FLOOD RISK AND DRAINAGE ASSESSMENT

Cleator Mill, Proposed Residential Development, Flood Risk Assessment.

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CONFIDENTIALITY STATEMENT

This report is addressed to and may be relied upon by the following:

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DOCUMENT HISTORY

VERSION	PURPOSE/DESCRIPTION	DATE
1	Draft Issue – for client comment	04.11.2020
2	Amended following Environment Agency comments	12.07.2021
3	Amended following addition flood modelling, LLFA & EA comments.	31.08.2022
4	Updated to suit the revised layout and unnamed watercourse flood modelling.	21.06.2023

1.0 EXECUTIVE SUMMARY

This assessment has looked at the implications of the proposed Residential developments in relation to flood risk, including overtopping and breach analysis as agreed with the Environment Agency during meetings in June 2019.

The proposed development site is shown as being in Flood Zone 3a on the Environment Agency flood maps. When reviewing the defended flood modelling undertaken by the Environment Agency the site is afforded protection for all events up to and including the 1:200 year return period.

The flow rates and water levels for varying events have been considered including the upper central and higher and flow rates are comparable to the 1:1000 year return period, giving a clear indication of potential water levels on the site when looking at the modelled results.

It is proposed to raise FFL's above the 1:1000 year flood levels, as these flood levels are comparable with the 1:100 year plus 70% climate change levels based upon flow rates. FFL's will be raised 600mm above the 1:1000 year flood level for each associated parcel of land. By raising the ground levels and FFL's, will afford the proposed development protection against flood waters regardless of the flood defence condition and performance.

The unnamed watercourse has been modelled pre- and post-development. The pre-modelling shows waters crossing the site at minimum depth from northeast to southwest direction, ultimately discharging to the River Ehen. Post-development betterment has been created with the introduction of a low-lying area which captures circa 767m^3 of and removes this from the flood risk associated with the unnamed watercourse. Flows are then conveyed around the site and to the same end location into the River Ehen. Based on the proposal the development offers betterment when compared to the existing position.

The Environment Agency surface water flood maps have been reviewed against the topography with flows shown coming over the site in a low-risk event. When reviewing the contours and local topography we believe that surface water flows would follow the road, given the kerb phase and raised levels to the site on the boundary as opposed to run straight across the site. As such surface water overland flow can be managed with the route maintained around the perimeter of the development site.

Safe access and egress have been established via the new proposed access road onto the A5086. The overland flood flow routes do not impede the proposed access/egress for the development's new entrance.

The Environment Agency does not provide a Flood Warning Service for Cleator. It is noted that the site is covered by the River Ehen, Calder, Irt and Esk Flood Alert areas, it would therefore be recommended this be included within the homeowner's packs.

A Surface Water Management Plan (SWMP) has been identified including the levels of treatment required to ensure the River Ehen water quality remains protected.

Any potential impact of the development can be adequately addressed by good drainage design.

2.0 INTRODUCTION

RWO Associates Ltd (RWO) has been instructed by Gleeson Regeneration client to prepare a Flood Risk Assessment to support a planning application for a proposed residential development at Cleator in Cumbria.

This site is covered by a Strategic Flood Risk Assessment (by Jacobs dated 2007 and published on the local authority website Strategic Flood Risk Assessment | Copeland Borough Council) commissioned by Copeland Borough Council. This, more detailed, site-specific Flood Risk Assessment supplements the findings of the Strategic Flood Risk Assessment. It is also covered by the more recent Draft Copeland Borough Council, Level 1 SFRA. For clarity and reference purposes this report has utilised the latest Draft SFRA dated 2018 to ensure the latest SFRA maps are utilised

Envireau Water has been utilised to undertake a Breach Analysis of the existing flood defences located on the North and Eastern boundaries, with the locations agreed with the Environment Agency during a meeting in June 2019. Evnireau Water have also modelled the flooding from the unnamed watercourse to the northeast of the development, which ultimately discharges into the River Ehen. The proposed development site has previously been granted outline planning permission for residential use, with RWO Associates Flood Risk assessment reference RO/FRA/RES/13000.3 utilised as a part of the previous planning application.

In addition to the Breach Analysis, Envireau Water has undertaken modelling of the unnamed watercourse located to the north of the development site, adjacent to the junction for Brookside. This analysis has included assessing the existing risk and also considered the impact as a result of the development with mitigation.

The site is currently Greenfield in nature and the client wishes to create residential development; location plans are included in Appendix A.

3.0 THE SITE

The proposed development site is located to the east of Cleator, about 300m to the south of Cleator Moor and immediately to the west of the Lake District National Park; Figure 1 below shows the site location.

Figure 1 – Site Location (Redline indicates approximate extents)

The River Ehen forms the eastern and southern boundary, with residential dwellings located to the west and north. To the immediate south of the proposed development site is the former Kangol hat factory, with the building varying in age between the early 19th Century and the 1960s. The original building was a linen mill in the 19th Century. The eastern portion of the site has a derelict factory located on it, currently owned by Gates. The A5086 is on the north-western boundary of the proposed development site.

4.0 PROPOSED DEVELOPMENT

It is proposed to consider the site for residential development, with circa 84 dwellings to be constructed. Based upon the Copeland Strategic Flood Risk Assessment the development site is located in Flood Zone 3a and 2, with the extent of the flood zone 3a being noted as defended on the online Environment Agency Flood Maps, an extract of the map can be seen below in Figure 2 (area identified as E8) with the full map included in Appendix B.

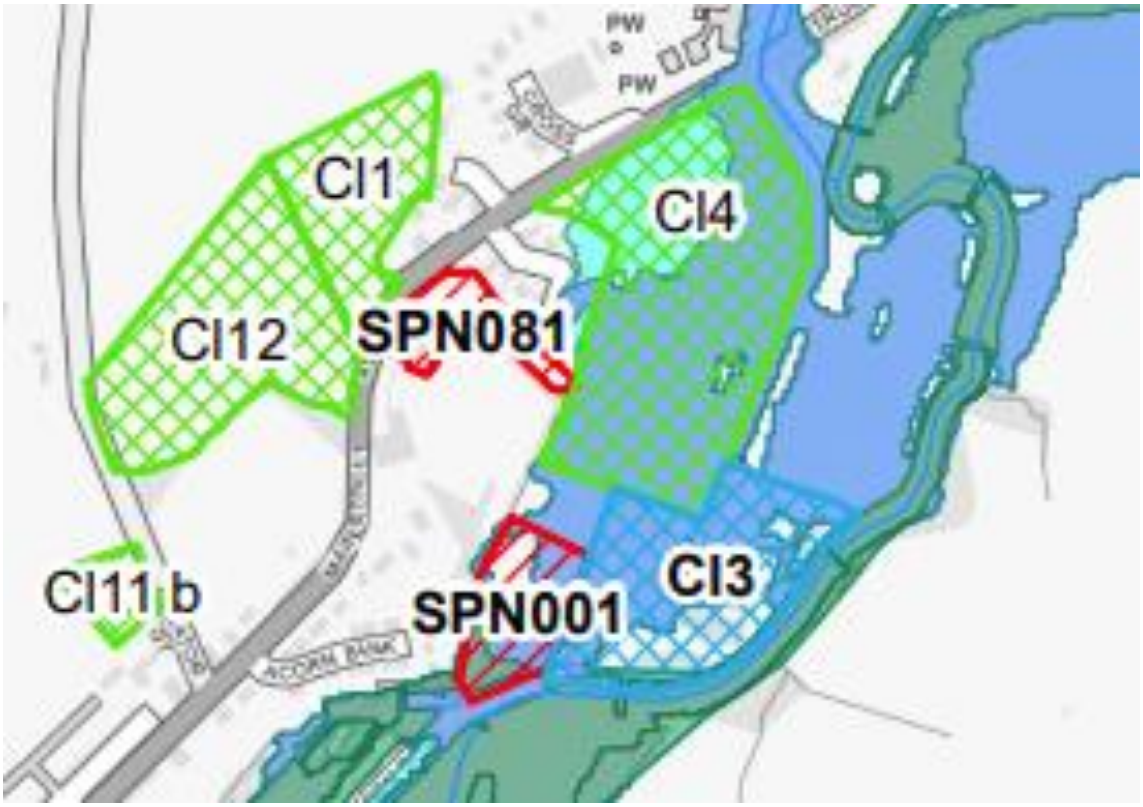


Figure 2 – Draft Copeland SFRA 2018 Extract

As the development site is shown as being located in Flood Zone 3a and 2 with an annual probability of flooding of greater than 1:100 years (>1%) and between 1:100 and 1:1000 years., it will therefore be subject to the sequential and exception test in accordance with NPPF Technical Guidance.

A site layout is included in Appendix C.

5.0 FLOOD RISK

River Ehen

The site is located adjacent to the River Ehen, to the west, within flood zone 3a and 2 as identified by the Copeland Strategic Flood Risk Assessment, map included in Appendix B. Modelled flood levels have been reviewed based upon the Environment Agency hydraulic modelling with further breach analysis undertaken by Envireau Water on behalf of the developer. Envireau Water has utilised the Environment Agency model from 2016, further details noted within the Envireau Water report are included in Appendix F. The unnamed watercourse to the northeast has also been modelled by Envireau Water and this has been included in Appendix G. The Environment Agency modelled flood levels are included below in Table 1.

Cross Section reference	10 Year	25 Year	50 Year	75 Year	100 Year	100+CC Year	200 Year	1000 Year
1896	63.74	63.852	63.898	63.941	63.972	64.029	64.7	64.939
1726	62.013	62.223	62.32	62.42	62.472	62.692	63.383	63.685
1806	63.052	63.284	63.418	63.553	63.621	63.823	63.779	64.135
1606	60.846	61.066	61.219	61.368	61.427	61.658	61.61	62.193
1502	60.275	60.504	60.626	60.744	60.808	61.001	60.953	61.398
1406	59.892	60.118	60.224	60.379	60.451	60.559	60.56	61.039
1299	59.379	59.549	59.64	59.733	59.775	59.912	60.56	61.039
1206	58.826	58.938	58.992	59.044	59.056	59.075	59.071	59.234

Table 1 – Modelled Flood Levels (defended)

Figure 3 below shows the positions of the modelled cross-sections referenced above;

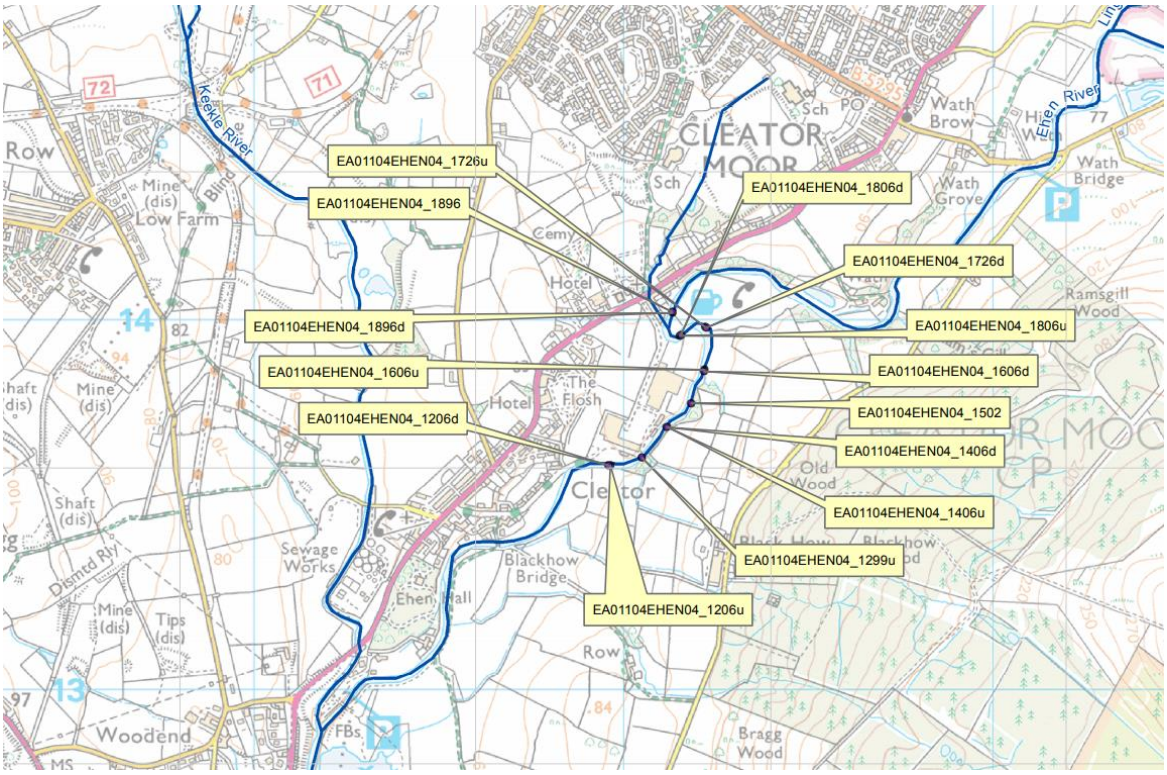


Figure 3 – Modelled Node Locations

RAB Consultants have been employed to survey the existing flood defences and access condition along with associated works, a copy of this report is included in Appendix E. The survey identifies various works which need undertaken immediately and within 1 year, it is recommended these works are carried out prior to works commencing, the total estimate value is £25,300 for the works as identified in the RAB report (RAB; 2869). It is then recommended that a condition survey be completed bi-annually as part of the management company's duties and the results are shared with

the Environment Agency to ensure the flood defences are maintained and any further defects are rectified as part of the Environment Agencies' duties. At the most vulnerable point, on the northern boundary with the River Ehen hard defences are located on the right boundary located between modelled node points 1896 and 1726, as can be seen in Figure 3. The Environment Agency data shows these hard defences are at a 1:200-year standard. Based upon their model and information supplied as part of Product 4. These conditions are generally identified as being condition grade 2, which is Good state of repair, except for some minor vegetation which is noted as condition grade 3. The vegetation should be dealt with and made good to ensure this asset is in all condition grade 2. The only flood defences graded Poor, condition 4, are located off-site southwest along Kiln Brow and do not impact the proposed development. The flood defences impacting the development site are graded mainly condition 3 and some condition 2, good to fair. As such none of, the flood defences are graded poor within the latest condition survey undertaken and included in Appendix E.

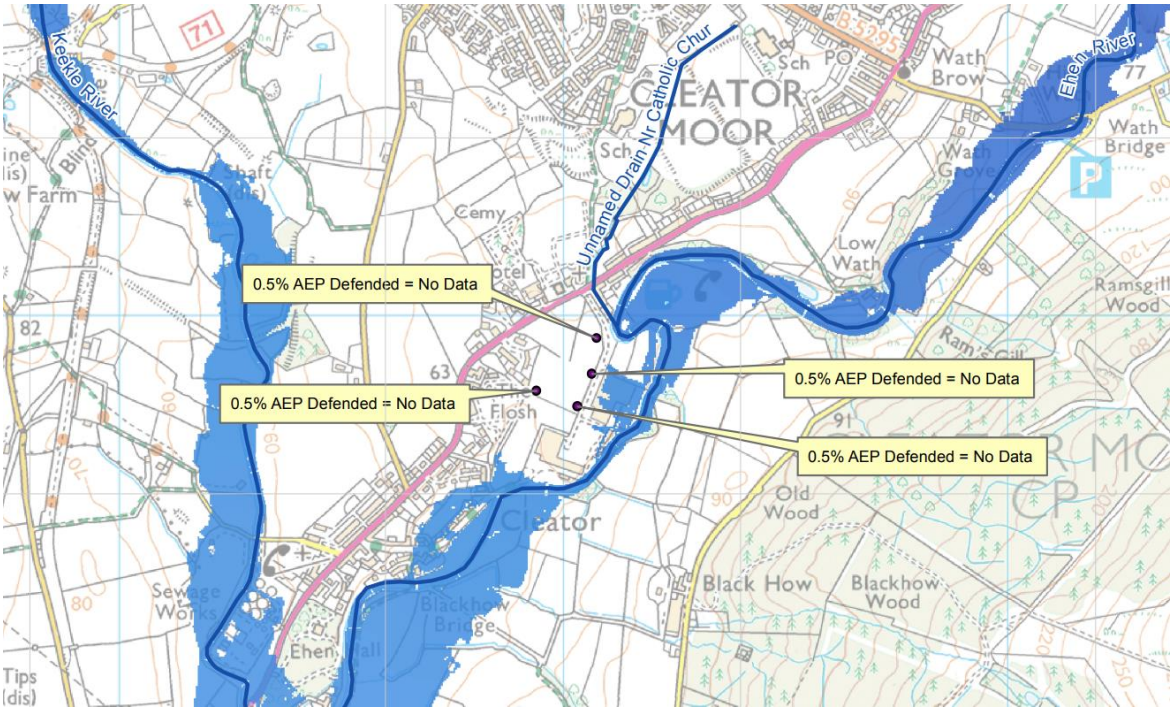


Figure 4 – Extract of Product 4 1:200 Year return period flooding. Defended Scenario

The above extract demonstrates that the site does not flood in the defended scenario when considering the 1 in 200 year turn period from the Environment Agencies modelled flood data. A full suite of Product 4 flood maps is included in Appendix H.

Flood water is shown as breaching the site on the 1 in the 1000 year return period, in the defended scenario impacting approximately 50% of the site as can be seen in the below extract;

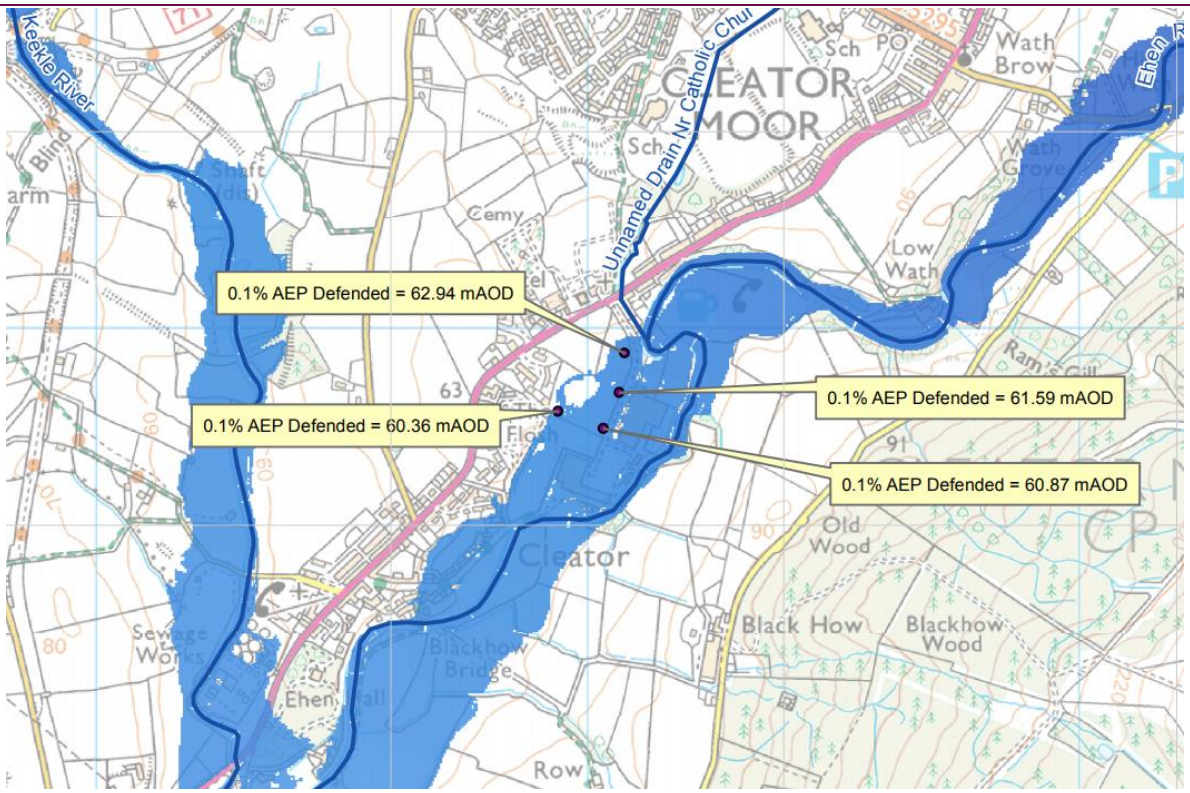


Figure 5 – Extract of Product 4 1:1000 Year return period flooding. Defended Scenario

Based upon the defended scenario the site is located in Flood Zone 2.

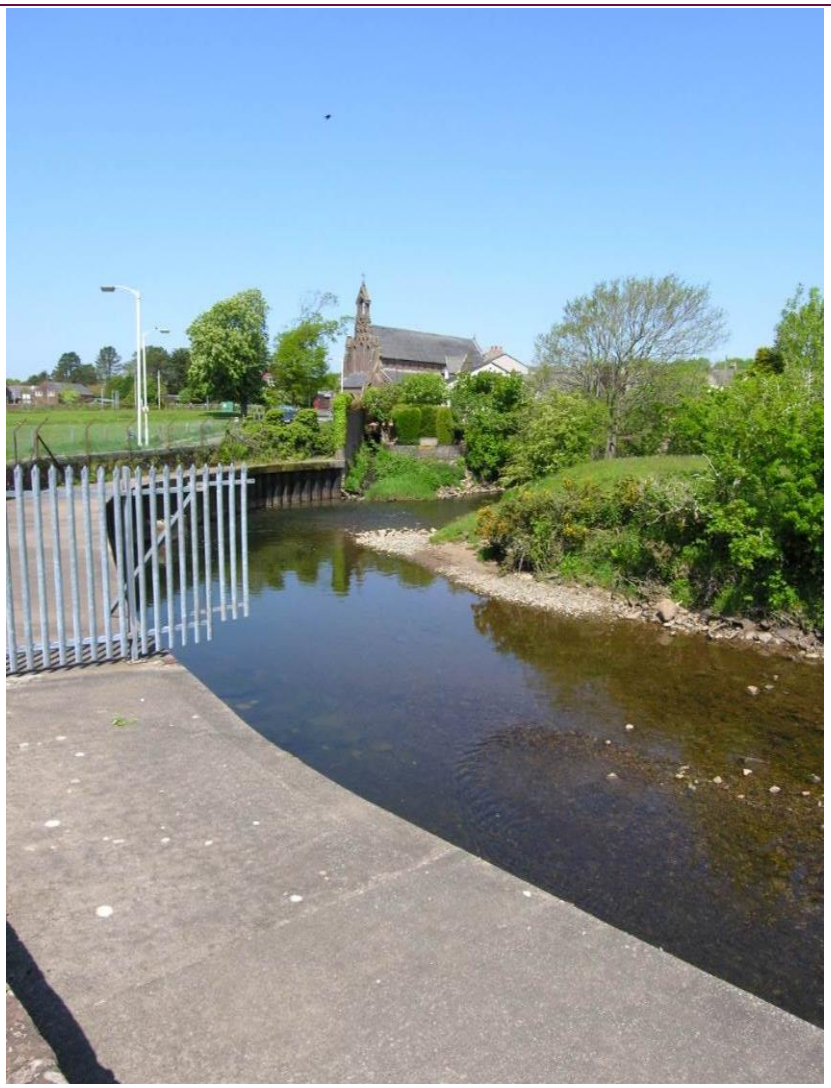


Photo 1 – Hard flood defences between 1896 & 1726

Downstream of the hard defences, soft earth defences exist continuing north to the extents of the Kangol Factory/premises. As states above these afford the site a level of protection to the 1:200 year modelled return period. The location of the modelled reference points has been cross-referenced against a topographical survey undertaken by Site; this is included in Appendix D; this includes sections showing the flood levels against the existing ground levels. The flood levels against the existing ground profiles along the site demonstrate the site is afforded protection up to and including the 1 in 200 years modelled flood level.

To assess the flood risk associated with the proposed development site climate change needs assessing under the Environment Agency guidance for higher central and upper-end allowances as per Table 1: peak river flow allowances by river basin district.

River Ehen – Climate Change Impact

As per the Environment Agency request, the higher central and upper-end allowances for the North West river basin district has been considered. As there is not an Environment Agency model for these climate change uplifts this has been calculated utilising the available data from the Environment Agency data and then compared for sensitivity based upon the peak flow rate increase against the 100 year return period event and comparing the calculated water level.

Node Reference	Water Level 100yr	Flow 100yr	Water Level 100yr + 20%CC	Flow 100yr + 20%CC	Flow 1% increase	Water Level 1% increase
1896	63.972	96.513	64.029	101.484	0.24855	0.00285
1726	62.472	127.207	62.692	143.88	0.83365	0.011
1806	63.621	91.358	63.823	93.242	0.0942	0.0101
1606	61.427	126.737	61.666	145.965	0.9614	0.01195
1502	60.808	129.137	61.001	151.25	1.10565	0.00965
1406	60.451	128.097	60.559	149.927	1.0915	0.0054
	Values taken from Environment Agency Model					

Table 2 – Climate Change increase of water level and flow for each 1% from 100yr to 100yr + 20% CC

Table 2 above shows the increase for each 1% uplift of climate change from the 100 year return period to the 100 year plus 20% climate change, the 1% uplift has been applied to the higher central and upper-end values as identified in Table 1: peak river flow allowances by river basin district.

	Higher central	15%	20%	25%
	Central	10%	15%	20%
North west	H++	25%	45%	95%
	Upper end	20%	35%	70%

Extract 1 – Table 1: peak river flow allowances by river basin district

	Water Level 100yr	Flow 100yr	Water Level 100yr + 20%CC	Flow 100yr + 20%CC	Water Level 100yr + 25%CC	Flow 100yr + 25%CC	Water Level 100yr + 70%CC	Flow 100yr + 70%CC	Flow 1000yr	Water Level 1000yr	Flow 1000yr vs 100 yr + 70% CC	Water level Increase 1000yr vs 100 yr + 70% CC
1896	63.972	96.513	64.029	101.484	64.04325	102.72675	64.1715	113.9115	147.259	64.939	33.3475	-0.7675
1726	62.472	127.207	62.692	143.88	62.747	148.04825	63.242	185.5625	173.534	63.685	-12.0285	-0.443
1806	63.621	91.358	63.823	93.242	63.8735	93.713	64.328	97.952	100.247	64.135	2.295	0.193
1606	61.427	126.737	61.666	145.965	61.72575	150.772	62.2635	194.035	165.107	62.193	-28.928	0.0705
1502	60.808	129.137	61.001	151.25	61.04925	156.77825	61.4835	206.5325	198.323	61.398	-8.2095	0.0855
1406	60.451	128.097	60.559	149.927	60.586	155.3845	60.829	204.502	202.596	61.039	-1.906	-0.21
	Values taken from Environment Agency Model											

Table 3 – Climate Change increase of 25% and 70% as per higher central and upper-end values in Extract 1 above.

Table 3 above gives the increased flow rate for the climate change variations requested, the calculated increase in water depth and a comparison between the modelled Environment Agency 1000-year return period and the calculated 100-year plus 70% climate change. It is worth noting that the calculated water level for the 100-year plus 70% Climate Change is a linear arrangement and assumes the channel profile remains as the water level for the 100-year modelled return period, on this basis, the approach is conservative as the channel, in reality, widens when looking at the surrounding topography.

	Water Level	Flow	Flow	Water Level	Flow	Water level Increase
	100yr + 70%CC	100yr + 70%CC	1000yr	1000yr	1000yr vs 100 yr + 70% CC	1000yr vs 100 yr + 70% CC
1896	64.1715	113.9115	147.259	64.939	33.3475	-0.7675
1726	63.242	185.5625	173.534	63.685	-12.0285	-0.443
1806	64.328	97.952	100.247	64.135	2.295	0.193
1606	62.2635	194.035	165.107	62.193	-28.928	0.0705
1502	61.4835	206.5325	198.323	61.398	-8.2095	0.0855
1406	60.829	204.502	202.596	61.039	-1.906	-0.21
	Values taken from Environment Agency Model					

Extract 2 – Extract of Table 2, showing the calculated 100-year +70% CC vs the 1000-year Environment Agency modelled flood data

When reviewing extract 2 above there are two node anomalies in 1896 & 1726, these nodes relate to locations against the hard flood defences as shown in Photo 1, therefore will not have a linear increase in the rate of discharge as flows are going through an S-bend arrangement as well as being against the hard defences on the southern side of the watercourse. The other nodes show a tangible arrangement between flow rate and predicted depth of water for the 100yr + 70% climate change event for example node 1806 has a 100yr + 70% climate change flow rate of 97.952, with the 1000 year being 100.247 with the predicted 100yr + 70% climate change given an increased water depth of 0.193m over the modelled result. As previously noted this is anticipated given that extrapolating the data out to predict the flow depths for various events does not take into account the change in channel profile however, this is the most accurate way of undertaking this work without fully modelling each reach and the above comparison gives confidence in the answer when comparing flow rate and depths. As such broadly speaking the 100yr + 70% climate change events results align with the 1000-year modelled results, although in some locations the predicted gives a slight increase in water depth.

It is recommended that the 1000yr modelled flood levels be utilised given the close comparison in flow rate between the 100yr + 70% climate change flow rates and the modelled 1000yr flow rates. For summary purposes

Flood History

The fact flood defences have been formed along the boundary with the River Ehen suggests a historic flooding problem. It is understood the flood defences in their current form were constructed in 1978 by English Industrial Estates.

It is noted that the Copeland SFRA states there was some flooding from the River Ehen that caused damage to the factory in the autumn of 2000. A previously prepared FRA noted that the site warden had been interviewed and could not recall any flooding in his 15 years, this was in March 2010. As such if any flooding did occur or to what extent it is unknown. It was noted during our site walkover that outfalls to the River Ehen did not have tidal flaps/non-return valves installed and as such, it may have been possible for waters to back up the onsite drainage system causing localised flooding.

Having reviewed available data and previously prepared reports it is understood during the extensive flooding in Cumbria during 2008 & 2009 this site was not affected.

Flood Defence Overtopping

Flood defences are affording the site protection from the risk of flooding, as identified in Appendix D. The hard flood defences are substantial and appear to be in an operational condition which is supported by the Environment Agencies grade 3 'fair', on the Environment Agencies asset condition criteria. The soft defences and the riverbank do not appear to be adequately maintained to the required standard to ensure effective operation; the Environment Agency have graded these 4 'poor'.

A previous report assessing the condition of the embankment was commissioned by Hampton Investment Properties Ltd and undertaken by Dr John Chatterton, this is included in Appendix E, for reference purposes only.

It is the responsibility of the Environment Agency to ensure flood defences are maintained under their statutory powers. As highlighted by the Environment Agency the flood defences are not within the developer's control and for this reason, all proposed FFL's will be raised above the required flood level so that the quality of the flood defences does not need to be taken into consideration.

As the site is protected to the 1:200-year return period, this risk could be reduced by raising ground levels within the proposed development site, as proposed. Considering the Environment Agencies own modelling data which demonstrates that the site is afforded protection for all events up to and including the 1:200-year return period the site is not currently on floodplain and based upon the flood zones, in the defended scenario, is located in flood zone 2, in effect. As the development does not form a functional flood plain and does not provide storage for flood waters in the current scenario the need for compensation for flood waters does not require addressing. The principle of not providing flood storage compensation was previously agreed upon in the approved 2015 application for residential dwellings on the proposed development site, with no objection raised by the Environment Agency.

Flood Defence Breaching

A detailed breach analysis has been prepared by Envireau Water, with the breach locations agreed in the meeting with the Environment Agency on the 20th June 2019, in their Penrith offices. The two agreed two locations were set as per the original locations agreed with Mott MacDonald who undertook the modelling in October 2013 for the previous application which was approved. In addition to the location, the required storm event was also agreed with the Environment Agency before progressing with the site-specific breach modelling, undertaken by Envireau Water.

based upon the requirements of the Environment Agency have been undertaken. The purpose of the breach analysis was to determine flood extents, depths, velocities and hazard ratings for the site for the 1:100-year return period with climate change as required under NPPF Technical Guidance. Figure 4 below shows the two breach locations which have been utilised and previously agreed with the Environment Agency.

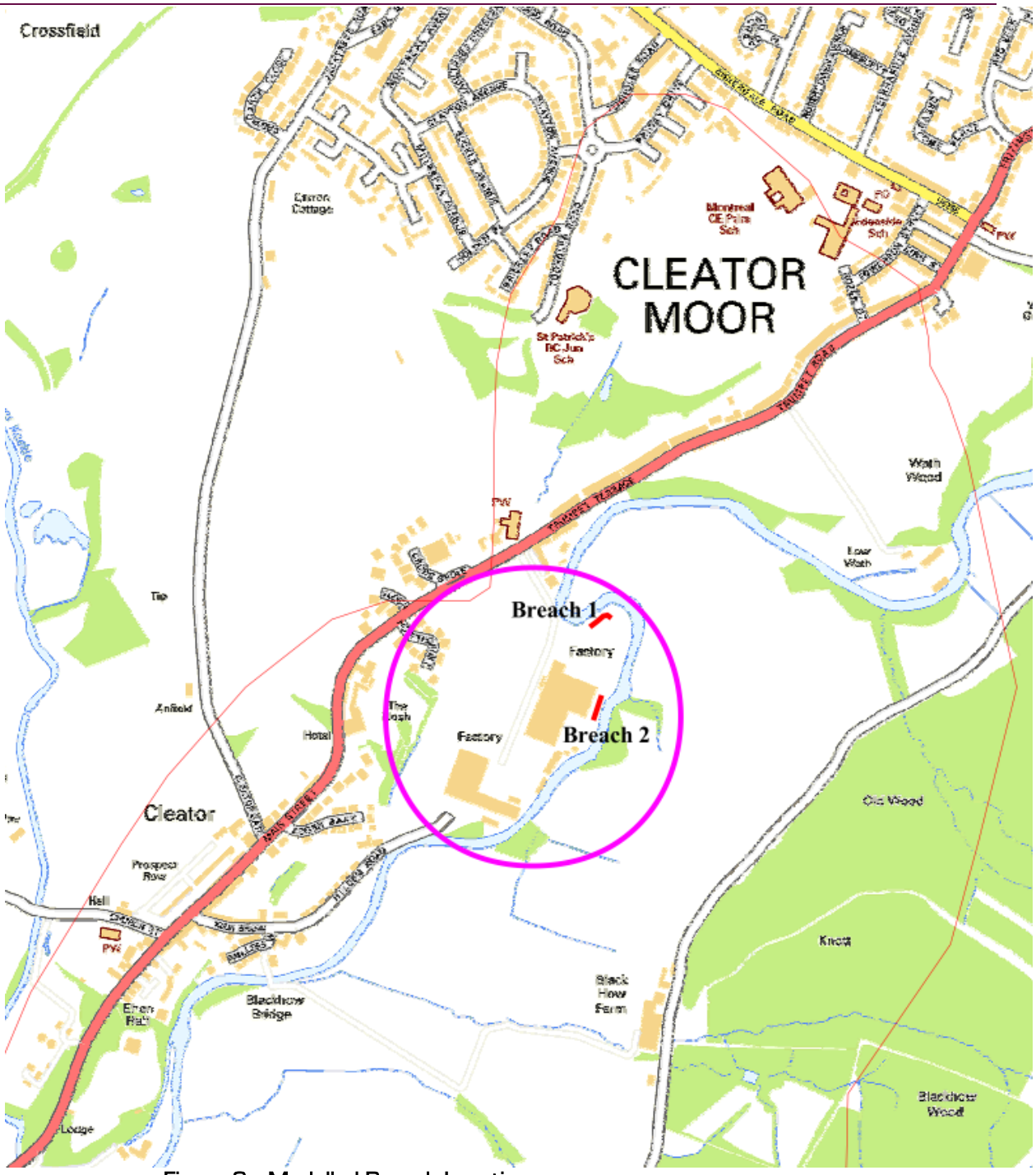


Figure 6 –Modelled Breach Locations

Breach 1

A breach in the gabion baskets north of the site has been considered for the 1:100 year plus climate change return period. The approximate location of the breach event is indicated in Figure 4. During the breach, floodwaters reach the site at the 1.5-hour mark, with the existing Kangol factory being flooded first and then flows head to the west reaching the proposed residential development site.

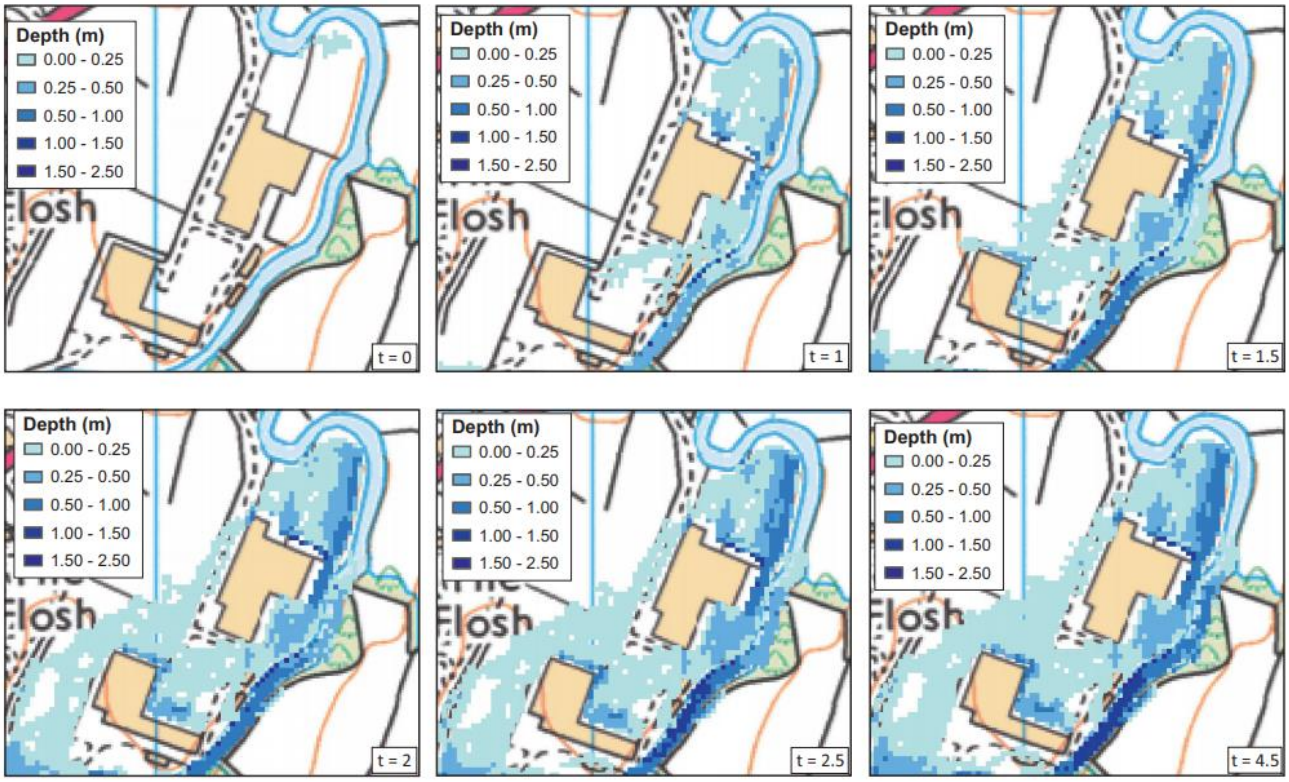


Figure 5 – Extract from Envireau Water of Breach 1

Breach 2

A breach in the earth embankment to the east of the site has been considered for the 1:100 year plus climate change return period. The approximate location of the breach event is indicated in Figure 4. During this breach event, the only building impacted upon is the Kangol Factory which does not form part of this application. As such the risk of the site flooding from a breach at this location is deemed low.

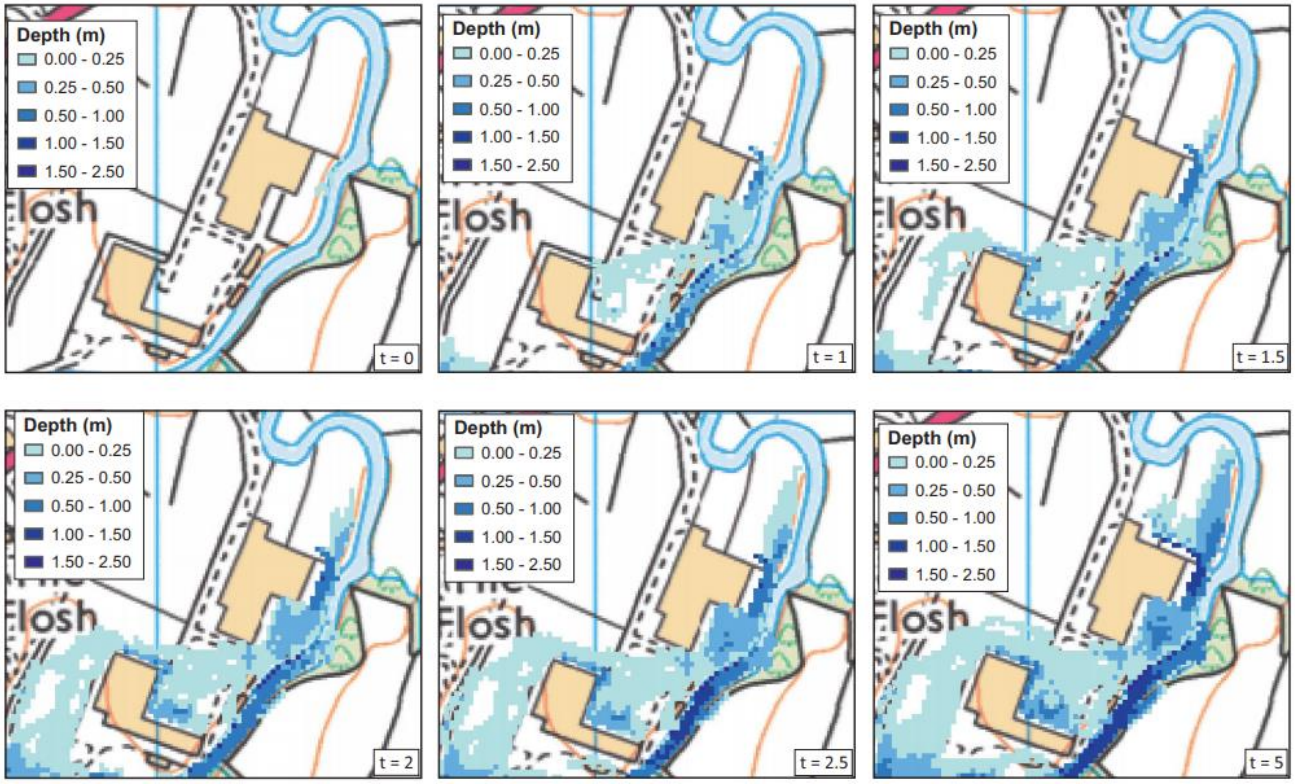


Figure 6 – Extract from Envireau Water of Breach 2

The Envireau Water report 'Updated Flood Risk Modelling – Cleator Mills Site' is included in Appendix F.

Unnamed Watercourse to Northeast

The watercourse to the North East fo the development site has been modelled by Envireau Water with the results included in Appendix K, along with velocity maps. It should be noted that the velocities are low as would be anticipated given the low flow depths. The overland flow route from the unnamed watercourse does not vary in terms of depth for all events up to the 100–year return period, this includes the risk associated with 90% blockage of the culvert which would convey flows to the River Ehen. The depth of water across the site is between 0.01m and 0.1m, so a maximum of 100mm.

The proposed site layout has been reviewed and considered in terms of managing overland flows and reducing the risk associated with overland flows. As part of this proposal, a low-lying area has been introduced to capture flows and reduce the volume of water being conveyed and transferred to the River Ehen. As part of the proposal to manage overland flows from the unnamed watercourse the number of dwellings has been reduced on the site from 115 down to 84 which creates the space to manage the flows and reduce the volume. The area created on the northeastern boundary can accommodate a volume of 767m^3 of flows from the unnamed watercourse. This in turn removes that volume from the overland flow and reduces the flood risk to third parties as a result. A site layout is included in Appendix C which includes the low-lying area.

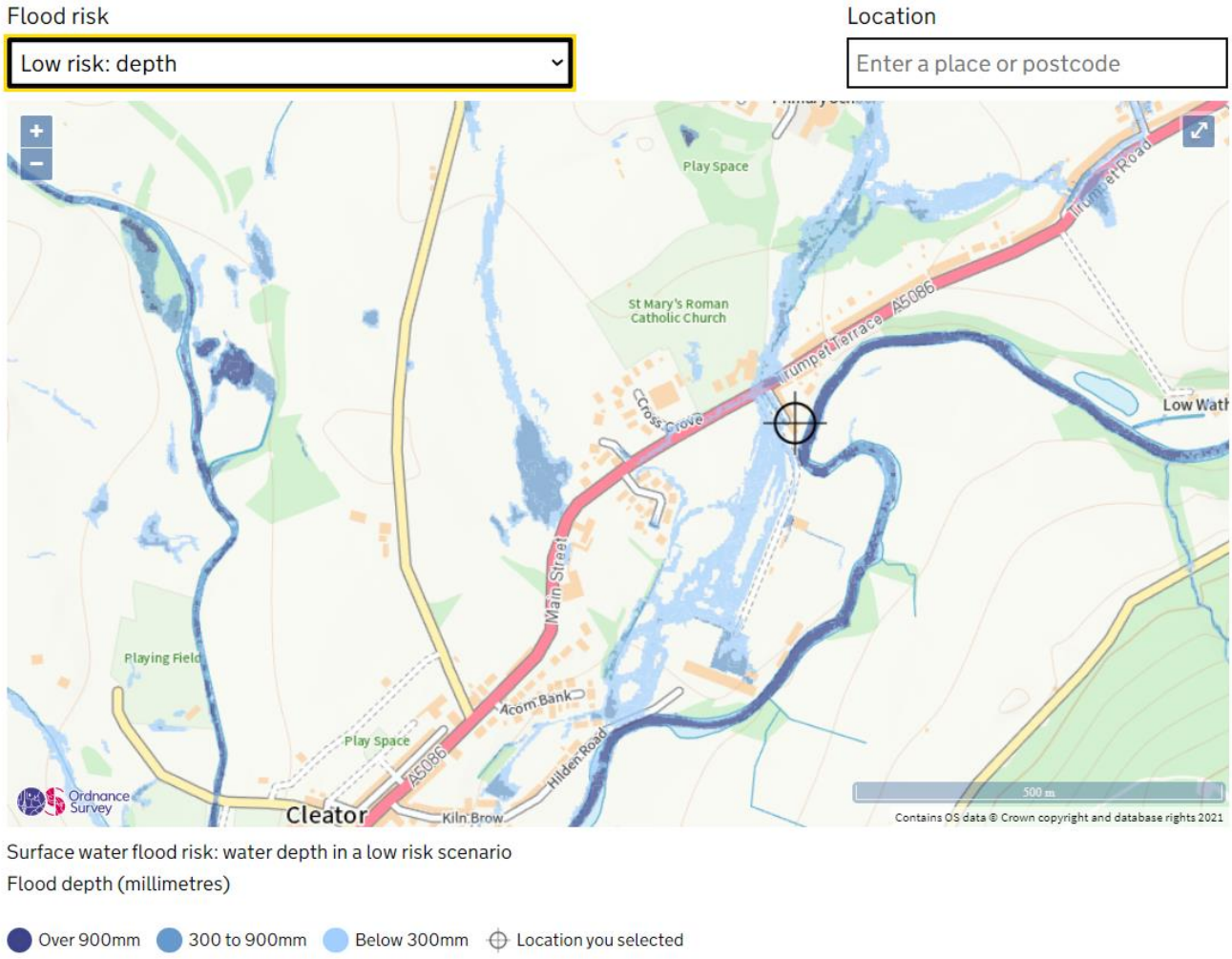
In terms of the overland flow route post development, there are no dwellings impacted and flows are being directed around the development and ultimately end up back in the river Ehen to the west of the proposed development. The routing of the flows varies slightly to the south of the site, as it utilises existing overland flow routes along the existing road pattern.

Based upon the proposal to control and convey overland flows from the unnamed watercourse, which will bring benefit to the local area and reduce flood risk by capturing some of the waters, the development will have a positive impact on the risk associated with the unnamed watercourse. The

modelling demonstrates the overland flow route can be managed as part of the proposed development.

Surface Water Flooding

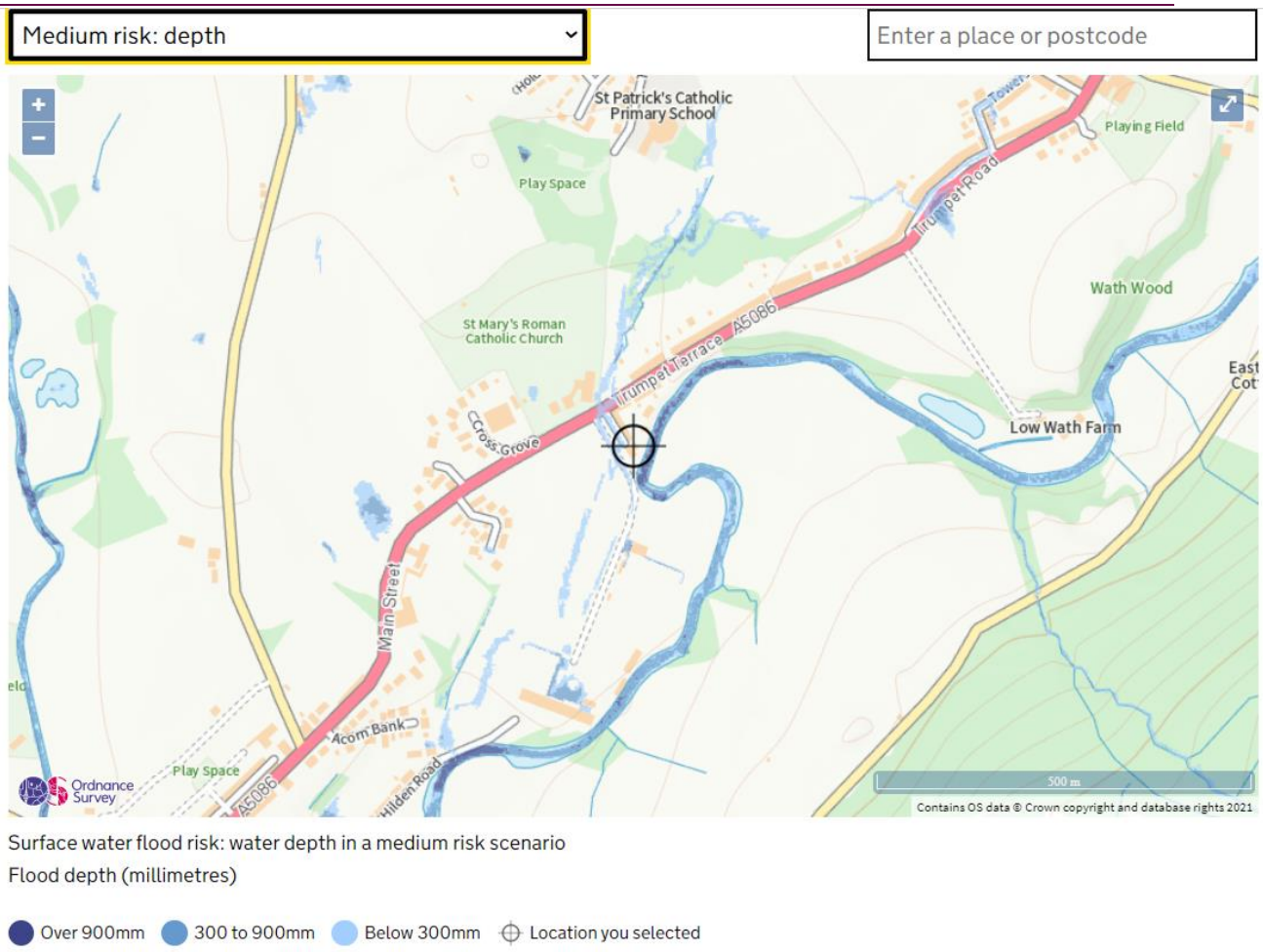
The surface water flood map available on the Environment Agency website (see Figure 7) indicated that part of the site is at risk of flooding due to surface water. The proposed residential development is at low risk of flows being conveyed across the site as identified by the Environment Agencies' own flood maps.



Extract 3 – Environment Agency Low-Risk Surface Water flood maps (17.07.2021)

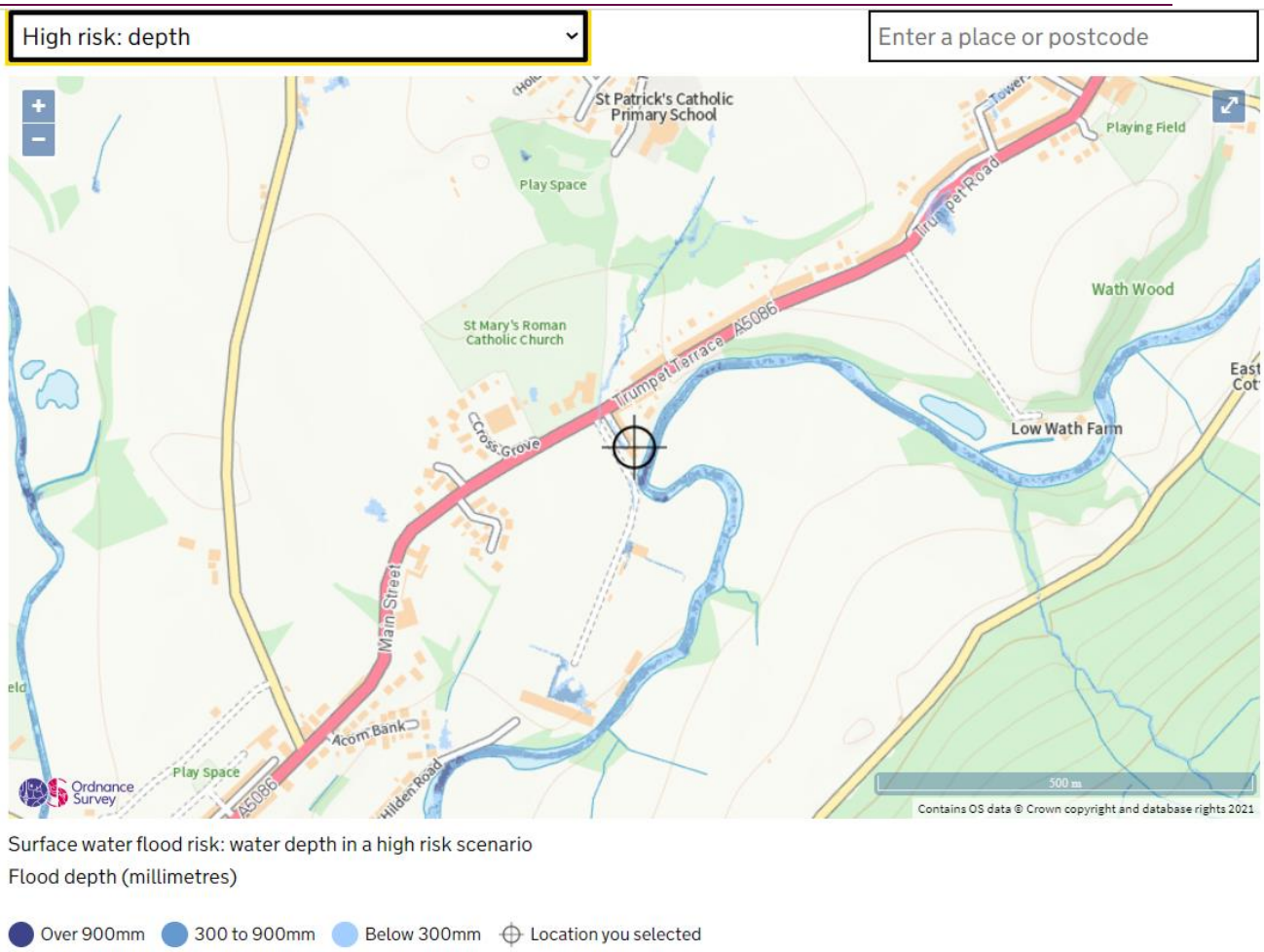
The flow route itself is somewhat questionable given the topography given the kerb face along the road is circa 100mm and the route of flows appears to follow a raised mound as can be seen in picture 2 below;

Photo 2 – Raised mound and kerbs along overland flood route



Extract 4 – Environment Agency Medium-Risk Surface Water flood maps (17.07.2021)

The Environment Agency medium flood risk maps demonstrate that no flows are being conveyed over the site and that water appears to be ponding in localised areas.



Extract 5 – Environment Agency High-Risk Surface Water flood maps (17.07.2021)

Extract 5 above highlights that the site is not at a high risk of surface water flooding.

Considering the risk of surface water flows and reviewing the local topography, a topographical survey is included in Appendix I, this demonstrates that flows would most likely follow the existing road rather than overtop the kerb and flow over the site. The data set utilised by the Environment Agency does not appear to take into account the kerbs. RWO have down a flow routing planning showing that the flows would follow the road wrapping around the site based on the existing levels and taking into account the kerbs, the drawing is included in Appendix J As such the surface water flood route for overland, flows could be maintained and the proposed dwellings afforded protection by raising FFL's over 300mm over the road levels and grading gardens from the higher FFL's to the lower road level. Raising the FFL's would ensure any overland flows which escaped the existing road would not flood properties and afford protection whilst maintaining flow routes.

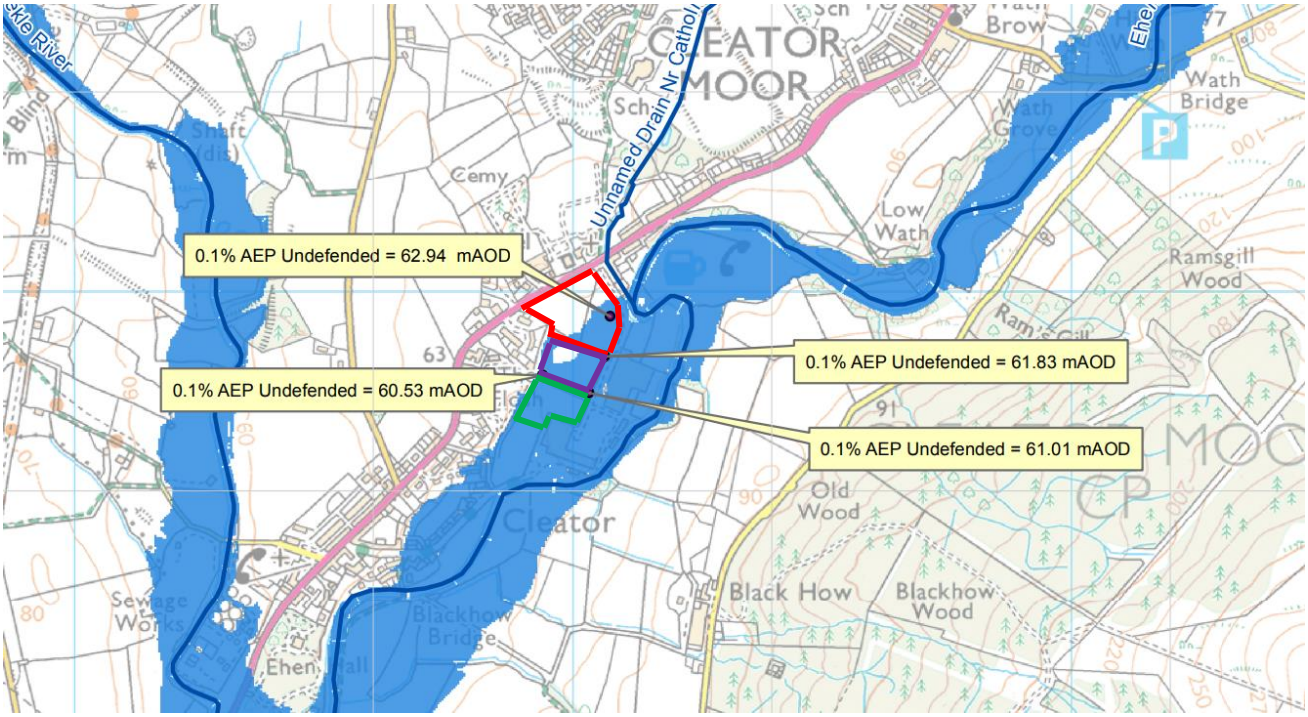
Based on the Environment Agency surface water flood map surface water runoff enters the River Ehen to the South. South-East of the development site. Ground levels should be maintained to ensure this flood route can be utilised in the event of a surface water flooding incident.

6.0 RECOMMENDED FINISHED FLOOR LEVELS

To afford future development a level of protection against future flooding, it is our normal recommendation to increase Finished Floor Levels (FFL) by 600mm over the 1:100-year return period plus climate change. However, as requested by the Environment Agency the 25% upper central and 70% higher central climate change has been reviewed and to ensure the site is protected against these potential future events it is recommended FFL's are raised above the

1000yr modelled flood levels for the undefended scenario. This scenario then ensures should the flood defences fall into disrepair the new dwellings will be afforded protection and not at risk of flooding.

Based upon these proposals FFL's across the site will be varied subject to the Environment Agencies modelled flood level for the 1:1000 year return period (0.1%).



Extract 6 – Environment Agency undefended 1000 year flood levels

Based upon the above-modelled flood levels the site has been split into three areas with a minimum FFL established for each area. Area 1 (red outline), relates to the modelled flood level of 62.94m, Area 2 (purple outline) the modelled flood level of 61.83m and Area 3 (green outline) the modelled flood level of 61.01m. With the FFL's being set 600mm above the relevant modelled flood level.

The proposal to raise ground levels will ensure in the event of the flood defences failing the proposed dwellings remain protected. A comparison between existing and proposed levels is included in Appendix M. This shows the only real significant ground-level changes are to the southern extent of the development, with some localised variations across the centre.

Area 1 covers the area in terms of topography for the 62.94m flood level on the basis it tied to the lower flood level of 61.83m ensuring these dwellings will be protected. The modelled flood node shows a water level of 62.94m, this area will require a minimum FFL of 63.54m AOD.

Area 2 covers the area in terms of topography for the 61.83m flood level on the basis it tied to the lower flood level of 61.01m ensuring these dwellings will be protected. The FFL's for Area 2 need to be at a minimum of 62.43m AOD. Area 3 starts at the flood level of 61.01m and covers the remainder of the site, requiring a minimum FFL of 61.061m AOD.

The FFL's have been reviewed across the site based upon the modelled 1:1000yr flood levels, given there is a direct relationship for most node points between the flow rates of the 1000yr return period and that of the calculated 100yr + 70% climate change allowance flow rate. Through the raising of FFL's the whole of the residential estate will be afforded protection for the lifetime of the development regardless of the flood defence quality and future maintenance.

7.0 SAFE ACCESS AND EGRESS

As the proposed development site will be serviced by new access onto the A5086 located to the west of the development site, safe access and egress will always be achievable. In the event of a breach occurring in the northern flood defences, the extents of flooding do not impact upon the proposed access.

It is noted that the Environment Agency does not provide a Flood Warning service for the Cleator community. However, taking into consideration the access/egress location and the proposed FFL's, the risk of access/egress being unachievable is deemed low.

The surface water management plan associated with this development site has been considered utilising the following documentation;

- Building Regulations Part H,
- Sewers for Adoption,
- CIRIA C697

8.0 GROUND CONDITIONS

Elliot Environmental have undertaken the Site Investigation associated with the site with Geo-Environmental Engineering undertaking further soil infiltration tests following BRE365. Elliot Environmental reported ground conditions to have Sand and Gravel, which prompted the further investigation works undertaken by Geo Environment Engineering.

Geo-Environmental Engineering received instruction to undertake six soil infiltration tests across the site following BRE365. Figure 2 below shows the locations of the soil infiltration test results.

Figure 2 – Soil Infiltration Test Locations

SA01 recorded Topsoil from 0.00 – 0.40m with Sand & Gravel recorded from 0.40 – 2.00m, soil infiltration test results for this location have been calculated as 6.04665^{-5} m/s.

SA02 recorded Topsoil from 0.00 – 0.30m, Sand from 0.30 – 0.70m and 0.70 – 2.00m Sand & Gravel, soil infiltration test results for this location have been calculated as 4.97347^{-5} m/s.

SA03 recorded Topsoil from 0.00 – 0.20m with Sand recorded from 0.20 – 0.80m and Sand & Gravel from 0.80 – 2.00m, soil infiltration test results for this location have been calculated as 2.39464^{-5} m/s.

SA04 recorded Topsoil from 0.00 – 0.30m with Sand & Gravel recorded from 0.30 – 1.50m, soil infiltration test results for this location have been calculated as 2.27591^{-5} m/s.

SA05 recorded Topsoil from 0.00 – 0.35m with Sand recorded from 0.35 – 0.60m and Sand & Gravel from 0.60 – 2.00m, soil infiltration test results for this location have been calculated as 2.24551^{-5} m/s.

SA06 recorded Topsoil from 0.00 – 0.50m with Sand & Gravel recorded from 0.50 – 0.90m and Sand & Gravel from 0.90 – 1.50m, soil infiltration test results for this location have been calculated as 4.22297^{-5} m/s.

All of the recorded soil infiltration rates are well within the acceptable rates and as such the site will be suitable to utilise infiltration. Based upon this in accordance with Building Regulations and the CIRIA SuDS train, surface water should discharge into suitably designed soil infiltration drainage systems.

Geo-Environmental Engineering report is included in Appendix G.

9.0 RECEIVING WATERS

The nearest watercourse is the River Ehen, which generally flows in a south-westerly direction. The Ehen is located on the immediate eastern and southern boundaries of the proposed development site. It has been reported that the water quality within the River Ehen is Quality A in the past.

There is also a small issue located in the western boundary, which discharges into the River Ehen. A further small watercourse is shown flowing southwest before sinking or being culverted approximately 75m from the northern end of the site.

The critical issue relating to the surface water run-off from the proposed development site relates to the River Ehen which is classified as a Site of Special Scientific Interest (SSSI) and a Special Area of Conservation (SAC). It is understood that a direct discharge to the River Ehen has been deemed as unacceptable, based upon this it is proposed to utilise infiltration to dispose of surface water as stated in section 8.0 of this report.

10.0 SURFACE WATER MANAGEMENT PLAN

The surface water management plan associated with this development site has been considered utilising the following documentation;

- Building Regulations Part H,
- Sewers for Adoption,
- CIRIA C697

Soil Infiltration

Section 4.0 Ground Conditions, includes a summary of the soil infiltration test results which have been undertaken by Geo-Environmental Engineering in accordance with BRE 365. A total of six tests have been undertaken, a summary of the results is below in table 1.

Soil Infiltration Test	Results
SA01	6.04665^{-5} m/s
SA02	4.97347^{-5} m/s
SA03	2.39464^{-5} m/s
SA04	2.27591^{-5} m/s
SA05	2.24551^{-5} m/s
SA06	4.22297^{-5} m/s

Table 1 – Soil Infiltration Test Results

The above summary of soil infiltration test results demonstrates that soil infiltration can be utilised across the proposed development site.

Based upon the soil infiltration test results the use of soakaways to accommodate the surface water runoff is deemed as viable. It is recommended that further water monitoring be undertaken to ascertain the water level across the proposed development.

11.0 CONCLUSIONS

This assessment has looked at the implications of the proposed Residential developments in relation to flood risk, including overtopping and breach analysis as agreed with the Environment Agency during meetings in June 2019.

The proposed development site is shown as being in Flood Zone 3a on the Environment Agency flood maps. When reviewing the defended flood modelling undertaken by the Environment Agency the site is afforded protection for all events up to and including the 1:200 year return period.

The flow rates and water levels for varying events have been considered including the upper central and higher and flow rates are comparable to the 1:1000 year return period, giving a clear indication of potential water levels on the site when looking at the modelled results.

It is proposed to raise FFL's above the 1:1000 year flood levels, as these flood levels are comparable with the 1:100 year plus 70% climate change levels based upon flow rates. FFL's will be raised 600mm above the 1:1000 year flood level for each associated parcel of land. By raising the ground levels and FFL's, will afford the proposed development protection against flood waters regardless of the flood defence condition and performance.

The unnamed watercourse has been modelled pre- and post-development. The pre-modelling shows waters crossing the site at minimum depth from northeast to southwest direction, ultimately discharging to the River Ehen. Post-development betterment has been created with the introduction of a low-lying area which captures circa 767m^3 of and removes this from the flood risk associated with the unnamed watercourse. Flows are then conveyed around the site and to the same end location into the River Ehen. Based on the proposal the development offers betterment when compared to the existing position.

The Environment Agency surface water flood maps have been reviewed against the topography with flows shown coming over the site in a low-risk event. When reviewing the contours and local topography we believe that surface water flows would follow the road, given the kerb phase and raised levels to the site on the boundary as opposed to run straight across the site. As such surface water overland flow can be managed with the route maintained around the perimeter of the development site.

Safe access and egress have been established via the new proposed access road onto the A5086. The overland flood flow routes do not impede the proposed access/egress for the development's new entrance.

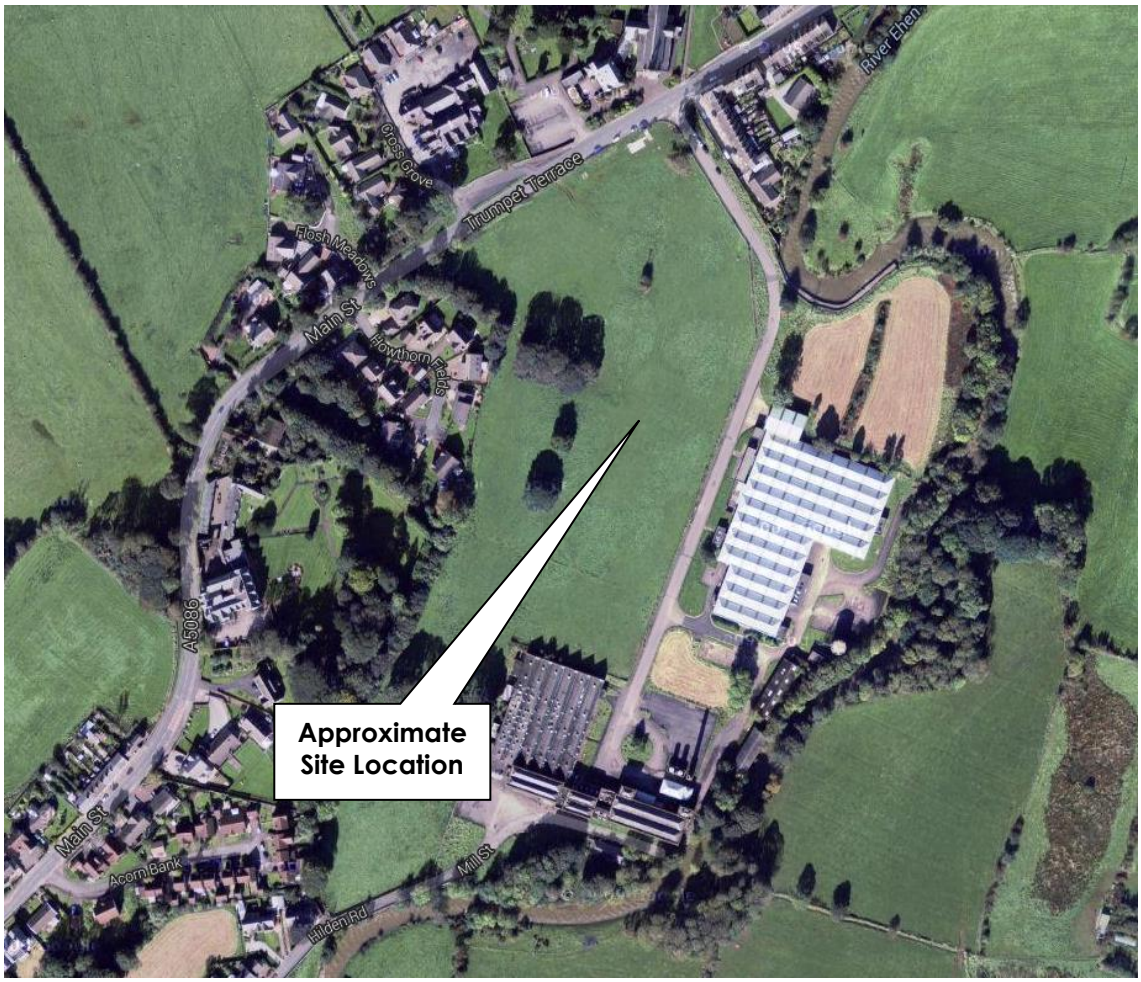
The Environment Agency does not provide a Flood Warning Service for Cleator. It is noted that the site is covered by the River Ehen, Calder, Irt and Esk Flood Alert areas, it would therefore be recommended this be included within the homeowner's packs.

A Surface Water Management Plan (SWMP) has been identified including the levels of treatment required to ensure the River Ehen water quality remains protected.

Any potential impact of the development can be adequately addressed by good drainage design.

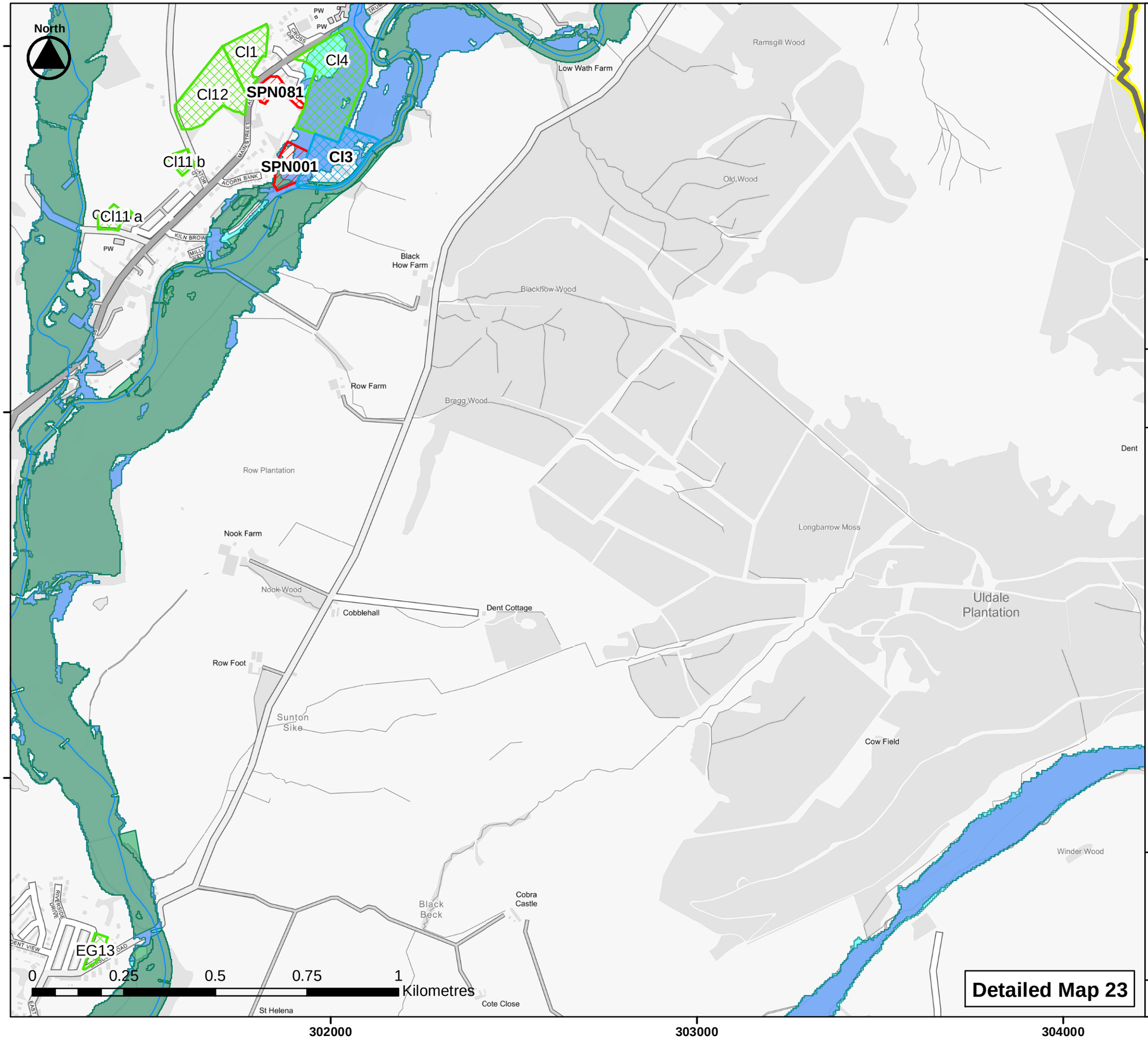
Ross Oakley
For and behalf of RWO Associates Limited
November 2020

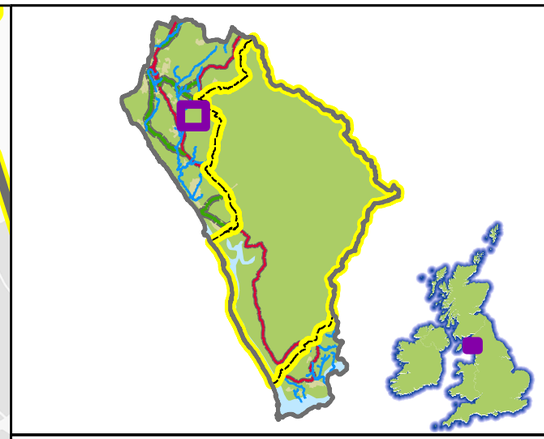
Appendix A Site Location Plan



Location Map	
Site	Cleator Mill - Residential
Client	Gleeson Regeneration
Job Number	19002
Scale	NTS

Appendix B Flood Map





LEVEL 1
STRATEGIC FLOOD RISK ASSESSMENT
For
COPELAND BOROUGH COUNCIL

Please select a data type from the dropdown menu below that you wish to view:

CBC boundary
LDNP boundary
Detailed River Network
Other LPA boundary

Potential Development Sites
Employment Allocations
Possible Housing Allocations
Employment Opportunity
Possible Opportunity Sites

New Sites Submitted 2
Residential
Mixed Use
Employment
Community Garden

Flood Zone 3b
Flood Zone 3a
Flood Zone 2

Show Site Reference Labels

JBA consulting

Copeland borough council

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Appendix C Proposed Engineering Layout

N

BOUNDARY RETAINING TO BE DISCUSSED WITH LAND OWNER

GABION RETAINING TO BASIN SUBJECT TO DETAILED DESIGN

PLOT 48 TO BE MOVED BACK TO ALLOW FOR FOUL SEWER EASEMENT

BOUNDARY RETAINING TO BE DISCUSSED WITH LAND OWNER

HEALTH & SAFETY:

1. CONTRACTOR SHOULD BE AWARE OF GENERAL CONSTRUCTION RISKS TO PREVENT SLIPS, TRIPS AND FALLS AND TAKE NECESSARY PRECAUTIONS WITHOUT SPECIAL INSTRUCTION.

ROADS & DRAINAGE

2. CONTRACTOR TO PROVIDE TRENCH SUPPORTS AS APPROPRIATE AND ENSURE THAT PLANT REMAINS A SAFE DISTANCE FROM TRENCHES PRIOR TO INSTALLING DRAINAGE
3. THE TIME THAT EXCAVATIONS ARE OPEN ON SITE SHOULD BE KEPT TO A MINIMUM AND ALL TRENCHES SHOULD BE SURROUNDED BY A BARRIER.
4. CONNECTIONS TO EXISTING SEWERS TO BE MADE BY APPROVED CONTRACTOR ONLY.
5. CONTRACTOR TO MAKE OPERATIVES AWARE OF ASSOCIATED DANGERS TO HEALTH SUCH AS LEPTOSPIROSIS (WEILS DISEASE) AND RECOMMENDED PRECAUTIONS. ADEQUATE WELFARE FACILITIES AND PROTECTIVE CLOTHING TO BE PROVIDED AS REQUIRED.
6. UNFINISHED MANHOLES MUST BE COVERED WITH LOAD BEARING MATERIALS AND SURROUNDED WITH BARRIERS.

PIPES & CABLES

7. CONTRACTOR TO OBTAIN ALL SERVICE RECORDS PRIOR TO WORKS COMMENCING.
8. SERVICE RECORDS TO BE REFERRED TO PRIOR TO WORK COMMENCING. CONTRACTOR TO PROCEED WITH CAUTION AND SERVICES TO BE LOCATED BY HAND DIG AND PROTECTED ACCORDINGLY.

EXCAVATIONS/FILL

9. CONTRACTOR TO ENSURE RELEVANT MEASURES ARE TAKEN TO KEEP PLANT AND PEOPLE A SAFE DISTANCE FROM STEEP SLOPES DURING THE WORKS.
10. CONTRACTOR TO ENSURE THAT PROCEDURES ARE IN PLACE TO KEEP PEOPLE A SAFE DISTANCE FROM WORKING PLANT WHERE NECESSARY.
11. CONTRACTOR TO REFER TO GROUND INVESTIGATION REPORT FOR CONTAMINATION TESTS AND TO PROVIDE ADEQUATE WELFARE FACILITIES AND PROTECTIVE CLOTHING AS REQUIRED.

DRAINAGE SPECIFICATIONS

1. ALL ADOPTABLE DRAINAGE WORKS AND MATERIALS TO BE IN ACCORDANCE WITH 'SEWERS FOR ADOPTION' 6TH EDITION, THE RELEVANT BRITISHEUROPEAN AND THE ADOPTING WATER AUTHORITIES STANDARDS/REQUIREMENTS/ADDENDUM TO THE MECHANICAL AND ELECTRICAL SPECIFICATION AND KITEMARKED.
2. FILLED GROUND MUST BE FILLED AND CONSOLIDATED UNDER THE SUPERVISION AND TO THE SATISFACTION OF THE ADOPTING WATER AUTHORITY BEFORE ANY SEWER WORKS ARE CARRIED OUT.
3. ALL ADOPTABLE SEWERS TO BE LAID TO A GRADE APPROVED BY THE WATER AUTHORITY.
4. PLASTIC CHANNEL SECTIONS IN MANHOLES ARE NOT ACCEPTABLE AND THE WATER AUTHORITY PREFER CLAYWARE CHANNEL IN MANHOLES. PLASTIC CHANNELS ARE DIFFICULT TO SET IN CONCRETE BECAUSE THEY FLOAT AND A SATISFACTORY FINISH CANNOT BE OBTAINED ON THE BENCHING.
5. THE WATER AUTHORITY IS NOT OBLIGED TO ACCEPT FILTER DRAINLAND DRAINAGE RUN-OFF INTO THE PUBLIC SEWER NETWORK OR ADOPTABLE DRAINAGE SYSTEM DIRECTLY OR INDIRECTLY. AN ALTERNATIVE METHOD OF DISPOSAL OF THE LAND DRAINAGE RUN-OFF WILL THEREFORE BE REQUIRED AND YOU WILL HAVE TO LIAISE WITH THE LOCAL AUTHORITY, LAND DRAINAGE SECTION WITH REGARD TO THE DISPOSAL OF THE FILTER DRAINLAND DRAINAGE RUN-OFF.
6. SULPHATE RESISTANT CEMENT (CQUOZC) AND PRECAST CONCRETE PRODUCTS MUST BE USED OR A LABORATORY REPORT PROVIDED PROVING THAT SUCH PRECAUTIONS ARE NOT NECESSARY.
7. THE ADOPTABLE SEWERS SHOULD BE A MINIMUM OF 1M AND MANHOLES 0.5M FROM KERB FACES AND SERVICE MARGINS.
8. "SEWERS MUST HAVE 5 METRES CLEARANCE FROM TREES AND HEDGES (PLEASE ALSO REFER TO FIGURE 2.3 ON PAGE 33 IN "SEWERS FOR ADOPTION" 6TH EDITION FOR RESTRICTIONS ON TREE PLANTING ADJACENT TO SEWERS)".
9. SEWERS TO BE LAID IN CLASS 'S' BEDDING (150MM GRANULAR BED AND SURROUND). WHERE DEPTH OF COVER TO TOP OF THE SEWER IS LESS THAN 1.2M IN HIGHWAYS AND VERGES OR LESS THAN 900MM IN NONE VEHICULAR ACCESS AREAS) THEN A CONCRETE SLAB SHOULD BE PROVIDE ABOVE GRANULAR BED AND SURROUND.
10. CLASS Z BEDDING DETAIL SHALL BE PROVIDED WHERE COVER TO THE PIPE BARREL IS LESS THAN 1.2M IN VEHICULAR TRAFFICKED AREAS AND 0.9M ELSEWHERE, TO ALL ROAD GULLY CONNECTIONS AND WITHIN AREAS OF DEEP ROOTING VEGETATION.
11. WHERE CLASS Z TRENCH BEDDING DETAIL IS USED, THE CONCRETE BED AND SURROUND SHALL BE DISCONTINUED AT EACH PIPE JOINT OVER THE FULL CROSS SECTION BY MEANS OF A SHAPED COMPRESSIBLE FILLER.
12. BEDDING AND BACKFILL MATERIAL TO CONFORM TO THE REQUIREMENT OF WATER INDUSTRY SPECIFICATION 4-08-02 (TABLE A2).
13. THE CHAMBER SIZE OF MANHOLES WITH MORE THAN ONE CONNECTION IN THEM MAY NEED TO BE INCREASED AN INCREMENT TO ACCOMMODATE THE CONNECTIONS AND BENDS.
14. ALL PRIVATE DRAINAGE WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH BUILDING REGULATIONS 2002 EDITION.
15. CONTRACTOR TO ESTABLISH POSITION SIZE AND DEPTH OF ALL EXISTING SEWERS AND SERVICES PRIOR TO COMMENCEMENT ON SITE.
16. THE CONTRACTOR SHALL ALLOW FOR THE PROTECTION, TEMPORARY AND PERMANENT SUPPORT, AND TEMPORARY AND PERMANENT DIVERSION WORKS, AS NECESSARY TO ALL EXISTING SERVICES.
17. THE CONTRACTOR SHALL ALLOW FOR ALL TRAFFIC MANAGEMENT IN CONNECTION WITH ROAD AND SEWER WORKS.
18. THE CONTRACTOR SHALL ALLOW FOR KEEPING SEWER TRENCHES AND EXCAVATIONS AS DRY AS PRACTICABLE BY PUMPING FROM TEMPORARY SUMPS AND DE-WATERING AS APPROPRIATE. THE POINT AND METHOD OF DISCHARGE TO BE AGREED WITH THE DRAINAGE AUTHORITY.
19. FOR PIPE SPECIFICATION PLEASE REFER TO ADDITIONAL NOTES.
20. VITRIFIED CLAY PIPES AND FITTINGS SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN295 AND BS 65 RESPECTIVELY AND BE KITEMARKED. ALL PIPES SHALL BE EXTRA STRENGTH TO BS EN OR EQUIVALENT BS EN295 PIPE CRUSHING STRENGTH.
21. STRUCTURED WALL PLASTIC PIPES TO WIS 4-35-01 MAY BE USED FOR FOUL & SURFACE WATER DRAINAGE, SUBJECT TO ADOPTING AUTHORITY APPROVAL.
22. PRECAST CONCRETE PRODUCTS SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS 5911 AND BE KITEMARKED. CONCRETE PIPES TO BE CLASS 120 UNLESS NOTED OTHERWISE.
23. ALL GRATINGS AND FRAMES SHALL BE DUCTILE IRON TO BS EN124 AND BE MANUFACTURED TO BS EN124 AND BE OF A HOUSECKING DESIGN WITH CAPTIVE HINGE ACCESS AND BE KITEMARKED. LOAD CLASS D400 FOR ROADS AND SERVICE YARD AREAS. CLASS C250 TO BE USED IN CAR PARKING AREAS.
24. BACKFILLING AND REINSTATEMENT TO TRENCHES IN PUBLIC HIGHWAYS SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS AND SPECIFICATIONS OF THE ADOPTING AUTHORITY, OR, IN THE ABSENCE OF SUCH, IN ACCORDANCE WITH THE REQUIREMENTS OF "THE STREET WORKS REGULATIONS 1992" AND RELEVANT PROVISIONS OF H.A.U.C. "SPECIFICATION FOR THE REINSTATEMENT OF OPENINGS IN HIGHWAYS" JUNE 1992, BOTH UNDER SECTION 71 OF THE NEW ROADS AND STREET WORKS ACT 1991.
25. ALL TRADITIONAL RAINWATER PIPE DOWN COMERS TO DISCHARGE TO TRAPPED GULLIES.
26. ALL SIPHONIC DRAINAGE DOWN COMERS TO MANUFACTURER SPECIFICATION.
27. ALL ROAD GULLIES ARE TO BE TRAPPED GULLIES.
28. ALL GULLY LEADS TO BE 150mm DIAMETER.
29. ALL REDUNDANT EXISTING DRAINAGE TO BE GRUBBED UP OR GROUTED, ANY EXISTING LIVE DRAINAGE SHOULD BE REPORTED TO THE ENGINEER AND RECONNECTED.
30. ALL ROAD GULLIES & LEADS TO BE CLEARED OF DEBRIS UPON COMPLETION OF WORKS.
31. THE CONTRACTOR MUST ENSURE THAT ANY OF THE EXISTING DRAINAGE WHICH IS LIVE IS KEPT CLEAR OF DEBRIS AND SHOULD ALLOW FOR JETTING THROUGH THE NEW & EXISTING DRAINAGE UPON COMPLETION.
32. CONTRACTOR TO TAKE MEASURES TO PROTECT HIS OPERATIVES WITH RESPECT TO THE PRESENCE OF GAS IN SEWER TRENCHES AND MANHOLES THROUGH THE USE OF GAS MONITORING EQUIPMENT AND BREATHING APPARATUS AS REQUIRED.
33. CONTRACTOR TO APPLY FOR SEWER PERMITS AND ROAD OPENING PERMITS AS NECESSARY FROM THE APPROPRIATE AUTHORITIES, PRIOR TO COMMENCING WORKS.
34. ADOPTABLE PLASTIC SEWER PIPES TO BE LAID IN MAXIMUM 3m LENGTHS UNLESS THERE IS A SPECIFIC OPERATIONAL NEED TO LAY LONGER LENGTHS.
35. WHERE PLASTIC PIPES ARE INSTALLED PRIOR TO GETTING APPROVAL THEN A LIGHT LINE CCTV SURVEY AND REPORT ARE REQUIRED PRIOR TO APPROVAL.

KEY

- SITE BOUNDARY
- ES 3000 / CWDMH / CL 0.000 / IL 0.000 — EXISTING ADOPTED COMBINED WATER
- EXISTING EASEMENT
- 1500 1:150 / FWMH / CL 0.000 / IL 0.000 — PROPOSED ADOPTED FOUL WATER
- PROPOSED EASEMENT
- PROPOSED CELLULAR STORAGE
- PROPOSED SuDS
- 1500 1:150 / SWMH / CL 0.000 / IL 0.000 — PROPOSED ADOPTED HIGHWAY DRAIN
- PROPOSED ADOPTED HIGHWAY GULLY
- PROPOSED PRIVATE FOUL WATER 1ST OFF
- PROPOSED HEADWALL
- ES 2.0m — EXPOSED BRICKWORK
- RH 0.5m — RETAINED HEIGHT
- ESW — EXTERNAL STEPS
- MAJOR CONTOUR
- MINOR CONTOUR
- 1:21 — PROPOSED GRADIENT
- 48.872 — EXISTING LEVELS
- 45.950 — PROPOSED LEVELS

DRAINAGE SUMMARY:

SURFACE WATER

- THE PROPOSED PLOTS ARE TO DRAIN VIA INFILTRATION TANKS THAT WILL BE SITUATED IN THE IN THE PRIVATE GARDENS AND/OR PRIVATE DRIVES.
- THE PRIVATE DRIVES AND SHARED PRIVATE DRIVES WILL BE POROUS ASPHALT AND DRAIN VIA INFILTRATION.
- THE PROPOSED HIGHWAY DRAINAGE IS TO DRAIN VIA CARRIER PIPES AND DISCHARGE INTO A INFILTRATION BASIN.

FOUL WATER

- THE FOUL DRAINAGE IS TO DRAIN TO THE SOUTH OF THE SITE INTO THE COMBINED DRAINAGE THAT IS SITUATED IN MILL STREET, SUBJECT TO LAND OWNERS AND UNITED UTILITIES APPROVAL.

Date	Revisions	Drawn	Checked	Rev
21.06.23	REVISED TO LATEST ARCHITECT LAYOUT	RL	AE	4
05.04.23	LEVELS REVISED FOLLOWING DETAILED FLOOD MODELING	RL	AE	3
13.11.20	INDICATIVE RETAINED HEIGHTS SHOWN AT BOUNDARY	SB	AE	2
09.11.20	FIRST ISSUE	SB	AE	1

Dwg Status: SCHEMATIC

NORTH EAST
0191 2585632

YORKSHIRE
0113 535 3500

RWO CONSULTING ENGINEERS

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Client: GLEESON HOMES

Project: CLEATOR MILLS

Title: ENGINEERING LAYOUT

DO NOT SCALE	Scale @ A0: 1:500	Drawn: SB	Checked: AE	Date: 09.11.20	
Job No: 19002		Dwg No: D001		Rev: 4	

Appendix D Topographical Survey and Site Sections

A1 - Do Not Scale.

Date	Revisions	Drawn	Rev.

Dwg Status: PRELIMINARY

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Client: GLEESON HOMES

Project: CLEATOR MILL
CUMBRIA

Title: PLAN ON NODE SECTION LOCATIONS

Scale	Drawn	Checked	Date
1:1000	NN	RWO	05.11.20

Job No.	Drawing No.	Revision
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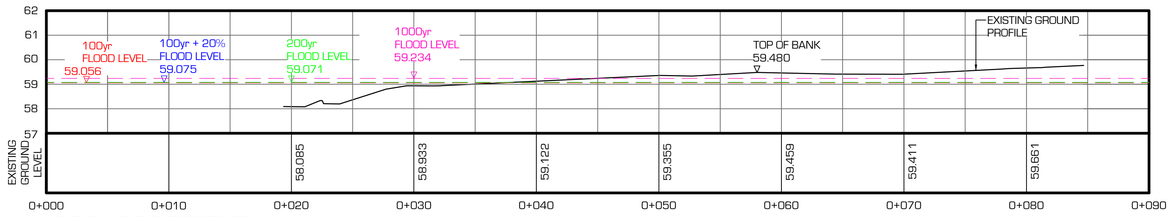

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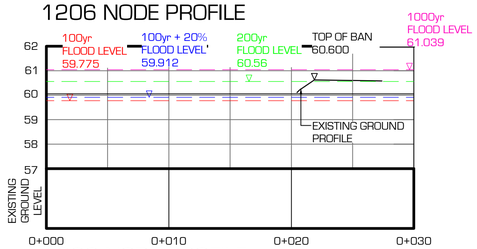

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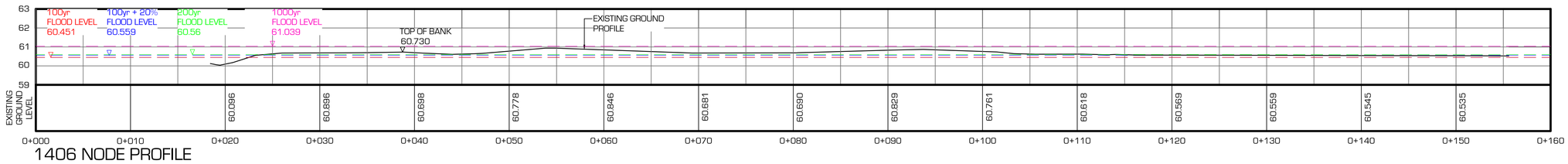

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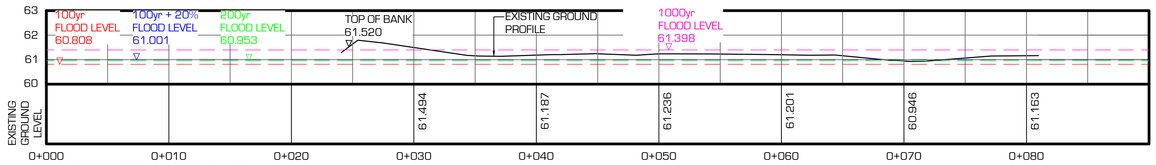

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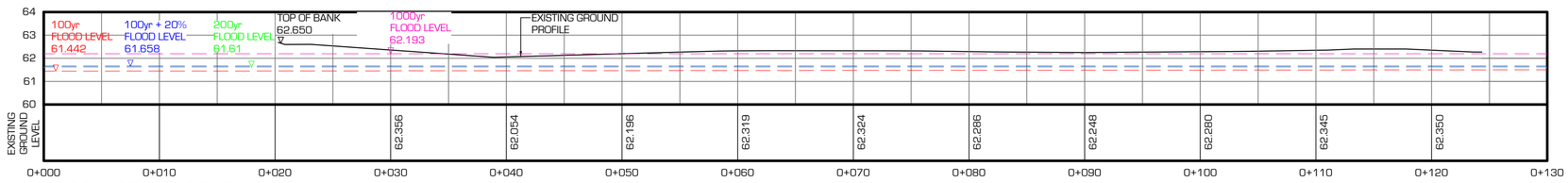
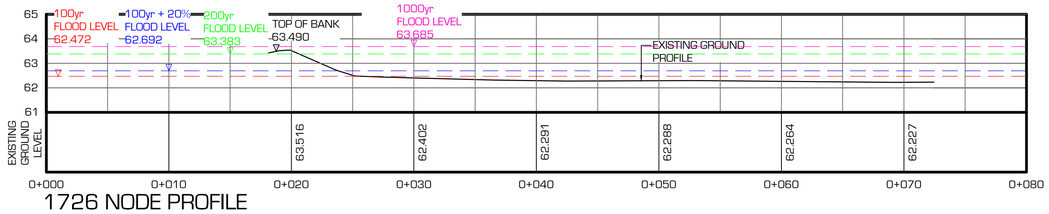
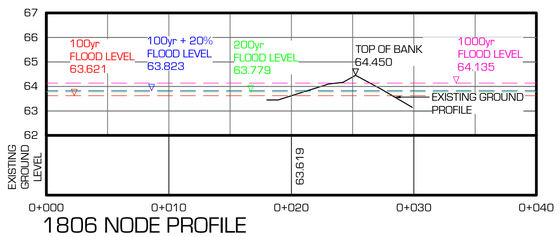


1606 NODE PROFILE



1726 NODE PROFILE



1806 NODE PROFILE

A1 - Do Not Scale.

Date	Revisions	Drawn	Rev.
06.05.2021	AMENDED TO SUIT COMMENTS	NN	2
06.05.2021	AMENDED TO SUIT COMMENTS	NN	1

Dwg Status: PRELIMINARY

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CUMBRIA

Title: SECTIONS THROUGH NODES

Scale	Drawn	Checked	Date
250H 500V	NN	RWO	05.11.20

Job No.	Drawing No.	Revision
19002	951	2

Appendix E Flood Defence Survey

Cleator Flood Asset Condition Assessment

23 MAR 2022
Version 1.0
RAB: 2869

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Revision History

Version	Date	Amendments	Issued to
1.0	23/03/2022		Ross Oakley

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1.0 Introduction

Cleator, Cumbria is in the Borough of Copeland in the Northwest of England. The River Ehen is within the catchment of Copeland's Wild Rivers and runs from Ennerdale Water to Sellafield where it enters the Irish Sea. The watercourse passes through Cleator, where there are numerous flood defences and structures around the watercourse including embankments, outfalls, walls, natural high ground and engineered high ground.

Approximately 1km of the River Ehen flood assets were inspected to assess their condition, defects and required maintenance. This report contains details of the findings of these inspections including estimated costs for the preservation of the assets.

2.0 Method

The condition grading and descriptions given below are the standards adopted by the Environment Agency. The five condition grades range from 'very good' to 'very poor', and the descriptions reflect condition according to flood defence performance.

Grade	Rating	Description
1	Very Good	Cosmetic defects that will have no effect on performance
2	Good	Minor defects that **will not** reduce the overall performance of the asset
3	Fair	Defects that **could** reduce performance of the asset
4	Poor	Defects that **would** significantly reduce the performance of the asset. Further investigation needed
5	Very Poor	Severe defects resulting in complete performance failure

The inspection was carried out and recorded in accordance with the Condition Assessment Manual (March 2012) and Version 4 of the Asset Template and Weighting Guidance on 28 January 2022 by Environment Agency accredited Flood Asset Inspectors.

Visual inspection is the simplest form of non-destructive testing, as it does not require any specialist equipment. It is a widely used technique for monitoring assets and their surroundings. However, as only the surface of a structure is visible, this method can only assess the surface details and condition of an asset; changes to interior structure and condition are not easily identifiable until they lead to changes to the surface of the asset. Assessment of an asset's surroundings remains a key indicator to the asset's performance and integrity.

The recommendations arising from the visual inspection include remedial works to address visible defects and bring each element of the asset back to at least "fair" condition, but also actions to overcome access constraints and/or the need for other tests or investigations to assess an assets performance and integrity.

3.0 Flood Assets and Condition Assessment

Figure 1 and Table 1 provide a summary of the location, type and condition grade of flood assets identified and inspected on 28 January 2022.

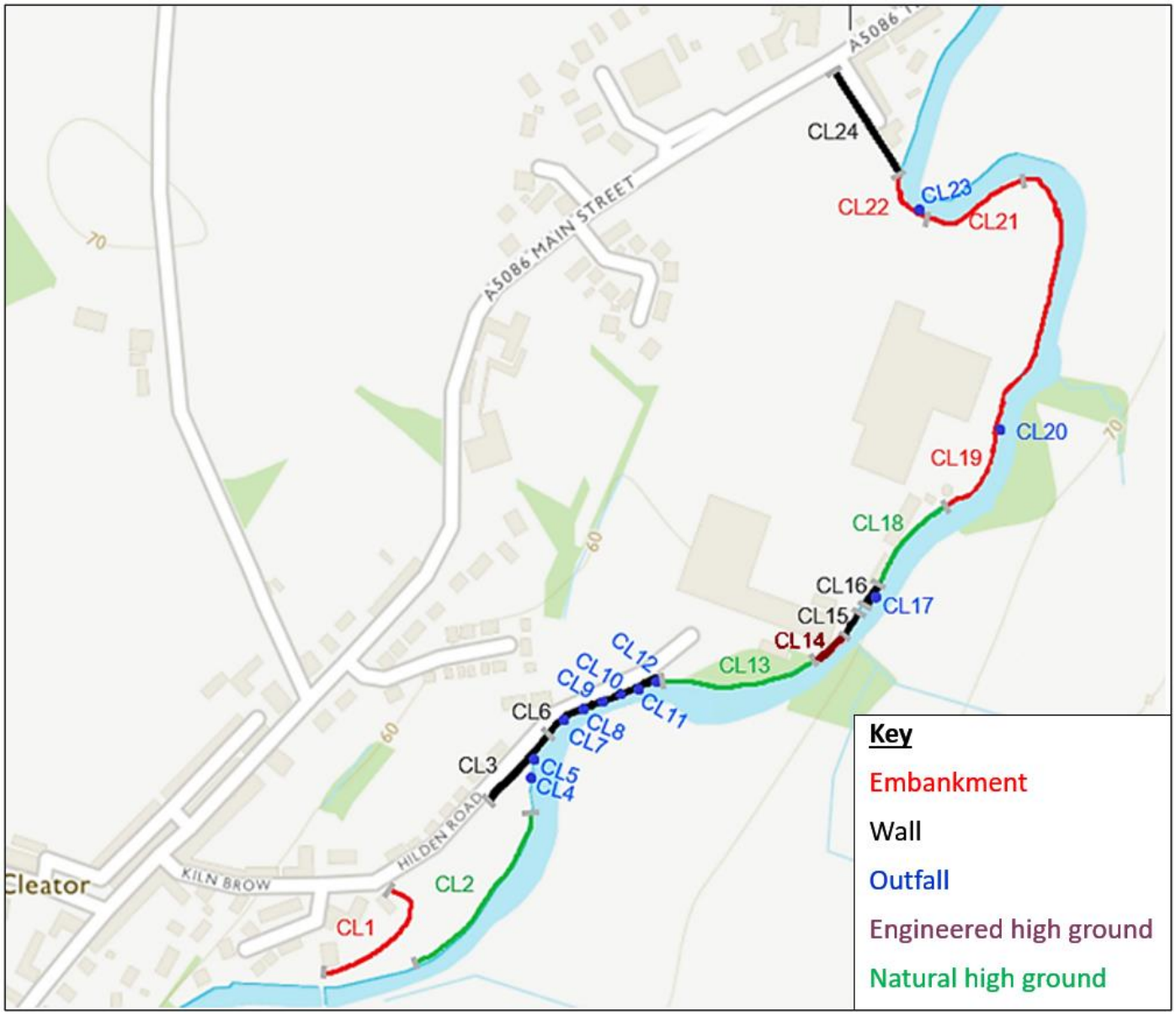


TABLE 1: FLOOD ASSET CONDITION SUMMARY.

Asset ID	Asset type/sub-type	Description	Grade
CL1	Defence - Embankment	Embankment running in front of houses below Hilden Road and Kiln Brow	4
CL2	Defence – Natural High Ground	Natural high ground located below Hilden Road before wall	3
CL3	Defence – Wall	Stone wall on Hilden Road with berm	4
CL4	Structure – Outfall	Outfall located on River Ehen	3
CL5	Structure – Outfall	Outfall located on River Ehen	3
CL6	Defence – Wall	Stone wall on Hilden Road	4
CL7	Structure – Outfall	One of six identical outfalls located within wall on Hilden Road	2
C8	Structure – Outfall	One of six identical outfalls located within wall on Hilden Road	2
CL9	Structure – Outfall	One of six identical outfalls located within wall on Hilden Road	2
CL10	Structure – Outfall	One of six identical outfalls located within wall on Hilden Road	2
CL11	Structure – Outfall	One of six identical outfalls located within wall on Hilden Road	2
CL12	Structure – Outfall	One of six identical outfalls located within wall on Hilden Road	2
CL13	Defence – Natural High Ground	Natural high ground located below Mill Street	3
CL14	Defence – Engineered High Ground	Engineered high ground in front of old mill	3
CL15	Defence – Wall	Stone wall in front of old mill	3
CL16	Defence – Wall	Brick wall with brick channel side located on River Ehen	3
CL17	Defence – Natural High Ground	Natural high ground located on River Ehen	3
CL18	Defence – Embankment	Earth embankment located on River Ehen	3
CL19	Structure – Outfall	Drainage pipe located on River Ehen	3
CL20	Structure – Outfall	Outfall located on River Ehen	3
CL21	Defence - Embankment	Earth embankment with gabions and sheet piling on River Ehen	3

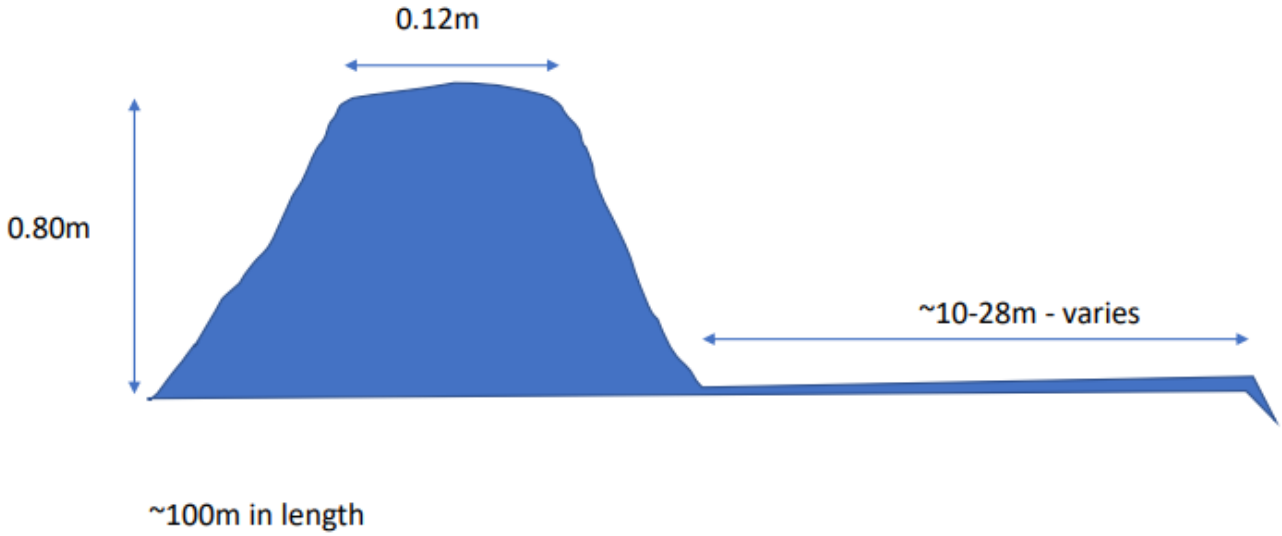
Asset ID	Asset type/sub-type	Description	Grade
CL22	Defence - Embankment	Earth embankment with stone and sheet piling on River Ehen	3
CL23	Structure – Outfall	Outfall located on River Ehen	3
CL24	Defence - Wall	Wall located off Main Street	3

4.0 Findings and Recommendations

The following is a summary of the findings and recommendations to bring all asset elements to at least "fair" condition, grade 3.

CL1 – Embankment

Small earth embankment protecting residential properties behind.



Comments

Variant weighting used for crest as <4m wide. Drainage pipe running through entire width of embankment, low spots, some animal holes and rutting on crest, landward face and exposed face have some holes and uneven slopes but are well vegetated. Undermining, minor erosion and light foreign objects present on channel side but currently stable.

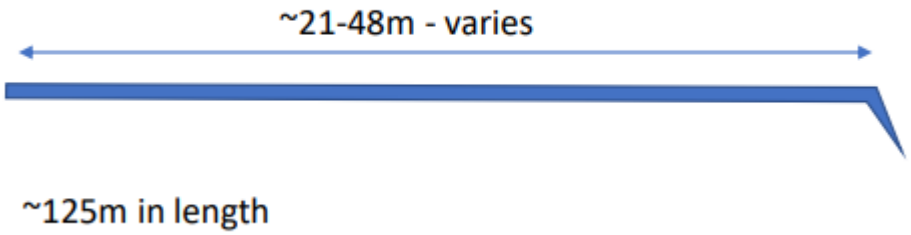
Grade = 4, Poor

Years	Recommendations	Cumulative Cost (£)
Immediate	• Install none return valve to drainage pipe	£400.00
1	• Inspect embankment annually and infill any identified low spots on crest with topsoil and lay down grass seed • Manage vegetation to avoid undesirable vegetation growth and maintain grass growth • Consider pest control	£600.00
5	• Continue to inspect the embankment yearly to keep track of and identify potential issues • Continue vegetation management to prevent the growth of undesirable vegetation on embankment	£3,500.00

	• Infill identified low spots on crest with topsoil and lay down grass seed • Monitor condition of landward toe to ensure vehicle use does not damage asset – infill low spots and lay down grass seed in areas of vegetation loss	
10	• Continue yearly inspections and vegetation management • If extensive damage has been incurred to the embankment, reprofile the bank and lay down grass seed	£12,500.00
15	• Continue yearly inspections and vegetation management • If extensive damage has been incurred to the embankment, reprofile the bank and lay down grass seed	£16,600.00

CL2 – Natural High Ground

Natural high ground located in a grass field in front of residential properties with a width of 21-48m between the channel side and road.



4.1.1 Comments

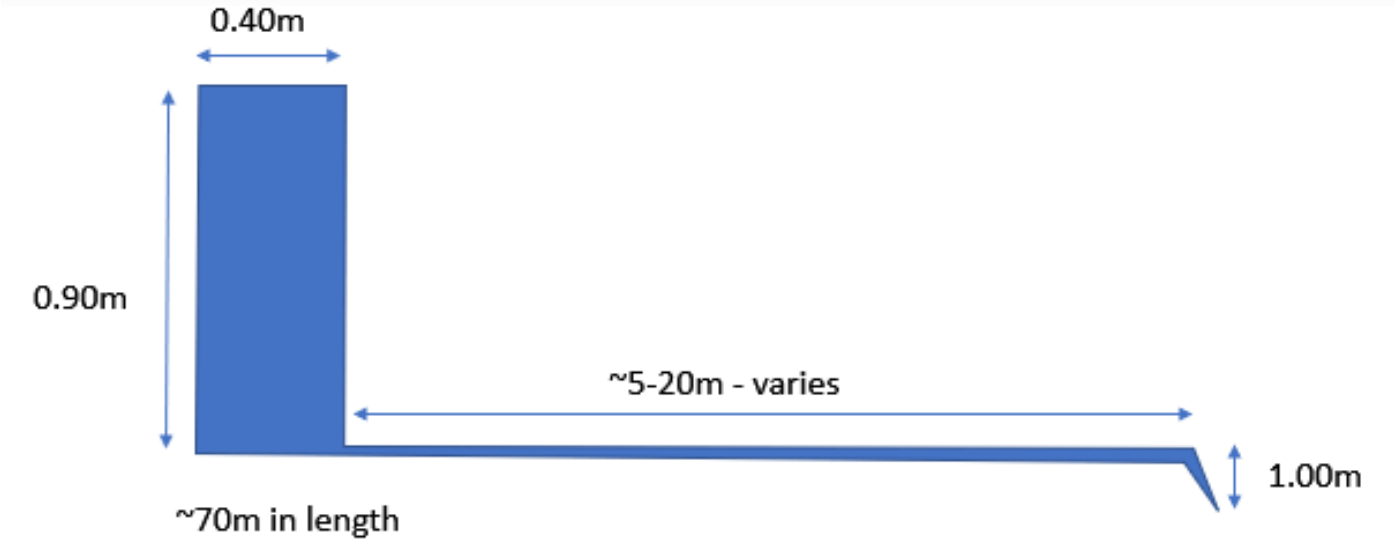
Significant undermining, erosion and presence of light foreign objects on channel side. High ground in good condition.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Conduct visual asset inspections annually, monitor erosion, maintain grass on high ground and ensure vegetation is kept stable and not blocking channel	£600.00
5	• Continue to inspect the high ground yearly to keep track of and identify potential issues • Continue with vegetation management and remove unstable trees	£3,100.00
10	• Continue yearly inspections and vegetation management • If considerate amounts of erosion are being incurred to the channel side, install coir erosion protection matting	£13,200.00
15	• Continue yearly inspections and vegetation management • If extensive erosion has been incurred to the channel side, consider reprofiling bank and installing rock armour	£21,500.00

CL3 – Wall

Stone wall next to road protecting residential properties but not designed as a flood wall.



4.1.2 Comments

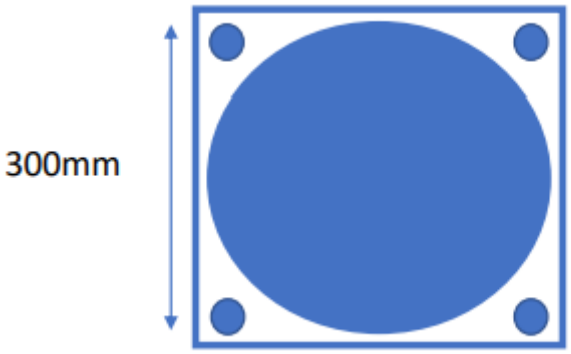
Variant weightings used for both faces as no revetments. Significant mortar loss to crest, holes through wall, bulging of wall where light foreign objects are growing in front on wall, distorting its shape and some erosion to channel side.

Grade = 4, Poor

Years	Recommendations	Cumulative Cost (£)
Immediate	• Rebuild wall and remove trees in front of wall	£1,900.00
1	• Conduct visual asset inspections annually • Carry out minor repairs to bricks and mortar and maintain grass on berm	£200.00
5	• Continue to inspect the wall yearly to keep track of and identify potential issues • Carry out small repairs to brickwork and management of surrounding vegetation	£1,000.00
10	• Carry out repointing of wall • Continue with annual visual asset inspections and management of surrounding vegetation	£2,100.00
15	• If there has been any serious structural damage to the wall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage • If extensive erosion has been incurred to the channel side, consider reprofiling bank and installing rock armour	£10,100.00

CL4 – Outfall

300mm diameter flapped outfall with concrete apron located on channel side in front of wall. Owner and operator unknown.



4.1.3 Comments

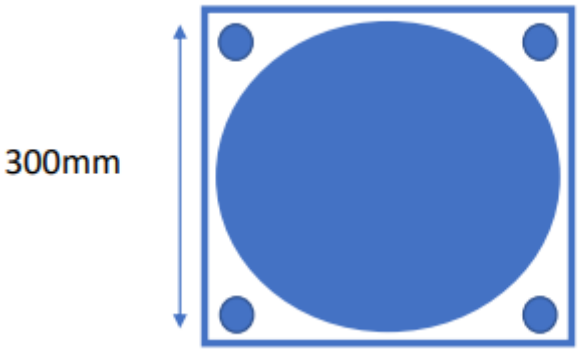
Vegetation around headwall. Unable to see through pipe and no CCTV footage available.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Conduct annual visual asset inspections and maintain surrounding vegetation to avoid damage incurring to outfall	£600.00
5	• Continue to inspect the outfall yearly, including CCTV inspections of the pipe every 5 years • Monitor and remove moss growth and vegetation growth on headwall to reduce damage to the headwall	£3,500.00
10	• Continue yearly inspections of outfall including CCTV inspections of pipe every 5 years • Continue with vegetation management • Carry out small repairs to brick and mortar loss	£6,900.00
15	• Continue yearly inspections of outfall and manage vegetation growth • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ relevant operative to repair damage	£17,400.00

CL5 – Outfall

300mm diameter flapped outfall with no apron located on channel side in front of wall. Owner and operator unknown.



4.1.4 Comments

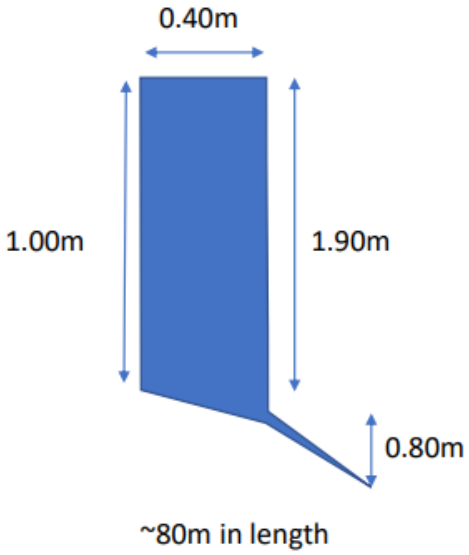
Outfall in good condition, very minor corrosion present on frame and flap valve. Unable to see through pipe and no CCTV footage available.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Conduct annual visual asset inspections and maintain surrounding vegetation to avoid damage incurring to outfall	£600.00
5	• Continue to inspect the outfall yearly, including CCTV inspections of the pipe every 5 years • Monitor and remove moss growth and vegetation growth on headwall to reduce damage to the headwall	£3,500.00
10	• Continue yearly inspections of the outfall including CCTV inspections of the pipe every 5 years • Continue with vegetation management	£6,900.00
15	• Continue yearly inspections of the outfall and manage vegetation growth • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£17,400.00

CL6 – Wall

Stone wall with 6 highway outfalls in wall connecting to previous wall, also not a flood wall.



4.1.5 Comments

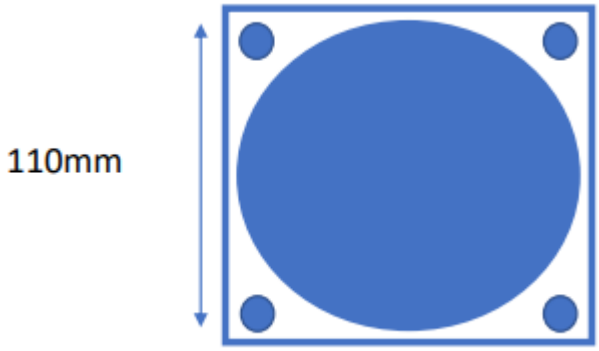
Heavy foreign objects growing towards channel on berm and channel side and undermining on channel side causing channel side to be unstable. Ivy growth on wall, heavy foreign objects growing close to wall causing bulging to wall and capping stones lost from crest halfway across wall.

Grade = 4, Poor

Years	Recommendations	Cumulative Cost (£)
Immediate	• Rebuild wall, remove unstable trees, and remove trees next to wall	£5,000.00
1	• Conduct visual asset inspections annually • Maintain surrounding vegetation to avoid wall incurring structural damage	£200.00
5	• Continue to inspect the wall yearly to keep track of and identify potential issues • Small repairs to brickwork and management of surrounding vegetation	£1,000.00
10	• Carry out repointing of wall and continue with small repairs to brickwork and management of surrounding vegetation	£2,100.00
15	• If there has been any serious structural damage to the wall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage • If extensive erosion has been incurred to the channel side, consider reprofiling bank and installing rock armour	£11,000

CL7 – Outfall

110mm diameter flapped highway outfall located within stone wall.



4.1.6 Comments

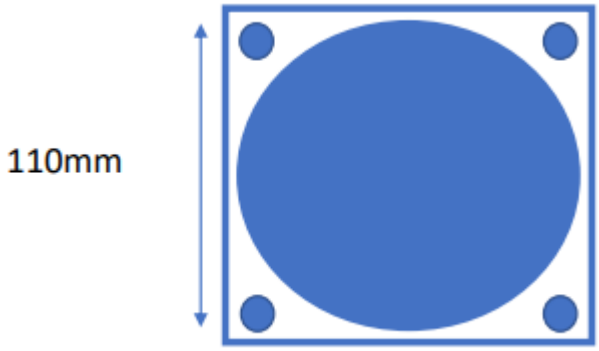
No signs of corrosion to flap valve or frame, pipe has minor leaf debris but no blockages or damage. Downstream headwall has some cracks, vegetation growth and mortar loss.

Grade = 2, Good

Years	Recommendations	Cumulative Cost (£)
1	• Conduct annual visual asset inspections and maintain surrounding vegetation to avoid damage incurring to outfall	£600.00
5	• Continue with annual inspections of the outfall • Monitor and remove moss growth and vegetation growth on headwall to reduce damage to the headwall	£3,500.00
10	• Continue with annual inspections of the outfall • Continue with vegetation management • Conduct small brick and mortar repairs on headwall	£6,900.00
15	• Continue with annual inspections of the outfall and vegetation management • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£14,800.00

CL8 – Outfall

110mm diameter flapped highway outfall located within stone wall.



4.1.7 Comments

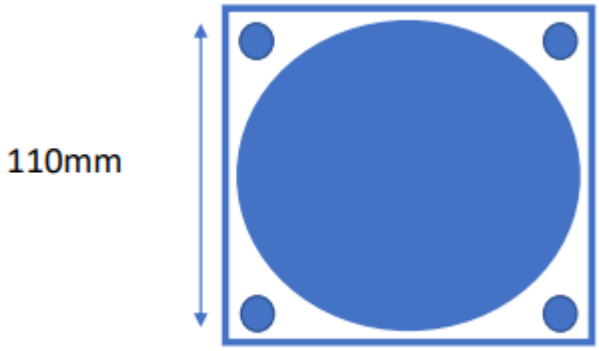
No signs of corrosion to flap valve or frame, pipe has minor leaf debris but no blockages or damage. Minor crack to downstream headwall, vegetation growth and mortar loss.

Grade = 2, Good

Years	Recommendations	Cumulative Cost (£)
1	• Conduct annual visual asset inspections and maintain surrounding vegetation to avoid damage incurring to outfall	£600.00
5	• Continue with annual inspections of the outfall • Monitor and remove moss growth and vegetation growth on headwall to reduce damage to the headwall	£3,500.00
10	• Continue with annual inspections of the outfall • Continue with vegetation management • Conduct small brick and mortar repairs on headwall	£6,900.00
15	• Continue with annual inspections of the outfall and vegetation management • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£14,800.00

CL9 – Outfall

110mm diameter flapped highway outfall located within stone wall.



4.1.8 Comments

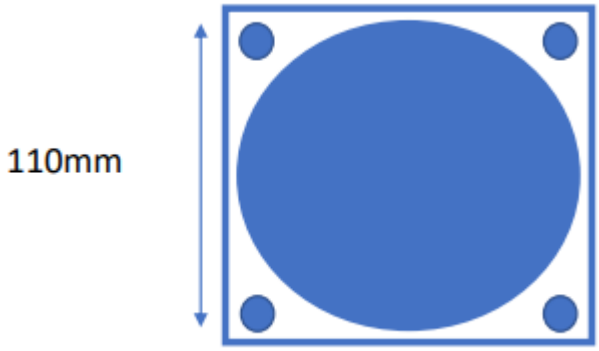
No corrosion to flap valve or frame. Cracks and mortar loss on headwall. Pipe has minor leaf debris but no blockages or damage.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Conduct annual visual asset inspections and maintain surrounding vegetation to avoid damage incurring to outfall	£600.00
5	• Continue with annual inspections of the outfall • Monitor and remove moss growth and vegetation growth on headwall to reduce damage to the headwall	£3,500.00
10	• Continue with annual inspections of the outfall • Continue with vegetation management • Conduct small brick and mortar repairs on headwall	£6,900.00
15	• Continue with annual inspections of the outfall and vegetation management • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£14,800.00

CL10 – Outfall

110mm diameter flapped highway outfall located within stone wall.



4.1.9 Comments

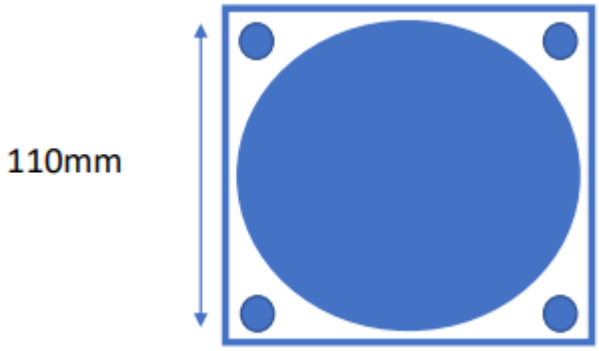
Ivy growth around frame and headwall. No corrosion to flap valve. Minor cracks and vegetation growth on headwall. Pipe has minor leaf debris but no blockages or damage.

Grade = 2, Good

Years	Recommendations	Cumulative Cost (£)
1	• Conduct annual visual asset inspections and maintain surrounding vegetation to avoid damage incurring to outfall	£600.00
5	• Continue with annual inspections of the outfall • Monitor and remove moss growth and vegetation growth on headwall to reduce damage to the headwall	£3,500.00
10	• Continue with annual inspections of the outfall • Continue with vegetation management • Conduct small brick and mortar repairs on headwall	£6,900.00
15	• Continue with annual inspections of the outfall and vegetation management • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£14,800.00

CL11 – Outfall

110mm diameter flapped highway outfall located within stone wall.



4.1.10 Comments

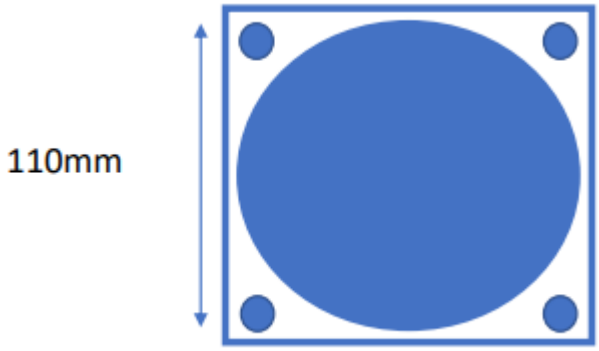
Ivy growth around frame and headwall. No corrosion to flap valve. Minor cracks and vegetation growth on headwall. Pipe has vegetation debris but no blockages or damage.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Conduct annual visual asset inspections and maintain surrounding vegetation to avoid damage incurring to outfall	£600.00
5	• Continue with annual inspections of the outfall • Monitor and remove moss growth and vegetation growth on headwall to reduce damage to the headwall	£3,500.00
10	• Continue with annual inspections of the outfall • Continue with vegetation management • Conduct small brick and mortar repairs on headwall	£6,900.00
15	• Continue with annual inspections of the outfall and vegetation management • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£14,800.00

CL12 – Outfall

110mm diameter flapped highway outfall located within stone wall.



4.1.11 Comments

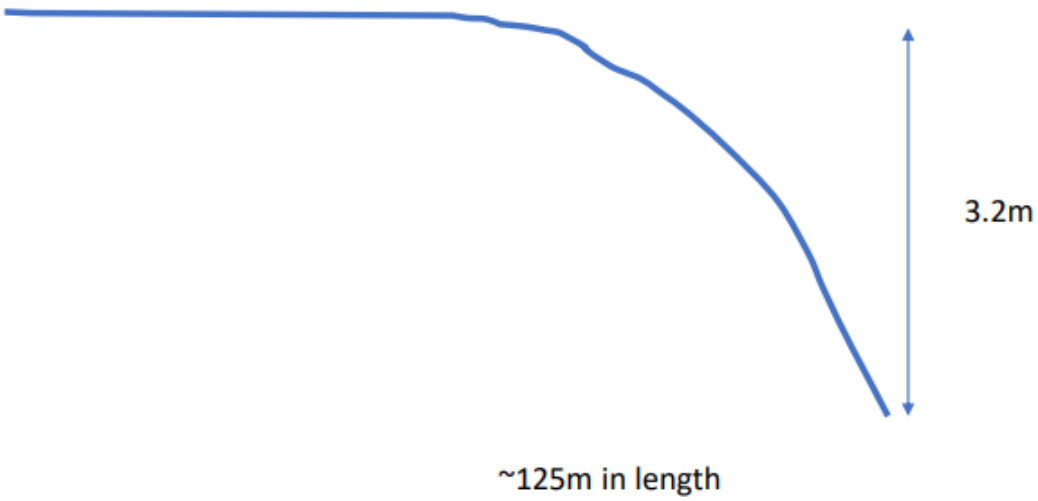
No corrosion to flap valve or frame. Minor cracks, mortar loss and minor vegetation growth on headwall. Pipe has minor leaf debris but no blockages or damage.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Conduct annual visual asset inspections and maintain surrounding vegetation to avoid damage incurring to outfall	£600.00
5	• Continue with annual inspections of the outfall • Monitor and remove moss growth and vegetation growth on headwall to reduce damage to the headwall	£3,500.00
10	• Continue with annual inspections of the outfall • Continue with vegetation management • Conduct small brick and mortar repairs on headwall	£6,900.00
15	• Continue with annual inspections of the outfall and vegetation management • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£14,800.00

CL13 – Natural High Ground

Stretch of natural high ground with vegetation and trees.



4.1.12 Comments

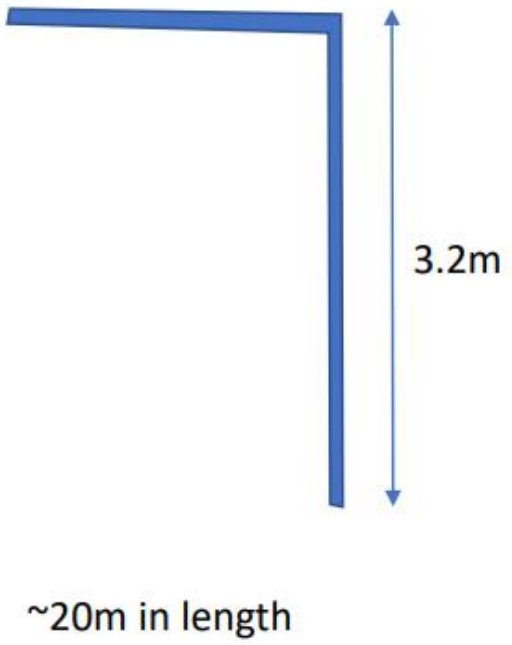
Significant undermining, erosion, and presence of light foreign objects on channel side. High ground in good condition.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Conduct visual asset inspections annually, monitor erosion and ensure vegetation is kept stable and not blocking channel	£700.00
5	• Continue to inspect high ground yearly to keep track of and identify potential issues • Continue with vegetation management and remove unstable trees	£5,500.00
10	• Continue yearly inspections and vegetation management • If considerate amounts of erosion are being incurred to the channel side, install erosion protection matting	£17,900.00
15	• Continue yearly inspections and vegetation management • If extensive erosion has been incurred to the channel side, consider reprofiling bank and installing further erosion protection measures such as rock armour	£34,200.00

CL14 – Engineered High Ground

Masonry retaining wall at edge of road with metal fencing above.



4.1.13 Comments

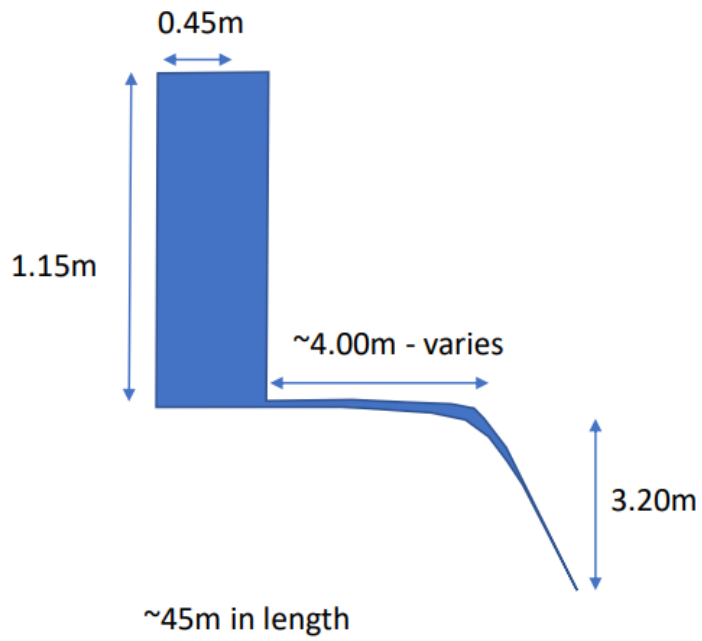
Light foreign objects and ivy growing in front of and on top of channel side wall. High ground is road in good condition. Heavy foreign object upstream with roots growing into channel side brickwork.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Conduct visual asset inspections annually and cut back surrounding vegetation to avoid damaging asset	£600.00
5	• Continue with annual visual asset inspections and vegetation management • Conduct small brick and mortar repairs	£1,100.00
10	• Continue with annual visual asset inspections and vegetation management • Consider repointing brickwork	£2,200.00
15	• Continue with annual visual asset inspections and vegetation management • If there has been any serious structural damage to the engineered high ground such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£12,000.00

CL15 – Wall

Masonry wall with capping stones with berm and channel side heavily vegetated with tree growth through wall.



4.1.14 Comments

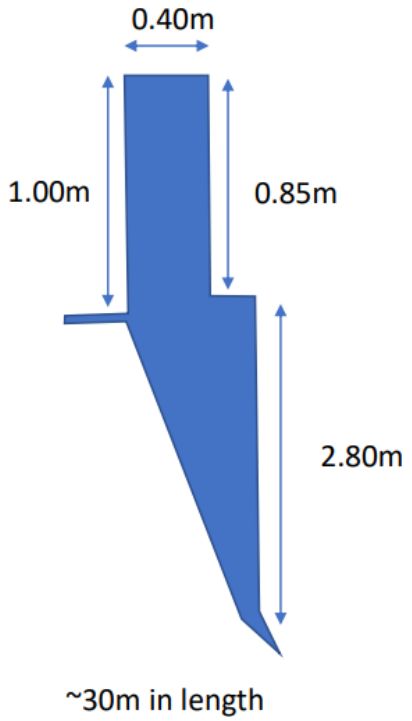
Several heavy foreign objects on berm and channel side. Severe mortar loss in landward face, exposed face difficult to inspect but wall covered in ivy and some tree roots and growing through it. Crest is uneven where ivy has grown around it.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Conduct visual asset inspections annually • Maintain surrounding vegetation including ivy removal to avoid wall incurring structural damage	£200.00
5	• Continue to inspect the wall yearly to keep track of and identify potential issues • Small repairs to brickwork and management of surrounding vegetation	£1,200.00
10	• Carry out repointing of wall and continue with small repairs to brickwork and management of surrounding vegetation	£2,400.00
15	• If there has been any serious structural damage to the wall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£7,700.00

CL16 – Wall

Brick wall with concrete landward face connecting to channel side brick retaining wall.



4.1.15 Comments

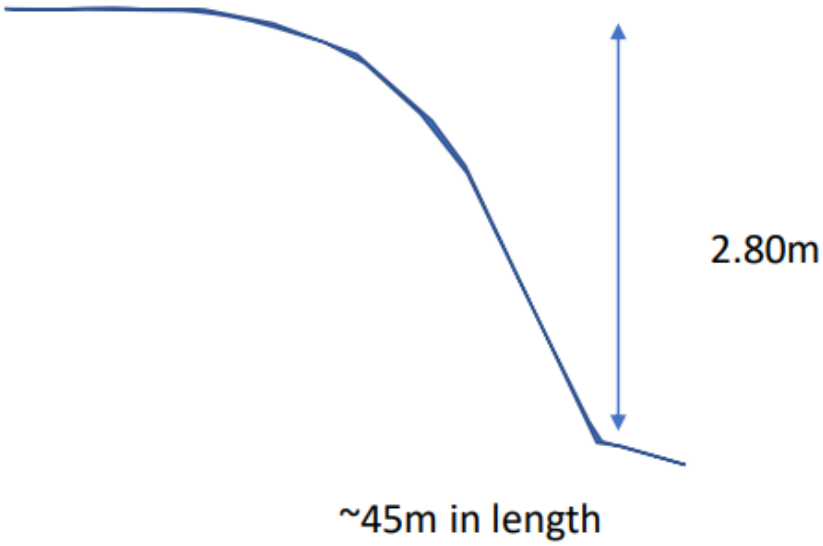
Extensive ivy growth, channel side wall is walling down with severe brick loss and root penetration. Heavy foreign objects growing on channel side causing brick displacement and loss. Crest is uneven due to brick loss but landward face is made from concrete slabs in good condition.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Conduct visual asset inspections annually • Maintain surrounding vegetation to avoid wall incurring structural damage	£200.00
5	• Continue to inspect the wall yearly to keep track of and identify potential issues • Small repairs to brickwork and management of surrounding vegetation	£1,200.00
10	• Carry out repointing of wall and continue with small repairs to brickwork and management of surrounding vegetation	£4,800.00
15	• If there has been any serious structural damage to the wall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£8,200.00

CL17 – Natural High Ground

Natural high ground heavily vegetated with tree growth with brick building directly behind.



4.1.16 Comments

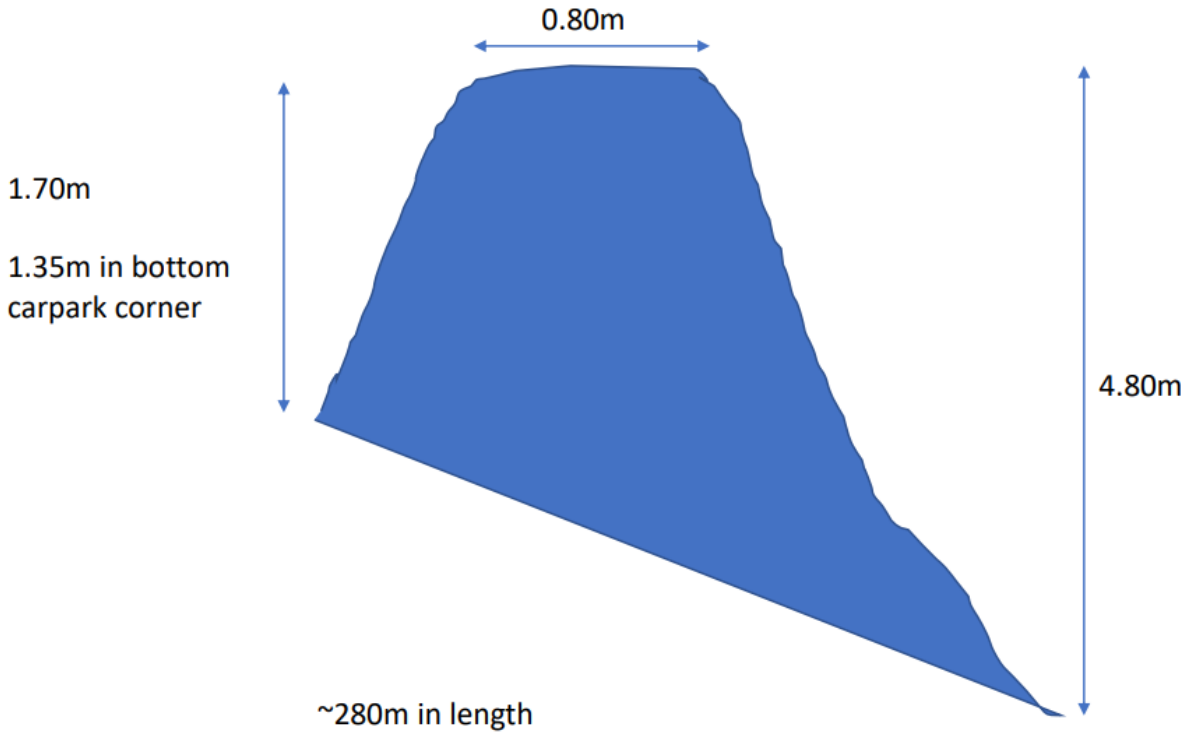
Heavy foreign objects on channel side leaning towards channel. Building <3m from channel on high ground.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Remove unstable trees • Conduct visual asset inspections annually, monitor erosion and movement which could affect nearby building • Ensure vegetation is kept stable and not blocking channel	£200.00
5	• Continue to inspect high ground yearly to keep track of and identify potential issues • Continue with vegetation management and remove unstable trees	£1,200.00
10	• Continue yearly inspections and vegetation management • If considerate amounts of erosion are being incurred to the channel side, install coir erosion protection matting	£4,800.00
15	• Continue yearly inspections and vegetation management • If extensive erosion has been incurred to the channel side, consider reprofiling bank and installing further erosion protection measures such as rock armour	£8,200.00

CL18 – Embankment

Earth embankment with unknown construction materials and unstable tree-ridden channel side, reducing stability of embankment. Unlikely to have clay core and may be comprised of waste material.



4.1.17 Comments

Low points and rutting in crest but well vegetated. Variant used for exposed face due to steepness. Exposed and landward faces have isolated bare patches. Telegraph pole behind embankment but embankment build around it. Severe undermining of channel side around heavy foreign objects with extensive root exposure.

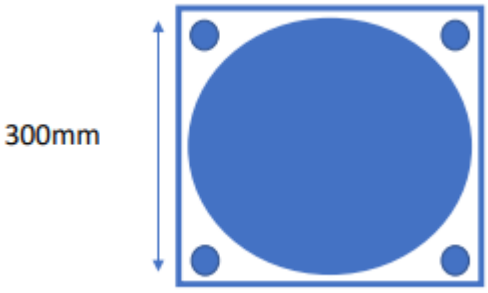
Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Consider installing erosion protection to channel side such as rock armour • Inspect embankment annually and infill any identified low spots on crest with topsoil and lay down grass seed • Manage vegetation to avoid undesirable vegetation growth	£7,200.00
5	• Continue to inspect the embankment yearly to keep track of, identify potential issues and monitor stability of telegraph pole within embankment	£33,400.00

	• Continue vegetation management to prevent the growth of undesirable vegetation on embankment • Infill identified low spots on crest with topsoil and lay down grass seed	
10	• Continue yearly inspections and vegetation management • Infill any identified low spots on crest with topsoil and lay down grass seed • If extensive damage has been incurred to embankment, reprofile bank and lay down grass seed	£90,100.00
15	• Continue yearly inspections and vegetation management • Infill any identified low spots on crest with topsoil and lay down grass seed • If extensive damage has been incurred to embankment, reprofile bank and lay down grass seed • Consider employing engineer to assess asset condition in detail to identify potential structural issues with embankment, employ relevant operative to repair damage	£166,600.00

CL19 – Outfall

300mm outfall on channel side of embankment with damaged concrete headwall.



4.1.18 Comments

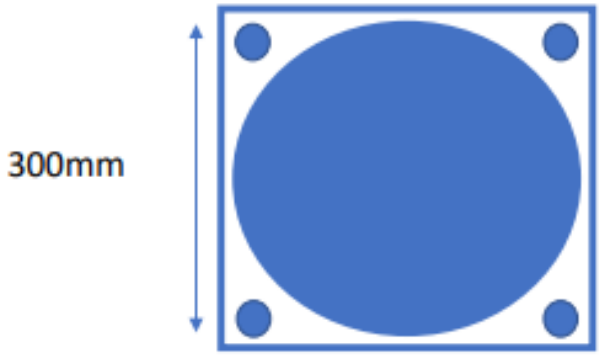
Drainage pipe halfway between wall and building on high ground. Unable to see through pipe and no CCTV footage available. Vegetation around headwall and at base of pipe.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Investigate stability of headwall, rebuild if necessary • Conduct CCTV inspection of pipe to assess condition • Conduct annual visual asset inspections and provide ongoing management of surrounding vegetation to avoid damage incurring to outfall	£600.00
5	• Continue to inspect the outfall yearly, including CCTV inspections of the pipe every 5 years • Monitor and remove moss growth and vegetation growth on headwall to reduce damage to the headwall • Carry out small repairs to any brick and mortar loss on headwall	£3,500.00
10	• Continue yearly inspections of outfall including CCTV inspections of pipe every 5 years • Continue with vegetation management • Carry out small repairs to any brick and mortar loss on headwall	£6,900.00
15	• Continue yearly inspections of outfall and manage vegetation growth • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ relevant operative to repair damage	£17,400.00

CL20 – Outfall

150mm clay drainage pipe located on channel side of embankment surrounded by rocks providing unstable headwall.



4.1.19 Comments

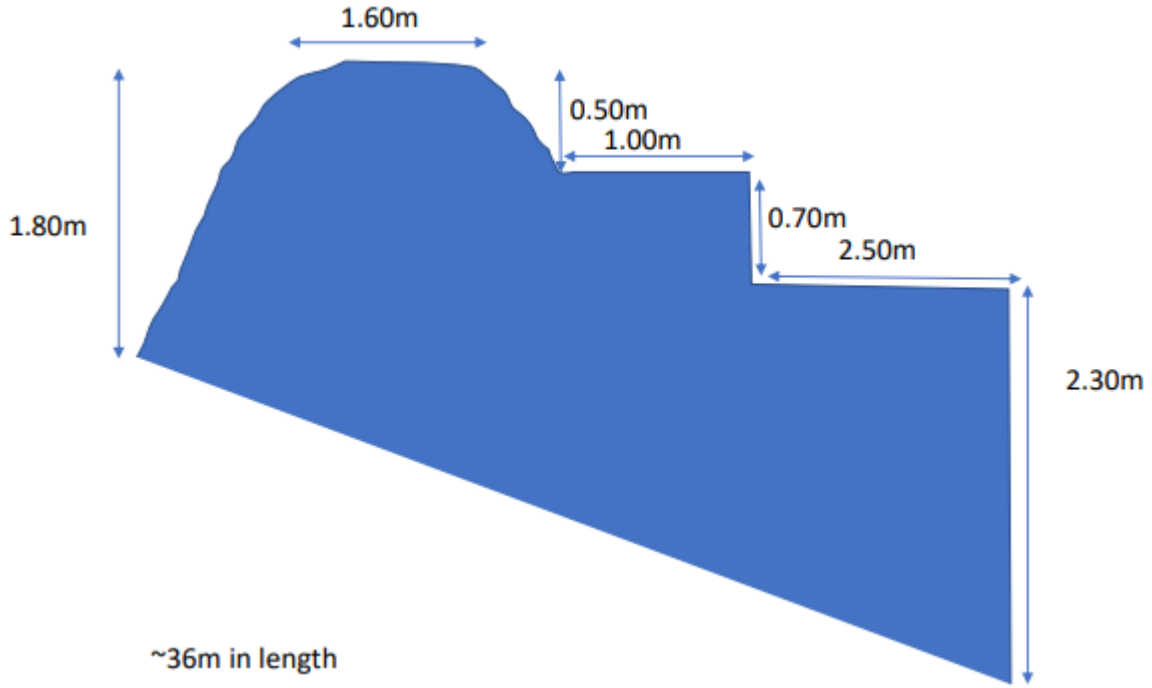
Downstream headwall in pieces. Unable to see through pipe and no CCTV footage available.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Rebuild headwall • Conduct CCTV inspection of pipe to assess condition • Conduct annual visual asset inspections and provide ongoing management of surrounding vegetation to avoid damage incurring to outfall	£600.00
5	• Continue to inspect the outfall yearly, including CCTV inspections of the pipe every 5 years • Monitor and remove moss growth and vegetation growth on headwall to reduce damage to the headwall • Carry out small repairs to any brick and mortar loss on headwall	£3,500.00
10	• Continue yearly inspections of outfall including CCTV inspections of pipe every 5 years • Continue with vegetation management • Carry out small repairs to any brick and mortar loss on headwall	£6,900.00
15	• Continue yearly inspections of outfall and manage vegetation growth • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ relevant operative to repair damage	£17,400.00

CL21 – Embankment

Earth embankment with gabion basket and sheet piling exposed faces and concrete berm.



4.1.20 Comments

Berm 2 and channel side in good condition with minor cosmetic defects to sheet piles. Vegetation growth through gabion baskets with a few broken wires but no gabion displacement. Uneven ground on exposed face 1 and landward face but well vegetated. Rutting and low spots in isolated places on crest. Variants used on crest as less than 4m wide and landward face due to steepness.

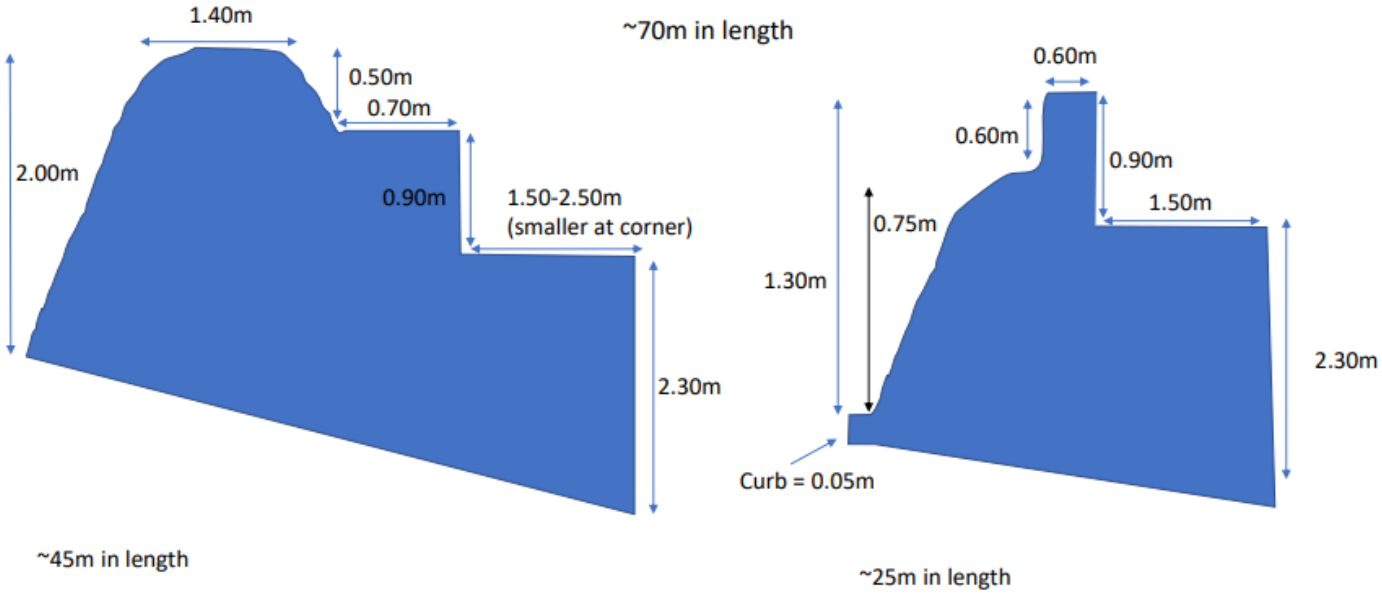
Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Repair gabion baskets and remove vegetation growing through • Inspect embankment annually and infill any identified low spots on crest with topsoil and lay down grass seed • Manage vegetation to avoid undesirable vegetation growth	£200.00
5	• Continue to inspect embankment yearly to keep track of, identify potential issues • Continue vegetation management to prevent growth of undesirable vegetation on embankment • Infill identified low spots on crest with topsoil and lay down grass seed	£1,100.00
10	• Continue yearly inspections and vegetation management	£2,500.00

	• If extensive damage has been incurred to embankment, reprofile bank and lay down grass seed • Repaint sheet piling • Repair any damage to gabion baskets	
15	• Continue yearly inspections and vegetation management • If extensive damage has been incurred to embankment, reprofile bank and lay down grass seed • Repair any damage to concrete apron and gabion baskets • Consider employing engineer to assess asset condition in detail to identify potential structural issues with embankment, employ relevant operative to repair damage	£9,600.00

CL22 – Embankment

Earth embankment with stone wall and sheet piling exposed faces and concrete berm. Crest height and embankment width reduce as earth landward face diminishes and crest changes to stone crest.



4.1.21 Comments

Minor vegetation growth within berm 1 and exposed face 2 with minor mortar loss. Uneven crest with some low spots but well vegetated. Berm 2 and channel side in good condition with minor cosmetic defects to sheet piling. Landward face and exposed face 1 are well vegetated but uneven. Landward face 2 around corner and has minor vegetation growing through stone and minor mortar loss.

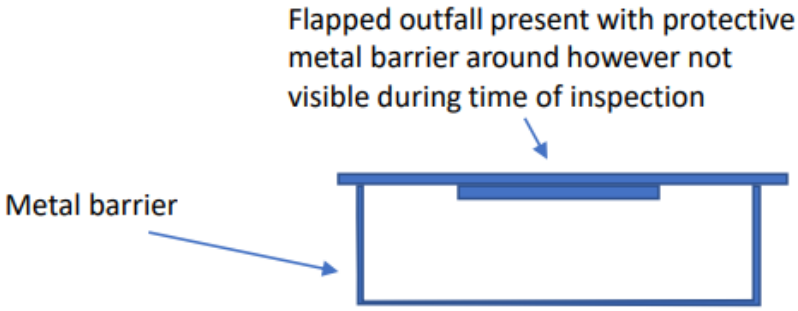
Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Inspect embankment annually and infill any identified low spots on crest with topsoil and lay down grass seed • Repair mortar loss and remove vegetation growing through • Manage vegetation to avoid undesirable vegetation growth	£200.00
5	• Continue to inspect embankment yearly to keep track of, identify potential issues • Continue vegetation management to prevent the growth of undesirable vegetation on embankment • Conduct small repairs on brick and mortar loss • Infill identified low spots on crest with topsoil and lay down grass seed	£1,600.00
10	• Continue yearly inspections and vegetation management	£3,400.00

	• If extensive damage has been incurred to embankment, reprofile bank and lay down grass seed • Continue with small repairs of brick and mortar loss • Repaint sheet piling • If extensive damage has been incurred to wall, rebuild wall	
15	• Continue yearly inspections and vegetation management • If extensive damage has been incurred to embankment, reprofile bank and lay down grass seed • Repair any damage to concrete apron and wall • Consider employing engineer to assess asset condition in detail to identify potential structural issues with embankment, employ relevant operative to repair damage	£9,600.00

CL23 – Outfall

Flapped outfall with unknown diameter located behind metal barrier which obstructs view of outfall.



4.1.22 Comments

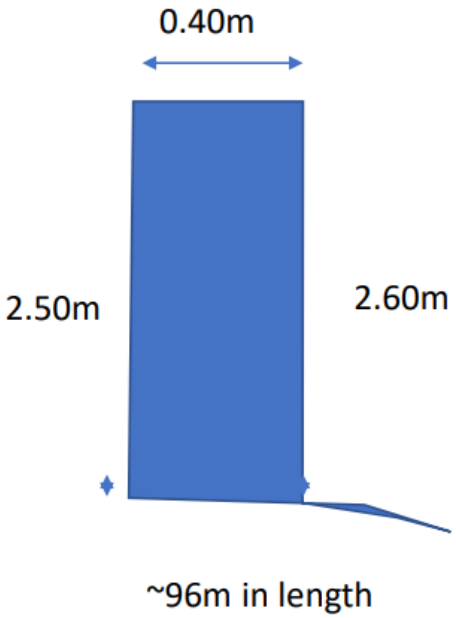
Minor corrosion to barrier. Unable to see headwall and pipe due to high water level and barrier around.

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Investigate dimensions and condition of outfall • Carry out CCTV inspection to assess pipe condition • Conduct annual visual asset inspections to assess the condition of the asset	£600.00
5	• Continue to inspect outfall yearly, including CCTV inspections of pipe every 5 years • Monitor stability of metal barrier and replace if necessary	£3,500.00
10	• Continue yearly inspections of the outfall • Manage any vegetation growth which could damage asset	£6,900.00
15	• Continue yearly inspections of the outfall and manage vegetation growth • If there has been any serious structural damage to the outfall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£23,700.00

CL24 – Wall

High stone wall with capping stones located off right bank and going away from main channel towards village.



4.1.23 Comments

Minor vegetation growth through crest. Minor mortar loss on exposed face and a couple of holes on both faces, not whole way though. Few bricks missing for drainage

Grade = 3, Fair

Years	Recommendations	Cumulative Cost (£)
1	• Repair holes in wall and remove vegetation • Conduct visual asset inspections annually • Maintain surrounding vegetation to avoid wall incurring structural damage	£200.00
5	• Continue to inspect the wall yearly to keep track of and identify potential issues • Conduct small repairs to brick and mortar loss and manage surrounding vegetation	£1,100.00
10	• Carry out repointing of wall and continue with small repairs to brickwork and management of surrounding vegetation	£2,200.00
15	• If there has been any serious structural damage to the wall over time such as cracking or movement, employ an engineer to investigate. If investigations have found structural damage, employ the relevant operative to repair the damage	£9,200.00

5.0 Summary Costs of Repair and Maintenance

TABLE 2: TOTAL COST

Asset	Immediate	1 Year	5 Years	10 Years	15 Years
CL1	£400.00	£600.00	£3,500.00	£12,500.00	£16,600.00
CL2		£600.00	£3,100.00	£13,200.00	£21,500.00
CL3	£1,900.00	£200.00	£1,000.00	£2,100.00	£10,100.00
CL4		£600.00	£3,500.00	£6,900.00	£17,400.00
CL5		£600.00	£3,500.00	£6,900.00	£17,400.00
CL6	£5,000.00	£200.00	£1,000.00	£2,100.00	£11,000.00
CL7		£600.00	£3,500.00	£6,900.00	£14,800.00
CL8		£600.00	£3,500.00	£6,900.00	£14,800.00
CL9		£600.00	£3,500.00	£6,900.00	£14,800.00
CL10		£600.00	£3,500.00	£6,900.00	£14,800.00
CL11		£600.00	£3,500.00	£6,900.00	£14,800.00
CL12		£600.00	£3,500.00	£6,900.00	£14,800.00
CL13		£700.00	£5,500.00	£17,900.00	£34,200.00
CL14		£600.00	£1,100.00	£2,200.00	£12,000.00
CL15		£200.00	£1,200.00	£2,400.00	£7,700.00
CL16		£200.00	£1,000.00	£2,000.00	£5,900.00
CL17		£200.00	£1,200.00	£4,800.00	£8,200.00
CL18		£7,200.00	£33,400.00	£90,100.00	£166,600.00
CL19		£600.00	£3,500.00	£6,900.00	£17,400.00
CL20		£600.00	£3,500.00	£6,900.00	£17,400.00
CL21		£200.00	£1,100.00	£2,500.00	£9,600.00
CL22		£200.00	£1,600.00	£3,400.00	£9,600.00
CL23		£600.00	£3,500.00	£6,900.00	£23,700.00
CL24		£200.00	£1,100.00	£2,200.00	£9,200.00
Total	£7,300.00	£18,000.00	£94,000.00	£233,700.00	£504,300.00

6.0 Summary

Overall, three of the flood assets are in poor condition, two are walls which will require reconstruction, and the first of the embankments requires the installation of a none return valve to retain its flood defence function. There are six outfalls in good condition and the remaining fourteen flood assets are in fair condition. All assets are no longer inspected by the Environment Agency and have a limited flood protection function, the capacity of the channel itself and the lower land on the opposite bank provides some protection to the site.

The associated costs from immediate action to 15 years ahead involve visual asset inspections which will allow the condition of each asset to be assessed in order to ensure the assets remain in good working order. Vegetation management is also a very consistent cost for almost all assets since root penetration and undesirable vegetation can destabilise assets which could cause them to fail. Mortar repair is a minor but regular maintenance requirement for all defences and structures containing brickwork to ensure internal degradation to brick structures is reduced.

Larger costs which may be required after a longer period of time include the replacement of sheet piling, bank reprofiling and repointing of walls. These costs would be necessary to ensure the assets remain stable.

The recommendations made in Section 4 emphasise monitoring and management to maintain assets to allow them to reach or maintain a condition grade of 3 - ‘Fair’. Monitoring and management makes up most of the 5 and 10 year costings outlined in Table 2, including yearly inspections, vegetation management, and minor repair work where required.

For the 15-year period, more intrusive, structural recommendations have been made to maintain assets to achieve condition grade 3 - ‘Fair’. These recommendations make assumptions that the assets will degrade over time, and that erosion of the channel side will continue. Investigations by engineers will be required to determine any further work required at the time.

Appendix A: Asset inspection logs

Asset inspection logs including photos are available to download as PDF documents.

Asset ID	CL1	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Defence	**Asset Type - Subtype**	Embankment				
Asset Location	Cleator						
Description	Near to Millers Walk, Cleator						
Current Asset Condition		**Target condition**	3				
Element Sequence	**Element Type**	**Material**	**Photo ref**	**Notes**	**ENI**	**Weighting**	**Condition**
1	Crest	Earth				9	3
2	Landward Face	Earth				7	3
3	Exposed Face	Earth				7	3
4	Channel Side	Earth				5	3
5	Berm	Earth				5	2
6							
7							
8							
9							
10							
11							
Calculated	3	**Worst**		**Override**			
Override Reason							
Comments	Variant weighting used for crest as <4m wide. Drainage pipe running through entire width of embankment, low spots, some animal holes and rutting on crest, Landward face and exposed face have some holes and uneven slopes but are well vegetated. Undermining, minor erosion and light foreign objects present on channel side but currently stable.						
Recommendations	Infill low spots on crest, remove drainage pipe from embankment and consider pest control.						

Asset ID		**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Channel	**Asset Type - Subtype**	Natural High Ground				
Asset Location	Cleator						
Description	Near to Millers Walk, Cleator						
Current Asset Condition	CL2	**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	High ground	Earth				2	2
2	Channel Side	Earth				5	3
3							
4							
5							
6							
7							
8							
9							
10							
11							

Calculated	3	**Worst**		**Override**			
Override Reason							
Comments	Significant undermining, erosion and presence of light foreign objects on channel side. High ground in good condition.						
Recommendations	Monitor erosion, consider installing erosion protection layer to channel side.						

Asset ID	CL3	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Defence	**Asset Type - Subtype**	Wall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Crest	Stone				7	3
2	Landward Face	Stone				9	4
3	Exposed Face	Stone				9	4
4	Channel Side	Earth				5	3
5	Berm	Earth				5	2
6							
7							
8							
9							
10							
11							

Calculated	3	**Worst**		**Override**	**4**		
Override Reason	Critical element has lower grading						
Comments	Variant weightings used for both faces as no revetments. Significant mortar loss to crest, holes through wall, bulging of wall where light foreign objects are growing in front on wall, distorting its shape and minor erosion to channel side.						
Recommendations	Rebuild wall and remove trees in front of wall.						

Asset ID	CL4	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure	**Asset Type - Subtype**	Outfall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	**Element Type**	**Material**	**Photo ref**	**Notes**	**ENI**	**Weighting**	**Condition**
1	Frame	Metal				7	2
2	Flap valve	Metal				9	2
3	Pipe	Unknown			X	9	3
4	Apron	Concrete				5	2
5	Downstream headwall	Stone and concrete				8	3
6							
7							
8							
9							
10							
11							

Calculated	2	**Worst**		**Override**	**3**	
Override Reason	Critical element has lower grading					
Comments	Vegetation around headwall. Unable to see through pipe and no CCTV footage available.					
Recommendations	Conduct a CCTV survey to inspect pipe and remove vegetation around headwall.					

Asset ID	CL5	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure	**Asset Type - Subtype**	Outfall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Frame	Metal				7	2
2	Flap valve	Metal				9	2
3	Pipe	Unknown			X	9	3
4	Downstream headwall	Stone and concrete				8	2
5							
6							
7							
8							
9							
10							
11							

Calculated	2	**Worst**		**Override**	**3**	
Override Reason	Critical element has lower grading					
Comments	Outfall in good condition, very minor corrosion present on frame and flap valve. Unable to see through pipe and no CCTV footage available.					
Recommendations	Conduct a CCTV survey to inspect pipe.					

Asset ID	CL6	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Defence	**Asset Type - Subtype**	Wall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Crest	Stone				7	4
2	Landward Face	Stone				9	4
3	Exposed Face	Stone				9	4
4	Channel Side	Earth				5	3
5	Berm	Earth				5	3
6							
7							
8							
9							
10							
11							

Calculated	4	**Worst**		**Override**	
Override Reason					
Comments	Heavy foreign objects growing towards channel on berm and channel side and undermining on channel side causing channel side to be unstable. Ivy growth on wall, heavy foreign objects growing close to wall causing bulging to wall and capping stones lost from crest halfway across wall.				
Recommendations	Rebuild wall, remove unstable trees and remove trees next to wall.				

Asset ID	CL7	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure	**Asset Type - Subtype**	Outfall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Frame	Metal				7	2
2	Flap valve	Metal				9	2
3	Pipe	Unknown				9	2
4	Downstream headwall	Stone and concrete				8	3
5							
6							
7							
8							
9							
10							
11							

Calculated	2	**Worst**		**Override**	
Override Reason					
Comments	No signs of corrosion to flap valve or frame, pipe has minor leaf debris but no blockages or damage. Downstream headwall has some cracks, vegetation growth and mortar loss.				
Recommendations	Continue with ongoing vegetation maintenance.				

Asset ID	CL8	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure	**Asset Type - Subtype**	Outfall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Frame	Metal				7	2
2	Flap valve	Metal				9	2
3	Pipe	Unknown				9	2
4	Downstream headwall	Stone and concrete				8	3
5							
6							
7							
8							
9							
10							
11							

Calculated	2	**Worst**		**Override**	
Override Reason					
Comments	No signs of corrosion to flap valve or frame, pipe has minor leaf debris but no blockages or damage. Minor crack to downstream headwall, vegetation growth and mortar loss.				
Recommendations	Continue with ongoing vegetation maintenance.				

Asset ID	CL9	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure	**Asset Type - Subtype**	Outfall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

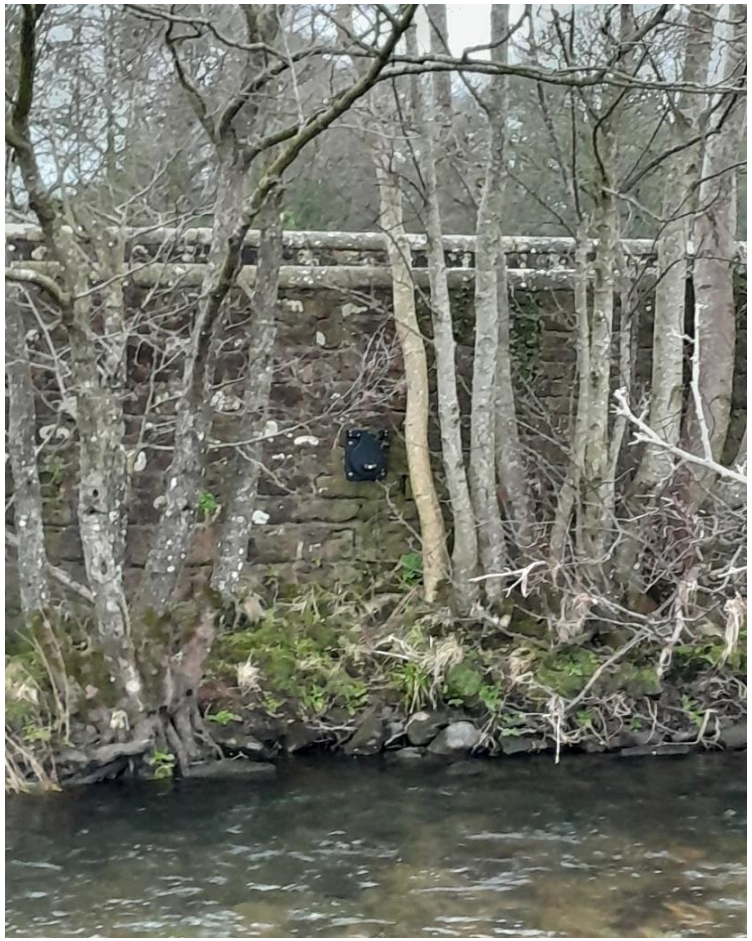
Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Frame	Metal				7	3
2	Flap valve	Metal				9	2
3	Pipe	Unknown			X	9	2
4	Downstream headwall	Stone and concrete				8	3
5							
6							
7							
8							
9							
10							
11							

Calculated	2	**Worst**		**Override**			
Override Reason							
Comments	No corrosion to flap valve or frame. Cracks and mortar loss on headwall. Pipe has minor leaf debris but no blockages or damage.						
Recommendations	Remove vegetation and continue with vegetation maintenance.						

Asset ID	CL10	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Due**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure	**Asset Type - Subtype**	Outfall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Frame	Metal				7	3
2	Flap valve	Metal				9	2
3	Pipe	Unknown			X	9	2
4	Downstream headwall	Stone and concrete				8	3
5							
6							
7							
8							
9							
10							
11							
Calculated	2	**Worst**		**Override**			
Override Reason							

Comments	Ivy growth around frame and headwall. No corrosion to flap valve. Cracks and vegetation growth on headwall. Pipe has minor leaf debris but no blockages or damage.
Recommendations	Remove vegetation and continue with vegetation maintenance.



Asset ID	CL11	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure	**Asset Type - Subtype**	Outfall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Frame	Metal				7	3
2	Flap valve	Metal				9	2
3	Pipe	Unknown			X	9	2
4	Downstream headwall	Stone and concrete				8	3
5							
6							
7							
8							
9							
10							
11							

Calculated	2	**Worst**		**Override**			
Override Reason							
Comments	Ivy growth around frame and headwall. No corrosion to flap valve. Minor cracks and vegetation growth on headwall. Pipe has vegetation debris but no blockages or damage.						
Recommendations	Remove vegetation and continue with vegetation maintenance.						

Asset ID	CL12	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure	**Asset Type - Subtype**	Outfall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Frame	Metal				7	3
2	Flap valve	Metal				9	2
3	Pipe	Unknown			X	9	2
4	Downstream headwall	Stone and concrete				8	3
5							
6							
7							
8							
9							
10							
11							

Calculated	2	**Worst**		**Override**	
Override Reason					

Comments	No corrosion to flap valve or frame. Minor cracks, mortar loss and minor vegetation growth on headwall. Pipe has minor leaf debris but no blockages or damage.
Recommendations	Remove vegetation and continue with vegetation maintenance.

Asset ID	CL13	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Channel	**Asset Type - Subtype**	Natural High Ground				
Asset Location	Cleator						
Description	Near to Millers Walk, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	High ground	Tarmac				2	2
2	Channel Side	Earth				5	3
3							
4							
5							
6							
7							
8							
9							
10							
11							

Calculated	3	**Worst**		**Override**			
Override Reason							

Comments	Significant undermining, erosion and presence of light foreign objects on channel side. High ground in good condition.
Recommendations	Monitor erosion, consider installing erosion protection layer to channel side.

Asset ID	CL14	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Channel	**Asset Type - Subtype**	Natural High Ground				
Asset Location	Cleator						
Description	Near to Millers Walk, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	High ground	Tarmac				2	2
2	Channel Side	Earth				5	3
3							
4							
5							
6							
7							
8							
9							
10							
11							

Calculated	3	**Worst**		**Override**			
Override Reason							

Comments	Light foreign objects and ivy growing in front of and on top of channel side wall. High ground is road in good condition. Heavy foreign object upstream with roots growing into channel side brickwork.
Recommendations	Remove trees on top of and in front of channel side brickwork. Remove ivy.

Asset ID	CL15	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Defence	**Asset Type - Subtype**	Wall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				
Element Sequence	**Element Type**	**Material**	**Photo ref**	**Notes**	**ENI**	**Weighting**	**Condition**
1	Crest	Stone				7	3
2	Landward Face	Stone				9	3
3	Exposed Face	Stone				9	3
4	Channel Side	Earth				5	3
5	Berm	Earth				5	3
6							
7							
8							
9							
10							
11							
Calculated	3	**Worst**		**Override**			
Override Reason							
Comments	Several heavy foreign objects on berm and channel side. Severe mortar loss in landward face, exposed face difficult to inspect but wall covered in ivy and some tree roots and growing through it. Crest is unever where ivy has grown around it.						
Recommendations	Rebuild wall, remove ivy and remove trees growing into wall.						

Asset ID	CL16	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Defence	**Asset Type - Subtype**	Wall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Crest	Stone				7	4
2	Landward Face	Stone				9	2
3	Exposed Face	Stone				9	3
4	Channel Side	Earth				5	4
5							
6							
7							
8							
9							
10							
11							

Calculated	3	**Worst**		**Override**	
Override Reason					

Comments	Extensive ivy growth, channel side wall is walling down with severe brick loss and root penetration. Heavy foreign objects growing on channel side causing brick displacement and loss. Crest is uneven due to brick loss but landward face is made from concrete slabs in good condition.
Recommendations	Rebuild wall and remove heavy foreign objects.

Asset ID	CL17	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Channel	**Asset Type - Subtype**	Natural High Ground				
Asset Location	Cleator						
Description	Near to Millers Walk, Cleator						
Current Asset Condition	3	**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	High ground	Tarmac				2	2
2	Channel Side	Earth				5	3
3							
4							
5							
6							
7							
8							
9							
10							
11							
Calculated	3	**Worst**		**Override**			
Override Reason							

Comments	Heavy foreign objects on channel side leaning towards channel. Building <3m from channel on high ground.
Recommendations	Continue with vegetation maintenance and monitor tree growth.

Asset ID	CL18	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Defence	**Asset Type - Subtype**	Embankment				
Asset Location	Cleator						
Description	Near to Millers Walk, Cleator						
Current Asset Condition	4	**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Crest	Earth				9	3
2	Landward Face	Earth				9	3
3	Exposed Face	Earth				9	3
4	Channel Side	Earth				7	4
5							
6							
7							
8							
9							
10							
11							
Calculated	3	**Worst**		**Override**			
Override Reason							

Comments	Low points and rutting in crest but well vegetated. Variant used for exposed face due to steepness. Exposed and landward faces have isolated bare patches. Telegraph pole behind embankment but embankment build around it. Severe undermining of channel side around heavy foreign objects with extensive root exposure.
Recommendations	Remove unstable trees on channel side, infill low spots on crest and seed bare patches.

Asset ID	CL19	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure	**Asset Type - Subtype**	Outfall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	**Element Type**	**Material**	**Photo ref**	**Notes**	**ENI**	**Weighting**	**Condition**
1	Pipe	Unknown			X	9	3
2	Apron	Concrete				5	3
3	Downstream headwall	Stone and concrete				8	3
4							
5							
6							
7							
8							
9							
10							
11							

Calculated	3	**Worst**		**Override**			
Override Reason							
Comments	Drainage pipe halfway between wall and building on high ground. Unable to see through pipe and no CCTV footage available. Vegetation around headwall and at base of pipe.						
Recommendations	Remove vegetation and provide ongoing vegetation maintenance. Conduct CCTV inspection of pipe.						

Asset ID	CL20	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure	**Asset Type - Subtype**	Outfall				
Asset Location	Cleator						
Description	Hilden Road, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Pipe	Unknown			X	9	3
2	Downstream headwall	Stone and concrete				8	4
3							
4							
5							
6							
7							
8							
9							
10							
11							

Calculated	3	**Worst**		**Override**		
Override Reason						
Comments	Downstream headwall in pieces. Unable to see through pipe and no CCTV footage available.					
Recommendations	Rebuild headwall and conduct CCTV inspection of pipe.					

Asset ID	CL21	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Defence	**Asset Type - Subtype**	Embankment				
Asset Location	Cleator						
Description	Near to Millers Walk, Cleator						
Current Asset Condition	3	**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Crest	Earth				9	3
2	Landward Face	Earth				7	2
3	Exposed Face 1	Earth				7	2
4	Berm 1	Gabions				5	3
5	Exposed Face 2	Gabions				7	3
6	Berm 2	Concrete				5	2
7	Channel Side	Sheet piling				5	2
8							
9							
10							
11							

Calculated	2	**Worst**		**Override**	**3**		
Override Reason	Critical element has worse condition grade						
Comments	Berm 2 and channel side in good condition with minor cosmetic defects to sheet piles. Vegetation growth through gabion baskets with a few broken wires but no gabion displacement. Uneven ground on exposed face 1 and landward face but well vegetated. Rutting and low spots in isolated places on crest. Variants used on crest as less than 4m wide and landward face due to steepness.						
Recommendations	Remove vegetation in gabions and repair wires. Infill low spots on crest.						

Asset ID	CL22	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Defence	**Asset Type - Subtype**	Embankment				
Asset Location	Cleator						
Description	Between Mill Street and Brookside, Cleator						
Current Asset Condition	3	**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Crest	Earth				9	3
2	Landward Face	Earth				7	2
3	Exposed Face 1	Earth				7	2
4	Berm 1	Stone				5	3
5	Exposed Face 2	Stone				7	2
6	Berm 2	Concrete				5	2
7	Channel Side	Sheet piling				5	2
8	Landward face 2	Stone				7	2
9							
10							
11							
Calculated	2	**Worst**		**Override**	**3**		
Override Reason	Critical element has worse condition grade						

Comments	Minor vegetation growth within berm 1 and exposed face 2 with minor mortar loss. Uneven crest with some low spots but well vegetated. Berm 2 and channel side in good condition with minor cosmetic defects to sheet piling. Landward face and exposed face 1 are well vegetated but uneven. Landward face 2 around corner and has minor vegetation growing through stone and minor mortar loss.
Recommendations	Monitor vegetation growth in wall and infill low spots in crest.

Asset ID	CL23	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Structure			**Asset Type - Subtype**	Outfall		
Asset Location	Cleator						
Description	Between Mill Street and Brookside, Cleator						
Current Asset Condition		**Target condition**	3				
Element Sequence	**Element Type**	**Material**	**Photo ref**	**Notes**	**ENI**	**Weighting**	**Condition**
1	Downstream headwall	Stone and concrete			X	8	3
2	Pipe	Unknown			X	9	3
3	Barrier	Metal				2	3
4							
5							
6							
7							
8							
9							
10							
11							
Calculated	3	**Worst**		**Override**			
Override Reason							
Comments	Minor corrosion to barrier. Unable to see headwall and pipe due to high water level and barrier around.						
Recommendations	Conduct CCTV inspection for pipe and headwall.						

Asset ID	CL24	**Frequency**					
Latest Assessment Date	28/01/2022	**Due Date**					
Asset Inspector	Alexandra Mackaness						
Asset Name	Defence	**Asset Type - Subtype**	Wall				
Asset Location	Cleator						
Description	Brookside, Cleator						
Current Asset Condition		**Target condition**	3				

Element Sequence	Element Type	Material	Photo ref	Notes	ENI	Weighting	Condition
1	Crest	Stone				7	3
2	Landward Face	Stone				9	3
3	Exposed Face	Stone				9	3
4							
5							
6							
7							
8							
9							
10							
11							

Calculated	3	**Worst**		**Override**	
Override Reason					
Comments	Minor vegetation growth through crest. Minor mortar loss on exposed face and a couple of holes on both faces, not whole way though. Few bricks missing for drainage.				
Recommendations	Repair holes in wall and remove vegetation.				

Appendix F Envireau Water Breach Analysis

UPDATED FLOOD RISK MODELLING REPORT

CLEATOR MILLS

For

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Blezard Business Park
Seaton Burn
Tyne and Wear
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Ref: P19-310 Cleator Mills Breach Assessment \ RPT Cleator Model.docx
March 2020

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Appendix A Previous Model Report
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Revision	Details	Completed by	Date	Checked by	Date
REV01	Final	RH	27/02/2020	LC	02/03/2020
REV02					
REV03					
REV04					

UPDATED FLOOD RISK MODELLING REPORT

CLEATOR MILLS

1 INTRODUCTION

1.1 Background

Envireau Water has been commissioned to provide an updated flood defence breach analysis at Cleator Mills, Cleator, Cumbria, CA23 3DU. This work follows on from a previous flood defence breach analysis undertaken by Mott MacDonald based on the Environment Agency hydraulic model produced in 2010. The previous modelling report is provided in Appendix A.

This report describes the methodology and results of the two-dimensional modelling and mapping of the flood defence breach scenarios.

1.2 Location and Setting

Cleator Mills (the "Site") is located to the south-east of Cleator Moor Village (Figure 1). The Site is centred on National Grid Reference NY 02067 13818. The River Ehen located adjacent to the north and eastern boundaries of the Site. The Site is split into three areas, the existing Kangol factory, a disused Kangol factory and a car park area. The flood defences are located between the river and Site.

1.3 Scope of Breach Analysis

The scope of the flood defence breach analysis is summarised below:

- Build a 2D model of the Site to replace the previous model developed by Mott MacDonald in 2013 which is not available.
- Obtain and apply new topographic survey information provided by RWO Associates (Appendix B) and LiDAR 1m Digital Terrain Model (DTM) from the Environment Agency dated 2013 (Ref. 1).
- Develop breach hydrographs using the updated 2016 Environment Agency hydraulic model for the River Ehen. The model was built and run using linked Flood modeller TUFLOW simulations.
- Prediction of flood extent, depth, velocities and hazard ratings for the 1 in 100 year plus climate change flood defence breach at two locations.

2 BREACH ANALYSIS

2.1 Breach Scenarios

Two breach scenarios are analysed in the updated assessment. The locations for the flood defence breaches were agreed with the Environment Agency in March 2010 and remain unchanged. Details of the two scenarios are provided in Table 1 below and shown on Figure 2.

Table 1 Breach Location and Details

Breach Scenario	Location	Defence Type	Breach Width (m)	Point X	Point Y	Elevation (mAOD)`	Bank
Breach 1	North of Site	Combination of gabion lined baskets and earth embankment	40	302196	513947	64.52	Right Bank
Breach 2	East of Site	Earth Embankment	40	302202	513840	62.49	Right Bank

The following criteria was agreed with the Environment Agency for the previous assessment and maintained for this update:

- One design event to be assessed – 1 in 100 year plus climate change.
- As both breach locations are on a fluvial river, the following breach width and time apply:
  - Combination of hard defence and earth bank: 40m width, 36 hours to closure.
  - Earth banks: 40m width, 36 hours to closure.
- The start of the breach is the bank-full condition or at the peak water level if lower.

2.2 Breach Methodology

The method used to assess the flood defence breach has been maintained from the previous assessment to ensure consistency between the two results. The method applied is summarised below.

- Review the updated Environment Agency hydraulic model which covers the entire River Ehen, including the two breach locations.
- Spill units representing the breach locations within the Environment Agency model were identified. Where necessary an interpolated channel cross section was added 40m downstream of the breach to ensure a breach width of 40m was achieved. Spill units that represent the breaches floodplains within the Environment Agency model are represented by 1D reservoir units with water exchanged between the river and floodplain via spill units.
- Where an interpolation was required a spill unit to connect it to the 1D reservoir unit was added to ensure all flood water from the main channel was captured.

- The breach was assumed to develop within a single one second timestep in the model run across the full 40m width. This represents a worst case scenario for the breach assessment.
- The breach was assumed to occur through the full embankment height to the surrounding ground level. This was represented within the Environment Agency model by lowering the elevation of the right bank spill at the breach location from the embankment level to the level of the surrounding floodplain.
- The level of the surrounding flood plain was obtained from the topographical survey provided by RWO Associates and 2013 Environment Agency LiDAR data. Table 2 identifies the embankment and floodplain elevation used within the model for each Breach. The floodplain elevations are above those used in the previous model due to the updated topographical survey and Environment Agency LiDAR data differing from that used in the previous model.

Table 2 Flood Defence and Floodplain Elevations

Breach Number	Flood Defence Elevation (mAOD)	Floodplain Elevation (mAOD)
Breach 1	64.52	62.6
Breach 2	62.49	61.5

- The hydrographs for the spill units representing the breach locations were used as an input to a 2D model of the Site to establish the flood depth, extent, velocity and hazard rating from each breach event.

3 2D HYDRODYNAMIC MODELLING

3.1 Approach

The 2D modelling approach is outlined below for assessing the two flood defence breaches for the 1 in 100 year plus climate change event:

1. Construct a 2D hydraulic model incorporating topographic data provided by RWO Associates and Environment Agency 1m LiDAR data dated 2013;
2. Insert the breach hydrographs for each scenario extracted from the updated Environment Agency River Ehen model;
3. Predict flood extents at the site for the specified return period of 1 in 100 year plus climate change;
4. Produce flood extent, depth, velocity and hazard maps.

The model was built and run within Flood Modeller v4.6.

3.2 Model Build

The model extent has been iteratively adjusted to cover a sufficient length of the River Ehen and the maximum flood plain extent which is flooded during the breach assessments. The same model extent was used for both breach scenario.

3.2.1 Digital Terrain Model

The DTM for the Site was produced using 1m resolution LiDAR dated 2013. To make sure flood water from the breach was no underestimated the DTM was edited to raise the channel elevation to the bank elevation. This ensured the watercourse channel was not available for storage or conveyance of the 'breached flows'. This is in accordance with the breach occurring at the same time as bank full conditions with the River Ehen.

Details of the grid used within the model is summarised in Table 3, each cell within the grid is assigned a z value, which is the elevation in mAOD. The previous assessment used a grid size of 7m, for this assessment a grid size of 5m was determined to provide sufficient detail for flood mapping, whilst not creating onerous model run times.

Table 3 2D Model Grid Details

Grid Information	
Grid Size (spacing)	5 m
Origin	301,135N 512,883E (British National Grid)
Orientation	0 degrees
Width of grid (in the east direction)	1260 m
Height of grid (in the north direction	1051 m

3.2.2 Boundary Conditions

The inflow (upstream) boundary is a flow-time boundary assigned to the breach location via a polyline shapefile. The breach hydrograph extracted from the updated Environment Agency model was assigned to the polyline to simulate the flood defence breach. The breach hydrographs are shown in Figure 3.

The peak flow for Breach 2 is greater than the peak flow for Breach 1. We have assumed this is different from the previous model due to the inclusion of flow re-entering the River Ehen from the floodplain between Breach 1 and Breach 2 in the updated Environment Agency model. However, we would naturally expect to see a higher flow at Breach 2 than at Breach 1.

3.2.3 Manning's n

A roughness grid was applied to the 2D grid based on land classification. The roughness values (Table 4) allows the model to calculate the resistance provided by the land to the flood water.

Table 4 Manning's n Values for Land Use Classification.

Land Classification	**Manning's n (Roughness)**
Water	0.035
Grassed floodplain	0.055
Buildings	0.300
Woodland	0.120
Roads and railways	0.020

3.3 Flood Hazard Classification

The hazard rating has been defined using the method outlined in Defra's Flood Risks to People report (FD2321/TRA) (Ref 2). The hazard rating is calculated from depth, velocity and debris factor at each time step in the model. The equations governing this calculation are provided below:

$$HR = d\,(v + 0.5) + DF$$

Where, HR = (flood) hazard rating;
D = depth of flooding (m);
V = velocity of floodwaters (m/s); and
DF = debris factor

The debris factor varies with depth and velocity for each land use classification as shown in Table 5. The debris factor used within the flood mapping is Urban as the Site is occupied as a factory and used for car parking with no extensive woodland coverage.

Table 5 Debris Factor for Land Use and Flood Depths (Table 4.1, FD2321/TRA)

Depths	Debris Factor		
	Pasture/Arable	Woodland	Urban
0 to 0.25 m	0	0	0
0.25 to 0.75 m	0	0.5	1
d>0.75m and/or v>2	0.5	1	1

Hazard rating (HR) has been classified into four categories as defined within FD2321/TRA, the catergorise are listed in Table 6.

Table 6 Hazard to People as a Function of Depth and Velocity (Table 4.2, FD2321/TRA)

Hazard Rating	Degree of Flood Hazard	Description
<0.75	Low	Caution *"Flood zone with shallow flowing water or deep standing water"*
0.75 – 1.25	Moderate	Dangerous for some (e.g. children) *"Danger: Flood zone with deep or fast flowing water"*
1.25 – 2.0	Significant	Dangerous for most people *"Danger: flood zone with deep fast flowing water"*
> 2.5	Extreme	Dangerous to all *"Extreme danger: flood zone with deep fast flowing water"*

4 RESULTS

4.1 Breach 1

During a 1 in 100 year plus climate change event flood defence breach at location 1 flood water flows onto the floodplain progressing south flooding the existing factory. Water then flows each side of the existing factory flooding the car park area and the disused factory downstream. Flood water re-enters the River Ehen near the existing factory site. Figure 4 shows the progression of the flood wave across the Site from the initial time at which the flood breaches fail (t = 0 hour) to the maximum flood extent (t = 4.5 hour).

Flood depths in the vicinity of the existing factory building are significant reaching up to 1.46m near the existing factory building. In the wider area surrounding the existing factory and land around the disused factory water depths reach up to 0.6m. Water depths in the car parking area reach 0.45m. The remainder of the floodplain flood depth typically reaching 0.26m.

The velocity reaches a maximum of 3.2m^3/s at the Site. The highest velocities are located close to the breach location and along the eastern edge of the Site adjacent to the River Ehen.

The hazard rating for the Site is typically Low (<0.75), however the hazard increased in areas with deeper flooding or higher velocities. These areas are located adjacent to the eastern edge of the existing factory and along the banks of the River Ehen. The hazard level of these areas are moderate to significant indicating that it would be dangerous to people during a flood defence breach.

Compared to the previous assessment the maximum flood depth has increased from 0.9m to 1.46m in the vicinity of the existing factory, this in turn has increased the hazard rating in these areas of the Site. However the maximum flood extent at the Site remains the same. The velocities experienced on site are slightly increased from those predicted in the previous breach due to the higher peak in the breach hydrograph.

4.2 Breach 2

During a 1 in 100 year plus climate change event flood defence breach at location 2, flood water flow onto the floodplain encountering the existing factory where is it deflected south through the car park towards the disused factory. As the breach progresses water flows towards the disused factory with some water re-entering the River Ehen downstream of the breach location. Water builds around the existing factory and begins to flow north adjacent to the River Ehen, while water flows around the disused building to the west before flowing south and back into the River Ehen south of the Site. Figure 5 shows the progression of the flood wave across the Site from the initial time at which the flood defence fails (t = 0 hour) to the maximum flood extent (t = 5 hour).

Flood depths in the vicinity of the existing factory are significant reaching up to 1.21m in depth along the eastern wall of the factory. Flood depths at the car park reach 0.55m. Flood depths at the disused factory reach 0.64m with the remainder of the floodplain typically reaching 0.27m.

The velocity reaches a maximum of 3.2m/s at the Site, high velocities are experienced on the eastern edge of the existing factory and to the south of the disused factory.

The hazard rating for the Site during Breach 2 is typically Low (<0.75), however like Breach 1 there are areas of higher hazards associated with deeper flooding or higher velocities. These areas are located adjacent to the eastern edge of the existing factory and along the bank of the River Ehen. The hazard level of these areas are moderate to significant indicating that it would be dangerous to people during a flood defence breach.

In comparison to the previous assessment the maximum flood extent has increased due to the updated Environment Agency hydraulic model incorporating flow back into the River Ehen from the floodplain upstream. This has resulted in a higher peak in Breach 2's hydrograph compared to Breach 1's.

The flood depth has also increased under Breach 2 scenario from 0.5m to 1.21m in the vicinity of the existing factory. This has increased velocities and hazard ratings at the site as a result of the increased volume and peak in the flood defence breach hydrograph. Therefore, although the hazard rating for the Site is typically Low, the area small areas with a hazard rating rising to moderate or significant..

5 FLOOD MAPPING

Flood maps have been produced from the outputs of the 2D model. The maps show the maximum depth, velocity, water level and hazard rating for each Breach individually. Flood maps figures for Breach 1 (Figure 6a – 6d) are provided in Appendix C and flood maps figures for Breach 2 (Figure 7a – 7d) are provided in Appendix D. Table 7 summarise the flood maps.

Table 7 Summary of Flood Maps

Figure Number	Parameter Shown	Breach Location	Return Perion
6a	Depth	Breach 1	100 year + Climate Change
6b	Velocity	Breach 1	100 year + Climate Change
6c	Water Level	Breach 1	100 year + Climate Change
6d	Hazard Rating	Breach 1	100 year + Climate Change
7a	Depth	Breach 2	100 year + Climate Change
7b	Velocity	Breach 2	100 year + Climate Change
7c	Water Level	Breach 2	100 year + Climate Change
7d	Hazard Rating	Breach 2	100 year + Climate Change

6 ASSUMPTIONS AND LIMITATIONS

The following assumptions were made within the model:

- The River Ehen is at bank-full levels downstream of the breach.
- Flood defence and embankment levels within the updated Environment Agency model are correctly representing the modelled area.
- The updated Environment Agency model accounts for surface runoff within the modelled area.
- The Site is an urban environment with no extensive woodland or pastureland.

The following limitations apply to the hydraulic model:

- LiDAR data has a verified vertical accuracy of +/- 15cm.
- Models are not calibrated or verified for flood extent due to breaches due to the lack of observed historic data.
- The updated Environment Agency model was only run to peak producing results for 25 hours. To run the dam breaches for 36hours to closure, the rising limb has been used as a proxy for the falling limb.

7 CONCLUSIONS

An updated flood defence breach analysis has been undertaken for two breach locations adjacent to Cleator Mills. The breach assessment methodology has been maintained from previous assessment to ensure consistency between assessments. The breach hydrographs have been updated applying the updated Environment Agency 2016 River Ehen hydraulic model results.

A new 2D hydraulic model was constructed using a grid assigned levels from a DTM and flow-time boundary conditions representing the inflow from the flood defence breach. The 2D model grid covered an area representing the potential for flooding from the breach with a grid size of 5m.

A flood defence breach at location 1 would result in extensive flooding of the Site. The main areas affected are the existing factory and car park area and the disused factory downstream of the Site. The hazard rating for the majority of the Site was Low, however there were areas that had a Moderate to Significant hazard rating where the flood depth was greater. In these areas the breach poses a significant risk to people.

A flood defence breach at location 2 would result in less extensive flooding with flood water covering the eastern edge of the existing factory, car parking area and disused factory area. Similar to Breach, 1 the hazard rating for the majority of the Site was Low, with areas experiencing greater flood depths having a Moderate to Significant hazard rating. These areas pose a significant risk to people during a flood defence breach at location 2.

The extent of flooding experienced in Breach 1 remains similar to that experienced in the previous assessment however the flood extent in Breach 2 is increased from that identified in the previous assessment. The flood depths for both assessments are increased by 0.56m and 0.71m for Breach 1 and Breach 2 respectively. The increased depths on Site have resulted in an increase in hazard ratings in these areas, however the majority of the Site remains within the Low hazard category.

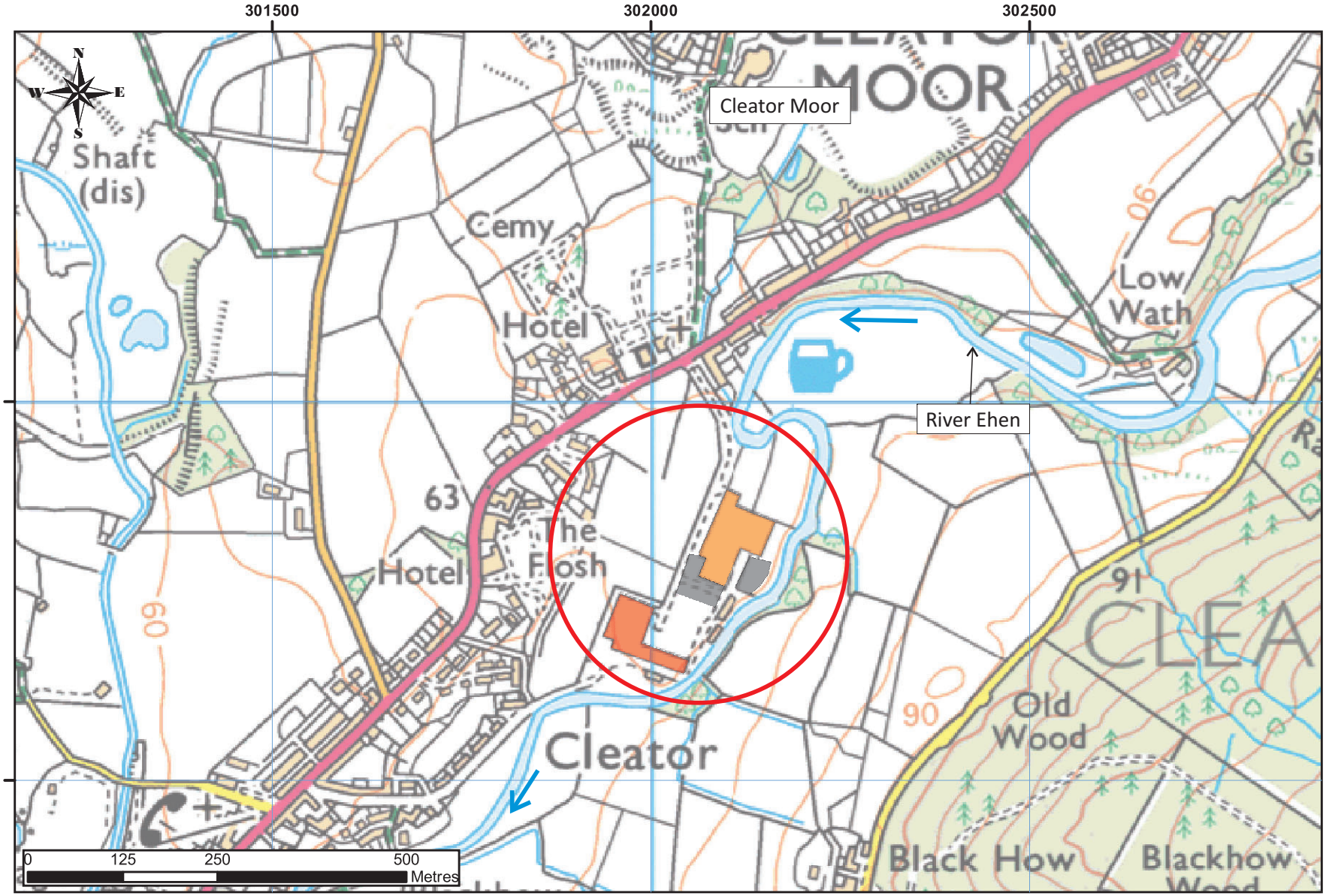
Envireau Water
02/03/2020

REFERENCES

Ref.1 Environment Agency (2013). LIDAR Tiles DTM: 2013 DTM 1M. https://environment.data.gov.uk/DefraDataDownload/?Mode=survey

Ref.2 DEFRA (2006). Flood Risks to People – Phaser 2, FD2321/TR2 Guidance Document.

FIGURES



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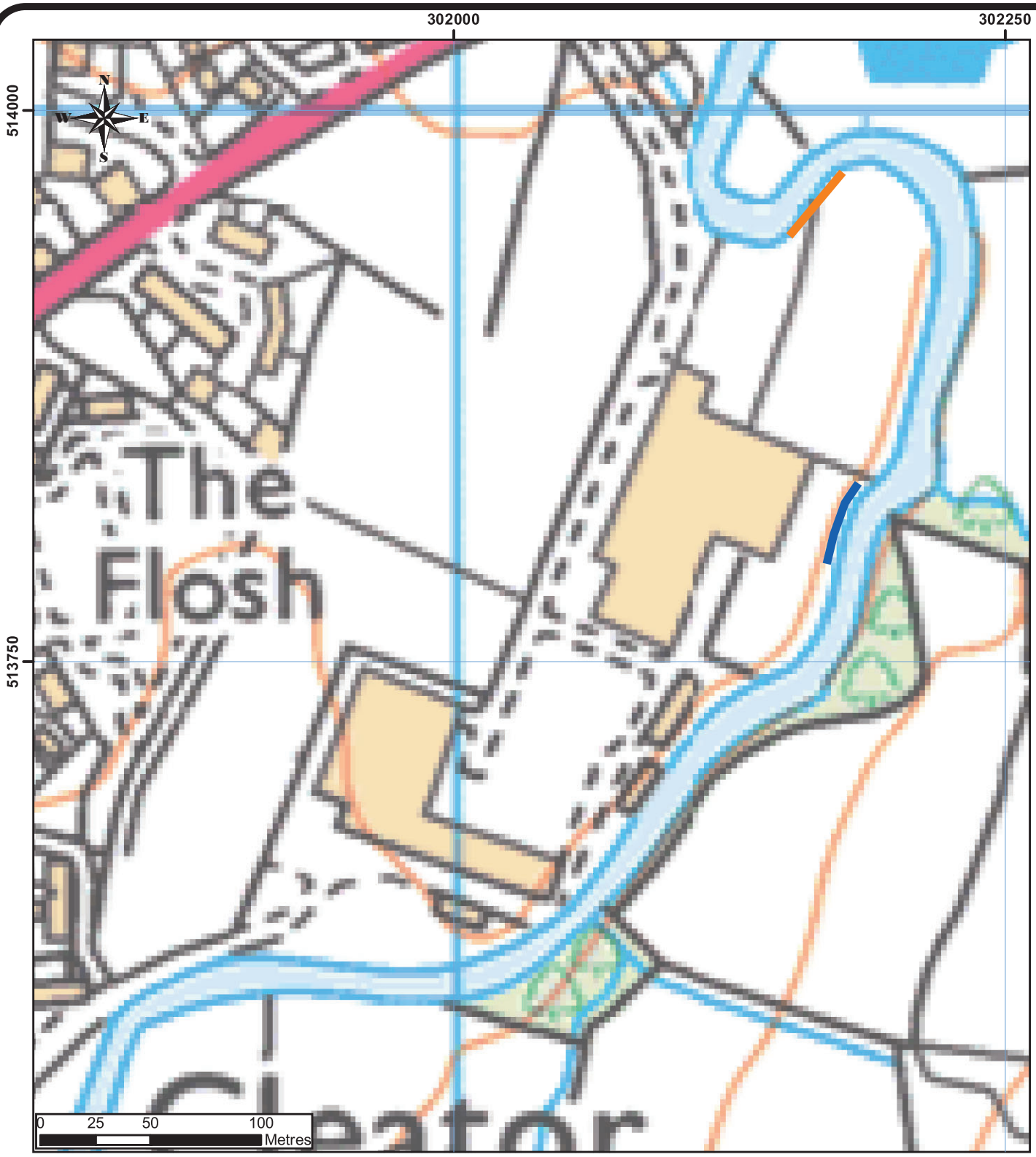
Ref: P19-310 Cleator Mills Breach Assessment\FIG 1 Site Setting Date: 27/02/2020	**RWO Associates -Cleator Mills**
Figure 1	Site Setting



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KEY

Breach 1 Location

Breach 2 Location

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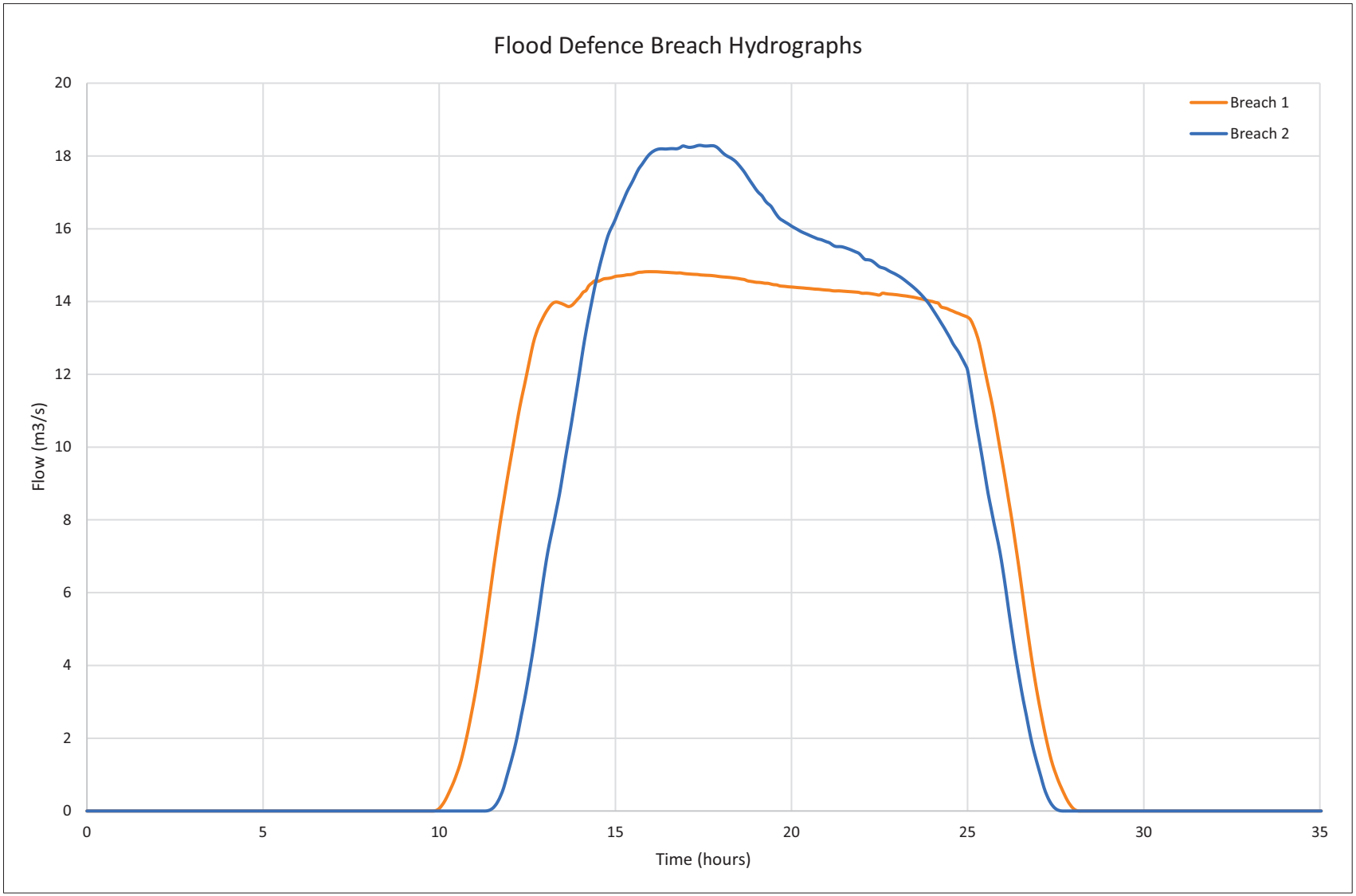
Ref: P19-310 Cleator Mills Breach Assessment\FIG 2 Breach Locations Date: 02/03/2020	**RWO Associates - Cleator Mills**
Figure 2	Flood Defence Breach Locations



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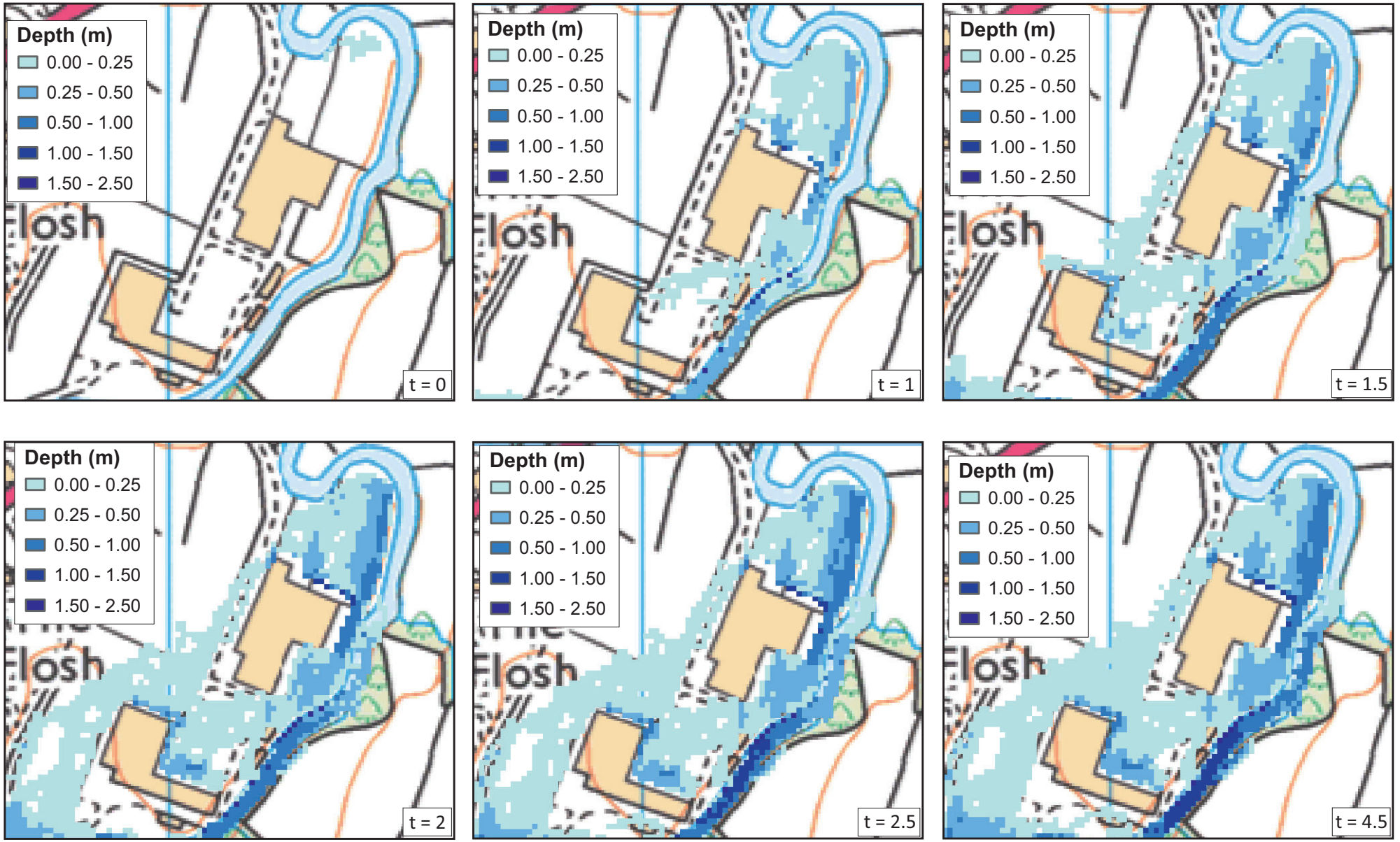
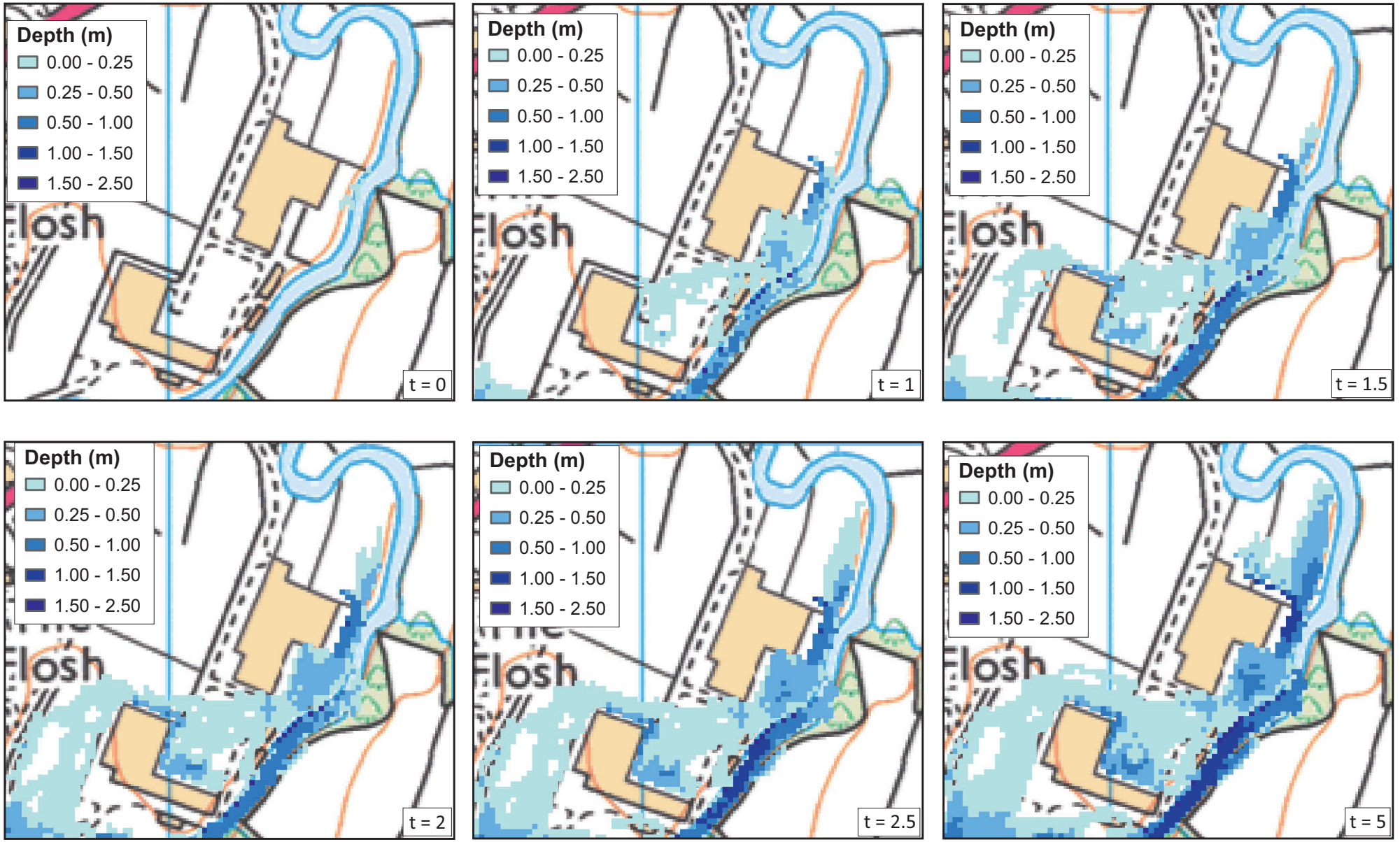
Ref: P19-310 Cleator Mills Breach Assessment\Flood Defence Breach Hydrographs Date: 02/03/2020	**RWO Associates -Cleator Mills**
Figure 3	Flood Defence Breach Hydrographs



envireau WATER

Ref: 19-310 Cleator Mills Breach Assessment\FIG 4 B1 Flood Wave Date: 28/02/2020	**RWO Associates - Cleator Mills**
Figure 4	Breach 1 Flood Wave Progression



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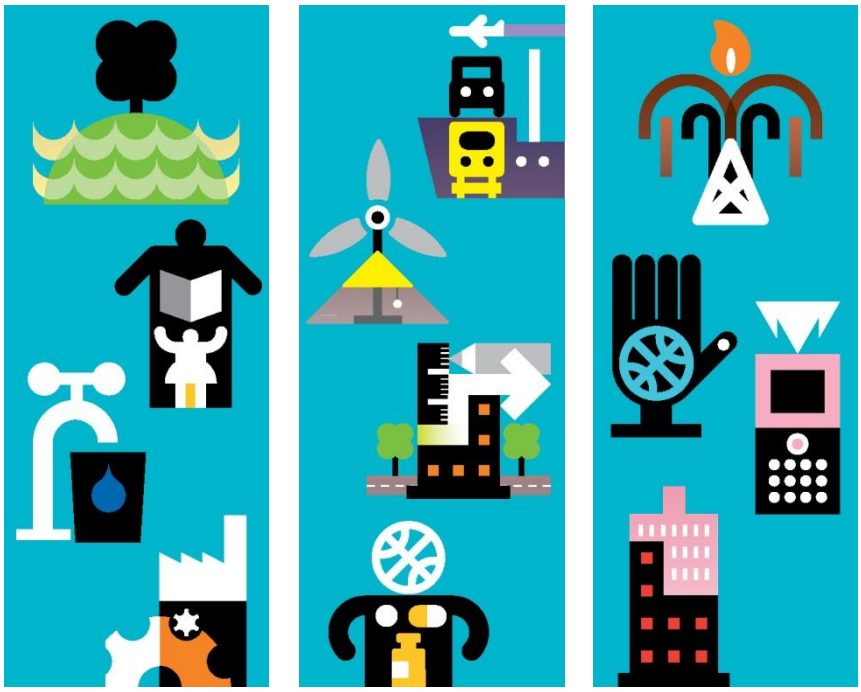
Ref: 19-310 Cleator Mills Breach Assessment\FIG 5 B2 Flood Wave Date: 28/02/2020	**RWO Associates - Cleator Mills**
Figure 5	Breach 2 Flood Wave Progression

APPENDIX A
PREVIOUS MODEL REPORT



Updated Flood Risk Modelling - Cleator Mills Site

Modelling Report

October 2013

RWO Associates

RWO ASSOCIATES

Mott MacDonald

Updated Flood Risk Modelling - Cleator Mills Site

Modelling Report

October 2013

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1 Introduction

1.1 Background and Objectives

Mott MacDonald has been commissioned by RWO Associates to undertake a flood defence breach analysis in the River Ehen catchment, near the Cleator Mills site at Cleator in Cumbria. This work follows on from the previous breach analysis work, which Mott MacDonald carried out for a proposed redevelopment of land on the Cleator Mills site in 2010.

The main objectives of the new study are:

- Set up and run a two-dimensional TUFLOW model with new ground survey now available;
- To map the spatial variation of depth, velocity and hazard rating across the floodplain resulting from failure of defences in two alternative locations for a fluvial flood with a return period of 100 year plus climate change.

This report describes the methodology and results of two-dimensional modelling and mapping of the River Ehen breach scenarios.

1.2 Study Area and Model Extent

The breach analyses cover an area situated to the south-east of Cleator Village, adjacent to the River Ehen. The location is shown on the map included in Appendix A. The River Ehen is located to the north and east of the Cleator Mills site. The site is divided into three sections, including the existing Kangol premises, a disused Kangol factory and a car park area.

1.3 Scope of Work

The scope of work for this study is summarised below:

- Use of the existing 2D model of the Cleator Mills site which was developed by Mott MacDonald in 2010;
- Update the model with new topographic survey information provided by RWO Associates;
- Use breach hydrographs as developed for the 2010 modelling and apply these at the same locations as for the 2010 modelling;
- Prediction of the flooding extent, flood depth, velocities and hazard ratings for the 1 in 100 year plus climate change fluvial event;
- Reporting.

2 Breach Analysis

The initial locations of defence breaches to be assessed were agreed with the Environment Agency in March 2010. Output from the existing ISIS model, developed by JBA in 2004, was used by Mott MacDonald in the 2010 study to generate breach scenario hydrographs. Hydrology and boundary inputs that form the basis of this assessment are based on the 2010 study.

2.1 Breach Constraints and Inputs

The following breach locations were used in the 2010 study:

Table 2.1: Breach Locations and Details

Breach	Location	Defence Type	Breach Width (m)	Point X	Point Y	Elevation (mAOD)	Bank
Breach 1	North of the site	Combination of gabion lined baskets and earth embankment	40	302196	513947	64.52	Right bank
Breach 2	East of the site	Earth embankment	40	302202	513840	62.49	Right bank

The following additional requirements were also agreed with the Environment Agency at the time:

- One design event to be considered: 1 in 100 year plus climate change return period;
- All of the breach locations are on a fluvial river, and therefore the following breach width and time to closure details were to be used:

  Earth bank: 40m width; 36 hours to closure.

  Combination of hard defence and earth bank: 40m width; 36 hours to closure.
- The start of the breach is the bank-full condition or at the peak water level if lower.

2.2 Breach Methodology

The following gives details of the method used in 2010 to model the breach hydrographs in the 1D ISIS model.

- The existing hydraulic model covers the entire reach of River Ehen, including the breaches identified in Table 2.1. The objective of the assessment was to determine a flow hydrograph through each of the breach locations. These hydrographs identified the flows leaving the main channel at these points and was then used as an input to a 2D model of the surrounding area to establish a flood extent and rate of inundation from the breach event.
- In the existing ISIS model of River Ehen, floodplains were represented by ISIS RESERVOIR units which model the rate of water accumulation in a storage pond/lake and made the assumption of a water level surface in the storage. Exchange of flow between river channel and flood cells was characterised by SPILL units representing side weir flow over the river banks.

- The breach locations were identified on the model network. Where necessary an interpolated channel cross-section was added 40m downstream to ensure the breach width of 40m was maintained. The interpolated channel cross-sections were also connected to the RESERVOIR units to ensure any excess water was spilled from the main channel onto the flood cells. This prevented any downstream water level increase, any backwater effect through the breach and also stabilised free flow conditions.

- The breaches were assumed to be formed over a single one second time step in the model runs. The breaches were assumed to form to the full extent of 40m width, thereby providing a 'worst-case' assessment for the development of the breach. The breach was taken as occurring through the full height of the embankment to the level of the surrounding land. This was represented by lowering the elevation of the right bank spill from embankment level to the elevation of the surrounding floodplain. This lower level was obtained from the LiDAR data available for the catchment (See Table 2.2).

Table 2.2: Embankment and Floodplain Levels

Breach Nr.	Embankment Elevation (mAOD)	Floodplain Elevation (mAOD)
Breach 1	64.52	62.5
Breach 2	62.49	61.0

3 2D Hydrodynamic Modelling

3.1 Introduction

The main purpose of this study was to assess the flood extent in the event of flood defence breach for the 100 year plus climate change fluvial event.

The approach to hydraulic modelling has comprised the following stages:

Step 1: constructing a two-dimensional hydraulic model incorporating the new topographic data made available by RWO Associates;

Step 2: breach analysis using the breach hydrographs generated in 2010 study;

Step 3: predicting flood extent for the specified fluvial return period (1 in 100 year plus climate change);

Step 4: producing flood extent, depth, velocity and hazard maps.

3.2 Model Build

The proposed development site is located to the south-east of the village of Cleator adjacent to the River Ehen. The extent of the model was estimated so that the model would include a sufficient length of the River Ehen within the model, whilst also including the Cleator Mills site that has a theoretical chance of flooding. Two breach locations are identified in the study area, as described in Table 2.1.

3.2.1 Digital Terrain Model

The Digital Terrain Model (DTM) for the Cleator Mills area was produced using 1m resolution LiDAR and ground based topographic survey data. In order to ensure that channel volume was not available to flood waters (since during a breach scenario channels are assumed to be full to bank-top) the DTM along channel lengths was raised to bank-top levels.

The topographic survey (North Associates - Kangol Factory,Cleater_topo.dwg) was provided by RWO Associates. The survey data was recorded in local coordinate system, therefore the first step was to transform it to the national coordinate system. After the transformation the 2d_zsh feature of TUFLOW was used to incorporate the survey into the DTM.

The TUFLOW model comprises of a grid of the Cleator Mills area, with grid points (z points) assigned elevations from the above mentioned sources. Details of the grid used for modelling the River Ehen at Cleator Mills are summarised in Table 3.1 below.

Table 3.1: Cleator Mills TUFLOW Model Grid Details

Grid Information	
Grid size (spacing)	7m
Origin	301,135N, 512,883E (British National Grid)
Orientation	0 degrees
Width of grid (in the east direction)	2.16km
Height of grid (in the north direction)	2.15km

A grid size of 7m was used as this is of sufficient detail for flood mapping, whilst not being so small as to result in unacceptably long model run times.

3.2.2 Boundary Conditions

The upstream boundary of the model is a flow-time boundary condition. Breach hydrographs were extracted at SPILL units connected to the model river cross-sections at each breach location for the 100 year plus climate change fluvial event. The breach hydrographs were developed in the 2010 modelling study and have been used in this updated study without modification. The breach hydrographs are shown on Figure 3.1

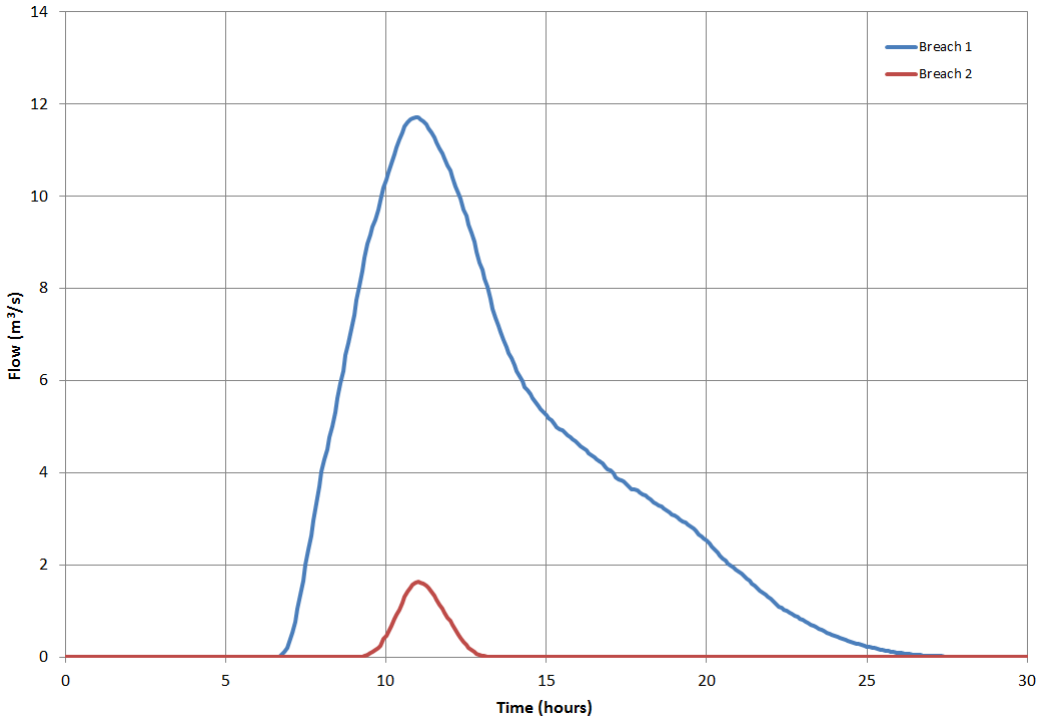


Figure 3.1 – Breach hydrographs

3.2.3 Manning's n

Land classification within the TUFLOW model determines the roughness values (Manning's n) of each land type, and therefore the resistance that is provided by the land to the flood water. For this study, a detailed land classification was used, as outlined in Table 3.2.

Table 3.2: Summary of Manning's n Values Used in the Model

Terrain Type	Roughness
Water	0.035
Grassed floodplain	0.055
Buildings	0.300
Woodland	0.120
Roads and railways	0.020

3.3 Flood Hazard Classification

Hazard rating has been defined in the *Supplementary Note on Flood Hazard ratings and Thresholds for Development Planning and Control Purpose – Classification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1* (Defra 2008). Hazard rating is calculated from depth, velocity and a debris factor at each time step in the model using the following equation:

$$HR = d (v + 0.5) + DF$$

where, HR = (flood) hazard rating;

d = depth of flooding (m);

v = velocity of floodwaters (m/s); and

DF = debris factor (0, 0.5, 1 depending on probability that debris will lead to a hazard).

The debris factor was based on the conservative land use classification. It varies with depth and velocity of flooding as shown in Table 3.3.

Table 3.3: Guidance on debris factors for different flood depths, velocities and dominant land use (from Table 4.2 in Flood Risks to People)

Depth (d)/Velocity (v)	Debris Factor based on Conservative Land Use
d = 0 to 0.25m	0.5
d = 0.25 to 0.75m	1.0
d > 0.75 and/or v > 2m/s	1.0

Hazard rating has been classified into four categories in the *Supplementary Note on Flood Hazard ratings and Thresholds for Development Planning and Control Purpose – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1* (Defra, 2008) for emergency planning purposes.

Table 3.4 summarises the four categories. This classification has been used in the description of the results.

Table 3.4: Hazard to People as a Function of Velocity and Depth

Hazard Rating	Degree of Flood Hazard	Elevation (m AOD) Bank
<0.75	Low	Caution "Flood zone with shallow flowing water or deep standing water"
0.75 – 1.25	Moderate	Dangerous for some (e.g. children) "Danger: Flood zone with deep or fast flowing water"
1.25 – 2.0	Significant	Dangerous for most people "Danger: flood zone with deep fast flowing water"
>2.0	Extreme	Dangerous for all "Extreme danger: flood zone with deep fast flowing water"

3.4 Scenarios Modelled

Two scenarios using the above methodology have been modelled for the 1 in 100 year plus climate change event. These scenarios are listed in Table 3.5 below:

Table 3.5: Scenarios Modelled

Breach Nr.	Design Event
Breach 1	100 year plus climate change
Breach 2	100 year plus climate change

Appendix A shows the location of breaches.

4 Results

4.1 Breach 1

A breach in the gabion lined baskets north of the site has been considered for the 1 in 100 year plus climate change event. The approximate location of the breached defence is indicated on the Appendix A. A breach of the flood defence was assumed to occur when the river was at bank-full downstream. During a breach for the 100 year plus climate change event, floodwaters flow onto the floodplain (see Figure 4.1), flooding the existing premises, car park area and the disused factory building downstream of the site. Some of the floodwaters flow back into the River Ehen near the downstream end of the existing Kangol premises. Flood depths in the vicinity of the breach are fairly significant reaching up to 0.90 m near this building.

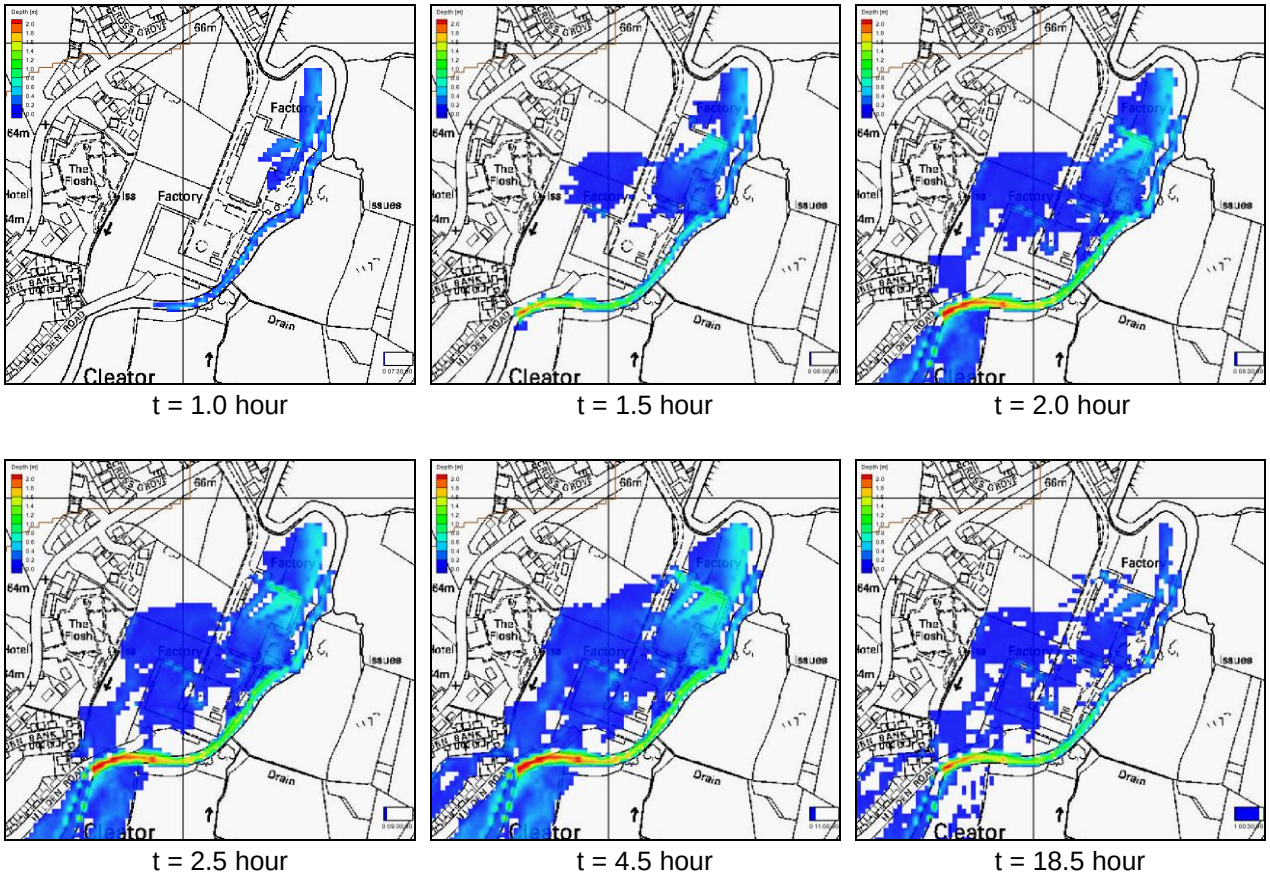


Figure 4.1 – Progress of flood wave from Breach 1

The hazard rating was generally low (0 to 0.75) throughout the site, although this was observed to be greater in the areas of deeper waters. There are areas, in the vicinity of the Kangol Building where the hazard rating is significant (1.25 to 2) implying that it is dangerous for most people.

4.2 Breach 2

A breach in the earth flood embankment east of the site was considered for the 100 year plus climate change event. The approximate location of the breached flood embankment is shown on Appendix A. For this analysis it has been assumed that the River Ehen was bank-full downstream of the breached

embankment. During a breach, floodwaters spread onto the floodplain (see Figure 4.2), inundating the Kangol premises, and then flow through parts of the car park area and the disused factory building. Flood depths generally remain low (0 to 0.25m) through the site, although there are small areas in the vicinity of the Kangol building where there is deeper flooding of up to 0.5m. The flood hazard rating of the breach floodwaters is low (0 to 0.75) as the depth of flooding is shallow (less than 0.25m) and the velocities are low (less than 0.3m/s) with the exception of a few areas in the vicinity of the existing building (0.8m/s).

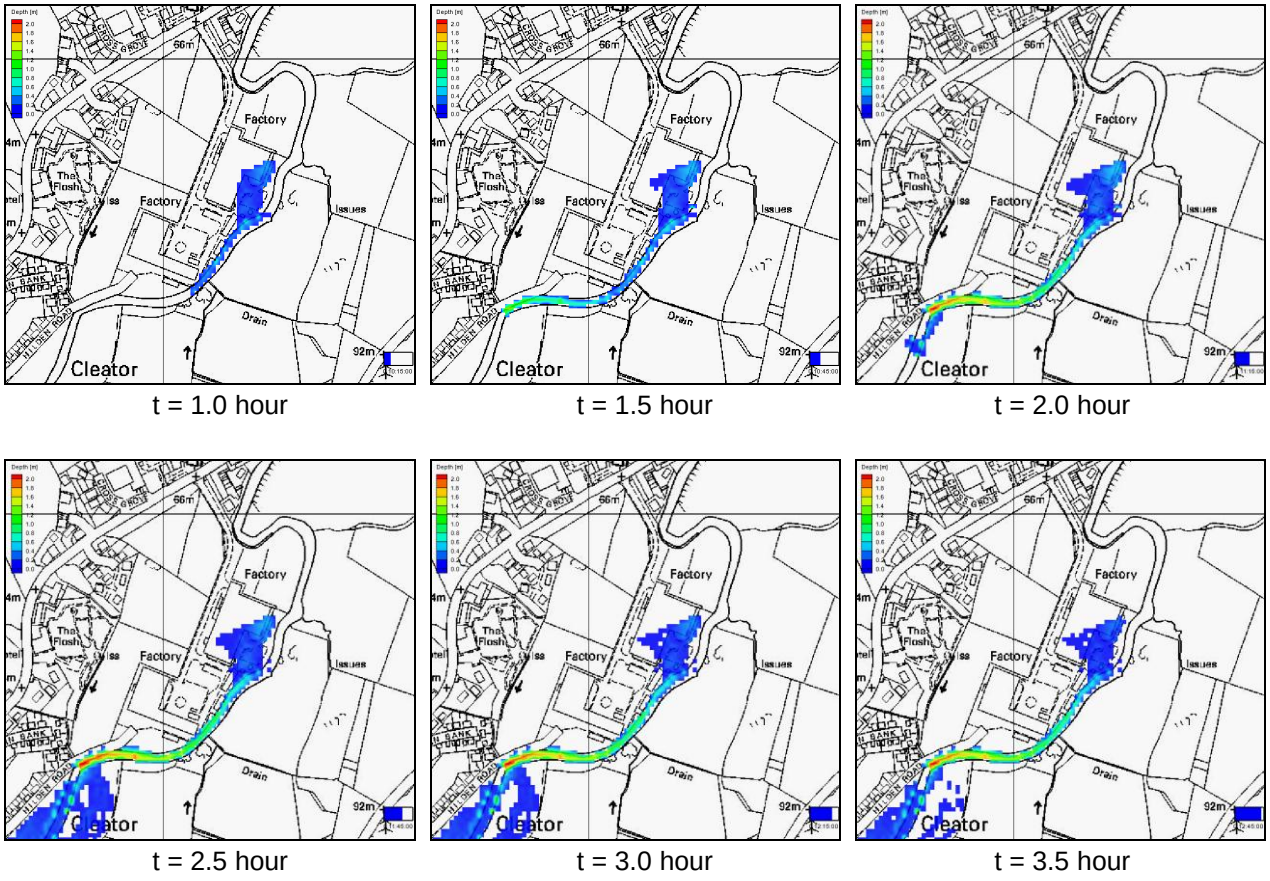


Figure 4.2 – Progress of flood wave from Breach 2

5 Flood Mapping

Flood maps have been produced from the outputs of the 2D modelling. The maps show maximum water level, flood depth, velocities and hazard rating for all of the scenarios which have been modelled. Table 5.1 summarises the flood maps located in Appendix B and discussed in Section 4.

Table 5.1: Summary of Flood Maps

Drawing No.	Parameter Shown	Breach Location	Return Period
1.01	Depth	Breach 1	100 year + 20%
2.01	Velocity	Breach 1	100 year + 20%
3.01	Water Level	Breach 1	100 year + 20%
4.01	Hazard Rating	Breach 1	100 year + 20%
1.03	Depth	Breach 2	100 year + 20%
2.03	Velocity	Breach 2	100 year + 20%
3.03	Water Level	Breach 2	100 year + 20%
4.03	Hazard Rating	Breach 2	100 year + 20%

6 Assumptions and Limitations

The model and input data are based on the following assumptions:

- River channel is bank-full downstream of breach locations.
- Flood defences and embankment levels used in the existing ISIS model are correctly representing the study area.
- The ISIS model accounts for surface runoff in the study area.

The model has several limitations which should be understood before applying the findings of this report:

- Models are not calibrated or verified, owing to lack of observed historic data.
- LiDAR data has verified accuracy of +/- 150mm.

7 Conclusions

The outputs from the updated Cleator Mills FRA Breach Analysis facilitate the assessment of extent and severity of flooding in the event of breaches in the fluvial defences. The breach hydrographs used were those produced in the previous breach analysis (2010) and are for the 100 year plus climate change event, based on best available data at the time.

Breach hydrographs were input as flow-time boundary conditions into the 2D TUFLOW model. The 2D model covered areas adequate to model the full extent of flood waters, using a grid size of 7m.

It was observed that the extent of flooding south of the breached gabion lined baskets (Breach 1) was significant. Areas affected were mainly near the existing Kangol premises, car park area and the disused factory building downstream of the site. Hazard rating was generally low through the site, with the exception of a few areas in the vicinity of the existing building. Flood waters were observed to be deeper in these areas (up to 0.9 m), and the hazard rating was identified to be significant (1.25 to 2) implying that it is dangerous for most people.

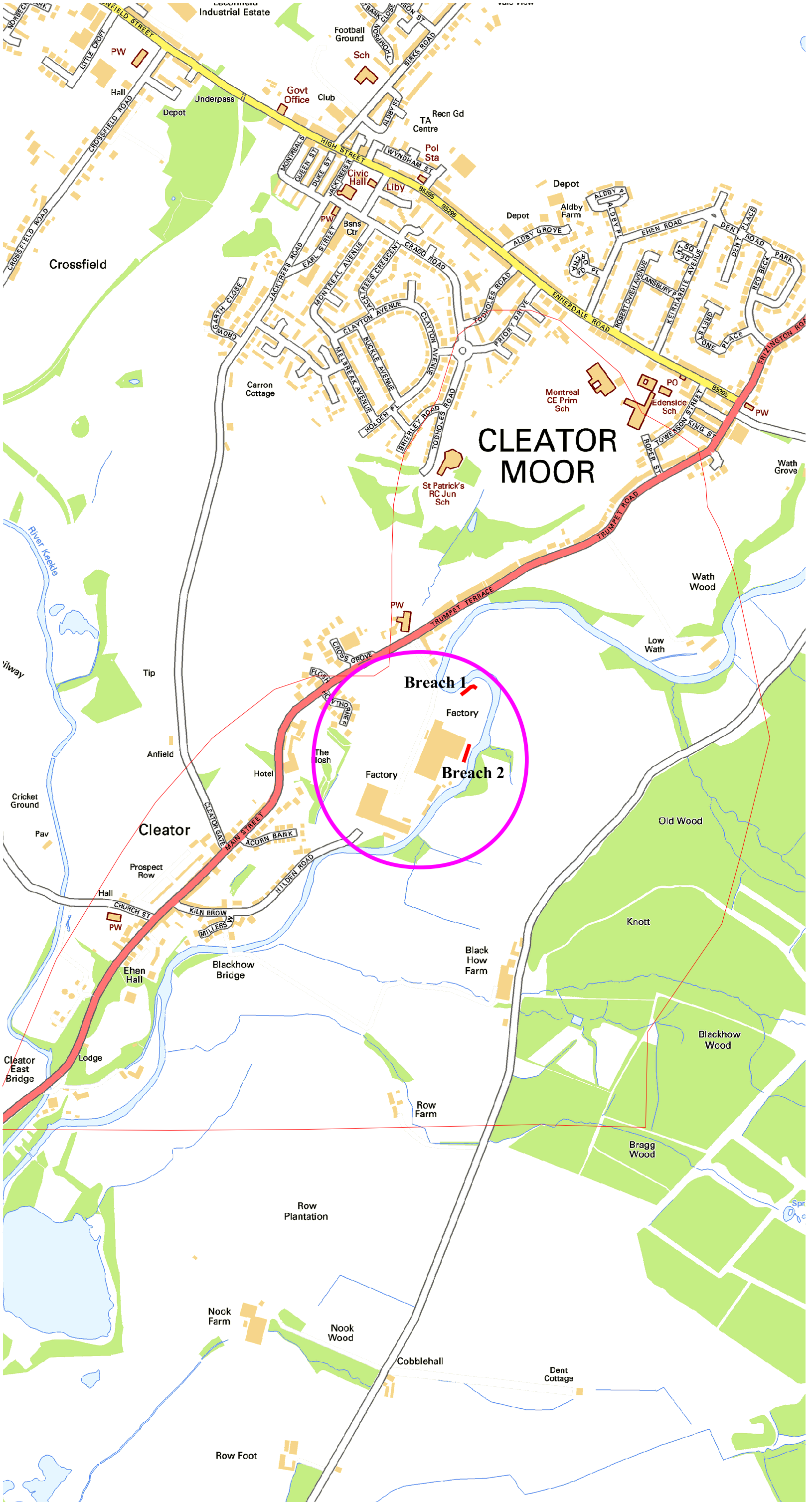
During a breach in the earth embankment east of the site (Breach 2), floodwaters covered the existing building and parts of the car park area. Flood depths generally remained low (0 to 0.25m) through the site, although there were small areas in the vicinity of the factory building where there was deeper flooding of up to 0.5m. The flood hazard rating of the breach floodwaters was low (0 to 0.75) as the depth of flooding was shallow (less than 0.25m) and the velocities were low (less than 0.3m/s) with the exception of a few areas in the vicinity of the existing building (0.8m/s).

The extent and severity of flooding predicted for both breaches is very similar to that predicted in the 2010 study. The additional ground based topographic data now available indicates that the area to north-west of the existing factory are lower than given by LiDAR data used in 2010. This results in greater flood extent in this area. However maximum values of flood depth, velocity and hazard around the site has not significantly changed.

Appendices

Appendix A. Study Area 15
Appendix B. Flood Maps 16

Appendix A. Study Area



KEY PLAN

LEGEND

Extent of 2D Domain

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Project Title

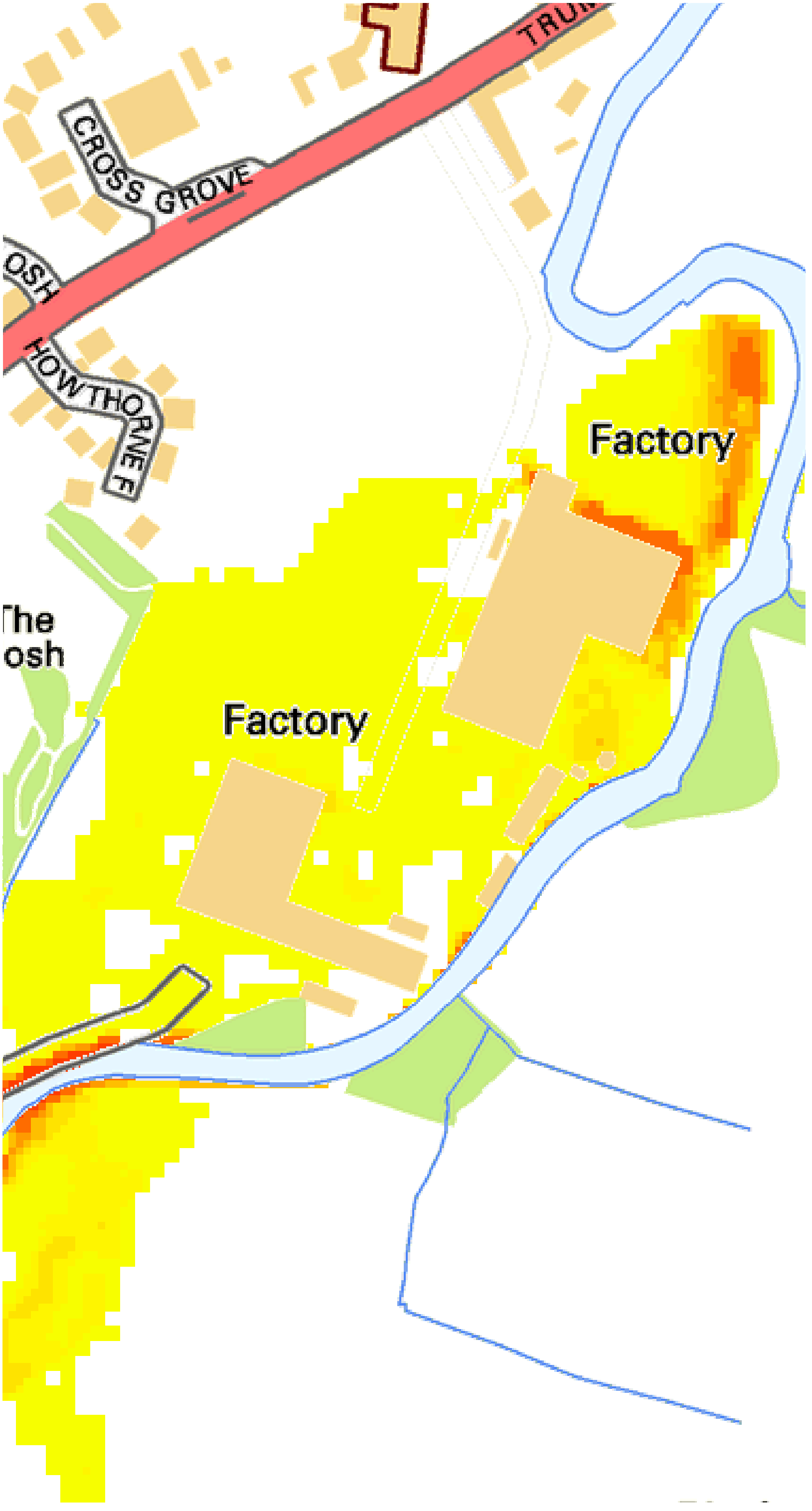
Flood Risk Modelling - Cleator Mill Site

Map Title

2D Model Extent

Date / Revision	14/10/2013
Modelled	IG
Checked	RJG
Approved	RJG
Drawing No.	0.01
Drawing Scale at A3	1:5000

Appendix B. Flood Maps



KEY PLAN

LEGEND

Depth [m]

- < 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

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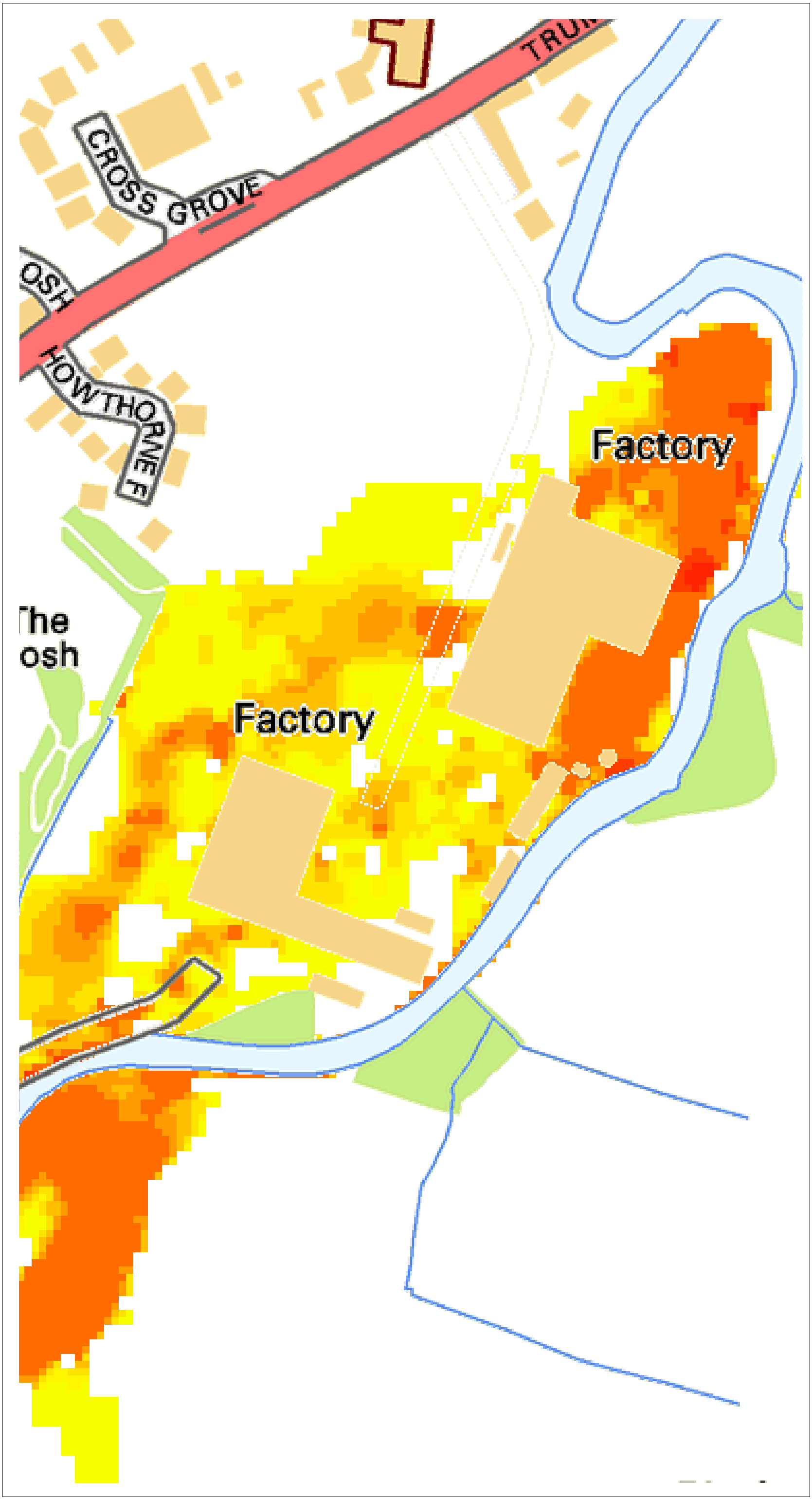
Project Title

Flood Risk Modelling - Cleator Mill Site

Map Title

Maximum flood depth for breach 1 (DTM 2013)

Date / Revision	14/10/2013
Modelled	IG
Checked	RJG
Approved	RJG
Drawing No.	1.01
Drawing Scale at A3	1:1100



KEY PLAN

LEGEND

Velocity [m/s]

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.40
- 0.40 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

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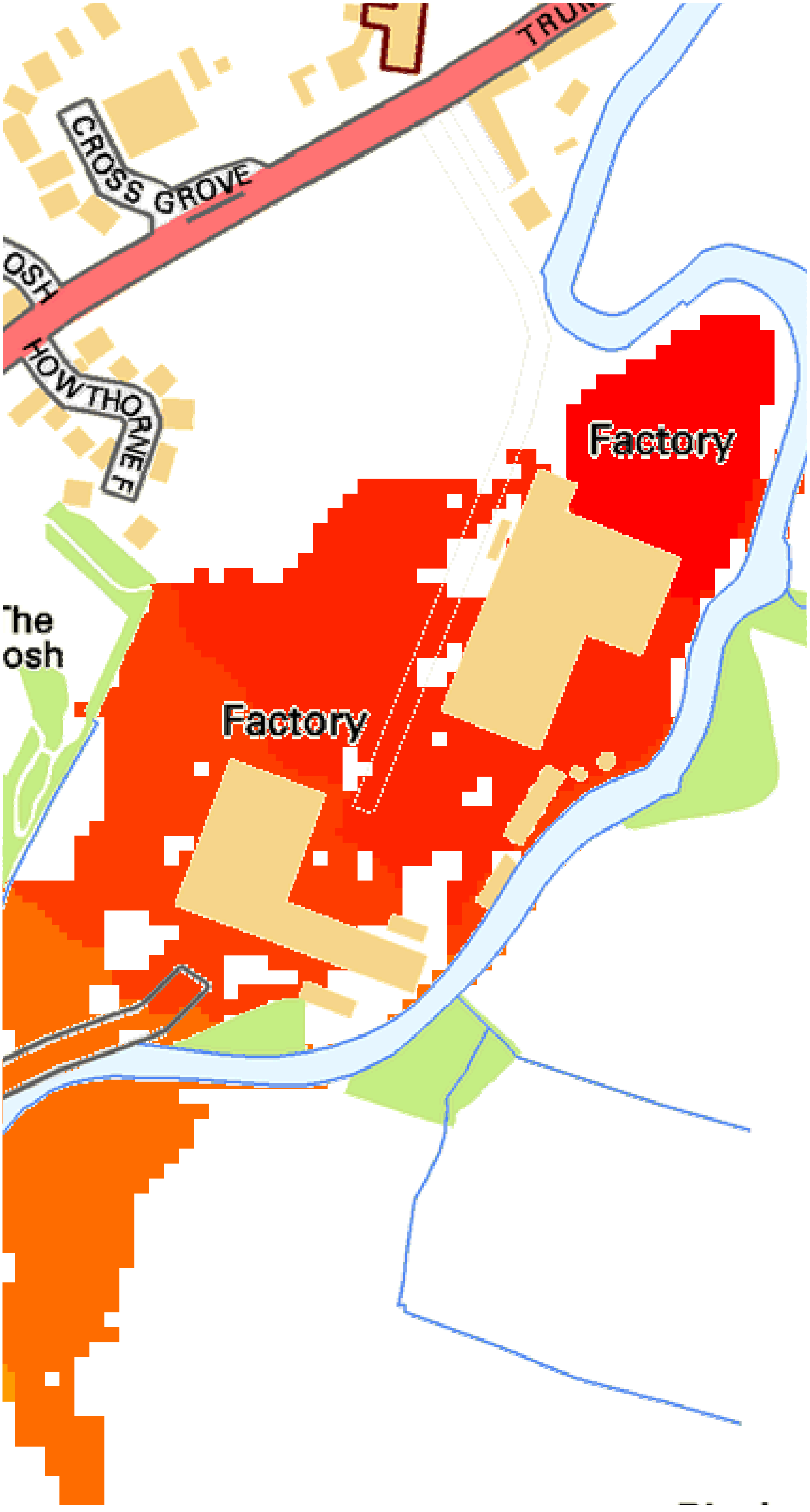
Project Title

Flood Risk Modelling - Cleator Mill Site

Map Title

Maximum flow velocity for breach 1 (DTM 2013)

Date / Revision	14/10/2013
Modelled	IG
Checked	RJG
Approved	RJG
Drawing No.	2.01
Drawing Scale at A3	1:1100



KEY PLAN

LEGEND

Water Level [mAOD]

- 50.340 - 51.758
- 51.758 - 53.175
- 53.175 - 54.593
- 54.593 - 56.010
- 56.010 - 57.428
- 57.428 - 58.845
- 58.845 - 60.263
- 60.263 - 61.681
- 61.681 - 63.098

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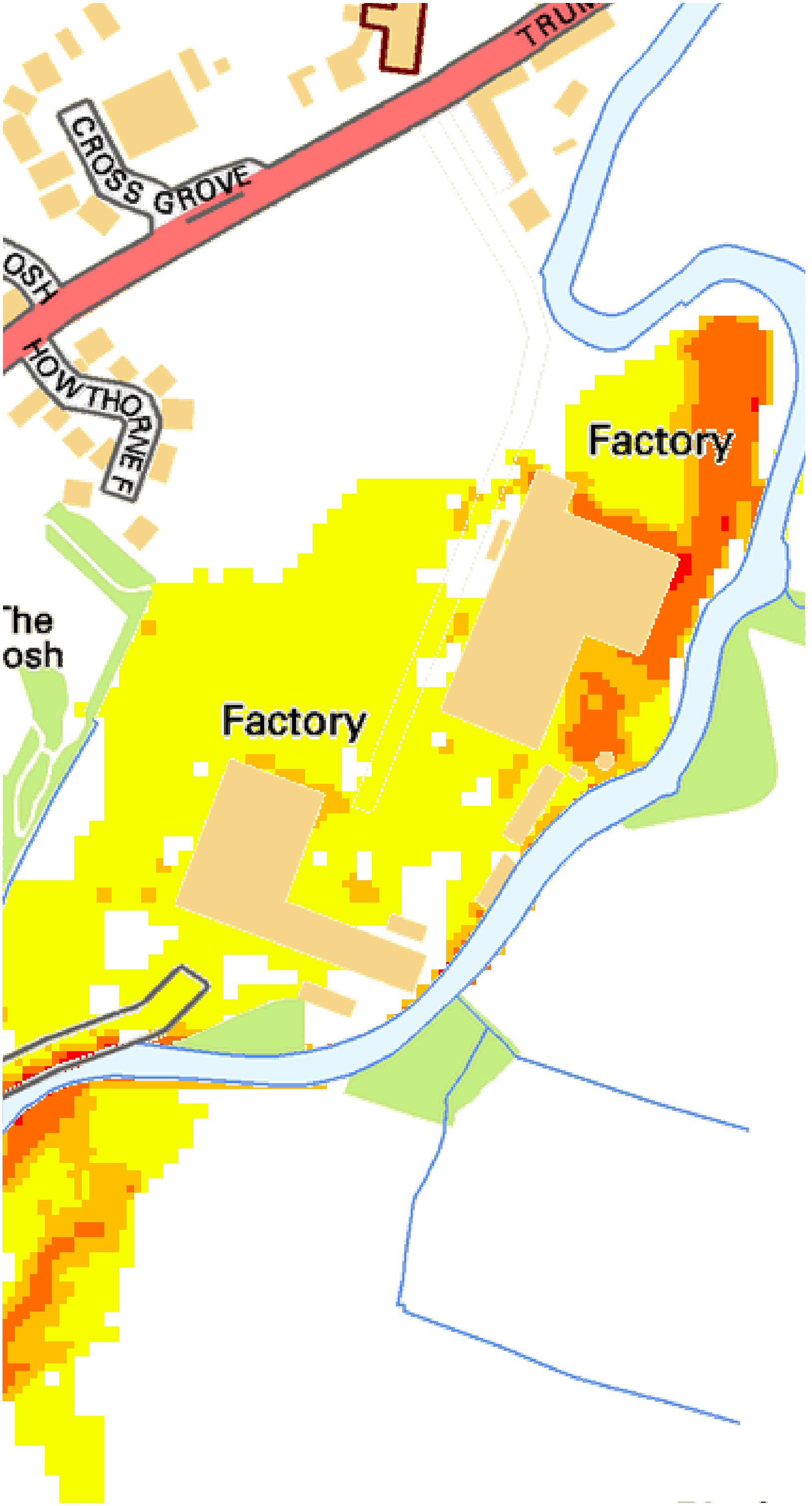
Project Title

Flood Risk Modelling - Cleator Mill Site

Map Title

Maximum water level for breach 1 (DTM 2013)

Date / Revision	14/10/2013
Modelled	IG
Checked	RJG
Approved	RJG
Drawing No.	3.01
Drawing Scale at A3	1:1100



KEY PLAN

LEGEND

Flood Hazard Category

- Low
- Moderate
- Significant
- Extreme

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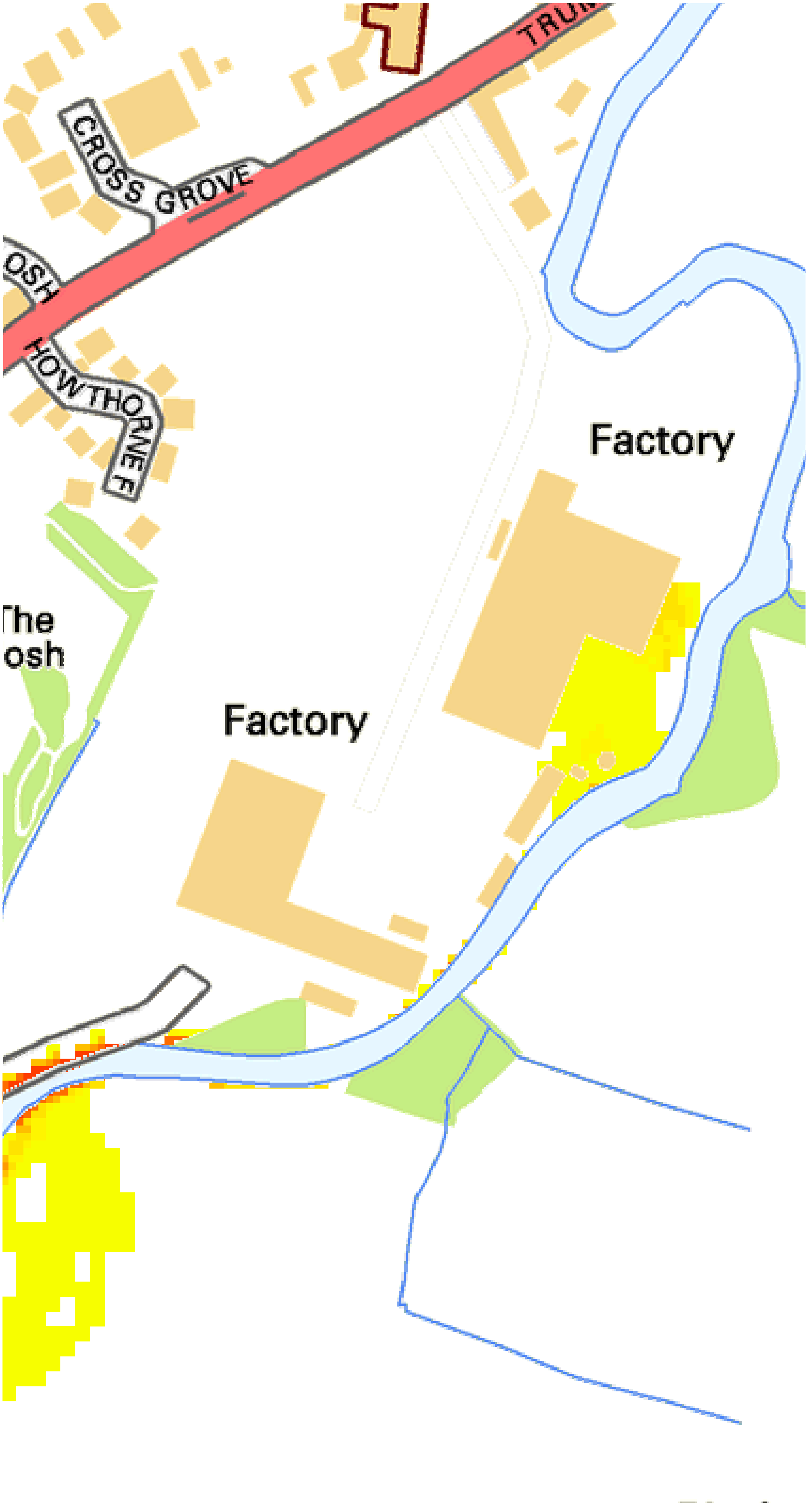
Project Title

Flood Risk Modelling - Cleator Mill Site

Map Title

Hazard categories for breach 1
(DTM 2013)

Date / Revision	14/10/2013
Modelled	IG
Checked	RJG
Approved	RJG
Drawing No.	4.01
Drawing Scale at A3	1:1100



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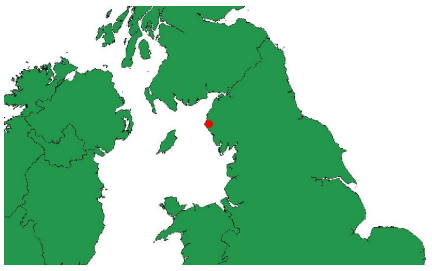

LEGEND

Depth [m]

- < 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

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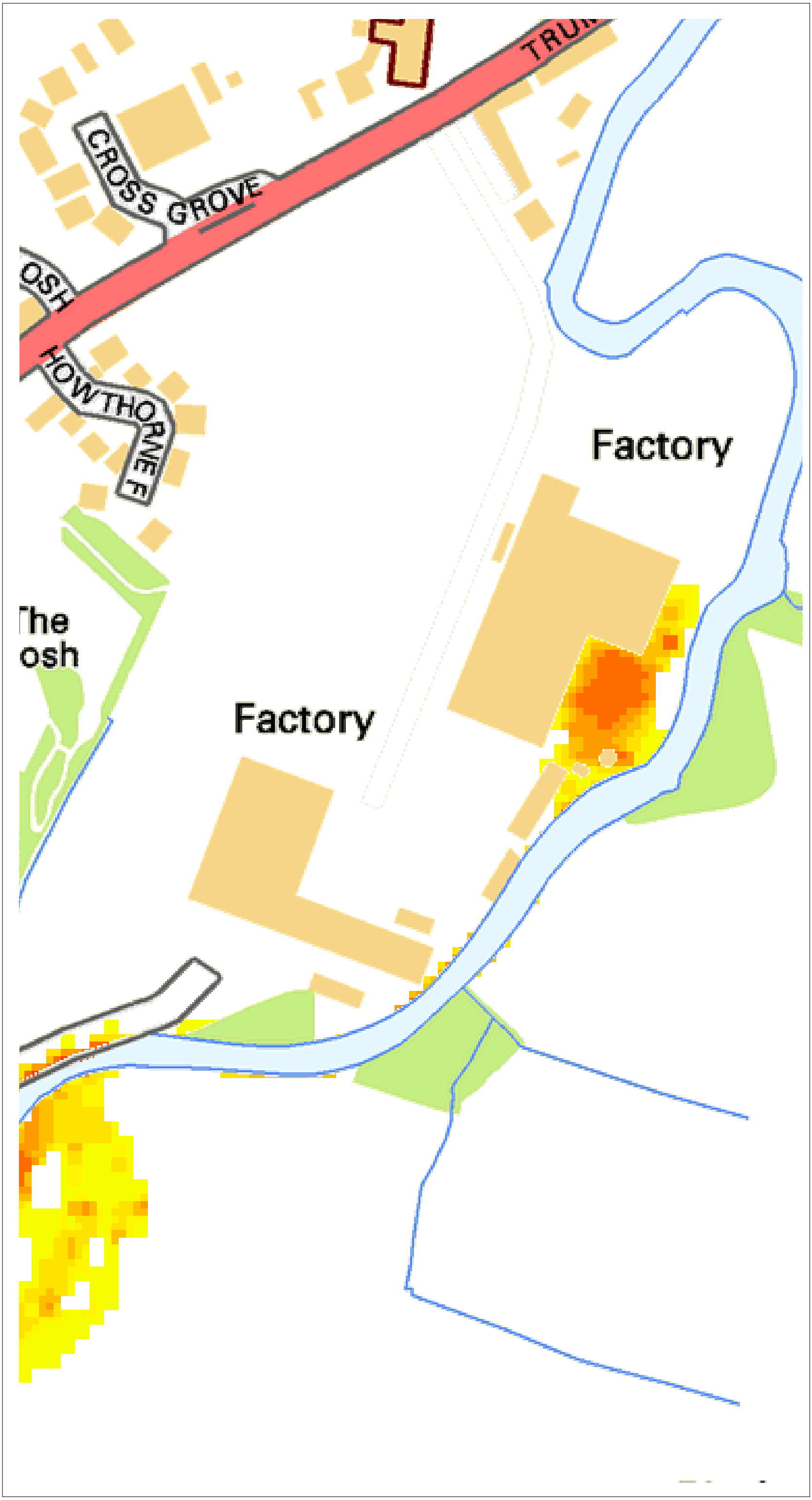
Project Title

Flood Risk Modelling - Cleator Mill Site

Map Title

Maximum flood depth for breach 2 (DTM 2013)

Date / Revision	14/10/2013
Modelled	IG
Checked	RJG
Approved	RJG
Drawing No.	1.03
Drawing Scale at A3	1:1100



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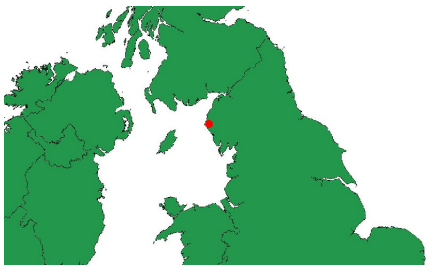

LEGEND

Velocity [m/s]

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.40
- 0.40 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

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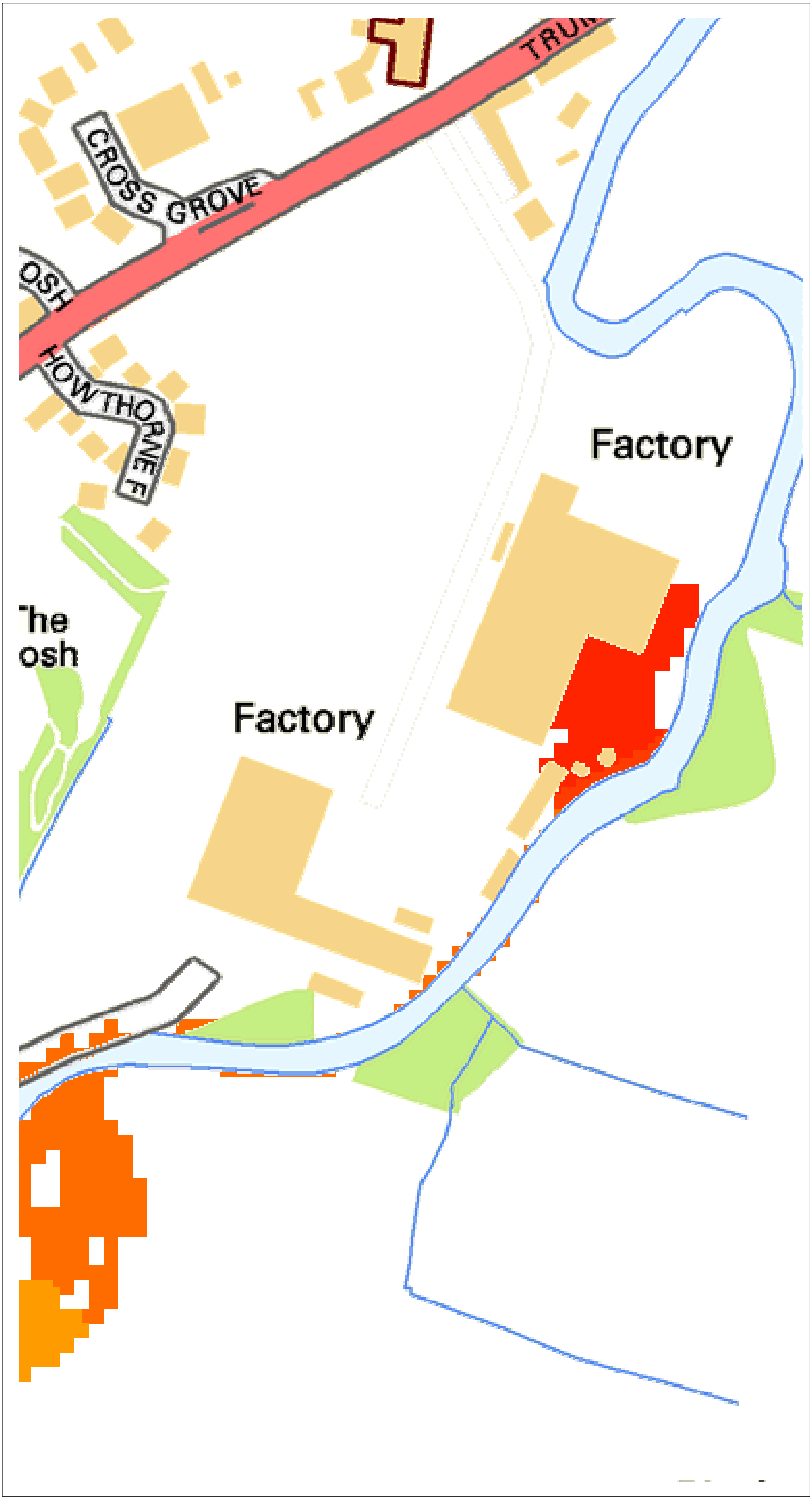
Project Title

Flood Risk Modelling - Cleator Mill Site

Map Title

Maximum flow velocity for breach 2 (DTM 2013)

Date / Revision	14/10/2013
Modelled	IG
Checked	RJG
Approved	RJG
Drawing No.	2.03
Drawing Scale at A3	1:1100



KEY PLAN

LEGEND

Water Level [mAOD]

- 50.340 - 51.758
- 51.758 - 53.175
- 53.175 - 54.593
- 54.593 - 56.010
- 56.010 - 57.428
- 57.428 - 58.845
- 58.845 - 60.263
- 60.263 - 61.681
- 61.681 - 63.098

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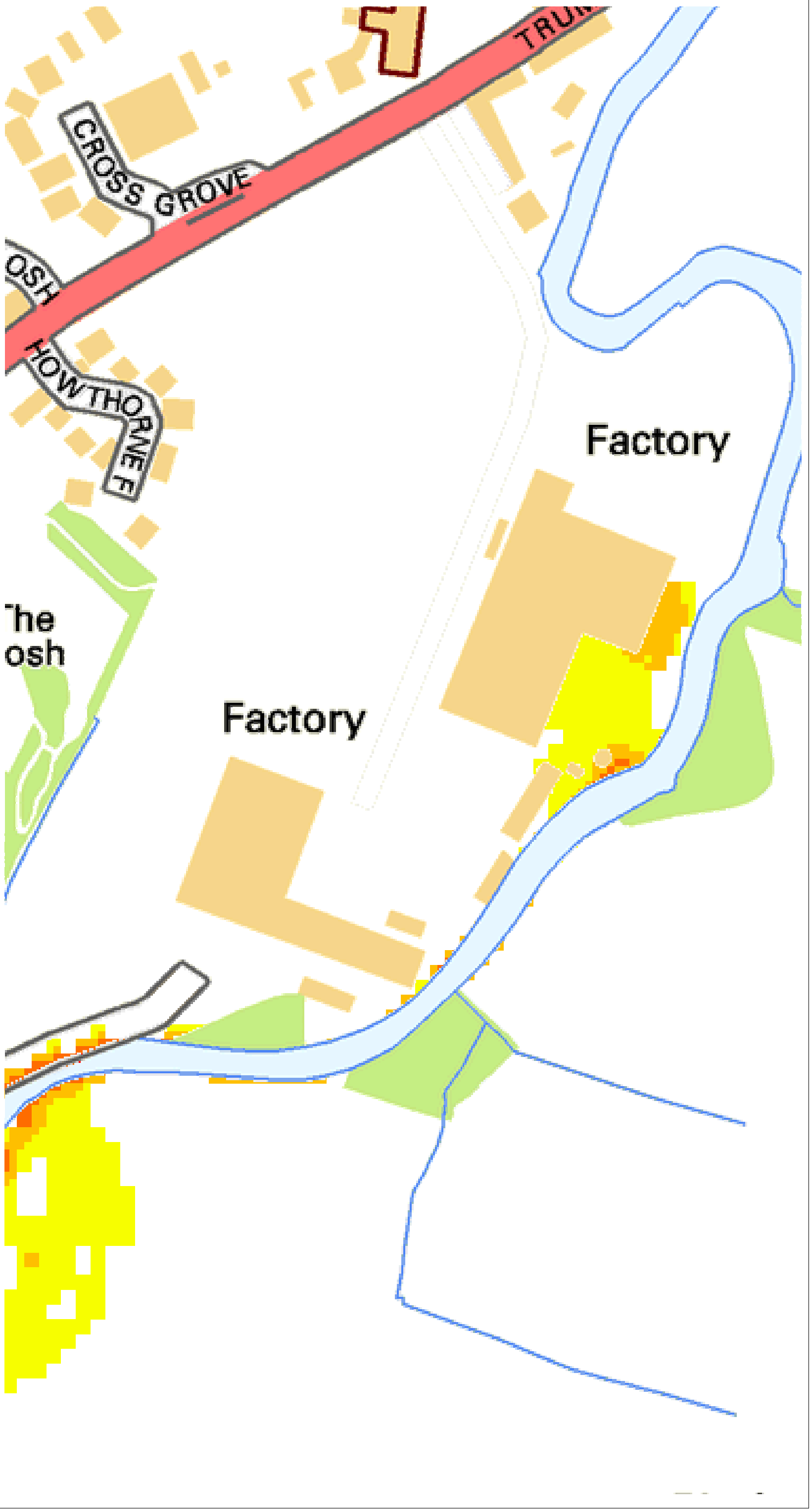
Project Title

Flood Risk Modelling - Cleator Mill Site

Map Title

Maximum water level for breach 2 (DTM 2013)

Date / Revision	14/10/2013
Modelled	IG
Checked	RJG
Approved	RJG
Drawing No.	3.03
Drawing Scale at A3	1:1100



KEY PLAN

LEGEND

Flood Hazard Category

- Low
- Moderate
- Significant
- Extreme

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Project Title

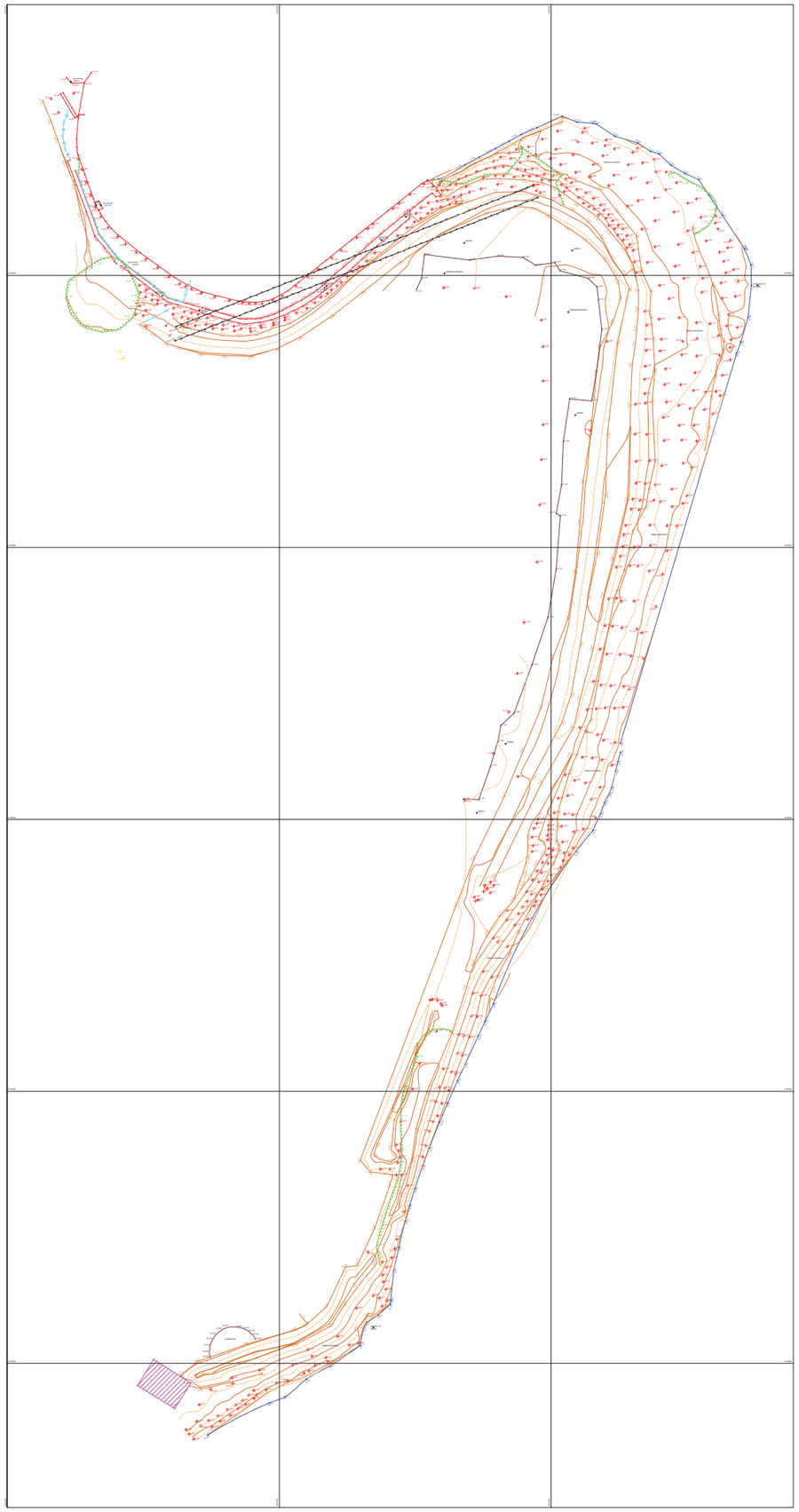
Flood Risk Modelling - Cleator Mill Site

Map Title

Hazard categories for breach 2 (DTM 2013)

Date / Revision	14/10/2013
Modelled	IG
Checked	RJG
Approved	RJG
Drawing No.	4.03
Drawing Scale at A3	1:1100

APPENDIX B
RWO ASSOCIATES TOPOGRAPHICAL SURVEY



KEY

LINETYPES

- VERGE
- FENCE - CHAIN LINK
- FENCE - METAL
- FENCE - WOODEN
- FENCE - POST & RAIL
- HEDGE
- WALL
- BARRIER
- CHANNEL LINE
- CONCRETE EDGE
- FOOTPATH
- TRACK
- BUILDING
- TREE
- GATE
- SURVEY STATION
- EAVES

UTILITY KEY

LINETYPES

- BT BELOW GROUND
- BT ABOVE GROUND
- BT ASSUMED ROUTE
- CATV BELOW GROUND
- CATV ABOVE GROUND
- CATV ASSUMED ROUTE
- COMMS BELOW GROUND
- COMMS ABOVE GROUND
- COMMS ASSUMED ROUTE
- GAS BELOW GROUND
- GAS ABOVE GROUND
- GAS ASSUMED ROUTE
- ELECTRIC BELOW GROUND
- ELECTRIC ABOVE GROUND
- ELECTRIC ASSUMED ROUTE
- WATER BELOW GROUND
- WATER ABOVE GROUND
- WATER ASSUMED ROUTE
- UNKNOWN BELOW GROUND
- UNKNOWN ABOVE GROUND
- GPR BELOW GROUND
- COMBINED WATER SEWER
- ASSUMED COMBINED WATER SEWER ROUTE
- FOUL WATER SEWER
- ASSUMED FOUL WATER SEWER ROUTE
- STORM WATER SEWER
- ASSUMED STORM WATER SEWER ROUTE
- REINSTATEMENT SCAR
- SURVEY BOUNDARY

ABBREVIATIONS

(AC)	ASSUMED CONNECTION	INT	INTERCEPTOR
AG	ABOVE GROUND	KV	KILO VOLT
(AR)	ASSUMED ROUTE	LD	LOOP DETECTOR
ASB	ASBESTOS CEMENT	LH	LAMP HOLE
AV	AIR VALVE	LP	LAMP POST
BB	BELISHA BEACON	LV	LOW VOLTAGE
BD	BACK DROP	MK	MARKER
BL	BASE LEVEL	MH	MANHOLE
BO	BOLLARD	MT	METER
BOL	BOLLARD LIGHT	MWELL	MONITORING WELL
BT	BRITISH TELECOM	OH	OVERHEAD
CATV	CABLE TELEVISION	PE	POLYETHYLENE
CB	CONTROL BOX	PTG	PIPE TO GROUND
CI	CAST IRON	PVC	POLYVINYL CALORIDE
CL	COVER LEVEL	TPR	TANDEM FROM RECORDS
CR	CABLE RISER	RE	RODDING EYE
CWS	COMBINED WATER SEWER	RED	REDUNDANT SERVICE
d	DEPTH OF SERVICE	RWP	RAIN WATER PIPE
DCH	DRAINAGE CHANNEL	SC	STOP COCK
DI	DUCTILE IRON	SI	SPUN IRON
DIS	DISGUISED	SOF	SOFFIT
ECT	END OF TRACE	SP	SOIL PIPE
EP	ELECTRIC POLE	SWS	SURFACE WATER SEWER
ER	EARTH ROD	SV	STOP VALVE
FFP	FUEL TANK FILL POINT	TL	TRAFFIC LIGHT
FH	FIRE HYDRANT	TLC	TRAFFIC LIGHT COVER
FWS	FOUL WATER SEWER	TP	TELECOM POLE
GPR	GROUND PENETRATING RADAR	UTL	UNABLE TO LIFT
GR	GAS RISER	UTS	UNABLE TO SURVEY
GV	GAS VALVE	UTT	UNABLE TO TRACE
GY	GULLY	VC	VITRIFIED CLAY
HV	HIGH VOLTAGE	VP	VENT PIPE
IC	INSPECTION COVER	WL	WATER LEVEL
id	INVERT DEPTH	WO	WASH OUT
IL	INVERT LEVEL	WR	WATER RISER

DISCLAIMER

Unless otherwise stated, all services shown on this plan have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to be direct.

No guarantee can be given that all services have been shown.
In ideal conditions the depth accuracies for the underground utilities located is +/- 10% of depth.

Utilities traced using GPR techniques show depths approximately from ground level to the top of the utility. Utilities traced using Electromagnetic technique provide an estimated depth which is measured from ground level to the centre of the utility. Drainage and pipes traced using Sonde Electromagnetic techniques show depths at approximately the Invert Level.

Where services are shown as "Taken From Records" on the drawing we are not liable for any loss that may arise due to a lack of accuracy in that guided information.

Due to BT's policy we are not permitted to lift their inspection chamber covers.

Reference should be made to the methodology used on site as detailed within the latest version of SiteScan Procedures for Utility Location Surveys.

SiteScan recommend that all excavations are to be carried out in accordance with HSG 47 (Avoiding Danger from Underground Services).

Plan accuracies of the order of + or - 100mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run in close proximity, separation may be impossible. Successful tracing of non-metallic pipes may be limited.

Existing record information showing underground services is often incomplete and of doubtful accuracy. It should be regarded only as an indication and cannot be guaranteed.

NOTES

REV	AMENDMENT	DRAWN	CHECKED
A	INITIAL RELEASE	NP	NG

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FISH QUAY
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T: 0191 257 2911
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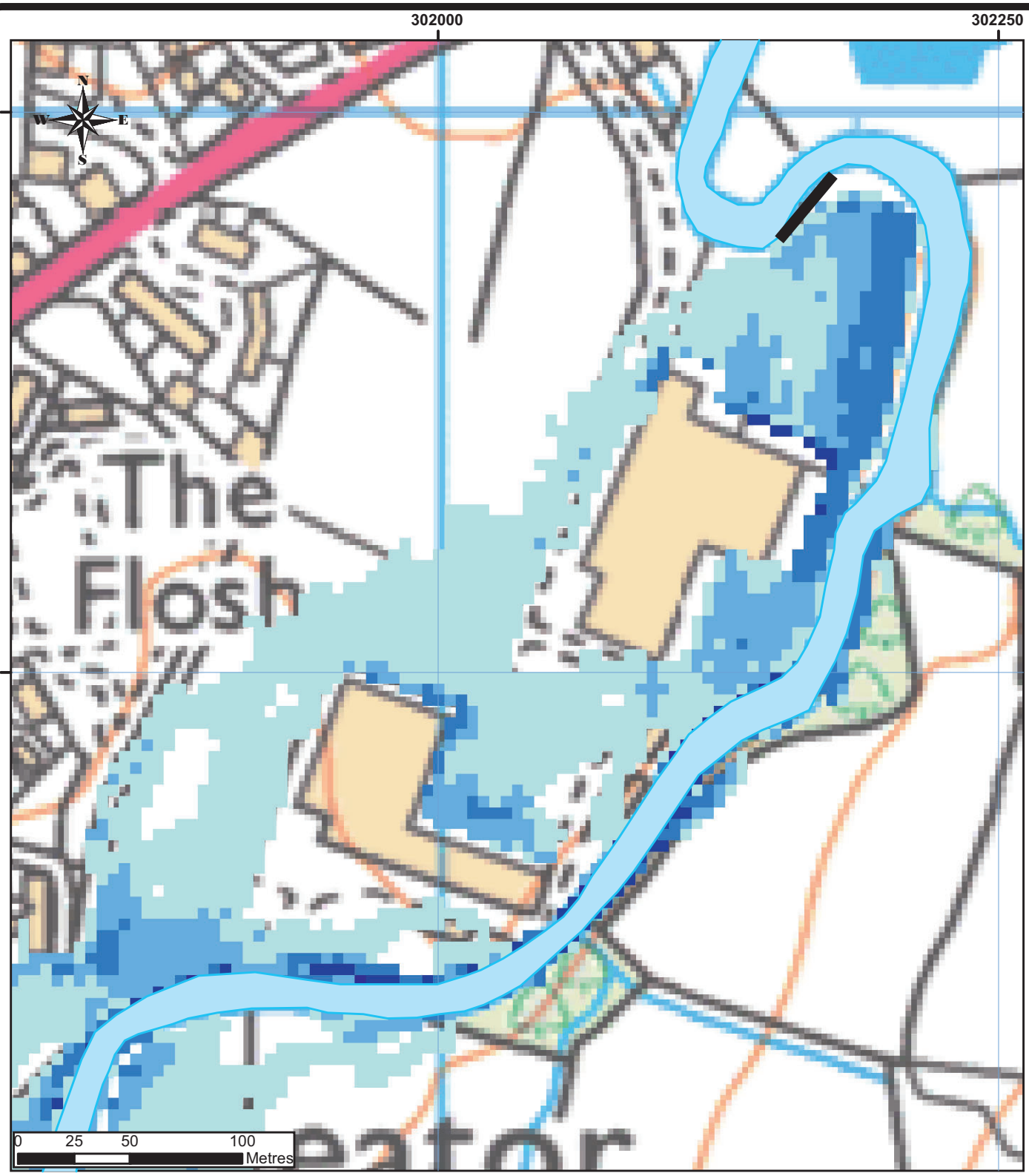
SiteScan
Information to build on

CLIENT	RWO ASSOCIATES		
PROJECT TITLE	KANGOL FACTORY, CLEATOR		
DRAWING TITLE	TOPOGRAPHICAL SURVEY		
SCALE / SIZE: 1:500 @ A1	DATE: 24.03.15	GRID/DATUM: OS	
SURVEYED BY: NP/NSC	DRAWN BY: NSC	APPROVED: NG	
PROJECT No.: P20004	SHEET No.: 1/1	REV.: A	

APPENDIX C
BREACH 1 FLOOD MAPS – FIGURES 6A, 6B, 6C AND 6D



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Flood Depth (m)

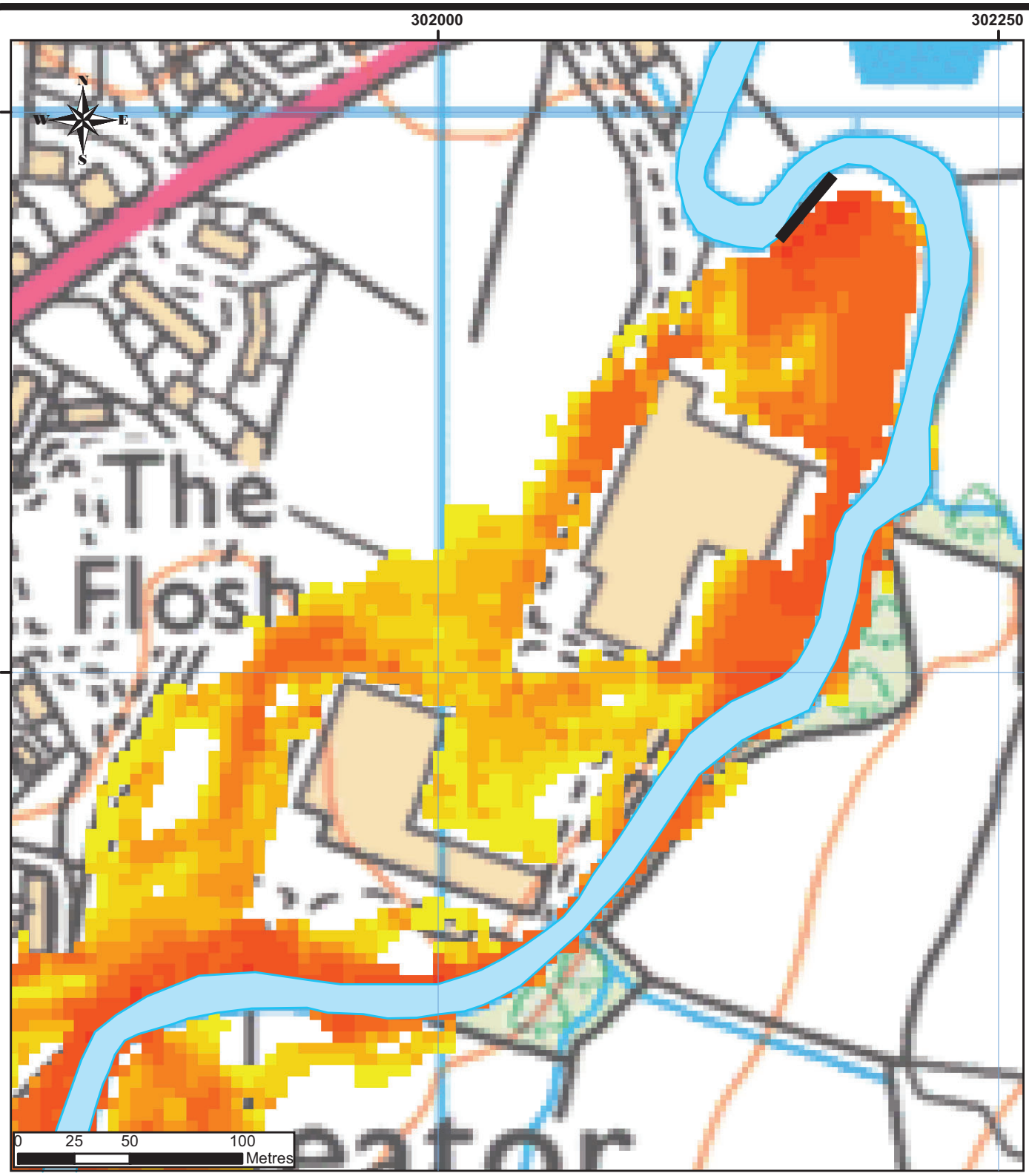
- 0.01 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.50

KEY

- Breach 1 Location
- River Ehen

envireau WATER

Ref: P19-310 Cleator Mills Breach Assessment\FIG 6a B1 Max Depth Date: 02/03/2020	**RWO Associates - Cleator Mills**
Figure 6a	Breach 1 Maximum Flood Depth



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KEY

Velocity (m/s)

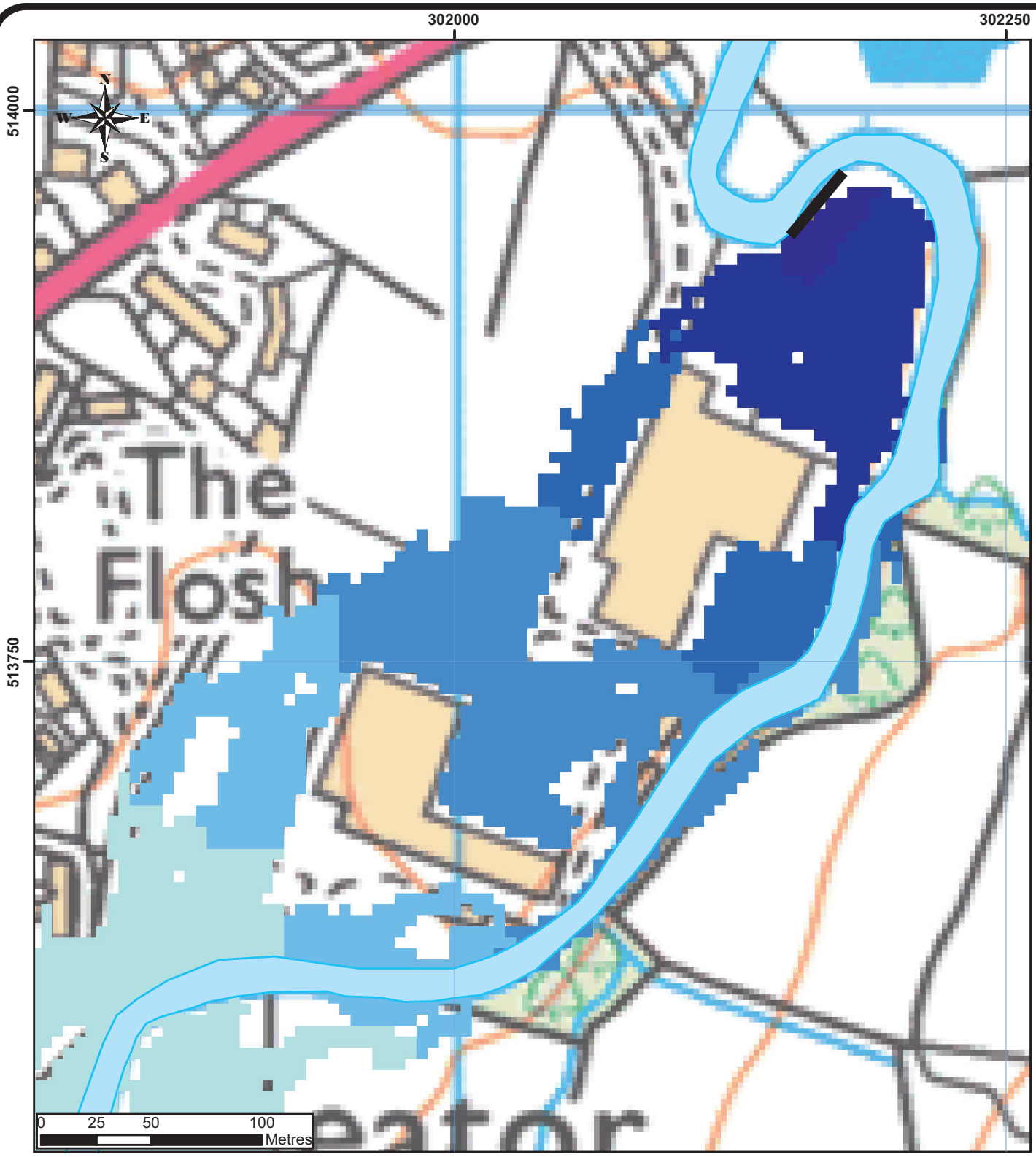
< 0.1	0.5 - 1.0
0.1 - 0.2	1.0 - 2.0
0.2 - 0.3	2.0 - 3.0
0.3 - 0.4	> 3
0.4 - 0.5	

Breach 1 Location

River Ehen

envireau WATER

Ref: P19-310 Cleator Mills Breach Assessment\FIG 6b B1 Max Velocity Date: 02/03/2020	**RWO Associates - Cleator Mills**
Figure 6b	Breach 1 Maximum Velocity



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WaterLevel (mAOD)

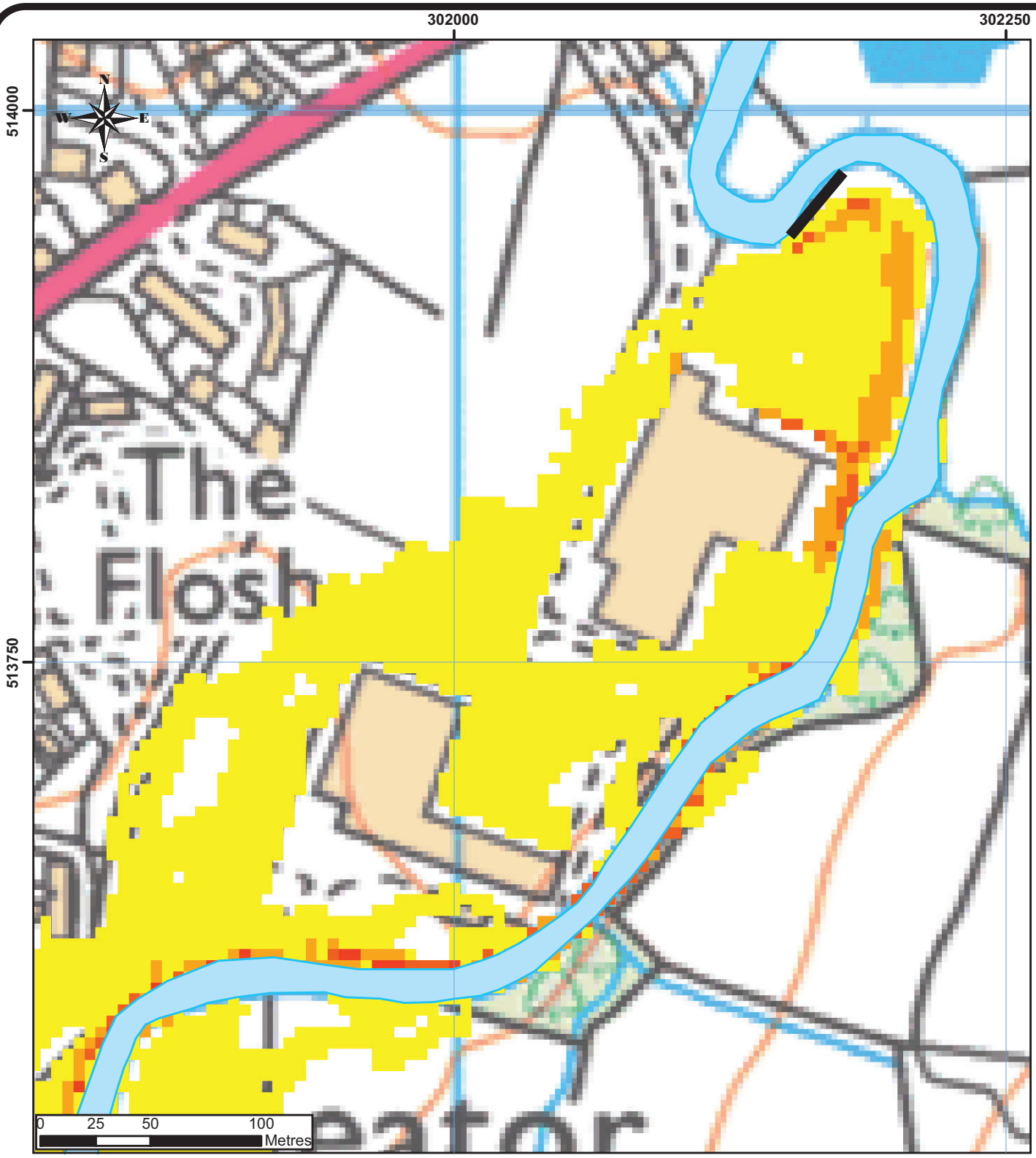
- < 59
- 59 - 60
- 60 - 61
- 61 - 62
- 62 - 63
- > 63

KEY

- Breach 1 Location
- River Ehen

envireau WATER

Ref: P19-310 Cleator Mills Breach Assessment\FIG 6c B1 Max Water Level Date: 02/03/2020	**RWO Associates - Cleator Mills**
Figure 6c	Breach 1 Maximum Water Level



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Flood Hazard Catergory

- Low
- Moderate
- Significant
- Extreme

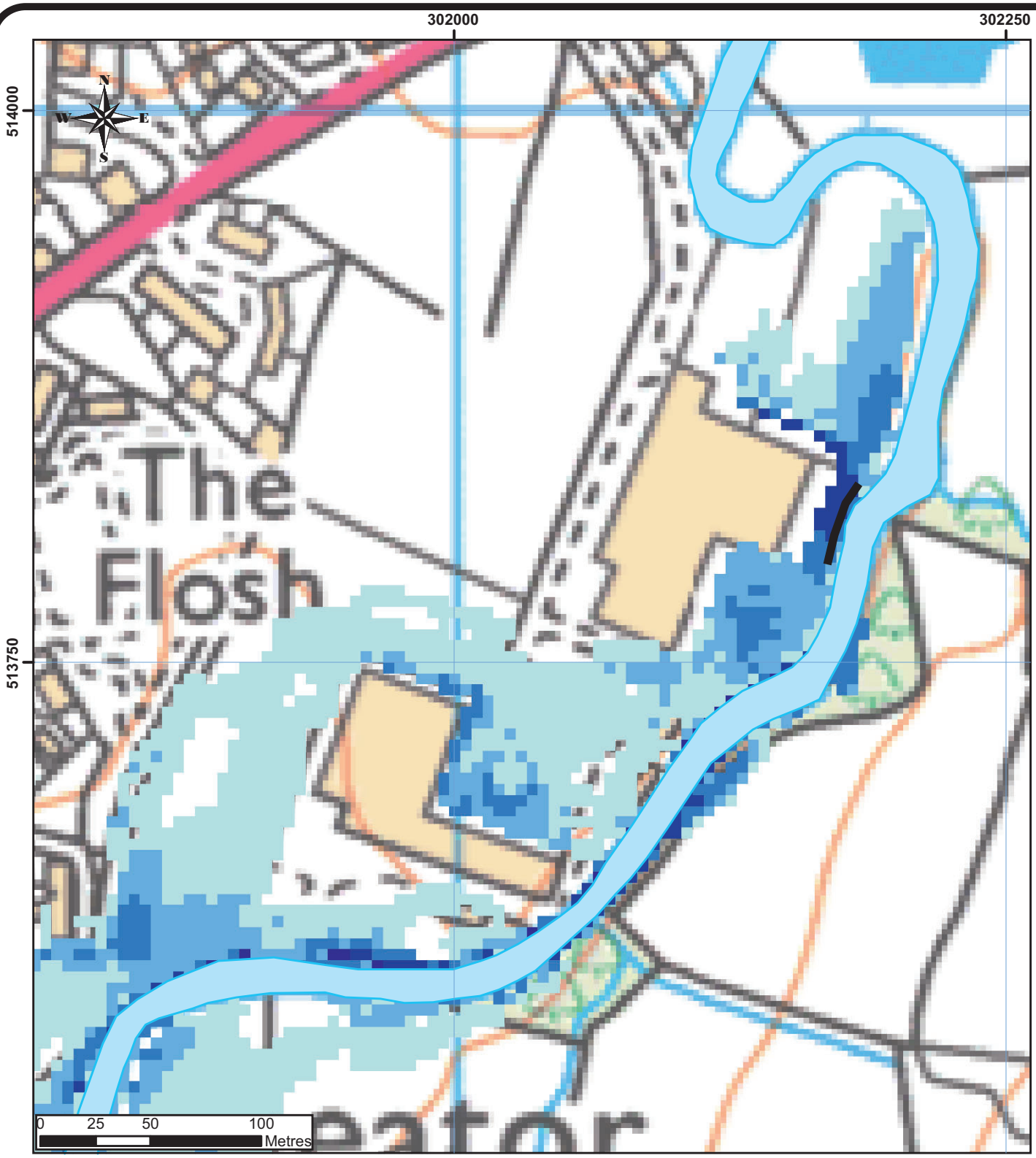
KEY

- Breach 1 Location
- River Ehen

envireau WATER

Ref: P19-310 Cleator Mills Breach Assessment\FIG 6d B1 Hazard Rating Date: 02/03/2020	**RWO Associates - Cleator Mills**
Figure 6d	Breach 1 Hazard Rating

APPENDIX C
BREACH 2 FLOOD MAPS – FIGURES 7A, 7B, 7C AND 7D



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Flood Depth (m)

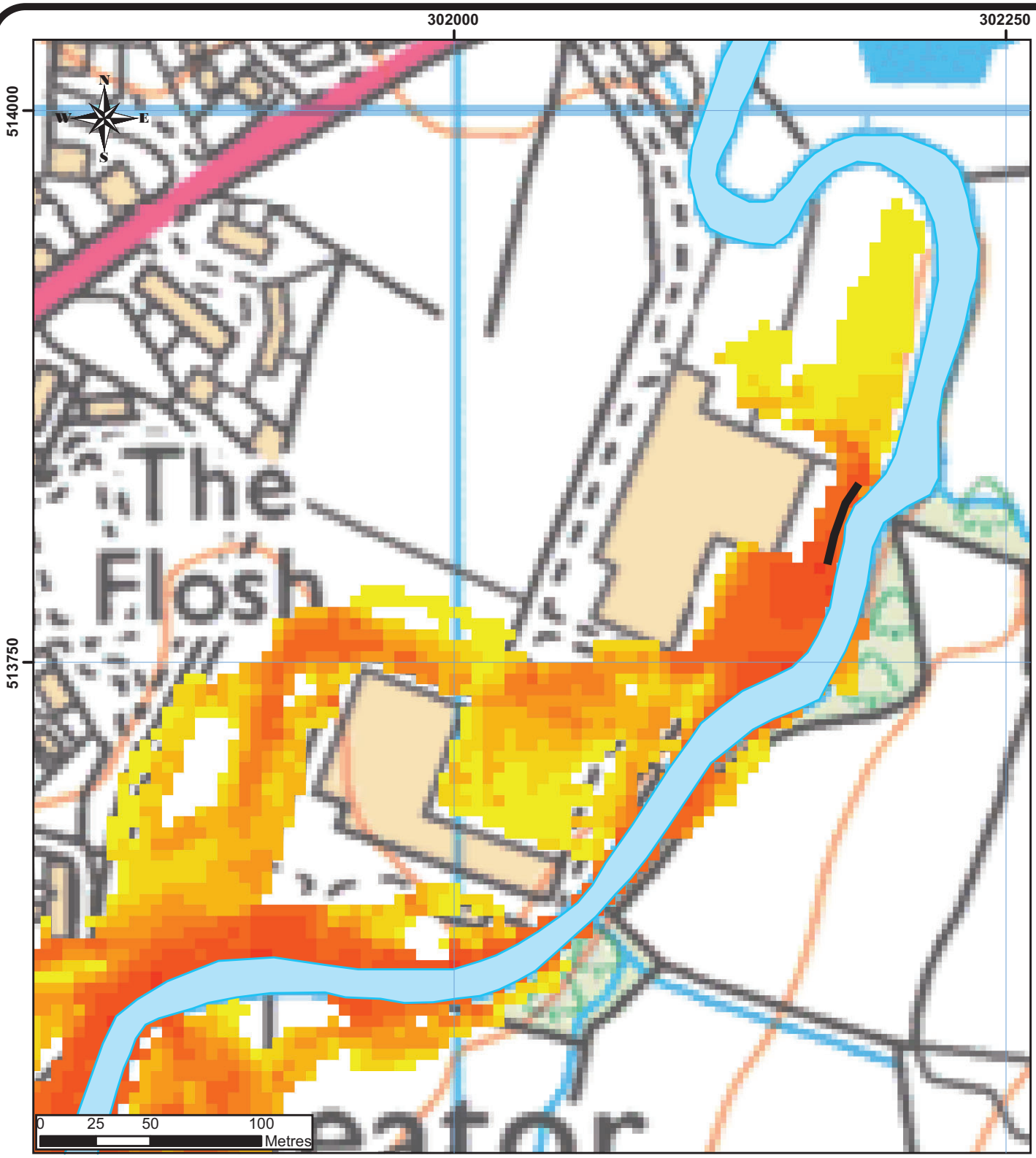
- 0.01 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.50

KEY

- Breach 2 Location
- River Ehen

envireau WATER

Ref: P19-310 Cleator Mills Breach Assessment\FIG 7a B2 Max Depth Date: 02/03/2020	**RWO Associates - Cleator Mills**
Figure 7a	Breach 2 Maximum Flood Depth



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KEY

Velocity (m/s)

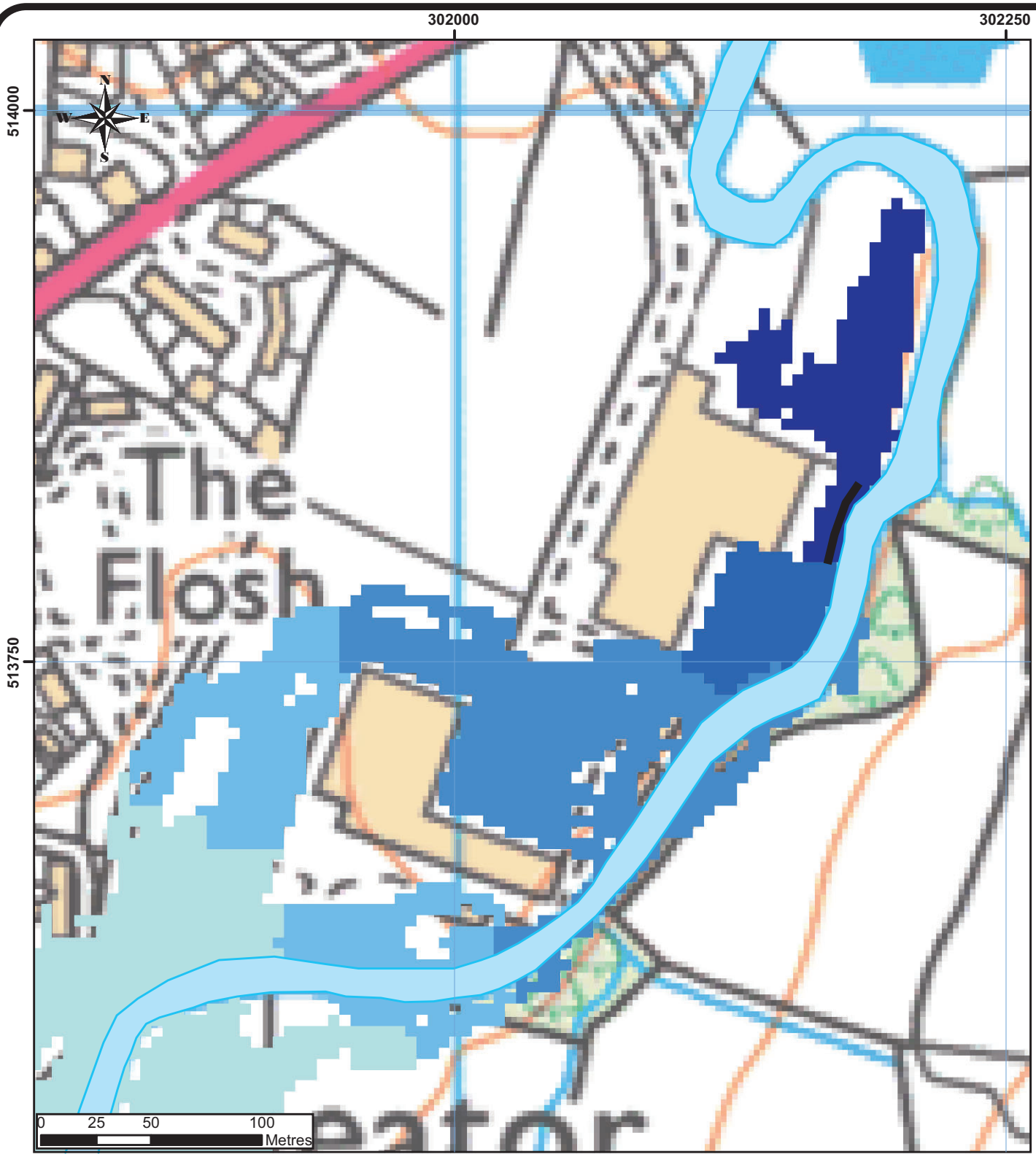
< 0.1	0.5 - 1.0
0.1 - 0.2	1.0 - 2.0
0.2 - 0.3	2.0 - 3.0
0.3 - 0.4	> 3
0.4 - 0.5	

Breach 2 Location

River Ehen

envireau WATER

Ref: P19-310 Cleator Mills Breach Assessment\FIG 7b B2 Max Velocity Date: 02/03/2020	**RWO Associates - Cleator Mills**
Figure 7b	Breach 2 Maximum Velocity



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WaterLevel (mAOD)

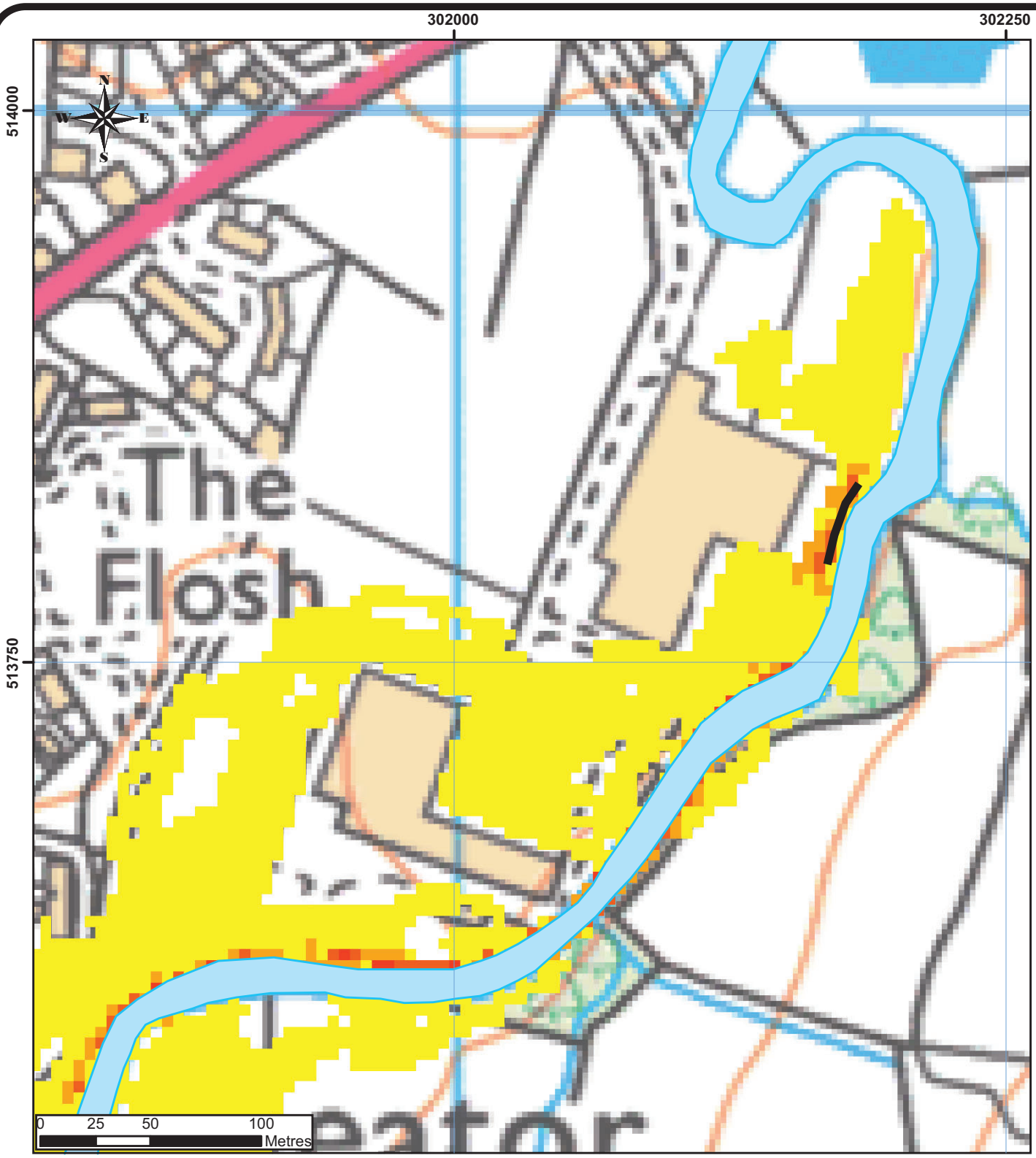
- < 59
- 59 - 60
- 60 - 61
- 61 - 62
- 62 - 63
- > 63

KEY

- Breach 2 Location
- River Ehen

envireau WATER

Ref: P19-310 Cleator Mills Breach Assessment\FIG 7c B2 Max Water Level Date: 02/03/2020	**RWO Associates - Cleator Mills**
Figure 7c	Breach 2 Maximum Water Level



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Flood Hazard Catergory

- Low
- Moderate
- Significant
- Extreme

KEY

- Breach 2 Location
- River Ehen

envireau WATER

Ref: P19-310 Cleator Mills Breach Assessment\FIG 7d B2 Hazard Rating Date: 02/03/2020	**RWO Associates - Cleator Mills**
Figure 7d	Breach 2 Hazard Rating

Appendix G Soil Infiltration Test Results

GEO Environmental Engineering

FAO Ross Oakley
RWO Associates Ltd
6A
Union Quay
North Shields
NE30 1HJ

Sent by Email

21st October 2013

Dear Ross,

Re: Land at Cleator Mills – Soakaway Test Letter Report

Please find attached to this letter the following information:

- Exploratory Hole Location Plan (TP01 to TP06)
- Trial Pit Logs
- Soakaway Test Workbook Extracts (SA01 to SA06 inclusive)

From the trial pit logs it can be seen that the ground conditions typically comprised grass and topsoil over sand and gravel with many cobbles and boulders to the terminal depths of the trial pits between c.1.50m and c.2.00m below current ground levels. No water ingress was noted within the trial pits, although the sand and gravel materials were generally unstable with the materials posing a risk of sidewall collapse.

As requested in-situ soakaway tests were undertaken at the six trial pit locations at depths varying between c.0.50m and c.2.00m below ground levels. All the trial pits successfully drained completely within 2 hours of commencing the tests.

I trust the above and attached is to your satisfaction and if you have any questions or then please call or email.

Yours Faithfully

.....

Curtis R. Evans *B.Sc (Hons) FGS*
Director
For and On Behalf Of Geo Environmental Engineering Ltd

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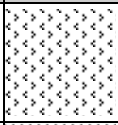
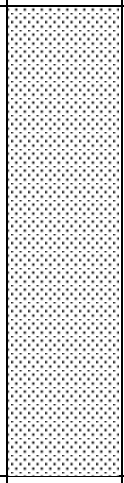
VAT No.: GB 986617072

GEO2013-776: Exploratory Hole Location Plan (Approximate Locations – Not to Scale)

GEO Environmental Engineering

GEO2013-776: TP01

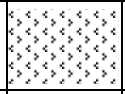
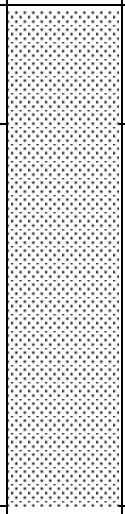
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	TURF over TOPSOIL: Grass over dark brown sandy gravelly clayey topsoil with some rootlets.		
0.40	2.00	Medium dense appearing reddish brown SAND and GRAVEL. Many cobbles and boulders noted throughout.		0.50m Soakaway Test (results on SA01)
		End of trial pit Trial pit remained dry on completion Trial pit noted as unstable below c.1.50m Soakaway test completed from c.0.50m to c.1.50m		

Site: Land at Cleator Mills
Client Reference: N/A
Engineer: CE
Plant: JCB3CX

Log Notes:
Spt = Standard Penetration test (blows per 300mm n300)
HSV = Hand Shear Vane (result in kN/m^2)
CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2013-776: TP02

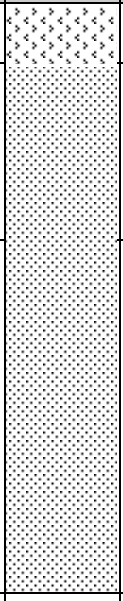
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	TURF over TOPSOIL: Grass over dark brown sandy gravelly clayey topsoil with some rootlets.		
0.30	0.70	Red brown slightly gravelly SAND.		
0.70	2.00	Medium dense appearing reddish brown SAND and GRAVEL. Many cobbles and boulders noted throughout.		1.00m Soakaway Test (results on SA02)
		End of trial pit Trial pit remained dry on completion Trial pit noted as unstable below c.1.50m Soakaway test completed from c.1.00m to c.2.00m		

Site: Land at Cleator Mills
Client Reference: N/A
Engineer: CE
Plant: JCB3CX

Log Notes:
Spt = Standard Penetration test (blows per 300mm n300)
HSV = Hand Shear Vane (result in kN/m^2)
CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

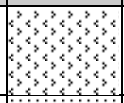
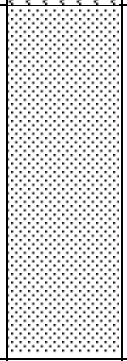
GEO2013-776: TP03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.20	TURF over TOPSOIL: Grass over dark brown sandy gravelly clayey topsoil with some rootlets.		
0.20	0.80	Red brown slightly gravelly SAND.		
0.80	2.00	Medium dense appearing reddish brown SAND and GRAVEL. Many cobbles and boulders noted throughout.		1.00m Soakaway Test (results on SA03)
		End of trial pit Trial pit remained dry on completion Trial pit noted as unstable below c.0.80m Soakaway test completed from c.1.00m to c.2.00m		

Site: Land at Cleator Mills
Client Reference: N/A
Engineer: CE
Plant: JCB3CX

Log Notes:
Spt = Standard Penetration test (blows per 300mm n300)
HSV = Hand Shear Vane (result in kN/m^2)
CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO2013-776: TP04

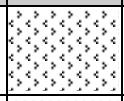
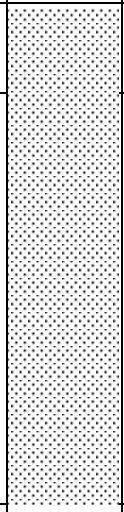
Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	TURF over TOPSOIL: Grass over dark brown sandy gravelly clayey topsoil with some rootlets.		
0.30	1.50	Medium dense appearing reddish brown SAND and GRAVEL. Many cobbles and boulders noted throughout.		0.50m Soakaway Test (results on SA04)
		End of trial pit Trial pit remained dry on completion Trial pit noted as unstable below c.1.00m Soakaway test completed from c.0.50m to c.1.50m		

Site: Land at Cleator Mills
Client Reference: N/A
Engineer: CE
Plant: JCB3CX

Log Notes:
Spt = Standard Penetration test (blows per 300mm n300)
HSV = Hand Shear Vane (result in kN/m^2)
CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

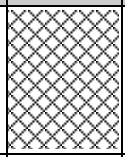
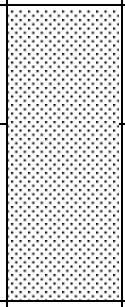
GEO2013-776: TP05

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.35	TURF over TOPSOIL: Grass over dark brown sandy gravelly clayey topsoil with some rootlets.		
0.35	0.60	Red brown slightly gravelly SAND.		
0.60	2.00	Medium dense appearing reddish brown SAND and GRAVEL. Many cobbles and boulders noted throughout.		1.00m Soakaway Test (results on SA05)
		End of trial pit Trial pit remained dry on completion Trial pit noted as unstable below c.1.50m Soakaway test completed from c.1.00m to c.2.00m		

Site: Land at Cleator Mills
Client Reference: N/A
Engineer: CE
Plant: JCB3CX

Log Notes:
Spt = Standard Penetration test (blows per 300mm n300)
HSV = Hand Shear Vane (result in kN/m^2)
CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO2013-776: TP06

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.50	MADE GROUND: TURF over TOPSOIL: Grass over dark brown sandy gravelly clayey topsoil with some rootlets and rare brick pieces.		
0.50	0.90	Red brown slightly gravelly SAND.		0.50m Soakaway Test (results on SA06)
0.90	1.50	Medium dense appearing reddish brown SAND and GRAVEL. Many cobbles and boulders noted throughout.		
		End of trial pit Trial pit remained dry on completion Trial pit noted as unstable below c.1.00m Soakaway test completed from c.0.50m to c.1.50m		

Site: Land at Cleator Mills
Client Reference: N/A
Engineer: CE
Plant: JCB3CX

Log Notes:
Spt = Standard Penetration test (blows per 300mm n300)
HSV = Hand Shear Vane (result in kN/m^2)
CBR = California Bearing Ratio by Mexe Cone Penetrometer (result as percentage)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

CALCULATIONS/SKETCHES

PROJECT	GEO2013-776 Land at Cleator Mills				
JOB No	2013-776	PREPARED BY	CRE	SHEET No	SA 01
DATE	21-Oct-13	CHECKED BY	CRE/GE	REV	P1

REF — OUTPUT

Calculation of soil infiltration rate in accordance with BRE Digest 365

Length of trial pit	=	L_{TP}	=	3.000 *m*
Width of trial pit	=	W_{TP}	=	0.450 *m*
Effective Depth	=	D_{TP}	=	1.500 *m* *(measured below incoming invert)*

75% Effective Depth of trial pit	=	D_{75}	=	(D_{TP} x 0.75)	=	1.125 *m*
50% Effective Depth of trial pit	=	D_{50}	=	(D_{TP} x 0.50)	=	0.750 *m*
25% Effective Depth of trial pit	=	D_{25}	=	(D_{TP} x 0.25)	=	0.375 *m*

Pit Voids = PV = 100 % *(For open pits, PV = 100%. For stone filled pits, PV = 30%)*

Carry out 3 tests, each measuring the time taken for water levels to fall from 75% effective depth to 25% effective depth

Test No 1	time to fall from 75% to 25% eff depth	=	T_1	=	40.0 *mins*
Test No 2	time to fall from 75% to 25% eff depth	=	T_2	=	*mins*
Test No 3	time to fall from 75% to 25% eff depth	=	T_3	=	*mins*
TAKE THE LONGEST OF THE 3 TESTS ABOVE		=	T_L	=	40.0 *mins*

Volume of water escaping during this test between D_{75} and D_{25}

$$V_{TP75_25} = (L_{TP} \times W_{TP} \times (D_{75} - D_{25}) \times PV) = 1.013 \text{ cu m.}$$

The mean surface area through which the above volume escapes, is the *wetted area.*
Only 50% of the effective depth is allowed in the calculation.

ie A_{P50} = (Wet Base Area + 50% of Wet Sides Area)

A_{P50} = (L_{TP} x W_{TP}) + (2L_{TP}+2W_{TP}) x D_{50}

A_{P50} = 1.350 + 5.175

A_{P50} = 6.525 *sq m*

Soil Infiltration Rate = f = $\dfrac{V_{TP75_25}}{A_{P50} \times 60 \times T_L}$ *m/s*

Soil Infiltration Rate = f = 6.46552E-05 *m/s*

Notes: Pit drained completely within 40 minutes.

CALCULATIONS/SKETCHES

PROJECT	GEO2013-776 Land at Cleator Mills				
JOB No	2013-776	PREPARED BY	CRE	SHEET No	SA 02
DATE	21-Oct-13	CHECKED BY	CRE/GE	REV	P1

REF — OUTPUT

Calculation of soil infiltration rate in accordance with BRE Digest 365

Length of trial pit	=	L_{TP}	=	2.000 *m*
Width of trial pit	=	W_{TP}	=	0.450 *m*
Effective Depth	=	D_{TP}	=	2.000 *m* *(measured below incoming invert)*

75% Effective Depth of trial pit	=	D_{75}	=	(D_{TP} x 0.75)	=	1.500 *m*
50% Effective Depth of trial pit	=	D_{50}	=	(D_{TP} x 0.50)	=	1.000 *m*
25% Effective Depth of trial pit	=	D_{25}	=	(D_{TP} x 0.25)	=	0.500 *m*

Pit Voids = PV = 100 % *(For open pits, PV = 100%. For stone filled pits, PV = 30%)*

Carry out 3 tests, each measuring the time taken for water levels to fall from 75% effective depth to 25% effective depth

Test No 1	time to fall from 75% to 25% eff depth	=	T_1	=	52.0 *mins*
Test No 2	time to fall from 75% to 25% eff depth	=	T_2	=	*mins*
Test No 3	time to fall from 75% to 25% eff depth	=	T_3	=	*mins*
TAKE THE LONGEST OF THE 3 TESTS ABOVE		=	T_L	=	52.0 *mins*

Volume of water escaping during this test between D_{75} and D_{25}

$$V_{TP75_25} = (L_{TP} \times W_{TP} \times (D_{75} - D_{25}) \times PV) = 0.900 \text{ cu m.}$$

The mean surface area through which the above volume escapes, is the *wetted area.*
Only 50% of the effective depth is allowed in the calculation.

ie A_{P50} = (Wet Base Area + 50% of Wet Sides Area)

$$A_{P50} = (L_{TP} \times W_{TP}) + (2L_{TP}+2W_{TP}) \times D_{50}$$

$$A_{P50} = 0.900 + 4.900$$

$$A_{P50} = 5.800 \text{ sq m}$$

Soil Infiltration Rate = f = $\dfrac{V_{TP75_25}}{A_{P50} \times 60 \times T_L}$ *m/s*

Soil Infiltration Rate = f = 4.97347E-05 *m/s*

Notes: Pit drained completely within 52 minutes.

CALCULATIONS/SKETCHES

PROJECT	GEO2013-776 Land at Cleator Mills				
JOB No	2013-776	PREPARED BY	CRE	SHEET No	SA 03
DATE	21-Oct-13	CHECKED BY	CRE/GE	REV	P1

REF — OUTPUT

Calculation of soil infiltration rate in accordance with BRE Digest 365

Length of trial pit	=	L_{TP}	=	2.500 *m*
Width of trial pit	=	W_{TP}	=	0.500 *m*
Effective Depth	=	D_{TP}	=	2.000 *m* *(measured below incoming invert)*

75% Effective Depth of trial pit	=	D_{75}	=	(D_{TP} x 0.75)	=	1.500 *m*
50% Effective Depth of trial pit	=	D_{50}	=	(D_{TP} x 0.50)	=	1.000 *m*
25% Effective Depth of trial pit	=	D_{25}	=	(D_{TP} x 0.25)	=	0.500 *m*

Pit Voids = PV = 100 % *(For open pits, PV = 100%. For stone filled pits, PV = 30%)*

Carry out 3 tests, each measuring the time taken for water levels to fall from 75% effective depth to 25% effective depth

Test No 1	time to fall from 75% to 25% eff depth	=	T_1	=	120.0 *mins*
Test No 2	time to fall from 75% to 25% eff depth	=	T_2	=	*mins*
Test No 3	time to fall from 75% to 25% eff depth	=	T_3	=	*mins*

TAKE THE LONGEST OF THE 3 TESTS ABOVE = T_L = 120.0 *mins*

Volume of water escaping during this test between D_{75} and D_{25}

$$= V_{TP75_25} = (L_{TP} \times W_{TP} \times (D_{75} - D_{25}) \times PV) = 1.250 \text{ cu m.}$$

The mean surface area through which the above volume escapes, is the *wetted area.*
Only 50% of the effective depth is allowed in the calculation.

ie A_{P50} = (Wet Base Area + 50% of Wet Sides Area)

A_{P50} = (L_{TP} x W_{TP}) + (2L_{TP}+2W_{TP}) x D_{50}

A_{P50} = 1.250 + 6.000

A_{P50} = 7.250 *sq m*

Soil Infiltration Rate = f = $\dfrac{V_{TP75_25}}{A_{P50} \times 60 \times T_L}$ *m/s*

Soil Infiltration Rate = f = 2.39464E-05 *m/s*

Notes: Pit drained completely within 120 minutes.

CALCULATIONS/SKETCHES

PROJECT	GEO2013-776 Land at Cleator Mills				
JOB No	2013-776	PREPARED BY	CRE	SHEET No	SA 04
DATE	21-Oct-13	CHECKED BY	CRE/GE	REV	P1

REF — OUTPUT

Calculation of soil infiltration rate in accordance with BRE Digest 365

Length of trial pit	=	L_{TP}	=	2.600 *m*
Width of trial pit	=	W_{TP}	=	0.500 *m*
Effective Depth	=	D_{TP}	=	1.500 *m* *(measured below incoming invert)*

75% Effective Depth of trial pit	=	D_{75}	=	(D_{TP} x 0.75)	=	1.125 *m*
50% Effective Depth of trial pit	=	D_{50}	=	(D_{TP} x 0.50)	=	0.750 *m*
25% Effective Depth of trial pit	=	D_{25}	=	(D_{TP} x 0.25)	=	0.375 *m*

Pit Voids = PV = 100 % *(For open pits, PV = 100%. For stone filled pits, PV = 30%)*

Carry out 3 tests, each measuring the time taken for water levels to fall from 75% effective depth to 25% effective depth

Test No 1	time to fall from 75% to 25% eff depth	=	T_1	=	120.0 *mins*
Test No 2	time to fall from 75% to 25% eff depth	=	T_2	=	*mins*
Test No 3	time to fall from 75% to 25% eff depth	=	T_3	=	*mins*

TAKE THE LONGEST OF THE 3 TESTS ABOVE = T_L = 120.0 *mins*

Volume of water escaping during this test between D_{75} and D_{25}

= V_{TP75_25} = (L_{TP} x W_{TP} x (D_{75} - D_{25}) x PV) = 0.975 *cu m.*

The mean surface area through which the above volume escapes, is the *wetted area.*
Only 50% of the effective depth is allowed in the calculation.

ie A_{P50} = (Wet Base Area + 50% of Wet Sides Area)

A_{P50} = (L_{TP} x W_{TP}) + (2L_{TP}+2W_{TP}) x D_{50}

A_{P50} = 1.300 + 4.650

A_{P50} = 5.950 *sq m*

Soil Infiltration Rate = f = $\frac{V_{TP75_25}}{A_{P50} \times 60 \times T_L}$ *m/s*

Soil Infiltration Rate = f = 2.27591E-05 *m/s*

Notes: Pit drained completely within 120 minutes.

CALCULATIONS/SKETCHES

PROJECT	GEO2013-776 Land at Cleator Mills				
JOB No	2013-776	PREPARED BY	CRE	SHEET No	SA 05
DATE	21-Oct-13	CHECKED BY	CRE/GE	REV	P1

REF — OUTPUT

Calculation of soil infiltration rate in accordance with BRE Digest 365

Length of trial pit	=	L_{TP}	=	2.700 *m*
Width of trial pit	=	W_{TP}	=	0.450 *m*
Effective Depth	=	D_{TP}	=	2.000 *m* *(measured below incoming invert)*

75% Effective Depth of trial pit	=	D_{75}	=	(D_{TP} x 0.75)	=	1.500 *m*
50% Effective Depth of trial pit	=	D_{50}	=	(D_{TP} x 0.50)	=	1.000 *m*
25% Effective Depth of trial pit	=	D_{25}	=	(D_{TP} x 0.25)	=	0.500 *m*

Pit Voids = PV = 100 % *(For open pits, PV = 100%. For stone filled pits, PV = 30%)*

Carry out 3 tests, each measuring the time taken for water levels to fall from 75% effective depth to 25% effective depth

Test No 1	time to fall from 75% to 25% eff depth	=	T_1	=	120.0 *mins*
Test No 2	time to fall from 75% to 25% eff depth	=	T_2	=	*mins*
Test No 3	time to fall from 75% to 25% eff depth	=	T_3	=	*mins*
TAKE THE LONGEST OF THE 3 TESTS ABOVE		=	T_L	=	120.0 *mins*

Volume of water escaping during this test between D_{75} and D_{25}

$$V_{TP75_25} = (L_{TP} \times W_{TP} \times (D_{75} - D_{25}) \times PV) = 1.215 \text{ cu m.}$$

The mean surface area through which the above volume escapes, is the *wetted area.*
Only 50% of the effective depth is allowed in the calculation.

ie A_{P50} = (Wet Base Area + 50% of Wet Sides Area)

A_{P50} = (L_{TP} x W_{TP}) + (2L_{TP}+2W_{TP}) x D_{50}

A_{P50} = 1.215 + 6.300

A_{P50} = 7.515 *sq m*

Soil Infiltration Rate = f = $\dfrac{V_{TP75_25}}{A_{P50} \times 60 \times T_L}$ *m/s*

Soil Infiltration Rate = f = 2.24551E-05 *m/s*

Notes: Pit drained completely within 120 minutes.

CALCULATIONS/SKETCHES

PROJECT	GEO2013-776 Land at Cleator Mills				
JOB No	2013-776	PREPARED BY	CRE	SHEET No	SA 06
DATE	21-Oct-13	CHECKED BY	CRE/GE	REV	P1

REF — OUTPUT

Calculation of soil infiltration rate in accordance with BRE Digest 365

Length of trial pit	=	L_{TP}	=	2.500 *m*
Width of trial pit	=	W_{TP}	=	0.450 *m*
Effective Depth	=	D_{TP}	=	1.500 *m* *(measured below incoming invert)*

75% Effective Depth of trial pit	=	D_{75}	=	(D_{TP} x 0.75)	=	1.125 *m*
50% Effective Depth of trial pit	=	D_{50}	=	(D_{TP} x 0.50)	=	0.750 *m*
25% Effective Depth of trial pit	=	D_{25}	=	(D_{TP} x 0.25)	=	0.375 *m*

Pit Voids = PV = 100 % *(For open pits, PV = 100%. For stone filled pits, PV = 30%)*

Carry out 3 tests, each measuring the time taken for water levels to fall from 75% effective depth to 25% effective depth

Test No 1	time to fall from 75% to 25% eff depth	=	T_1	=	60.0 *mins*
Test No 2	time to fall from 75% to 25% eff depth	=	T_2	=	*mins*
Test No 3	time to fall from 75% to 25% eff depth	=	T_3	=	*mins*

TAKE THE LONGEST OF THE 3 TESTS ABOVE = T_L = 60.0 *mins*

Volume of water escaping during this test between D_{75} and D_{25}

$$V_{TP75_25} = (L_{TP} \times W_{TP} \times (D_{75} - D_{25}) \times PV) = 0.844 \text{ cu m.}$$

The mean surface area through which the above volume escapes, is the *wetted area.*
Only 50% of the effective depth is allowed in the calculation.

ie A_{P50} = (Wet Base Area + 50% of Wet Sides Area)

A_{P50} = (L_{TP} x W_{TP}) + (2L_{TP}+2W_{TP}) x D_{50}

A_{P50} = 1.125 + 4.425

A_{P50} = 5.550 *sq m*

Soil Infiltration Rate = f = $\dfrac{V_{TP75_25}}{A_{P50} \times 60 \times T_L}$ *m/s*

Soil Infiltration Rate = f = 4.22297E-05 *m/s*

Notes: Pit drained completely within 60 minutes.

GEO Environmental Engineering

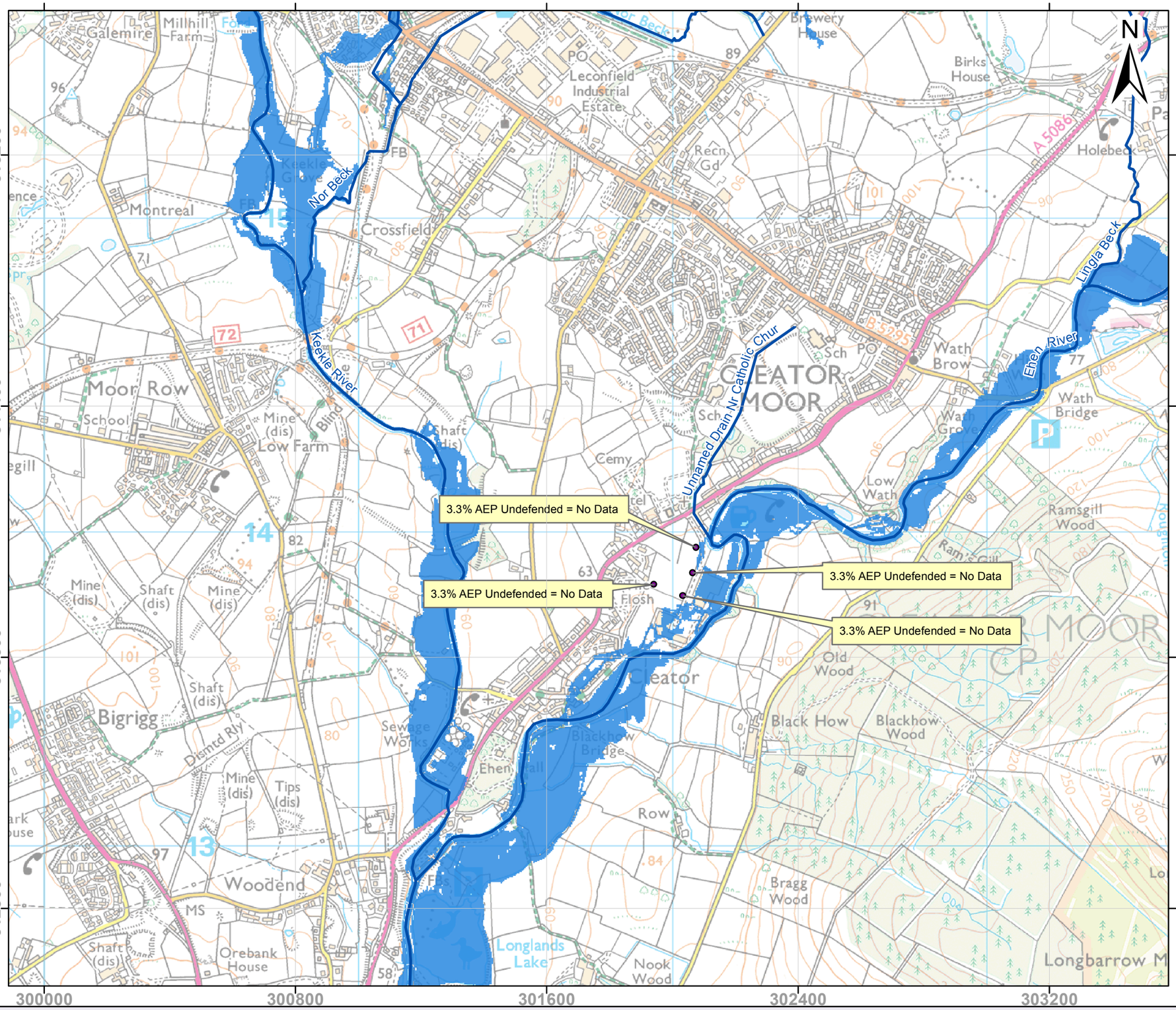
Geotechnical
&
Environmental
Drilling Experts
&
Consultants

Intellectual Copyright 2013

Appendix H Environment Agency Flood Data

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 10 July 2019
Our Ref: CL132929
NGR: 301,733 514,107



Key

Main River

1 in 30 Undefended Scenario

mAOD

High : 113.229

Low: 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.

Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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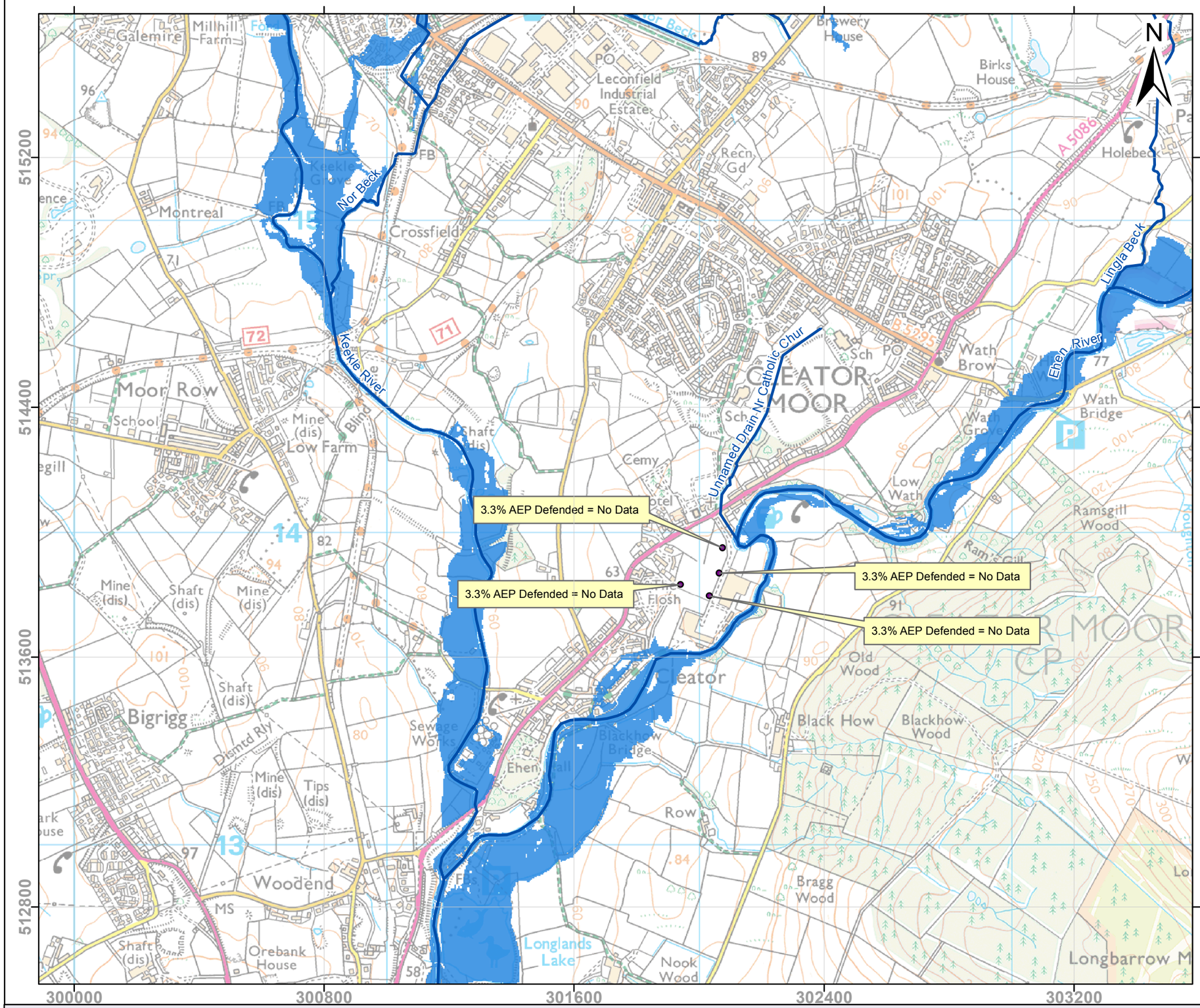

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Environment Agency

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 10 July 2019
Our Ref: CL132929
NGR: 301,733 514,107

Key

Main River

1 in 30 Defended Scenario

mAOD

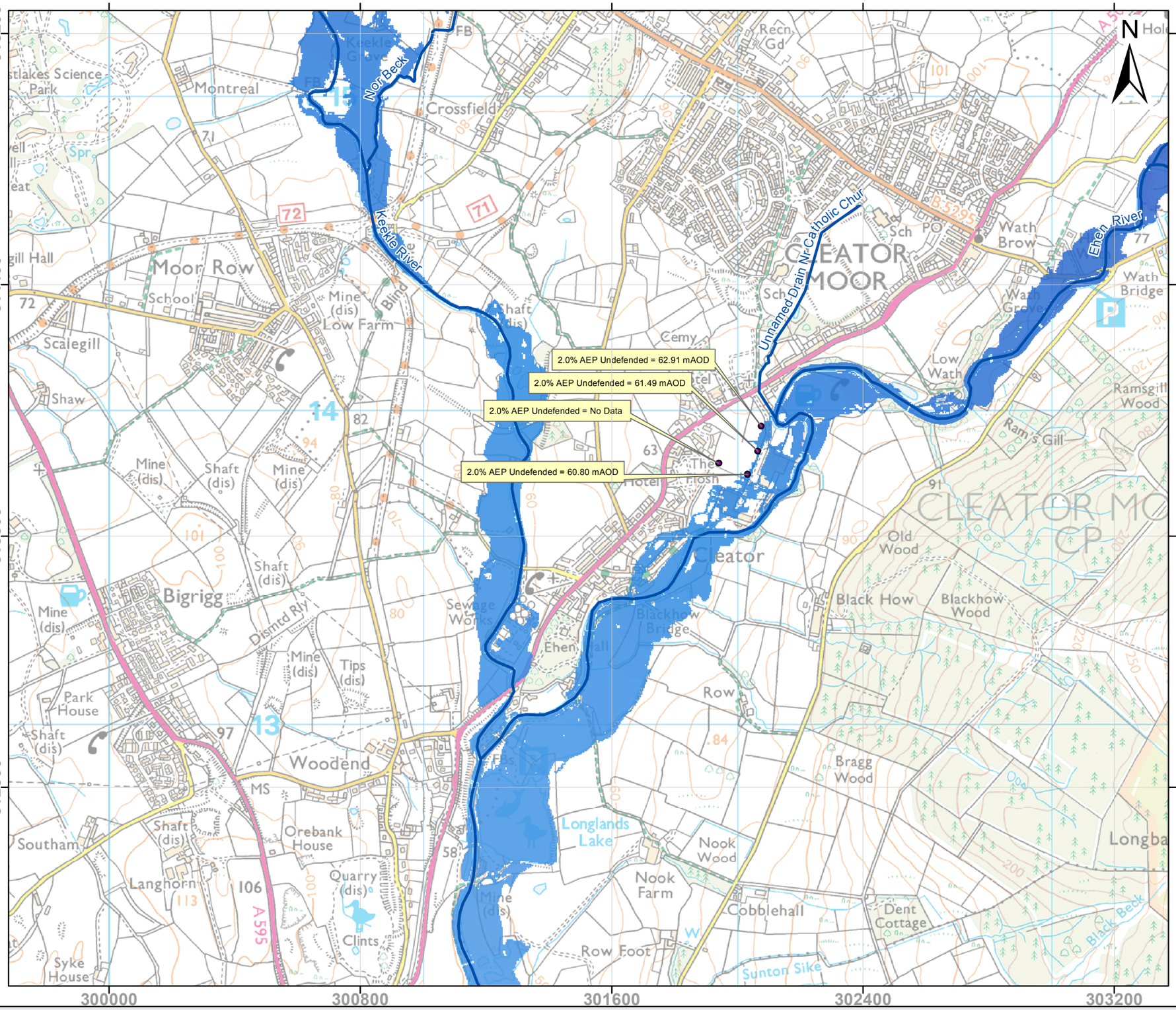
High : 113.229

Low : 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



Environment Agency

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 09 July 2019
Our Ref: CL132929
NGR: 301,526 513,720

Key

Main River

1 in 50 Undefended Scenario

mAOD

High : 113.229

Low : 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.

Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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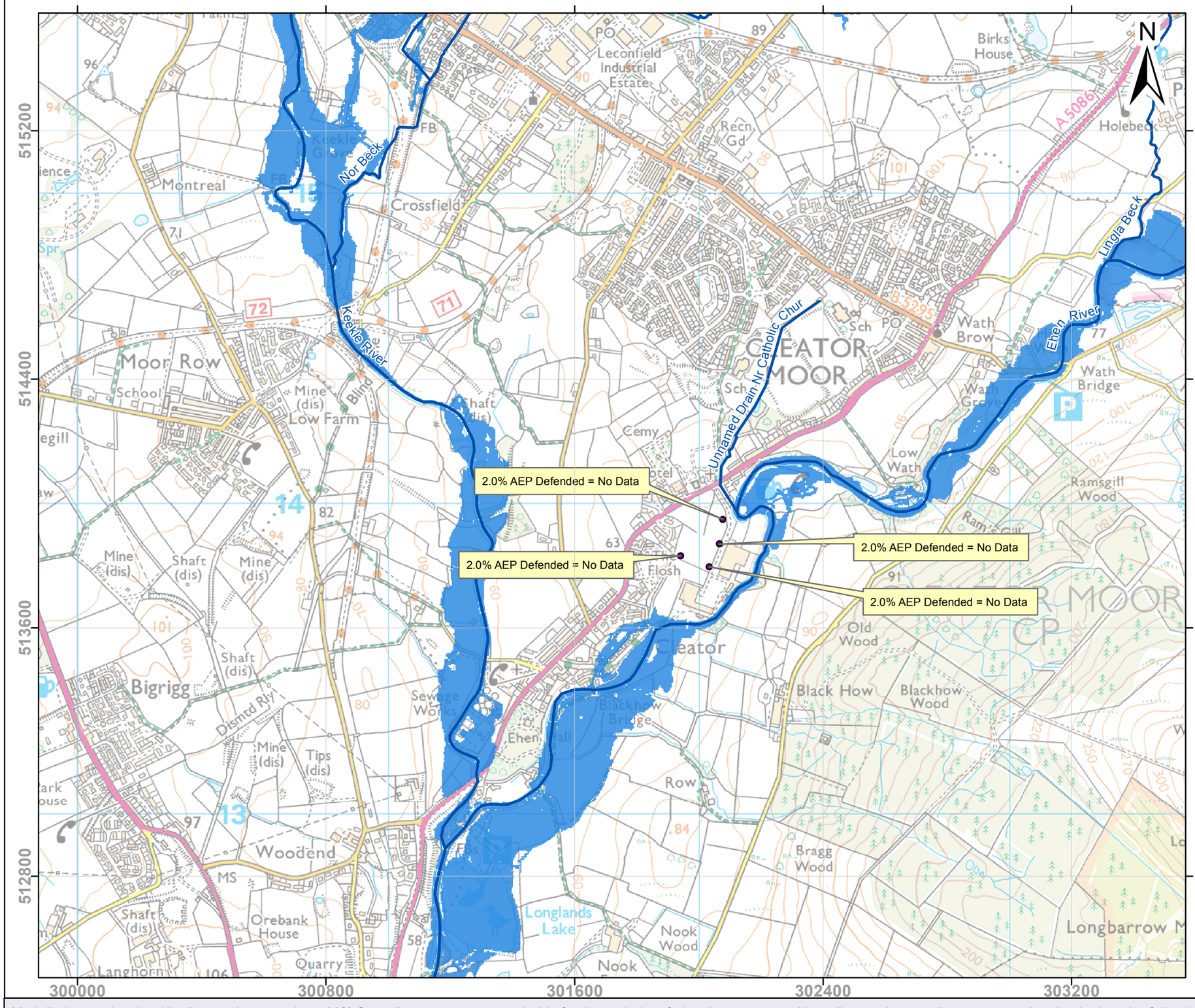

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Environment Agency

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 10 July 2019
Our Ref: CL132929
NGR: 301,720 514,026

Key

Main River

1 in 50 Defended Scenario

mAOD

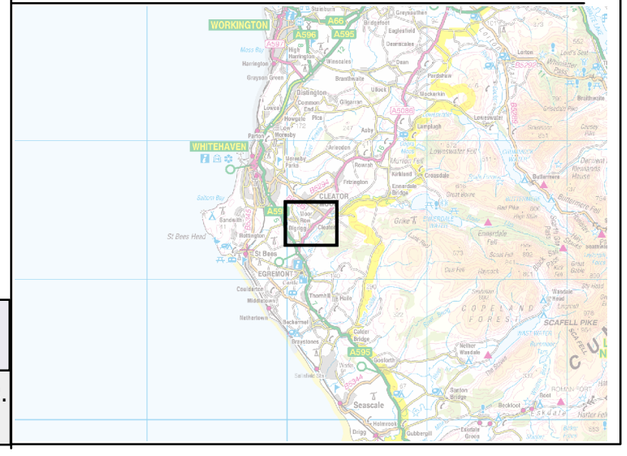
High : 113.329

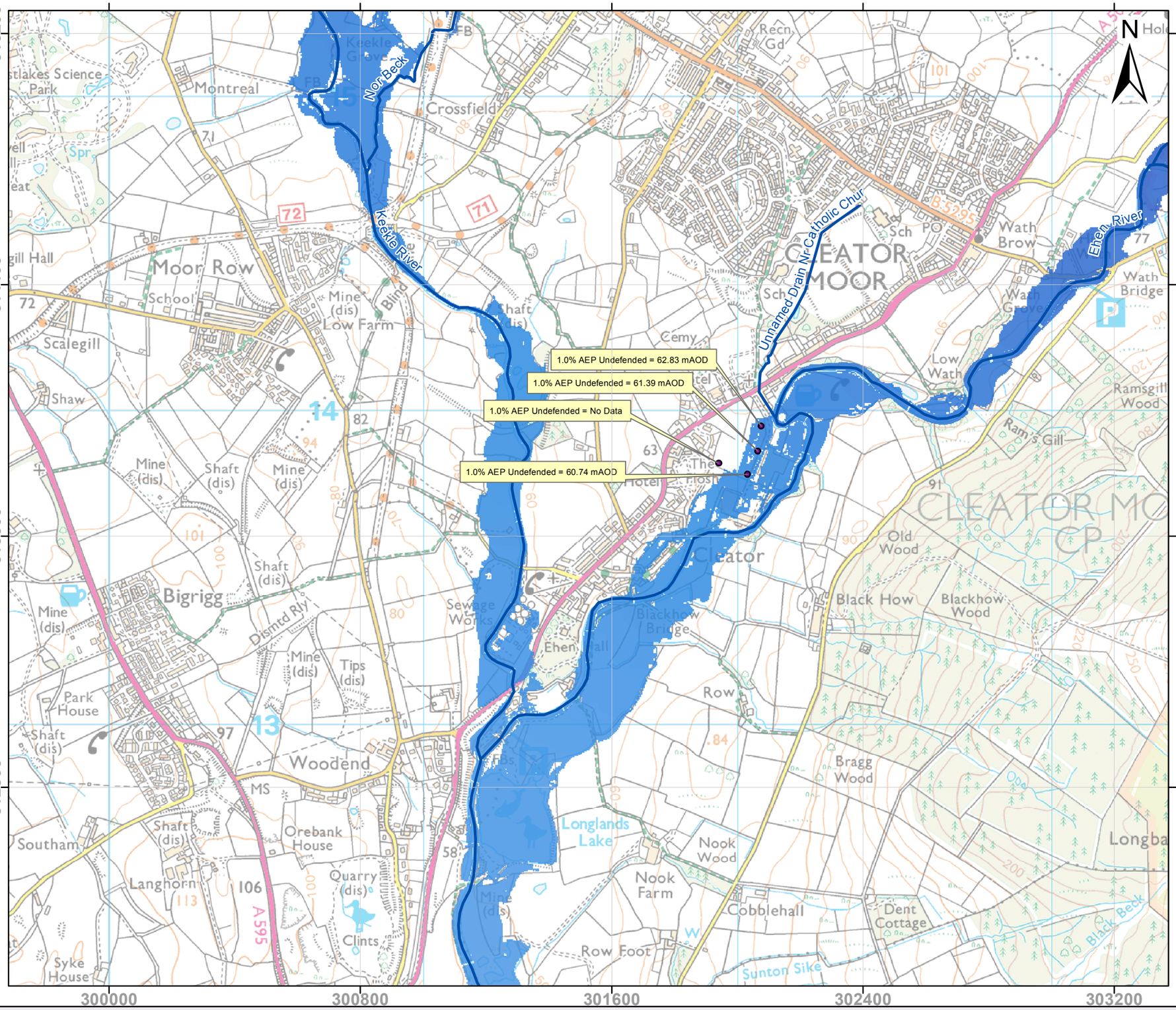
Low : 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.





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Environment Agency

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 09 July 2019
Our Ref: CL132929
NGR: 301,526 513,720

Key

Main River

1 in 100 Undefended Scenario

mAOD

High : 113.343

Low : 0

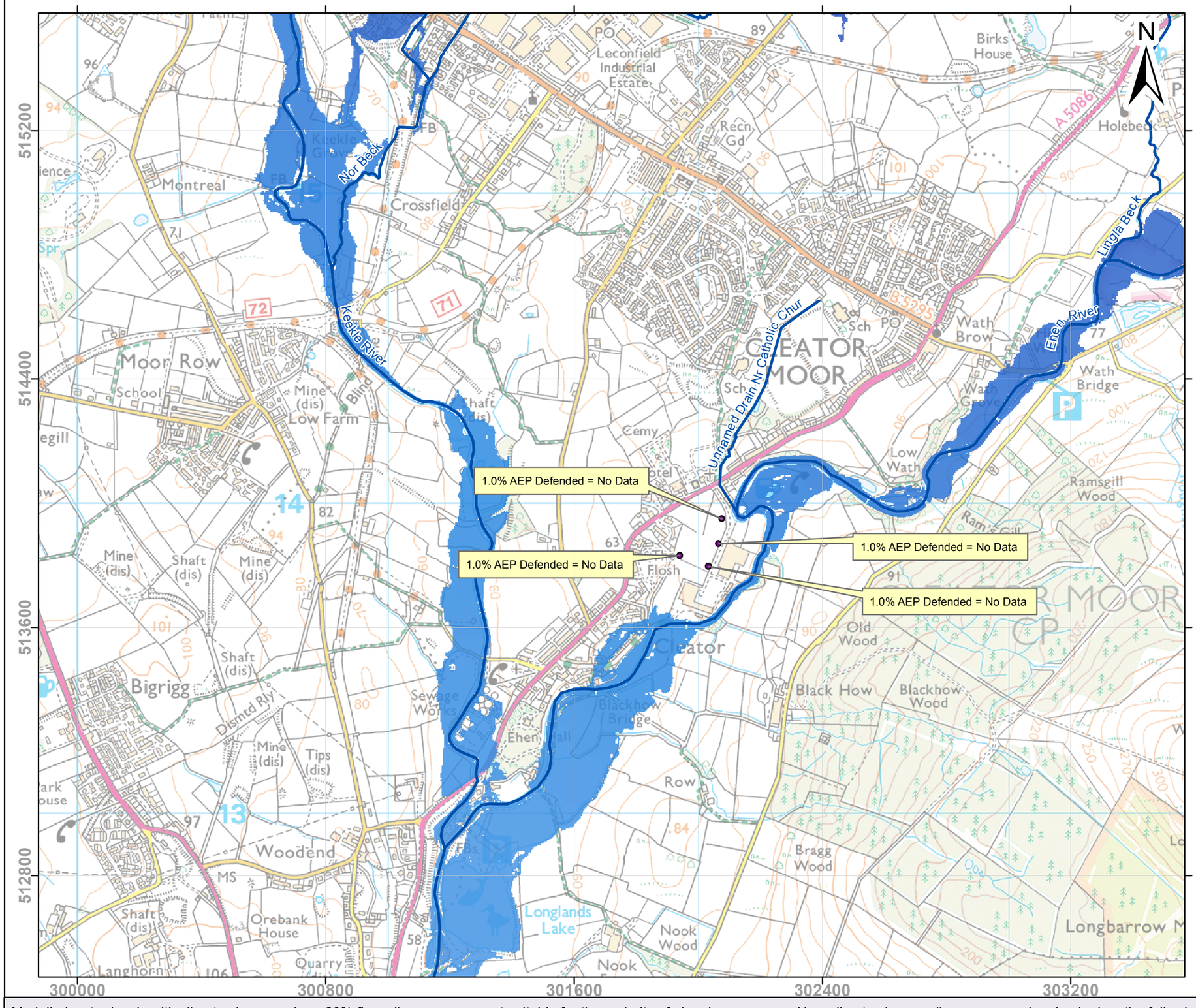
Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 10 July 2019
Our Ref: CL132929
NGR: 301,720 514,026



Key

Main River

1 in 100 Defended Scenario

mAOD

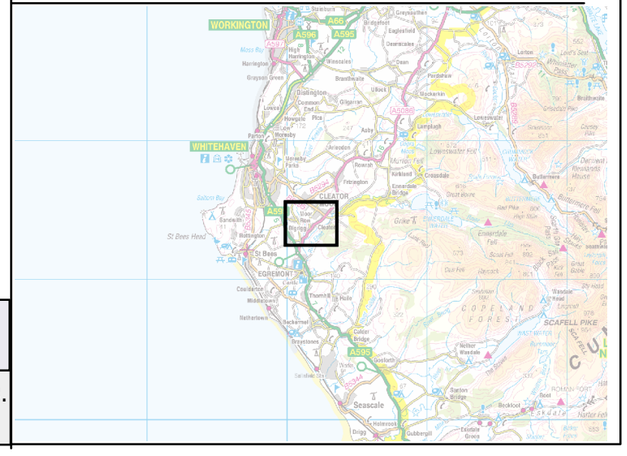
High : 113.325

Low : 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



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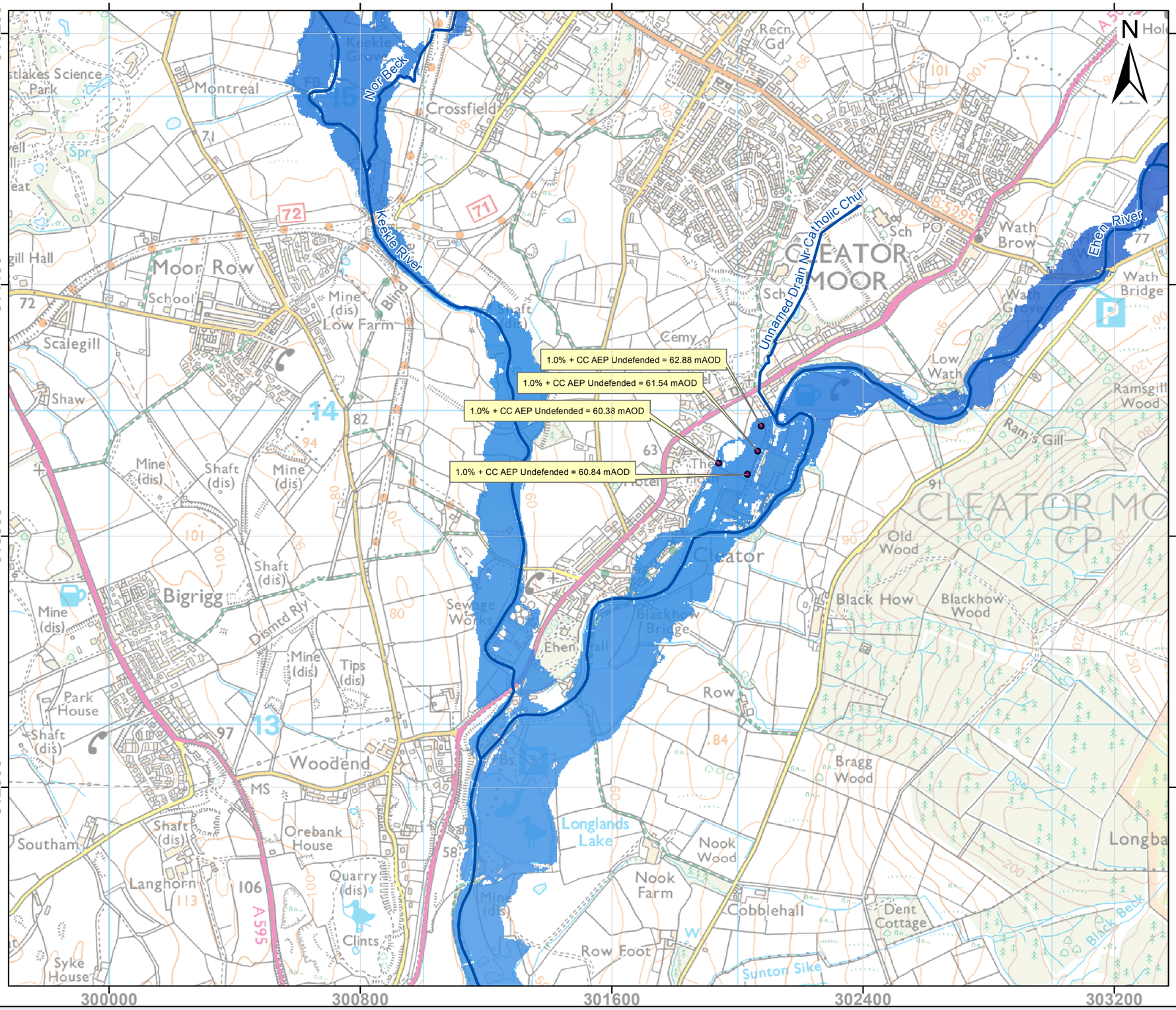

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 09 July 2019
Our Ref: CL132929
NGR: 301,526 513,720

Key

Main River

1 in 100 + CC Undefended

mAOD

High : 113.547

Low : 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.

Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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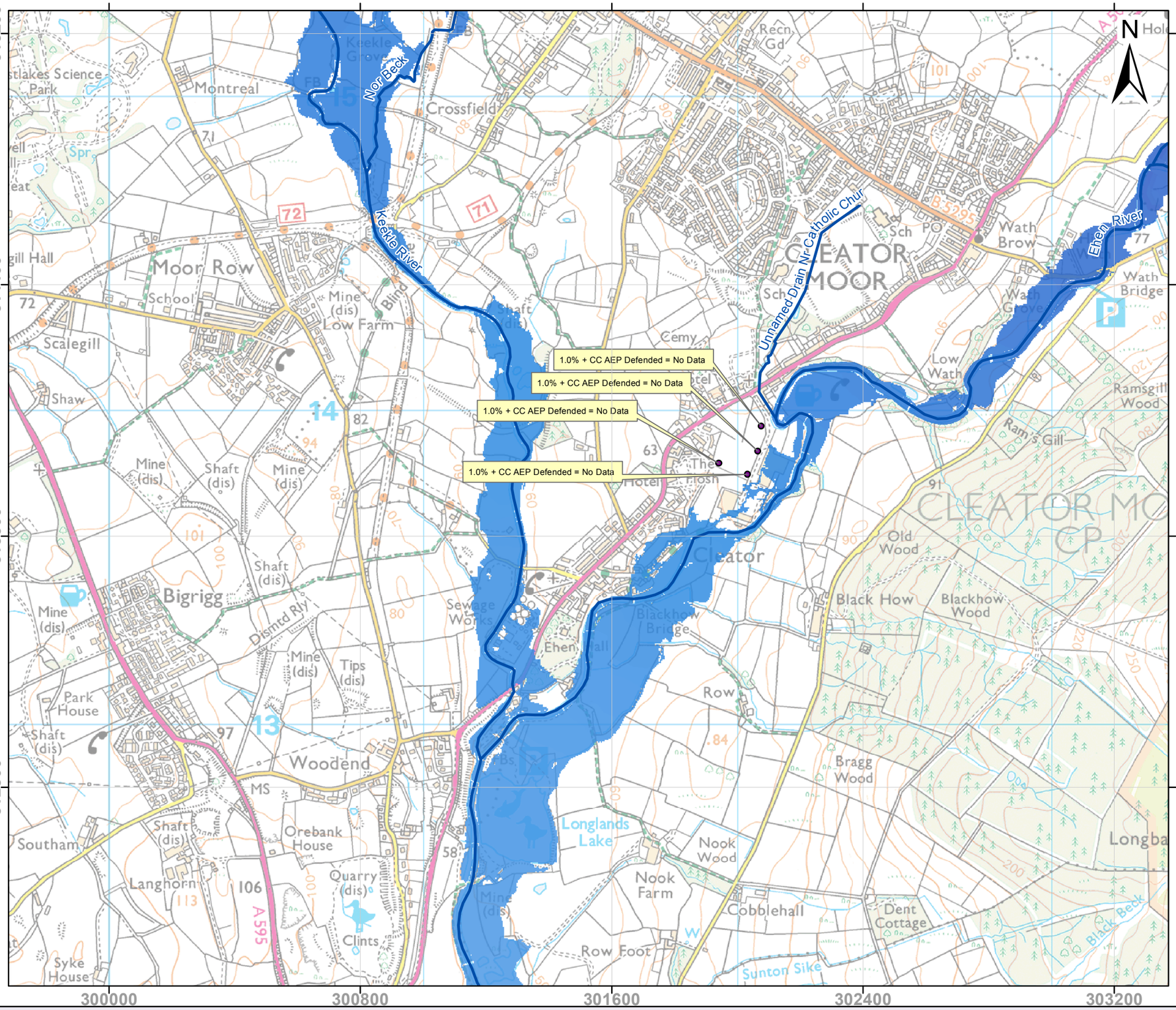

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 09 July 2019
Our Ref: CL132929
NGR: 301,526 513,720

Key

Main River

1 in 100 + CC Defended Scenario

mAOD

High : 113.542

Low : 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.

Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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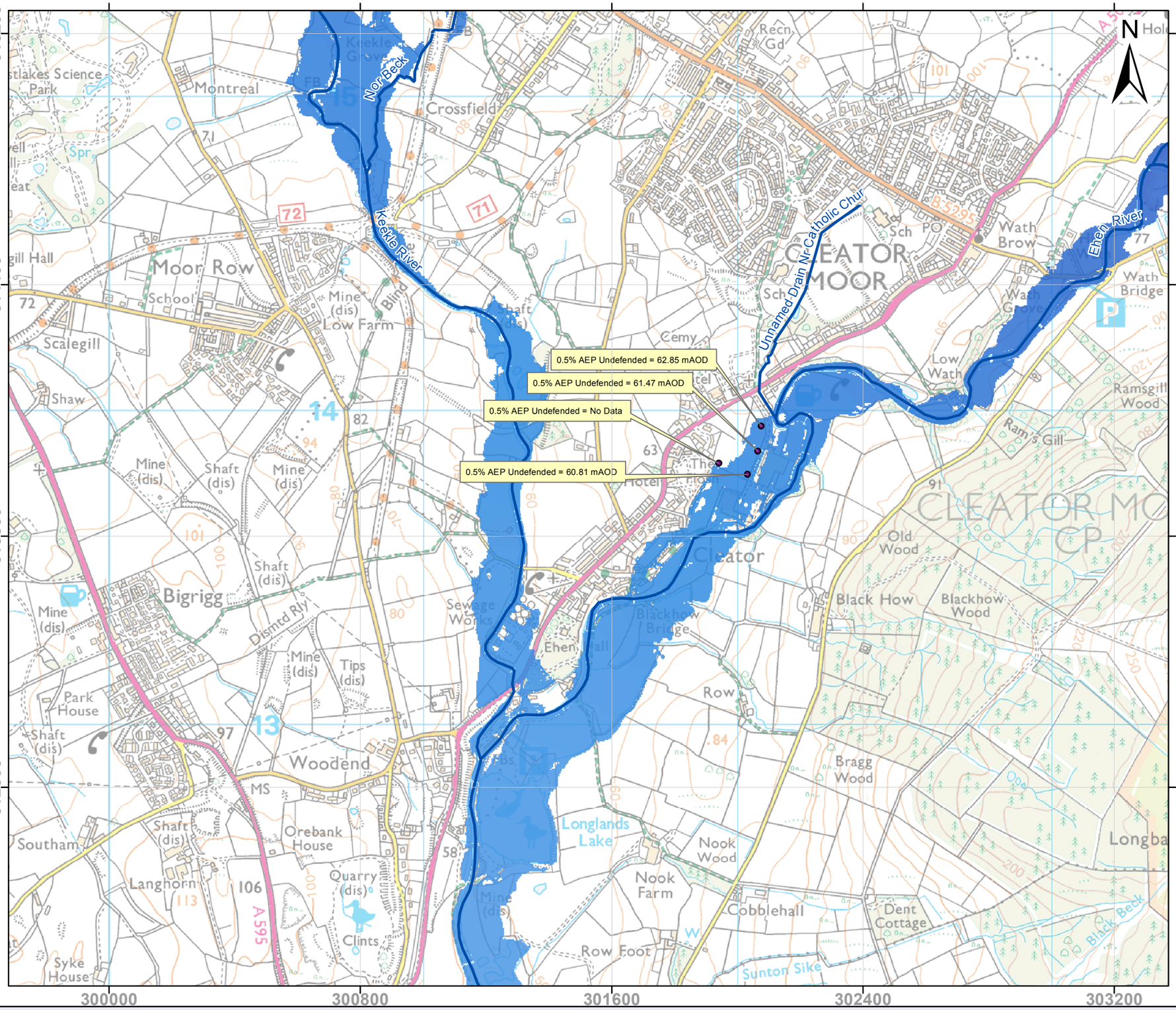

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 09 July 2019
Our Ref: CL132929
NGR: 301,526 513,720

Key

Main River

1 in 200 Undefended Scenario

mAOD

High : 113.464

Low : 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.

Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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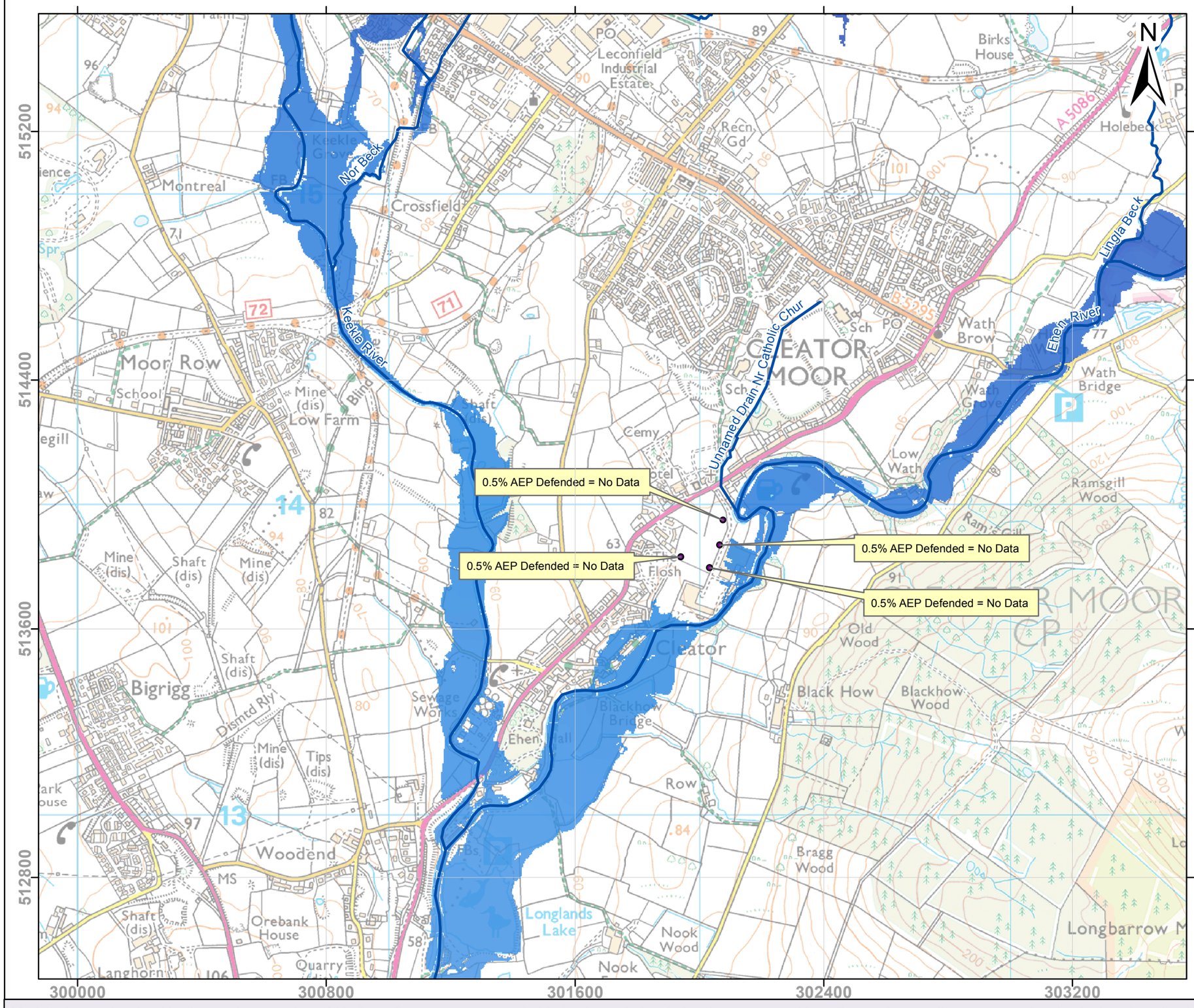
Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 10 July 2019
Our Ref: CL132929
NGR: 301,720 514,026



Key

Main River

1 in 200 Defended Scenario

mAOD

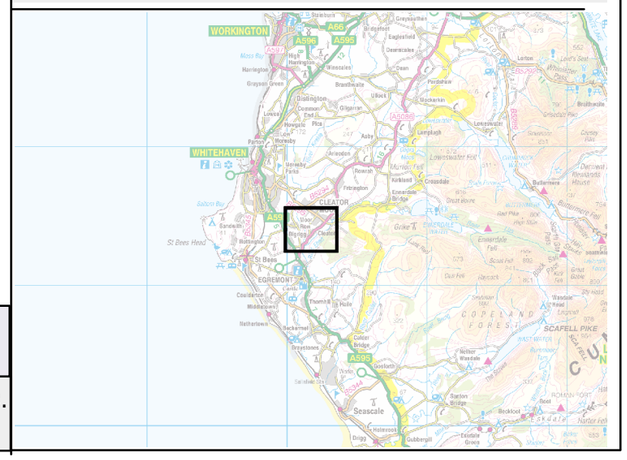
High : 113.456

Low : 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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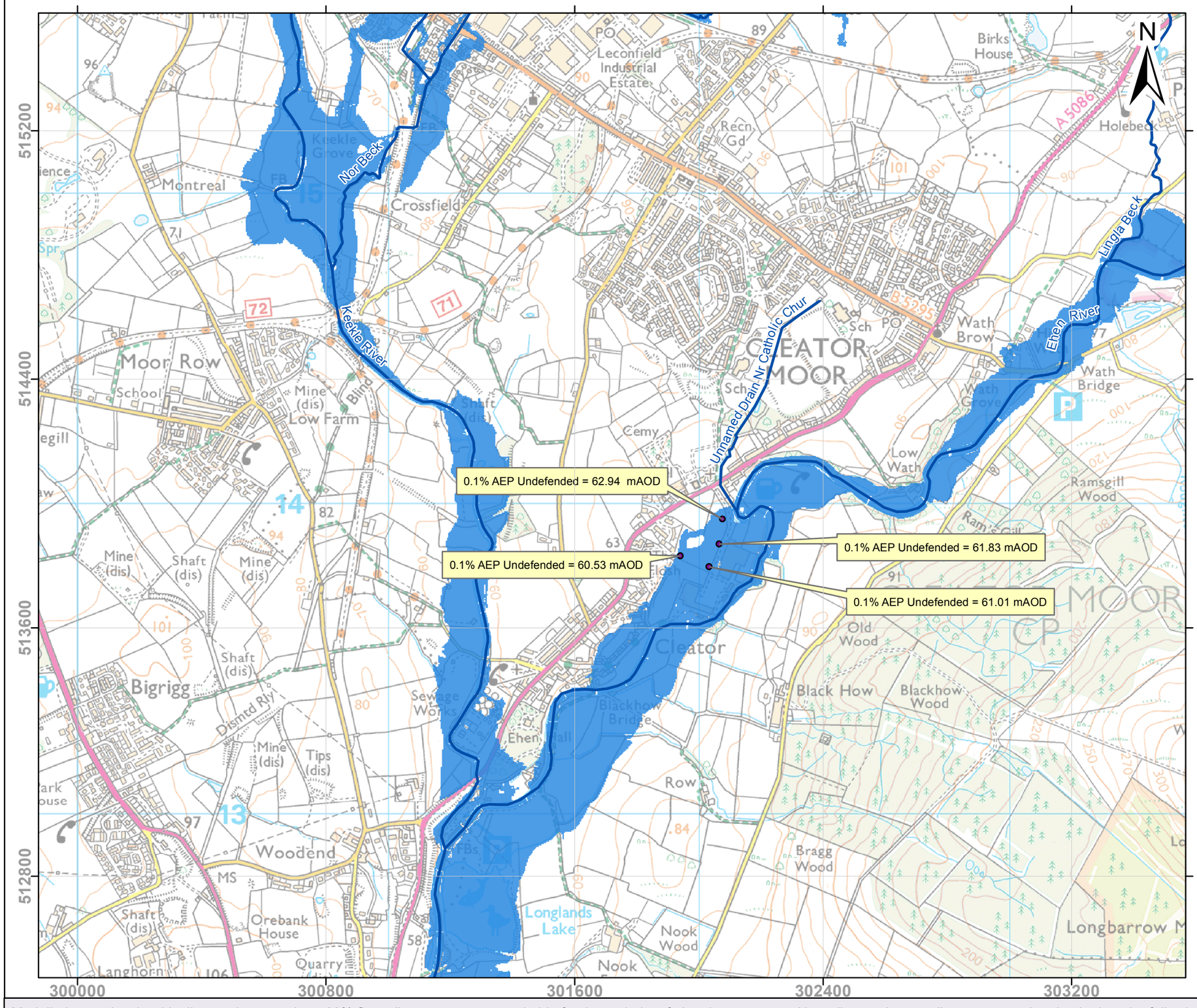

Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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Environment Agency

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 10 July 2019
Our Ref: CL132929
NGR: 301,720 514,026

Key

Main River

1 in 1000 Undefended Scenario

mAOD

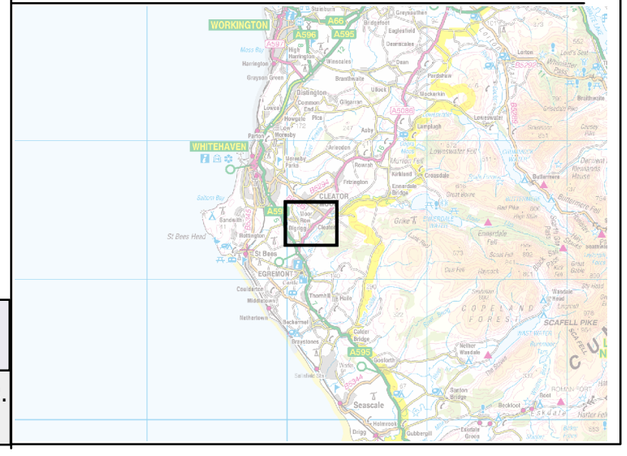
High : 114.31

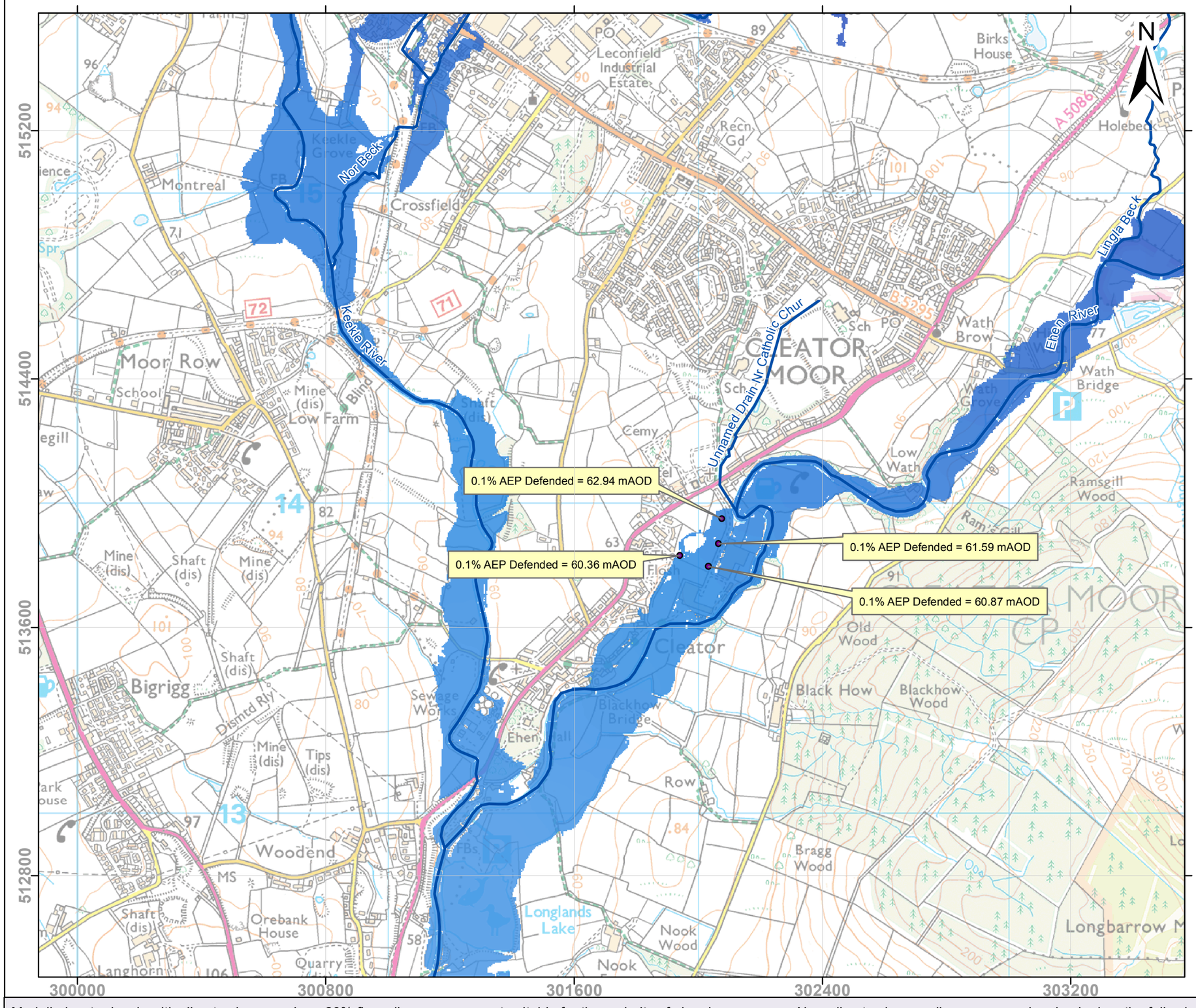
Low: 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.





Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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Environment Agency

Fluvial Model Level Map: Cleator Mills, Cleator, CA23 3DU

Produced: 10 July 2019
Our Ref: CL132929
NGR: 301,720 514,026

Key

Main River

1 in 1000 Defended Scenario

mAOD

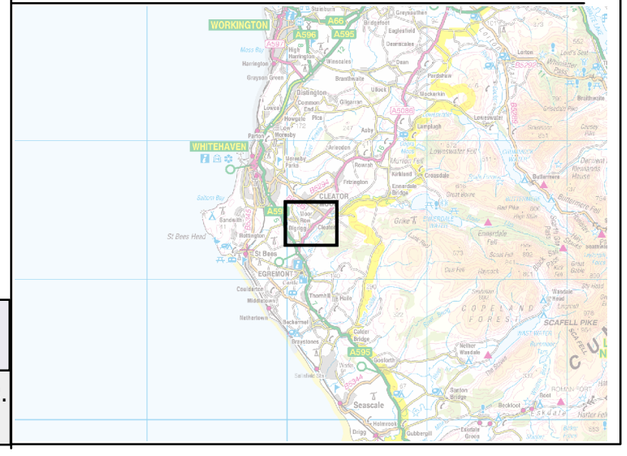
High : 114.319

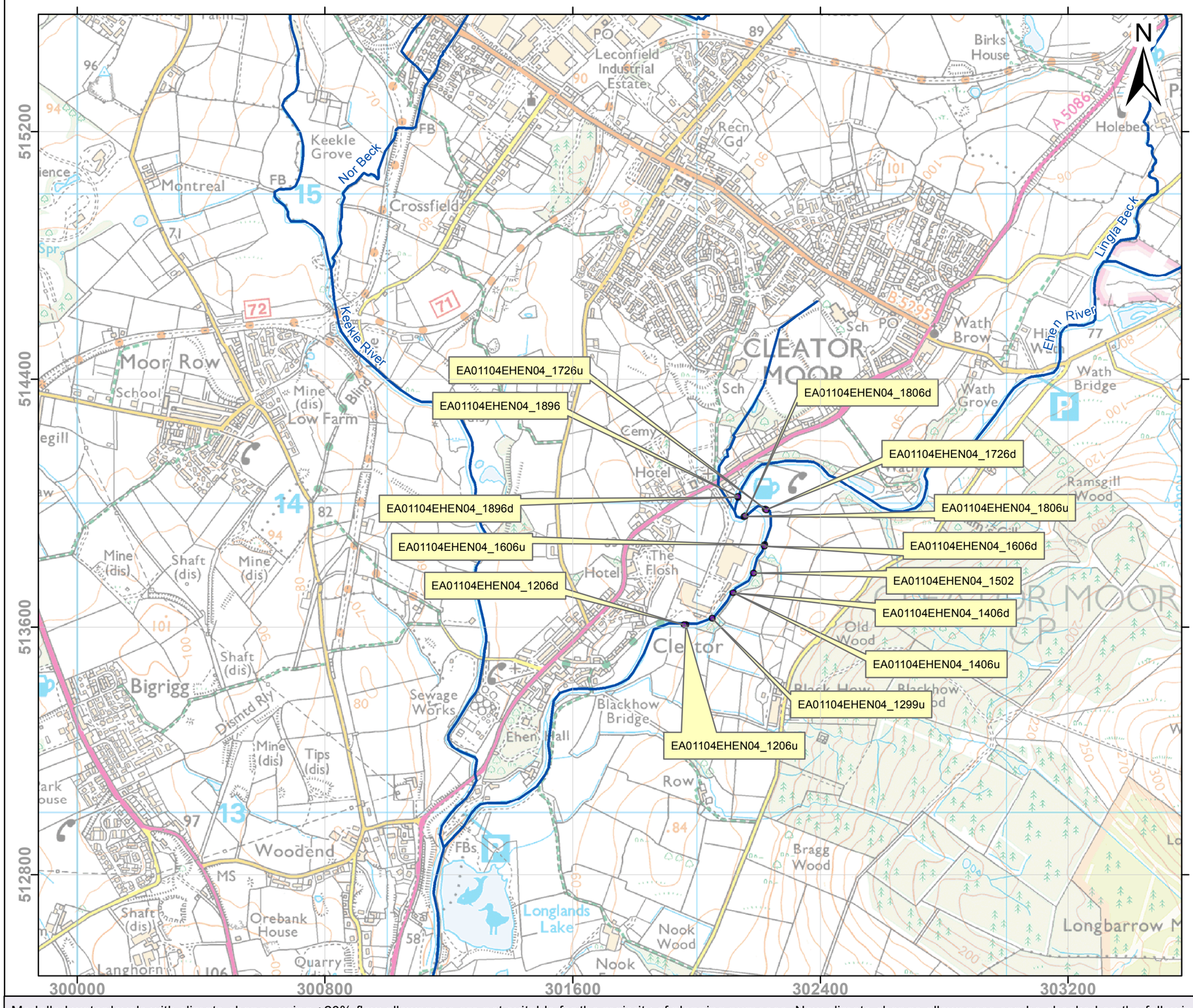
Low : 0

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.





Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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Environment Agency

Node Point Location Map: Cleator Mills, Cleator, CA23 3DU

Produced: 10 July 2019
Our Ref: CL132929
NGR: 301,720 514,026

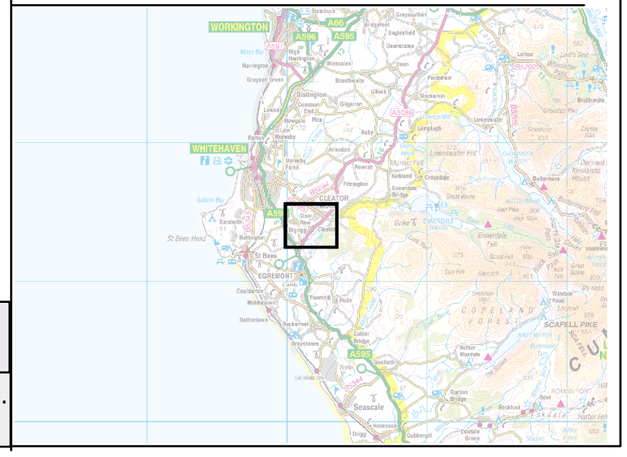
Key

- Modelled Node Point
- Main River

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



Node Point ID	Defended Model Flood group	Return Period(Yrs)	Water Level (maod	Flow (cumecs)
EA01104EHEN4_1726d	EA1104FRMEHEN2015_def	10	62.013	85.003
EA01104EHEN4_1726d	EA1104FRMEHEN2015_def	25	62.223	101.675
EA01104EHEN4_1726d	EA1104FRMEHEN2015_def	50	62.32	111.803
EA01104EHEN4_1726d	EA1104FRMEHEN2015_def	75	62.42	122.091
EA01104EHEN4_1726d	EA1104FRMEHEN2015_def	100	62.472	127.207
EA01104EHEN4_1726d	EA1104FRMEHEN2015_def	100+CC	62.692	143.88
EA01104EHEN4_1726d	EA1104FRMEHEN2015_def	200	63.383	140.216
EA01104EHEN4_1726d	EA1104FRMEHEN2015_def	1000	63.685	173.534
EA01104EHEN4_1726u	EA1104FRMEHEN2015_def	10	62.772	67.006
EA01104EHEN4_1726u	EA1104FRMEHEN2015_def	25	62.972	101.675
EA01104EHEN4_1726u	EA1104FRMEHEN2015_def	50	63.086	111.803
EA01104EHEN4_1726u	EA1104FRMEHEN2015_def	75	63.198	122.091
EA01104EHEN4_1726u	EA1104FRMEHEN2015_def	100	63.251	127.207
EA01104EHEN4_1726u	EA1104FRMEHEN2015_def	100+CC	63.419	143.88
EA01104EHEN4_1726u	EA1104FRMEHEN2015_def	200	63.779	92.749
EA01104EHEN4_1726u	EA1104FRMEHEN2015_def	1000	64.135	100.247
EA01104EHEN4_1806d	EA1104FRMEHEN2015_def	10	63.052	77.551
EA01104EHEN4_1806d	EA1104FRMEHEN2015_def	25	63.284	86.275
EA01104EHEN4_1806d	EA1104FRMEHEN2015_def	50	63.418	89.701
EA01104EHEN4_1806d	EA1104FRMEHEN2015_def	75	63.553	91.197
EA01104EHEN4_1806d	EA1104FRMEHEN2015_def	100	63.621	91.358
EA01104EHEN4_1806d	EA1104FRMEHEN2015_def	100+CC	63.823	93.242
EA01104EHEN4_1806d	EA1104FRMEHEN2015_def	200	63.779	92.749
EA01104EHEN4_1806d	EA1104FRMEHEN2015_def	1000	64.135	100.247
EA01104EHEN4_1896	EA1104FRMEHEN2015_def	10	63.948	76.434
EA01104EHEN4_1896	EA1104FRMEHEN2015_def	25	64.086	85.916
EA01104EHEN4_1896	EA1104FRMEHEN2015_def	50	64.146	90.072

EA01104EHEN4_1896	EA1104FRMEHEN2015_def	75	64.194	92.974
EA01104EHEN4_1896	EA1104FRMEHEN2015_def	100	64.223	94.056
EA01104EHEN4_1896	EA1104FRMEHEN2015_def	100+CC	64.291	98.815
EA01104EHEN4_1896	EA1104FRMEHEN2015_def	200	64.015	100.488
EA01104EHEN4_1896	EA1104FRMEHEN2015_def	1000	64.152	116.027
EA01104EHEN4_1896d	EA1104FRMEHEN2015_def	10	63.74	77.543
EA01104EHEN4_1896d	EA1104FRMEHEN2015_def	25	63.852	87.567
EA01104EHEN4_1896d	EA1104FRMEHEN2015_def	50	63.898	92.126
EA01104EHEN4_1896d	EA1104FRMEHEN2015_def	75	63.941	95.293
EA01104EHEN4_1896d	EA1104FRMEHEN2015_def	100	63.972	96.513
EA01104EHEN4_1896d	EA1104FRMEHEN2015_def	100+CC	64.029	101.484
EA01104EHEN4_1896d	EA1104FRMEHEN2015_def	200	64.7	120.715
EA01104EHEN4_1896d	EA1104FRMEHEN2015_def	1000	64.939	147.259
EA01104EHEN4_1806u	EA1104FRMEHEN2015_def	10	63.052	77.551
EA01104EHEN4_1806u	EA1104FRMEHEN2015_def	25	63.284	86.275
EA01104EHEN4_1806u	EA1104FRMEHEN2015_def	50	63.418	89.701
EA01104EHEN4_1806u	EA1104FRMEHEN2015_def	75	63.553	91.197
EA01104EHEN4_1806u	EA1104FRMEHEN2015_def	100	63.621	91.358
EA01104EHEN4_1806u	EA1104FRMEHEN2015_def	100+CC	63.823	93.242
EA01104EHEN4_1806u	EA1104FRMEHEN2015_def	200	64.276	97.704
EA01104EHEN4_1806u	EA1104FRMEHEN2015_def	1000	63.754	86.424
EA01104EHEN4_1606u	EA1104FRMEHEN2015_def	10	61.545	85.032
EA01104EHEN4_1606u	EA1104FRMEHEN2015_def	25	61.765	101.24
EA01104EHEN4_1606u	EA1104FRMEHEN2015_def	50	61.882	111.013
EA01104EHEN4_1606u	EA1104FRMEHEN2015_def	75	61.994	121.169
EA01104EHEN4_1606u	EA1104FRMEHEN2015_def	100	62.052	126.737
EA01104EHEN4_1606u	EA1104FRMEHEN2015_def	100+CC	62.231	145.965
EA01104EHEN4_1606u	EA1104FRMEHEN2015_def	200	62.192	141.565

EA01104EHEN4_1606u	EA1104FRMEHEN2015_def	1000	62.545	185.438
EA01104EHEN4_1606d	EA1104FRMEHEN2015_def	10	60.834	85.032
EA01104EHEN4_1606d	EA1104FRMEHEN2015_def	25	61.064	101.24
EA01104EHEN4_1606d	EA1104FRMEHEN2015_def	50	61.208	111.013
EA01104EHEN4_1606d	EA1104FRMEHEN2015_def	75	61.354	121.169
EA01104EHEN4_1606d	EA1104FRMEHEN2015_def	100	61.427	126.737
EA01104EHEN4_1606d	EA1104FRMEHEN2015_def	100+CC	61.666	145.965
EA01104EHEN4_1606d	EA1104FRMEHEN2015_def	200	61.61	129.311
EA01104EHEN4_1606d	EA1104FRMEHEN2015_def	1000	62.193	165.107
EA01104EHEN4_1502	EA1104FRMEHEN2015_def	10	60.275	85.057
EA01104EHEN4_1502	EA1104FRMEHEN2015_def	25	60.504	101.728
EA01104EHEN4_1502	EA1104FRMEHEN2015_def	50	60.626	111.889
EA01104EHEN4_1502	EA1104FRMEHEN2015_def	75	60.744	122.965
EA01104EHEN4_1502	EA1104FRMEHEN2015_def	100	60.808	129.137
EA01104EHEN4_1502	EA1104FRMEHEN2015_def	100+CC	61.001	151.25
EA01104EHEN4_1502	EA1104FRMEHEN2015_def	200	60.953	146.021
EA01104EHEN4_1502	EA1104FRMEHEN2015_def	1000	61.398	198.323
EA01104EHEN4_1406d	EA1104FRMEHEN2015_def	10	59.892	85.08
EA01104EHEN4_1406d	EA1104FRMEHEN2015_def	25	60.118	101.697
EA01104EHEN4_1406d	EA1104FRMEHEN2015_def	50	60.224	111.657
EA01104EHEN4_1406d	EA1104FRMEHEN2015_def	75	60.379	122.255
EA01104EHEN4_1406d	EA1104FRMEHEN2015_def	100	60.451	128.097
EA01104EHEN4_1406d	EA1104FRMEHEN2015_def	100+CC	60.559	149.927
EA01104EHEN4_1406d	EA1104FRMEHEN2015_def	200	60.56	144.657
EA01104EHEN4_1406d	EA1104FRMEHEN2015_def	1000	61.039	202.596
EA01104EHEN4_1406u	EA1104FRMEHEN2015_def	10	59.892	85.08
EA01104EHEN4_1406u	EA1104FRMEHEN2015_def	25	60.118	101.697
EA01104EHEN4_1406u	EA1104FRMEHEN2015_def	50	60.244	111.657

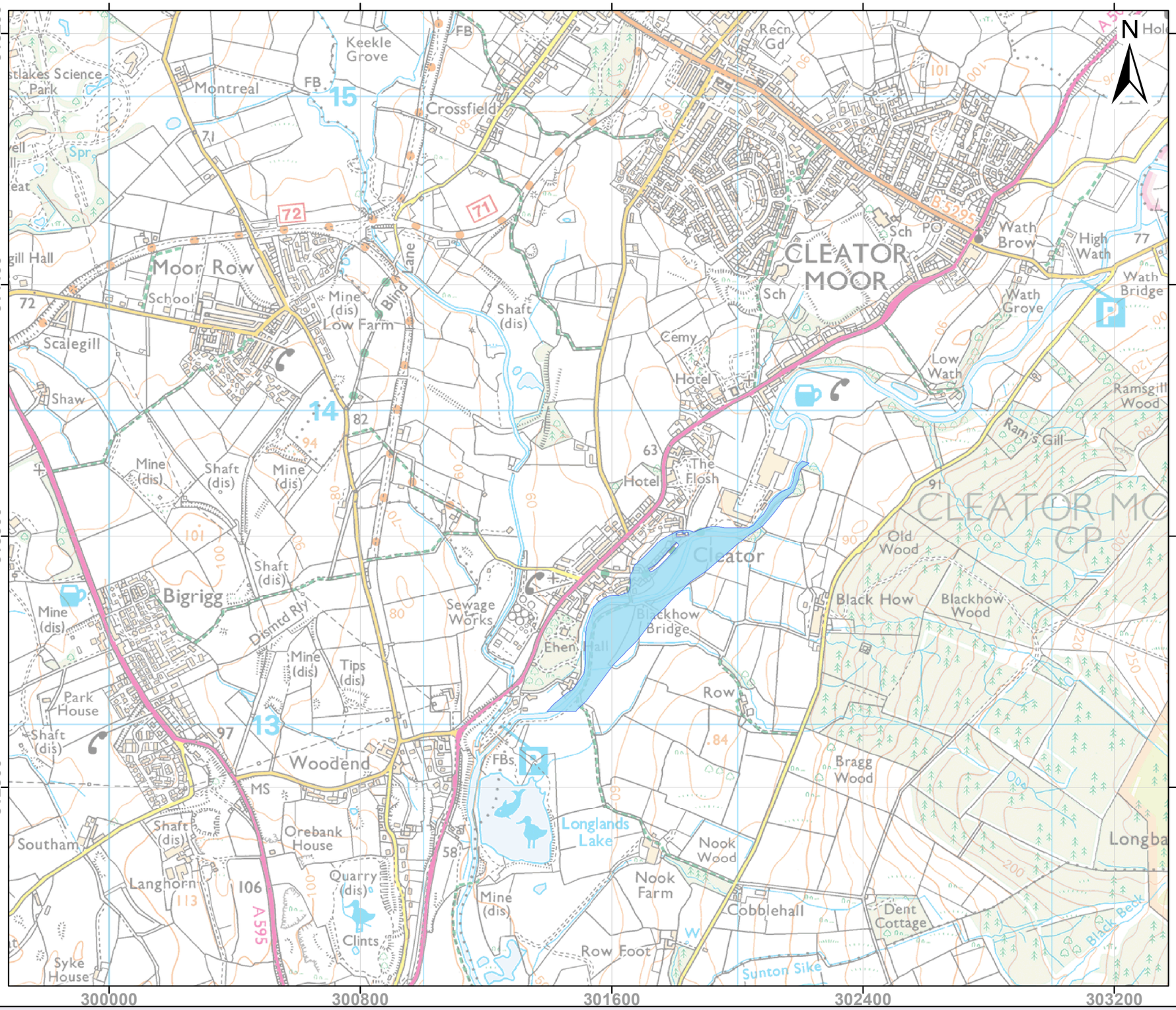
EA01104EHEN4_1406u	EA1104FRMEHEN2015_def	75	60.379	122.255
EA01104EHEN4_1406u	EA1104FRMEHEN2015_def	100	60.451	128.097
EA01104EHEN4_1406u	EA1104FRMEHEN2015_def	100+CC	60.599	149.927
EA01104EHEN4_1406u	EA1104FRMEHEN2015_def	200	60.953	146.021
EA01104EHEN4_1406u	EA1104FRMEHEN2015_def	1000	61.398	198.323
EA01104EHEN4_1299u	EA1104FRMEHEN2015_def	10	59.379	85.106
EA01104EHEN4_1299u	EA1104FRMEHEN2015_def	25	59.549	101.801
EA01104EHEN4_1299u	EA1104FRMEHEN2015_def	50	59.64	111.974
EA01104EHEN4_1299u	EA1104FRMEHEN2015_def	75	59.733	123.071
EA01104EHEN4_1299u	EA1104FRMEHEN2015_def	100	59.775	129.253
EA01104EHEN4_1299u	EA1104FRMEHEN2015_def	100+CC	59.912	152.206
EA01104EHEN4_1299u	EA1104FRMEHEN2015_def	200	60.56	144.657
EA01104EHEN4_1299u	EA1104FRMEHEN2015_def	1000	61.039	202.596
EA01104EHEN4_1206u	EA1104FRMEHEN2015_def	10	58.826	85.128
EA01104EHEN4_1206u	EA1104FRMEHEN2015_def	25	58.938	101.546
EA01104EHEN4_1206u	EA1104FRMEHEN2015_def	50	58.992	111.299
EA01104EHEN4_1206u	EA1104FRMEHEN2015_def	75	59.044	121.701
EA01104EHEN4_1206u	EA1104FRMEHEN2015_def	100	59.056	127.645
EA01104EHEN4_1206u	EA1104FRMEHEN2015_def	100+CC	59.075	150.014
EA01104EHEN4_1206u	EA1104FRMEHEN2015_def	200	59.88	146.482
EA01104EHEN4_1206u	EA1104FRMEHEN2015_def	1000	60.205	210.945
EA01104EHEN4_1206d	EA1104FRMEHEN2015_def	10	58.826	85.128
EA01104EHEN4_1206d	EA1104FRMEHEN2015_def	25	58.938	101.546
EA01104EHEN4_1206d	EA1104FRMEHEN2015_def	50	58.992	111.299
EA01104EHEN4_1206d	EA1104FRMEHEN2015_def	75	59.044	121.701
EA01104EHEN4_1206d	EA1104FRMEHEN2015_def	100	59.056	127.645
EA01104EHEN4_1206d	EA1104FRMEHEN2015_def	100+CC	59.075	150.014
EA01104EHEN4_1206d	EA1104FRMEHEN2015_def	200	59.071	144.439
EA01104EHEN4_1206d	EA1104FRMEHEN2015_def	1000	59.234	203.897

Node Point ID	Undefended Model Flood group	Return Period(Yrs)	Water Level (maod)	Flow (cumecs)
EA01104EHEN4_1726d	EA1104FRMEHEN2015	10	62.024	85.635
EA01104EHEN4_1726d	EA1104FRMEHEN2015	25	62.203	98.295
EA01104EHEN4_1726d	EA1104FRMEHEN2015	50	62.29	104.334
EA01104EHEN4_1726d	EA1104FRMEHEN2015	75	62.392	109.629
EA01104EHEN4_1726d	EA1104FRMEHEN2015	100	62.443	112.064
EA01104EHEN4_1726d	EA1104FRMEHEN2015	100+CC	62.208	119.508
EA01104EHEN4_1726d	EA1104FRMEHEN2015	200	62.241	140.216
EA01104EHEN4_1726d	EA1104FRMEHEN2015	1000	63.035	135.814
EA01104EHEN4_1726u	EA1104FRMEHEN2015	10	62.78	85.635
EA01104EHEN4_1726u	EA1104FRMEHEN2015	25	62.933	98.295
EA01104EHEN4_1726u	EA1104FRMEHEN2015	50	63.003	104.334
EA01104EHEN4_1726u	EA1104FRMEHEN2015	75	63.062	109.629
EA01104EHEN4_1726u	EA1104FRMEHEN2015	100	63.089	112.064
EA01104EHEN4_1726u	EA1104FRMEHEN2015	100+CC	63.17	119.508
EA01104EHEN4_1726u	EA1104FRMEHEN2015	200	63.383	118.004
EA01104EHEN4_1726u	EA1104FRMEHEN2015	1000	63.339	135.814
EA01104EHEN4_1806d	EA1104FRMEHEN2015	10	63.097	67.006
EA01104EHEN4_1806d	EA1104FRMEHEN2015	25	63.284	69.381
EA01104EHEN4_1806d	EA1104FRMEHEN2015	50	63.367	71.016
EA01104EHEN4_1806d	EA1104FRMEHEN2015	75	63.438	72.753
EA01104EHEN4_1806d	EA1104FRMEHEN2015	100	63.469	73.652
EA01104EHEN4_1806d	EA1104FRMEHEN2015	100+CC	63.563	76.122
EA01104EHEN4_1806d	EA1104FRMEHEN2015	200	63.544	75.778
EA01104EHEN4_1806d	EA1104FRMEHEN2015	1000	63.754	86.424
EA01104EHEN4_1896	EA1104FRMEHEN2015	10	63.778	64.737
EA01104EHEN4_1896	EA1104FRMEHEN2015	25	63.844	66.953
EA01104EHEN4_1896	EA1104FRMEHEN2015	50	63.887	68.838

EA01104EHEN4_1896	EA1104FRMEHEN2015	75	63.929	71.243
EA01104EHEN4_1896	EA1104FRMEHEN2015	100	63.949	72.743
EA01104EHEN4_1896	EA1104FRMEHEN2015	100+CC	64.016	78.371
EA01104EHEN4_1896	EA1104FRMEHEN2015	200	64.002	77.1
EA01104EHEN4_1896	EA1104FRMEHEN2015	1000	64.458	112.23
EA01104EHEN4_1896d	EA1104FRMEHEN2015	10	63.601	65.878
EA01104EHEN4_1896d	EA1104FRMEHEN2015	25	63.667	68.625
EA01104EHEN4_1896d	EA1104FRMEHEN2015	50	63.707	70.898
EA01104EHEN4_1896d	EA1104FRMEHEN2015	75	63.743	73.527
EA01104EHEN4_1896d	EA1104FRMEHEN2015	100	63.758	75.168
EA01104EHEN4_1896d	EA1104FRMEHEN2015	100+CC	63.805	81.063
EA01104EHEN4_1896d	EA1104FRMEHEN2015	200	63.794	79.925
EA01104EHEN4_1896d	EA1104FRMEHEN2015	1000	63.925	97.461
EA01104EHEN4_1806u	EA1104FRMEHEN2015	10	63.097	67.006
EA01104EHEN4_1806u	EA1104FRMEHEN2015	25	63.284	69.381
EA01104EHEN4_1806u	EA1104FRMEHEN2015	50	63.367	71.016
EA01104EHEN4_1806u	EA1104FRMEHEN2015	75	63.438	72.753
EA01104EHEN4_1806u	EA1104FRMEHEN2015	100	63.469	73.652
EA01104EHEN4_1806u	EA1104FRMEHEN2015	100+CC	63.563	76.122
EA01104EHEN4_1806u	EA1104FRMEHEN2015	200	63.544	75.778
EA01104EHEN4_1806u	EA1104FRMEHEN2015	1000	63.754	86.424
EA01104EHEN4_1606u	EA1104FRMEHEN2015	10	61.556	85.791
EA01104EHEN4_1606u	EA1104FRMEHEN2015	25	61.738	99.175
EA01104EHEN4_1606u	EA1104FRMEHEN2015	50	61.834	106.938
EA01104EHEN4_1606u	EA1104FRMEHEN2015	75	61.928	115.064
EA01104EHEN4_1606u	EA1104FRMEHEN2015	100	61.974	119.209
EA01104EHEN4_1606u	EA1104FRMEHEN2015	100+CC	62.107	132.378
EA01104EHEN4_1606u	EA1104FRMEHEN2015	200	62.077	129.311

EA01104EHEN4_1606u	EA1104FRMEHEN2015	1000	62.468	165.107
EA01104EHEN4_1606d	EA1104FRMEHEN2015	10	60.846	85.791
EA01104EHEN4_1606d	EA1104FRMEHEN2015	25	61.066	99.175
EA01104EHEN4_1606d	EA1104FRMEHEN2015	50	61.219	106.938
EA01104EHEN4_1606d	EA1104FRMEHEN2015	75	61.368	115.064
EA01104EHEN4_1606d	EA1104FRMEHEN2015	100	61.442	119.209
EA01104EHEN4_1606d	EA1104FRMEHEN2015	100+CC	61.658	132.378
EA01104EHEN4_1606d	EA1104FRMEHEN2015	200	61.61	141.565
EA01104EHEN4_1606d	EA1104FRMEHEN2015	1000	62.193	165.107
EA01104EHEN4_1502	EA1104FRMEHEN2015	10	60.291	85.849
EA01104EHEN4_1502	EA1104FRMEHEN2015	25	60.51	100.509
EA01104EHEN4_1502	EA1104FRMEHEN2015	50	60.632	109.947
EA01104EHEN4_1502	EA1104FRMEHEN2015	75	60.75	120.011
EA01104EHEN4_1502	EA1104FRMEHEN2015	100	60.814	125.364
EA01104EHEN4_1502	EA1104FRMEHEN2015	100+CC	60.984	143.259
EA01104EHEN4_1502	EA1104FRMEHEN2015	200	60.947	139.137
EA01104EHEN4_1502	EA1104FRMEHEN2015	1000	61.321	193.319
EA01104EHEN4_1406d	EA1104FRMEHEN2015	10	59.906	86.039
EA01104EHEN4_1406d	EA1104FRMEHEN2015	25	60.115	101.387
EA01104EHEN4_1406d	EA1104FRMEHEN2015	50	60.238	110.983
EA01104EHEN4_1406d	EA1104FRMEHEN2015	75	60.397	121.057
EA01104EHEN4_1406d	EA1104FRMEHEN2015	100	60.435	126.415
EA01104EHEN4_1406d	EA1104FRMEHEN2015	100+CC	60.562	144.742
EA01104EHEN4_1406d	EA1104FRMEHEN2015	200	60.549	140.363
EA01104EHEN4_1406d	EA1104FRMEHEN2015	1000	61.039	194.063
EA01104EHEN4_1406u	EA1104FRMEHEN2015	10	59.09	86.039
EA01104EHEN4_1406u	EA1104FRMEHEN2015	25	60.115	101.387
EA01104EHEN4_1406u	EA1104FRMEHEN2015	50	60.238	110.983

EA01104EHEN4_1406u	EA1104FRMEHEN2015	75	60.367	121.057
EA01104EHEN4_1406u	EA1104FRMEHEN2015	100	60.435	126.415
EA01104EHEN4_1406u	EA1104FRMEHEN2015	100+CC	60.562	144.742
EA01104EHEN4_1406u	EA1104FRMEHEN2015	200	60.549	140.363
EA01104EHEN4_1406u	EA1104FRMEHEN2015	1000	60.998	194.063
EA01104EHEN4_1299u	EA1104FRMEHEN2015	10	59.39	86.067
EA01104EHEN4_1299u	EA1104FRMEHEN2015	25	59.547	101.558
EA01104EHEN4_1299u	EA1104FRMEHEN2015	50	59.634	111.404
EA01104EHEN4_1299u	EA1104FRMEHEN2015	75	59.725	121.991
EA01104EHEN4_1299u	EA1104FRMEHEN2015	100	59.767	127.705
EA01104EHEN4_1299u	EA1104FRMEHEN2015	100+CC	59.881	1146.854
EA01104EHEN4_1299u	EA1104FRMEHEN2015	200	59.854	142.423
EA01104EHEN4_1299u	EA1104FRMEHEN2015	1000	60.162	201.548
EA01104EHEN4_1206u	EA1104FRMEHEN2015	10	58.833	86.088
EA01104EHEN4_1206u	EA1104FRMEHEN2015	25	58.937	101.308
EA01104EHEN4_1206u	EA1104FRMEHEN2015	50	58.989	110.761
EA01104EHEN4_1206u	EA1104FRMEHEN2015	75	59.039	120.695
EA01104EHEN4_1206u	EA1104FRMEHEN2015	100	59.059	126.069
EA01104EHEN4_1206u	EA1104FRMEHEN2015	100+CC	59.088	144.551
EA01104EHEN4_1206u	EA1104FRMEHEN2015	200	59.08	140.338
EA01104EHEN4_1206u	EA1104FRMEHEN2015	1000	59.218	195.285
EA01104EHEN4_1206d	EA1104FRMEHEN2015	10	58.833	86.088
EA01104EHEN4_1206d	EA1104FRMEHEN2015	25	58.937	101.308
EA01104EHEN4_1206d	EA1104FRMEHEN2015	50	58.989	110.761
EA01104EHEN4_1206d	EA1104FRMEHEN2015	75	59.039	120.695
EA01104EHEN4_1206d	EA1104FRMEHEN2015	100	59.059	126.069
EA01104EHEN4_1206d	EA1104FRMEHEN2015	100+CC	59.088	144.551
EA01104EHEN4_1206d	EA1104FRMEHEN2015	200	59.08	140.338
EA01104EHEN4_1206d	EA1104FRMEHEN2015	1000	59.218	195.285



Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Environment Agency

Historic Flood Map: Cleator Mills, Cleator, CA23 3DU

Produced: 09 July 2019
Our Ref: CL132929
NGR: 301,526 513,720

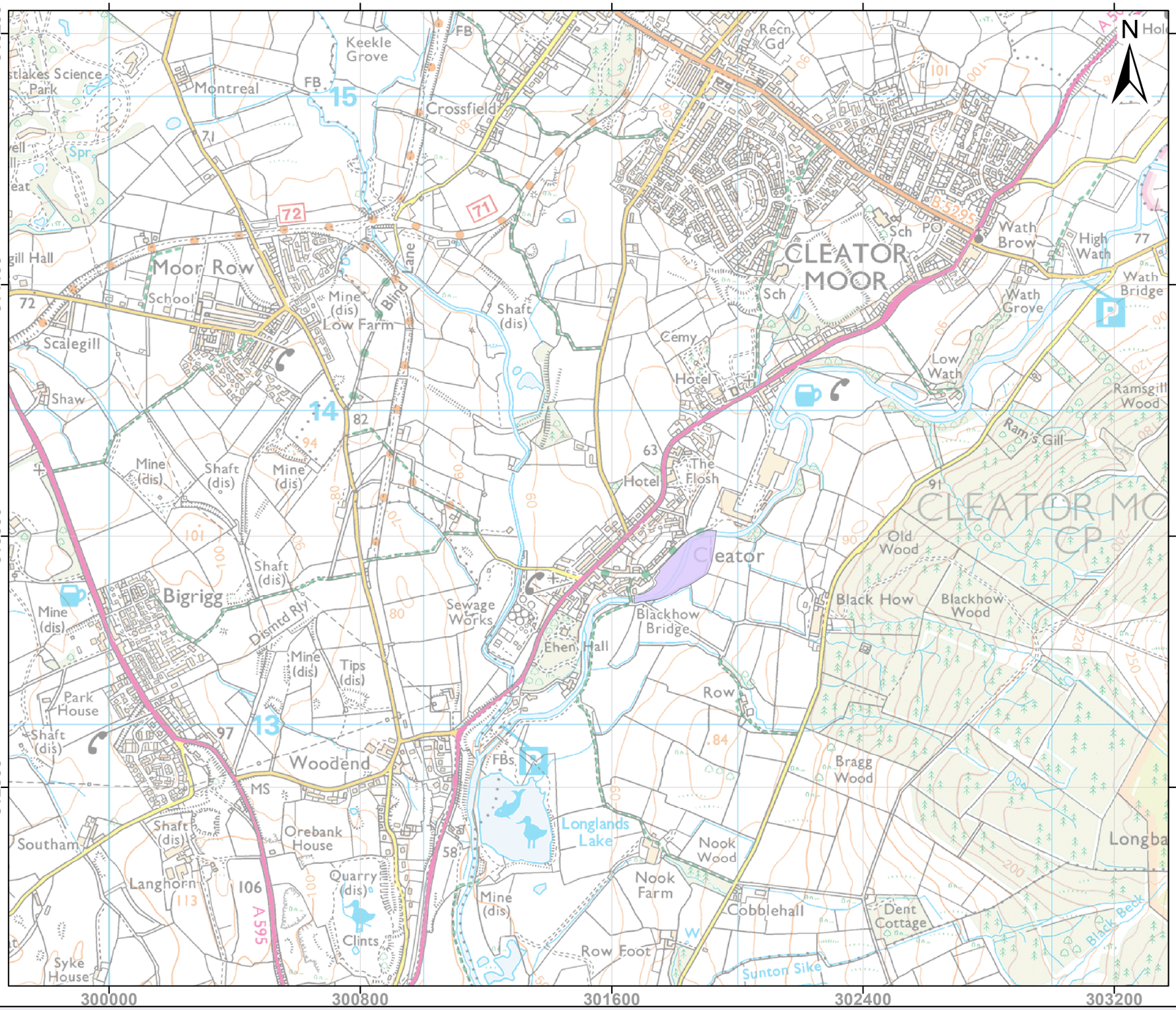
Key

November 2009 Recorded Flood Outline

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Environment Agency

Historic Flood Map: Cleator Mills, Cleator, CA23 3DU

Produced: 09 July 2019
Our Ref: CL132929
NGR: 301,526 513,720

Key

October 2017 Recorded Flood Outline

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.

Appendix I Topographical Survey

Edmondson Surveys Ltd
Suite 8, Cumbria House, Gilwilly Road
Penrith, Cumbria. CA11 9FF
Telephone Number: 01768 861814
www.edmondsonsurveys.co.uk
e-mail: survey@edmondsonsurveys.co.uk

File	E2532\Kang500	Client	Site Scan Ltd
Note	All levels and the plan grid are in metres and are both relative to the Ordnance Survey.	Project	Former Kangol Factory Site Cleator, West Cumbria
		Description	Topographic Survey
		Surveyed	04–08/11/2010
		Drawing Number	E2532/01/A
		Plotted	09–10/11/2010
		Scale	1:500

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KEY

LINETYPES

- VERGE
- FENCE - CHAIN LINK
- FENCE - METAL
- FENCE - WOODEN
- FENCE - POST & RAIL
- HEDGE
- WALL
- BARRIER
- CHANNEL LINE
- CONCRETE EDGE
- FOOTPATH
- TRACK
- BUILDING
- TREE
- GATE
- SURVEY STATION
- EAVES

UTILITY KEY

LINETYPES

- BT BELOW GROUND
- BT ABOVE GROUND
- BT ASSUMED ROUTE
- CATV BELOW GROUND
- CATV ABOVE GROUND
- CATV ASSUMED ROUTE
- COMMS BELOW GROUND
- COMMS ABOVE GROUND
- COMMS ASSUMED ROUTE
- GAS BELOW GROUND
- GAS ABOVE GROUND
- GAS ASSUMED ROUTE
- ELECTRIC BELOW GROUND
- ELECTRIC ABOVE GROUND
- ELECTRIC ASSUMED ROUTE
- WATER BELOW GROUND
- WATER ABOVE GROUND
- WATER ASSUMED ROUTE
- UNKNOWN BELOW GROUND
- UNKNOWN ABOVE GROUND
- CPR BELOW GROUND
- COMBINED WATER SEWER
- ASSUMED COMBINED WATER SEWER ROUTE
- FOUL WATER SEWER
- ASSUMED FOUL WATER SEWER ROUTE
- STORM WATER SEWER
- ASSUMED STORM WATER SEWER ROUTE
- REINSTATEMENT SCAR
- SURVEY BOUNDARY

ABBREVIATIONS

(AC)	ASSUMED CONNECTION	INT	INTERCEPTOR
AG	ABOVE GROUND	KV	KILO VOLT
(AR)	ASSUMED ROUTE	LD	LOOP DETECTOR
ASB	ASBESTOS CEMENT	LH	LAMP HOLE
AV	AIR VALVE	LP	LAMP POST
BB	BELISHA BEACON	LV	LOW VOLTAGE
BD	BACK DROP	MK	MARKER
BL	BASE LEVEL	MH	MANHOLE
BO	BOLLARD	MT	METER
BOL	BOLLARD LIGHT	MWELL	MONITORING WELL
BT	BRITISH TELECOM	OH	OVERHEAD
CATV	CABLE TELEVISION	PE	POLYETHYLENE
CB	CONTROL BOX	PTG	PIPE TO GROUND
CI	CAST IRON	PVC	POLYVINYL CHLORIDE
CL	COVER LEVEL	TPR	TAKEN FROM RECORDS
CR	CABLE RISER	RE	RODDING EYE
CWS	COMBINED WATER SEWER	RED	REDUNDANT SERVICE
d	DEPTH OF SERVICE	RWP	RAIN WATER PIPE
DCH	DRAINAGE CHANNEL	SC	STOP COCK
DI	DUCTILE IRON	SI	SPUN IRON
DIS	DISUSED	SOP	SOFFIT
EOT	END OF TRACE	SP	SOIL PIPE
EP	ELECTRIC POLE	SWS	SURFACE WATER SEWER
ER	EARTH ROD	SV	STOP VALVE
FFP	FUEL TANK FILL POINT	TL	TRAFFIC LIGHT
FH	FIRE HYDRANT	TLC	TRAFFIC LIGHT COVER
FWS	FOUL WATER SEWER	TP	TELECOM POLE
GPR	GROUND PENETRATING RADAR	UTL	UNABLE TO LIFT
GR	GAS RISER	UTS	UNABLE TO SURVEY
GV	GAS VALVE	UTT	UNABLE TO TRACE
GY	GULLY	VC	VITRIFIED CLAY
HV	HIGH VOLTAGE	VP	VENT PIPE
IC	INSPECTION COVER	WL	WATER LEVEL
id	INVERT DEPTH	WO	WASH OUT
IL	INVERT LEVEL	WR	WATER RISER

DISCLAIMER

Unless otherwise stated, all services shown on this plan have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to be direct.

No guarantee can be given that all services have been shown.
Is ideal confirms the depth accuracies for the underground utilities located is +/- 10% of depth.

Utilities traced using GPR techniques show depths approximately from ground level to the top of the utility. Utilities traced using Electromagnetic techniques provide an estimated depth which is measured from ground level to the centre of the utility. Drainage and pipes traced using Sonde Electromagnetic techniques show depths at approximately the Invert Level.

Where services are shown as 'Taken From Records' on the drawing we are not liable for any loss that may arise due to a lack of accuracy in that quoted information.

Due to BT's policy we are not permitted to lift their inspection chamber covers.

Reference should be made to the methodology used on site as detailed within the latest version of SiteScan Procedures for Utility Location Surveys.

SiteScan recommend that all excavations are to be carried out in accordance with HSG 47 (Avoiding Danger from Underground Services).

Plan accuracies of the order of + or - 150mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run in close proximity, separation may be impossible. Successful tracing of non-metallic pipes may be limited.

Existing record information showing underground services is often incomplete and of doubtful accuracy. It should be regarded only as an indication and cannot be guaranteed.

NOTES

REV	AMENDMENT	DRAWN	CHECKED

SITESCAN
Vita House, Fish Quay, North Shields, Tyne & Wear, NE30 1JA
www.sitescanltd.com info@sitescanltd.com
Tel: 0191 2572911

CLIENT	RWO
PROJECT TITLE	KANGOL FACTORY CLEATER
DRAWING TITLE	DRAINAGE SURVEY
SCALE AT A1	NTS
DATE	JUN 2013
ORIGINATOR	
SURVEYED BY	JRD
DRAWN BY	JRD
APPROVED	NC
PROJECT No.	CLE/RWO/DRAIN
SHEET No.	1 of 1
REV	A

Appendix J Overland Flow Route

Date	Revisions	Drawn	Checked	Rev
Dwg Status	INFORMATION			

NORTH EAST
0191 2389032

YORKSHIRE
0113 535 3500

CONSULTING ENGINEERS

WWW.RWO.GROUP
INFO@RWO.GROUP

Client
GLEESON HOMES

Project
CLEATOR MILLS

Title
OVERLAND FLOW ROUTE PLAN

DO NOT SCALE	Scale @ A0: 1:250	Drawn AGM	Checked	Date 12.07.2021
Job No 19002		Dwg No SK003		Rev

Appendix K Unnamed Watercourse Modelling

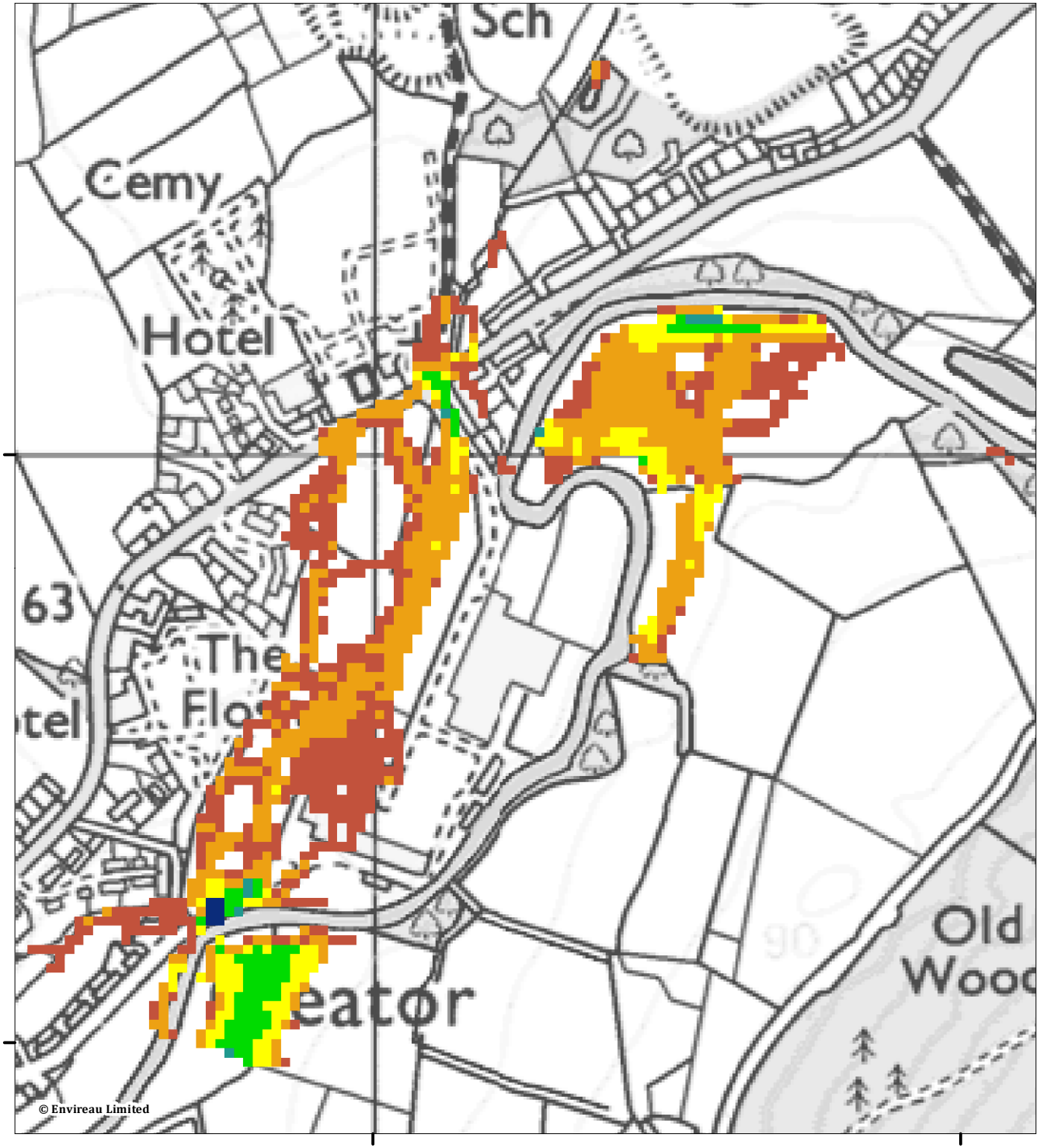

Figure 1: Tributary Flood Velocity 20 year

Cleator Mills

Maximum Velocity (m/s)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- > 1.0

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

31 August 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	20yrV

envireau WATER

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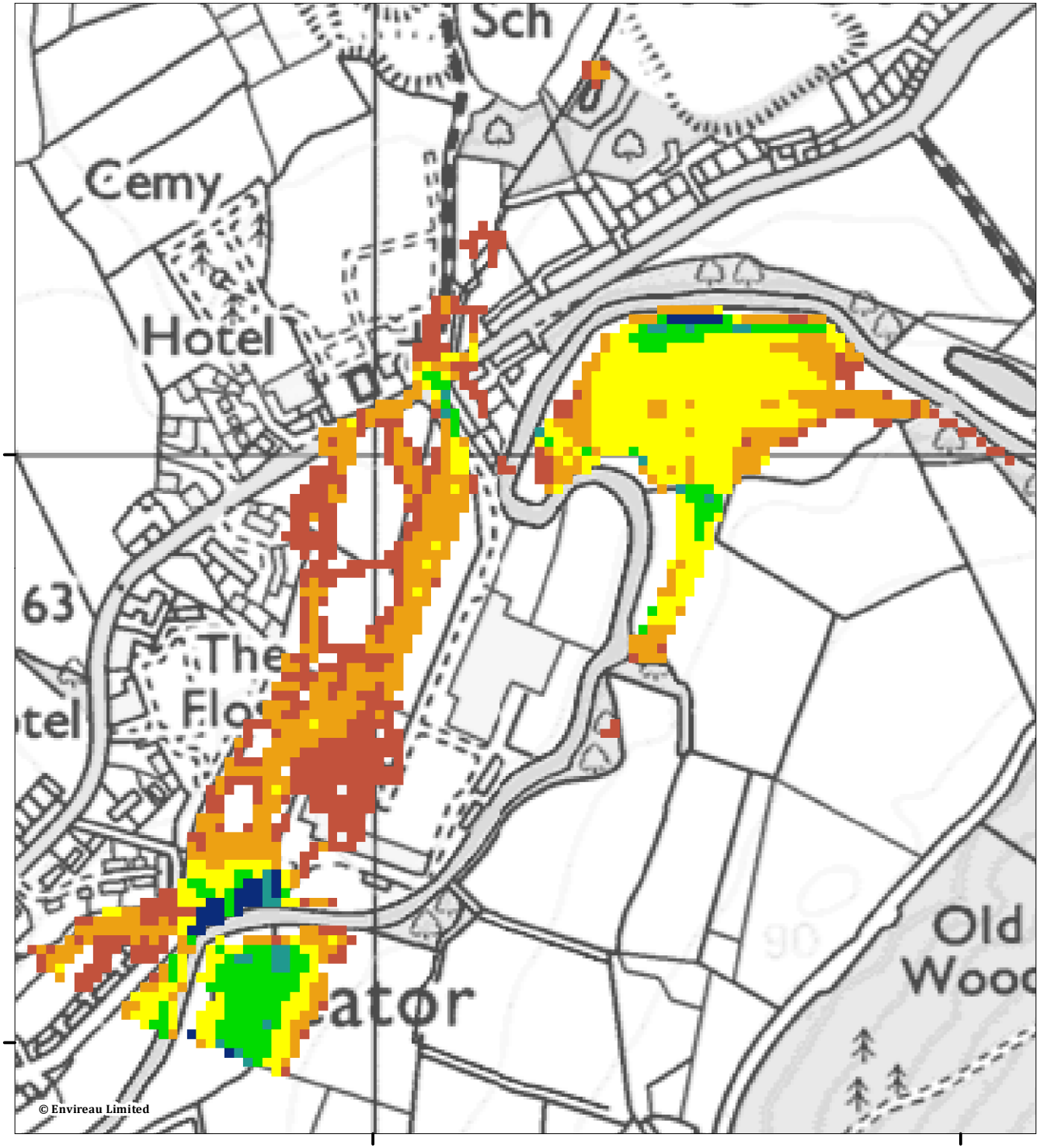

Figure 2: Tributary Flood Velocity 100 year

Cleator Mills

Maximum Velocity (m/s)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- > 1.0

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

31 August 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	100yrV

envireau WATER

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Figure 3: Tributary Flood Velocity 100 year + CC

Cleator Mills

Maximum Velocity (m/s)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- > 1.0

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

31 August 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	100yrCCV

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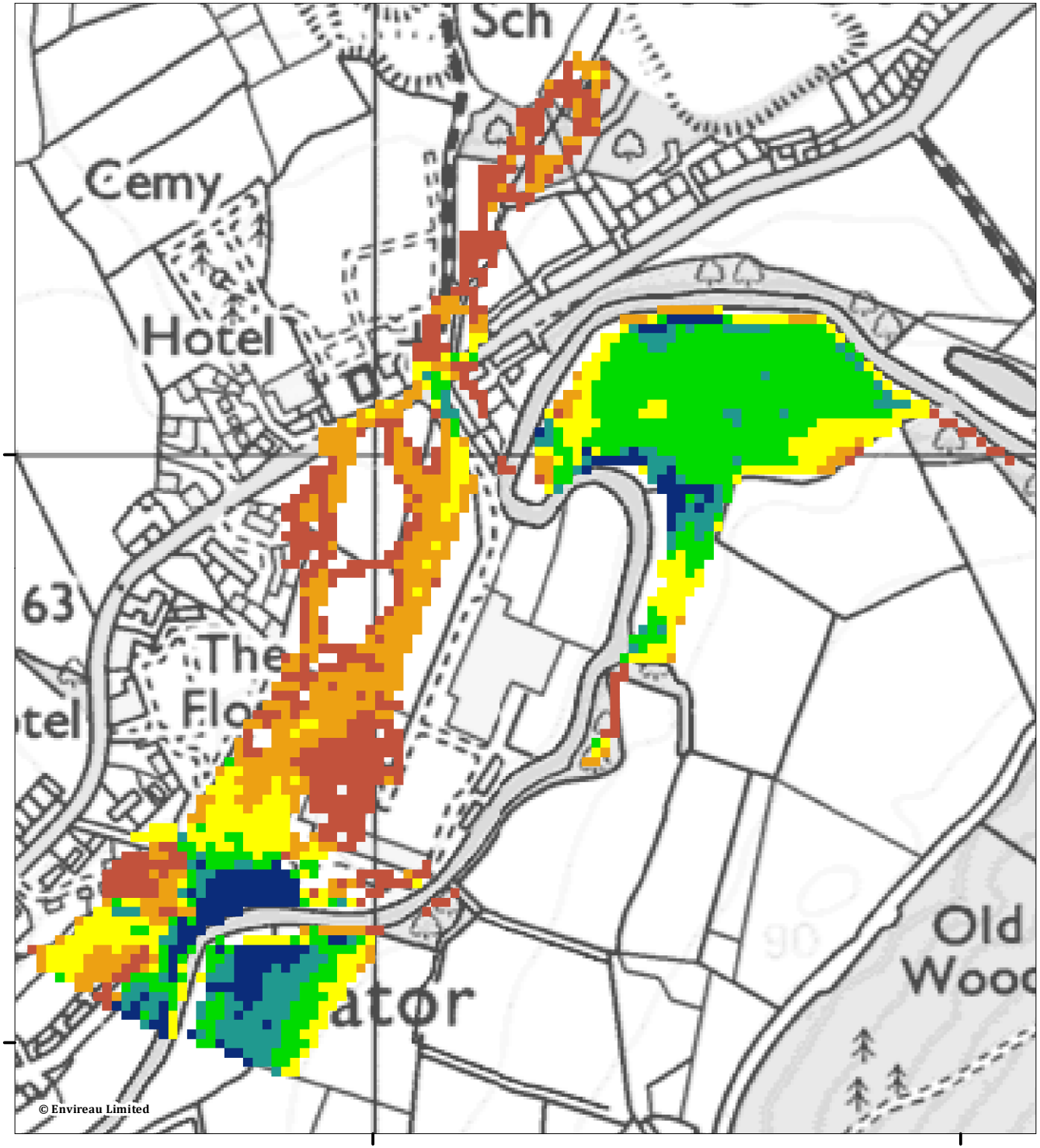

Figure 4: Tributary Flood Velocity 1,000 year

Cleator Mills

Maximum Velocity (m/s)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- > 1.0

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

31 August 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	1000yrV

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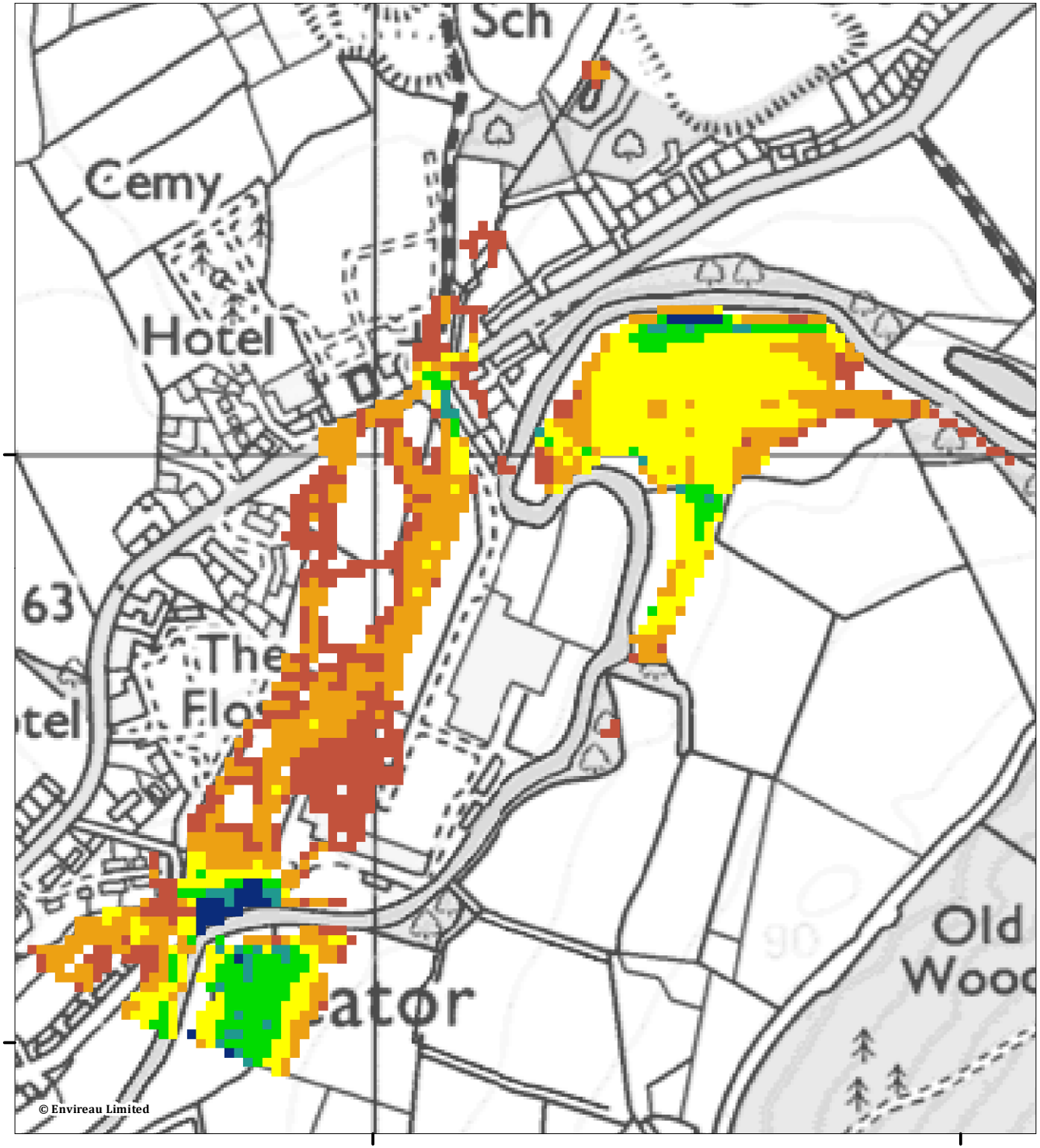

Figure 5: Tributary Flood Velocity 100 year 90% Blockage

Cleator Mills

Maximum Velocity (m/s)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- > 1.0

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

31 August 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	100yr90%BlockedV

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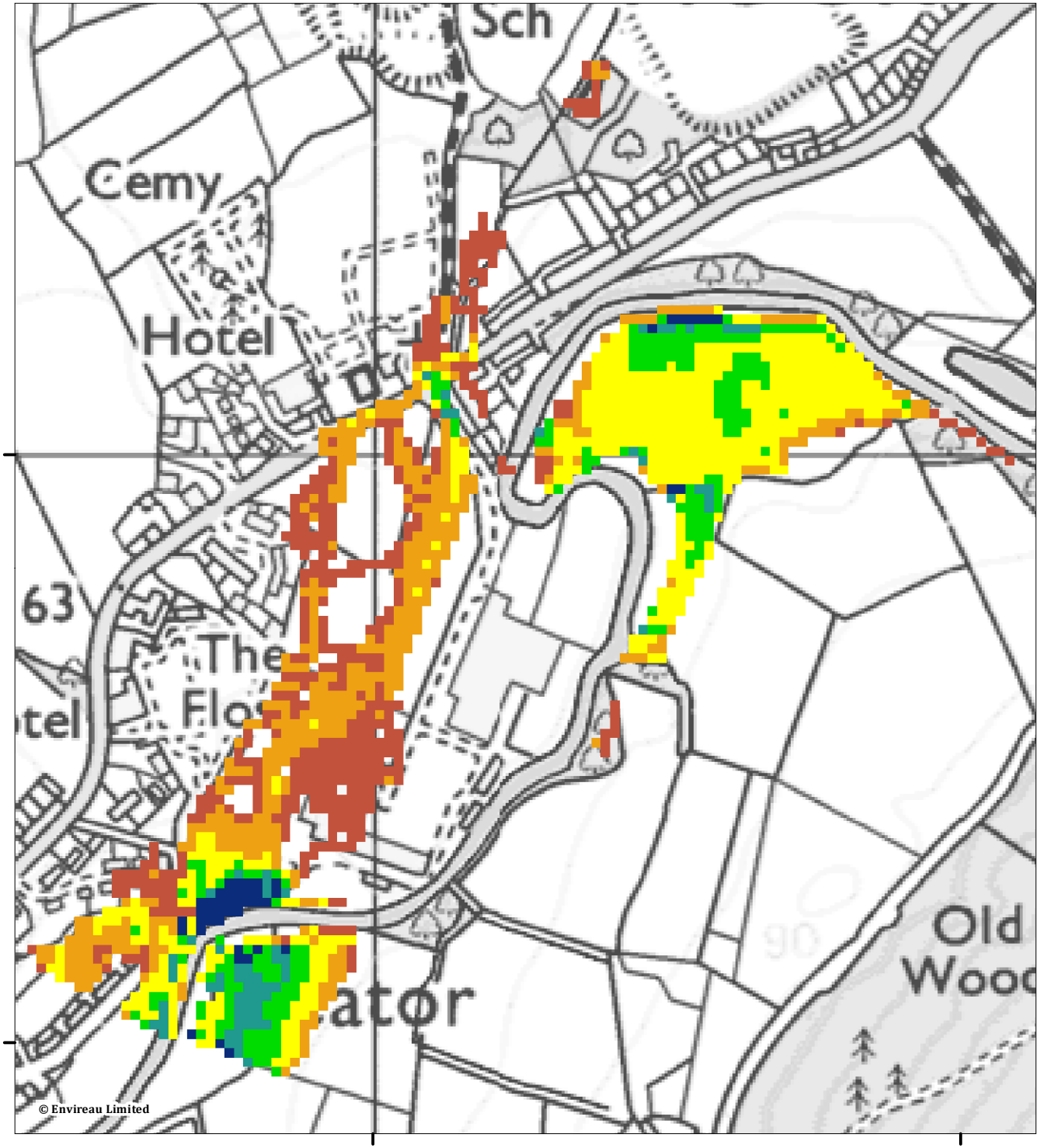

Figure 5: Tributary Flood Velocity 100 year + CC 90% Blockage

Cleator Mills

Maximum Velocity (m/s)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0
- > 1.0

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

31 August 2022

NGR: 302,130 E / 513,903 N

Project No. P21-281

Client: RWO Assocaites

Drawn by: RH

Ref: 100yrCC90%BlockedV

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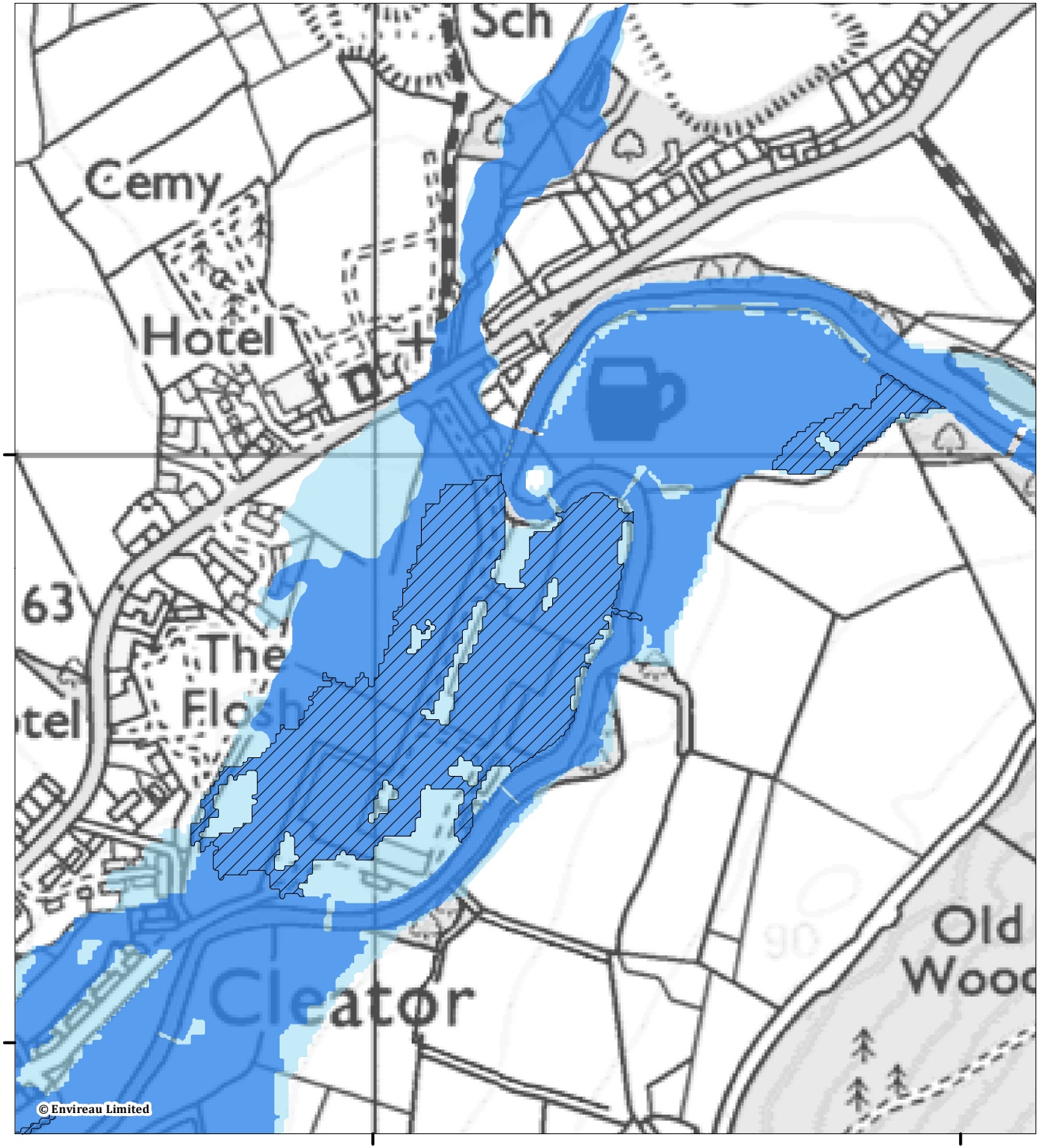

Figure 1: Environment Agency Mapped Flood Risk

Cleator Mills

- Areas Benefiting from Flood Defences
- Environment Agency Flood Zone 3
- Environment Agency Flood Zone 2

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

30 June 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	EAFloodRisk

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Trumpet Terrace
Jackson Road
Main Street
A5086
Acorn Barn
Kynpol
Cheese Cafe
Cross Cottage
Community Park
Millennium Green
187 m
500 ft
© OpenStreetMap contributors

Figure 2: Tributary Flood Risk 20 year

Cleator Mills

Maximum Flood Depth (m)

- 0.01 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.18

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

30 June 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	20yr

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Figure 3: Tributary Flood Risk 100 year

Cleator Mills

Maximum Flood Depth (m)

- 0.01 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.18

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

30 June 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	100yr

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Figure 4: Tributary Flood Risk 100 year plus CC

Cleator Mills

Maximum Flood Depth (m)

- 0.01 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.18

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

30 June 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	100yrCC

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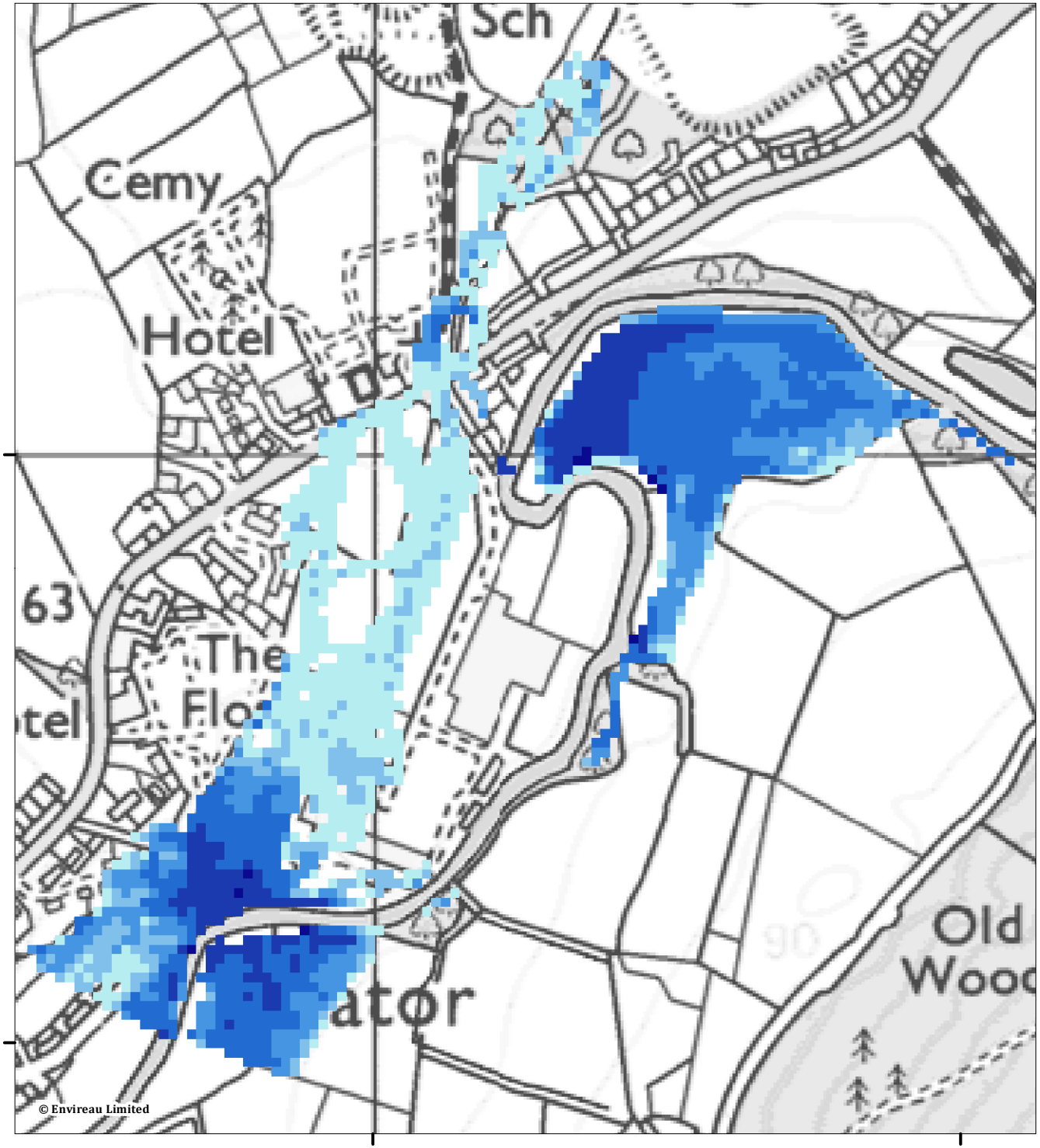

Figure 5: Tributary Flood Risk 1,000 year

Cleator Mills

Maximum Flood Depth (m)

- 0.01 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.18

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

30 June 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	1000yr

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Figure 6: Tributary Flood Risk 100 year 90% Blocked

Cleator Mills

Maximum Flood Depth (m)

- 0.01 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.18

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

30 June 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	100yr90%blocked

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Figure 7: Tributary Flood Risk 100 year plus CC 90% Blocked

Cleator Mills

Maximum Flood Depth (m)

- 0.01 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.18

Notes:

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0 50 100 150 200 Meters

Scale: 1:5,000 at A4

30 June 2022

NGR: 302,130 E / 513,903 N

Project No.	P21-281
Client:	RWO Assocaites
Drawn by:	RH
Ref:	100yrCC90%blocked

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Appendix L Unnamed Watercourse Flow Routes

HEALTH & SAFETY:

1. CONTRACTOR SHOULD BE AWARE OF GENERAL CONSTRUCTION RISKS TO PREVENT SLIPS, TRIPS AND FALLS AND TAKE NECESSARY PRECAUTIONS WITHOUT SPECIAL INSTRUCTION

ROADS & DRAINAGE

2. CONTRACTOR TO PROVIDE TRENCH SUPPORTS AS APPROPRIATE AND ENSURE THAT PLANT REMAINS A SAFE DISTANCE FROM TRENCHES PRIOR TO INSTALLING DRAINAGE
3. THE LENGTH OF EXCAVATION OPEN IN SITE SHOULD BE KEPT TO A MINIMUM AND ALL TRENCHES SHALL BE FENCED OFF OR HAVE A BARRIER.
4. CONNECTIONS TO EXISTING SEWERS TO BE MADE BY APPROVED CONTRACTOR ONLY.
5. CONTRACTOR TO MAKE OPERATIVES AWARE OF ASSOCIATED DANGERS TO HEALTH SUCH AS LEPTOSPIROSIS (WEILS DISEASE) AND RECOMMENDED PRECAUTIONS. ADEQUATE WELFARE FACILITIES AND PROTECTIVE CLOTHING TO BE PROVIDED AS REQUIRED.
6. UNFINISHED MANHOLES MUST BE COVERED WITH LOAD BEARING MATERIALS AND SURROUNDED WITH BARRIER.

PIPES & CABLES

7. CONTRACTOR TO OBTAIN ALL SERVICE RECORDS PRIOR TO WORKS COMMENCING.
8. SERVICE RECORDS TO BE REFERRED TO PRIOR TO WORK COMMENCING. CONTRACTOR TO PROCEED WITH CAUTION AND SERVICES TO BE LOCATED BY HAND DIG AND PROTECTED ACCORDINGLY.

EXCAVATIONPITS:

9. CONTRACTOR TO ENSURE RELEVANT MEASURES ARE TAKEN TO KEEP PLANT AND PEOPLE A SAFE DISTANCE FROM STEEP SLOPES DURING THE WORKS.
10. CONTRACTOR TO ENSURE THAT PROCEDURES ARE IN PLACE TO KEEP PEOPLE A SAFE DISTANCE FROM WORKING PLANT WHERE NECESSARY.
11. CONTRACTOR TO REFER TO GROUND INVESTIGATION REPORT FOR CONTAMINATION TESTS AND TO PROVIDE ADEQUATE WELFARE FACILITIES AND PROTECTIVE CLOTHING AS REQUIRED.

EXISTING UU COMBINED SEWER TO REMAIN, EXACT LOCATION, PIPE DIAMETER AND DEPTHS TO BE CONFIRMED PRIOR TO ANY WORKS COMMENCING. EXACT EASEMENTS TO BE CONFIRMED WITH UU

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PROPOSED CONNECTION INTO EXISTING UU SEWER SUBJECT TO APPROVAL, INVERT LEVELS AND EXACT LOCATION TO BE CONFIRMED ON SITE PRIOR TO WORKS COMMENCING

KEY

FLOOD ROUTE DIRECTIONS BASED UPON ANY FLOODING AS IDENTIFIED WITHIN THE DRAINAGE MODELING FLOODING CAUSED BY ANY BLOCKAGES IN THE SYSTEM TO BE SORTED WITHIN THE ADOPTABLE HIGHWAY

SUBJECT TO LOCAL AUTHORITY APPROVAL

01.09.2022	FIRST ISSUE		AD	RO	1
Date	Revisions		Drawn	Checked	Rev

Dwg Status: FIRST ISSUE

NORTH EAST 0191 2680620

YORKSHIRE 0113 535 3500

RWO CONSULTING ENGINEERS

WWW.RWO.GROUP INFO@RWO.GROUP

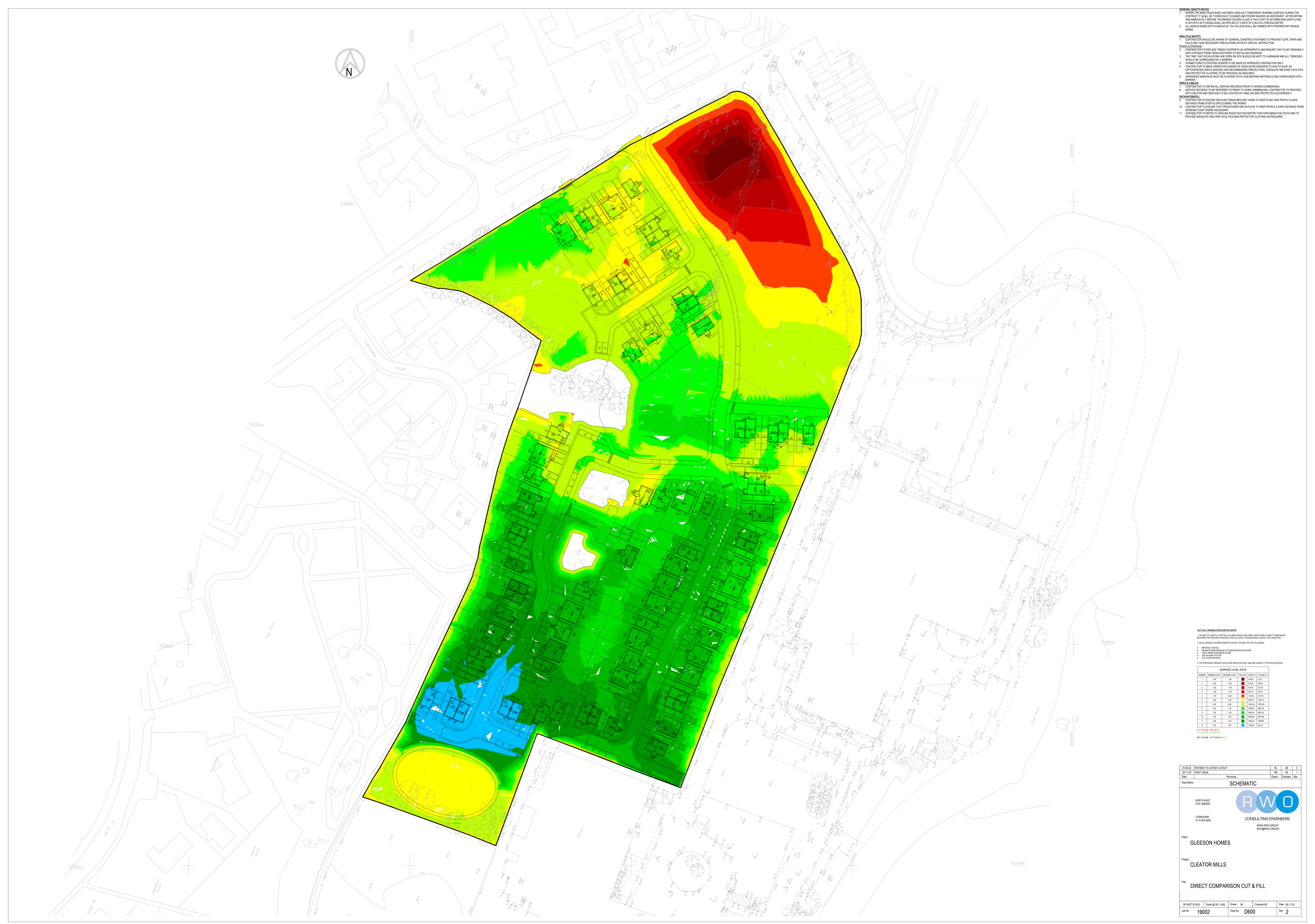
Client: GLEESON HOMES

Project: CLEATOR MILLS

Title: FLOOD ROUTING FROM THE UNNAMED WATERCOURSE

DO NOT SCALE	Scale @ A0: 1:500	Drawn AD	Checked RO	Date 01.09.2022	
Job No 19002	Dwg No D202			Rev 1	

Appendix M Ground Raising Comparison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