43655.60
								Total Storage Requirement (m^3)	110.00

Average: 101.50

APPENDIX H

Estimate of brownfield surface water run-off rate

16/008: Kirklees College, Dewsbury

Estimate of peak run-off rate from Site 29-Apr-16

NGR	424360	422138		
Catchment area	10300.00	m^2		
% Impermeable (PIMP)	100			
Area draining to sewer	10300.00	m^2		
Length of catchment: L	151	m		
Catchment surface	Impermeable			
SAAR	733	From catchment descriptors		
UCWI	130	Winter profile. From Fig 4.6 SUDS Manual		
SOIL	0.45	Soil type 4		
PR	83.59	Equation 7.3 Wallingford Procedure Vol. 1 Also in Box 4.7, SUDS Manual		
C_v = PR/PIMP	0.84			
C_R	1.3		Wallingford	
U/s elevation	43.95	m		
d/s elevation	43.09	m		
Slope	0.6%	1 in	175.58	
Time of entry	3	min	assuming previous piped drainage	
Time of flow	2.52	min	assuming	1 m/s
Time of concentration T_c	6.00	min	Estimated	

Check for 1-year event:

M1-6min rainfall	3.07	mm
Point intensity	30.65	mm/h
ARF	0.95	
Average intensity	29.12	mm/h
Peak flow rate	91	l/s
70% of peak flow rate	63.35	l/s

End of Report