

**Land at Bilsham PV,
West Sussex
Flood Risk Assessment**

On behalf of BNRG Renewables Ltd.

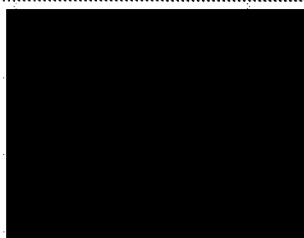


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For and on behalf of Peter Brett Associates LLP				

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1 Executive Summary

1.1 General

- 1.1.1 BNRG Renewables Ltd is proposing to construct a new photovoltaic park on Greenfield land at Bilsham Farm, to the north of Bognor Regis, West Sussex. The site is situated to the north of the A259 and is entirely enclosed by Greenfield and small country lanes. The nearest development is the village of Yapton to the north east.
- 1.1.2 This report considers the policy requirements for the proposed PV park as defined in the National Planning Policy Framework (NPPF).
- 1.1.3 Consultation with the Environment Agency (EA) and a review of the Arun District Council Strategic Flood Risk Assessment (SFRA) has formed the basis of the appraisal of flood risk at the site.
- 1.1.4 The classification of Flood Zones ignores the presence of existing flood defences, and as such, the parts of the site at Bilsham Farm are located in Flood Zone 3 – ‘High Probability’; the probability of flooding is greater than 1% annual probability (1 in 100 years) with the remainder lying within Flood Zones 1 and 2.
- 1.1.5 The proposed site is considered to fall under the definition of “essential infrastructure” as defined in Table 2 of the Technical Guidance to the NPPF.
- 1.1.6 As defined in Table 3 of the Technical Guidance to the NPPF, development classified as ‘Essential Infrastructure’ is compatible within Flood Zones 3a and 3b subject to the requirements of the Sequential Test and the Exception Test being met.
- 1.1.7 Analysis of potentially available land and the Sequential Test has been addressed by others, separate to this Flood Risk Assessment.
- 1.1.8 This report demonstrates that the requirements of the Exception Test as laid out in the NPPF are met.
- 1.1.9 The most significant actual risk to the site (the risk taking account of existing defences) is from fluvial flooding. The principal residual risk to the site (the risk ignoring the presence of existing defences) is from tidal flooding. The site benefits from extensive coastal defences but no fluvial flood defences.
- 1.1.10 As mitigation against flood risk at the site, the vast majority of the infrastructure will be located within Flood Zone 1 or otherwise raised at least 150mm above the predicted 1 in 200 year (0.5% AEP) undefended tidal flood level of 2.79mAOD. This is a conservative approach; as the site benefits from extensive coastal defences such a flooding event is extremely unlikely.
- 1.1.11 Some of the panels will be located in Flood Zones 2 and 3. Panels which are located within the predicted fluvial flooding zone (as defined by the 1 in 1000 year event) will be situated so the trailing edge is at a minimum of 1.4mAOD, significantly above the predicted 1 in 1000 (0.1% AEP) flood level of 1.23mAOD. The connections for panels in these areas will be located in the centre of two adjoining panels at a minimum level of 1.8mAOD.
- 1.1.12 The existing surface water regime will not be affected by the proposed development which will continue to drain naturally at existing rates.
- 1.1.13 Access and egress to the site during extreme flood events will not be precluded. Site personnel will receive EA flood warnings to allow planning of maintenance work to avoid putting themselves at risk.

2 Introduction

2.1 General

- 2.1.1 Government policy with respect to development in flood risk areas is contained within the National Planning Policy Framework (NPPF) and the Technical Guidance to the NPPF, both published in March 2012 by the Department for Communities and Local Government (DCLG).
- 2.1.2 The NPPF and the Technical Guidance replace Planning Policy Statement 25 (PPS25) 'Development and Flood Risk' along with the PPS25 Practice Guide. However, the Technical Guidance to the NPPF retains key elements of PPS25 as "an interim measure pending a wider review of guidance to support planning policy".
- 2.1.3 The Local Planning Authority will make decisions with regard to any planning application within any floodplain or flood risk area. The Environment Agency (EA) is a designated statutory consultee and plays a key role in providing advice on development and flood risk issues.
- 2.1.4 Peter Brett Associates LLP (PBA) has prepared this study in accordance with the NPPF and the Technical Guidance. PBA has many years of experience in, amongst other areas, the assessment of flood risk, hydrology, flood defence and river engineering.
- 2.1.5 PBA has been one of the EA's National Framework Consultants for flood risk mapping, Term Consultant to the South West Region of the Agency and has provided engineering services through the NEECA2 Framework Agreement. PBA has been involved in the assessment of both tidal and fluvial flooding and the design and implementation of flood defences on behalf of the Agency as well as undertaking numerous Flood Risk Assessments to support planning application submissions.
- 2.1.6 This flood risk assessment has been prepared in accordance with the NPPF and Local Planning Policy.
- 2.1.7 However, it should be noted that the insurance market applies its own tests to properties in terms of determining premiums and the insurability of properties for flood risk. Those undertaking development in areas which may be at risk of flooding are advised to contact their insurers or the Association of British Insurers (ABI) to seek further guidance prior to commencing development.
- 2.1.8 PBA do not warrant that the advice in this report will guarantee the availability of flood insurance either now or in the future.

3 Proposed Development Site

3.1 Site Location

- 3.1.1 The proposed site forms part of Bilsham Farm, located east of the village of Bilsham, West Sussex. The site is enclosed by greenfield land and is situated south of the B223 (Barnham Road), the B2132 lies to the east and the village of Flansham lies to the south. The site is approximately 3.0km as the crow flies from the south east coast of England (National Grid Reference SU 96172 02490).
- 3.1.2 The site comprises 5 fields totalling approximately 36 hectares of arable land. The site is bordered by a number of field ditches and watercourses, locally referred to as Ryfes. The Ryebank Rife to the southwest drains east and eventually joins the River Arun at Littlehampton. It is also connected to a minor watercourse which discharges to the sea at Middleton-on-Sea. The Yapton Rife to the northwest runs southwest before it splits into the Ryebank Rife and the Lidsey Rife. The Lidsey Rife then runs through Bognor Regis and into the sea.
- 3.1.3 A location plan is provided in Appendix A.

3.2 Development Proposals

- 3.2.1 BNRG Renewables Ltd is seeking planning permission for a Photovoltaic (PV) Park for solar energy generation. The proposals include:
- Arrays of PV panels
 - Inverter huts
 - Transformer substation
 - Access tracks
- 3.2.2 Once operational, the park will have no permanent manned presence. Monitoring will be carried out remotely and only occasional visits for maintenance will be required.
- 3.2.3 The photograph below provides an example of how the arrays of PV panels will be arranged.



Figure 1: Photograph depicting the probable arrangement of the PV panels

A plan showing the proposed development is located in Appendix A.

3.3 Existing Site Levels

- 3.3.1 Levels across the site vary between 0.6mAOD at the western corner to 4.6mAOD in the eastern corner. The site gently slopes away from the highpoint in the eastern part of the site to the low-lying and relatively flat areas at the southwestern and northwestern edges.
- 3.3.2 Topographical survey information is presented in Figure 2, Appendix A.

3.4 Existing Site Surface Water Drainage

- 3.4.1 As a consequence of the topography, the site generally drains in a westerly direction. Within the site there are four drains which discharge to the Yapton and Ryebank Rifes on the site's northwestern and southwestern boundaries respectively. Surface water generated on site will flow into these Rifes, either directly or via the site drains.
- 3.4.2 Some surface water may naturally collect in the overgrown pits in the northwestern corner of the site.
- 3.4.3 The Yapton Rife and site drains form part of an extensive drainage network which is connected to the sea via the River Arun, the Lidsey Rife and the Ryebank Rife.

4 Assessment of Flood Risk

4.1 Sources of Data

- 4.1.1 This Chapter is based on information provided through consultation with the EA and from review of the Arun District Council SFRA.

4.2 Flood Zone

- 4.2.1 As defined in the information provided by the EA (reproduced in Appendix A), parts of the site is within Flood Zone 3 as defined in Table 1 in the Technical Guidance to the NPPF. It should be noted that the Flood Zone definitions ignore the presence of existing defences.

4.3 Existing Defences

- 4.3.1 The coastline of Bognor Regis and Middleton-on-Sea benefits from extensive tidal defences, including a series of breakwaters and groynes. From the Ryebank Rife to the Arun, tidal flood defence comprises shingle ridge with low walls at Poole Place to Atherington, and the Shingle Ridge beach at Atherington to Littlehampton Harbour. The standard of protection provided by these defences is typically in the region of 1 in 100 year (1% annual exceedance probability), with crest levels generally ranging from 4.6m to 5.3m AOD.
- 4.3.2 From the Aldingbourne Rife to the Ryebank Rife tidal flood protection comprises a pumping station and flapped outfall from the Aldingbourne Rife. At Elmer, an offshore rubble mound acts as a wave energy screen. There is also active beach recharge at Elmer. The estimated standard of protection in this region is 1 in 200 year (0.5% AEP).
- 4.3.3 The proposed PV site lies approximately 3.0km inland from the southern shoreline as the crow flies.
- 4.3.4 The site does not benefit from the presence of fluvial flood defences.

4.4 Tidal Flooding

- 4.4.1 Tidal flooding extents and levels have been provided by the EA (reproduced in Appendix A). These had been derived using TUFLOW in 2009 and include tidal TUFLOW extents for the 1 in 20 year event to 1 in 1000 year flood extents (ignoring the presence of existing defences).
- 4.4.2 The maximum predicted 1 in 200 year (0.5% AEP) tidal flood level in the vicinity of the site is 2.79mAOD. Modelled 1 in 1000 year tidal flood extents were also supplied, with the maximum predicted level being 3.07mAOD. Consequently, in the absence of existing defences, during an extreme tidal event, areas of the site would be subjected to significant flood depths. However, not all of the site would be flooded; the eastern part of the site would remain flood free.
- 4.4.3 The Arun District Council SFRA presents the results of modelled tidal flood events taking account of existing defences. For the 1 in 200 year (0.5% AEP) event, including an allowance for sea level rise to 2106, there is no predicted flooding in the vicinity of the site. Therefore, the actual tidal flooding risk (the risk with defences in place) is assessed as being negligible.

Wave Action

- 4.4.4 In the case whereby wave overtopping or breaching of the existing flood defences occurs, wave action may cause damage, particularly to those areas immediately and close behind the

defence. The proposed development is approximately 3.0km from the coast and consequently wave energy will dissipate before reaching the site.

Future Sea Level Rise

- 4.4.5 Table 4 of the *Technical Guidance to the NPPF* provides recommended contingency allowances for net sea level rise. Using these allowances, the predicted sea level between 2008 and 2040 rise (over the 25 year lifetime of the development) is 196mm in the south east of England. Assuming that this increase in peak tidal level directly translates to an equivalent in inland tidal floodwater levels, the 1 in 200 year tidal flood level at Bilsham in 2040 would be 2.99m AOD. This is assuming that no defences are in place. The actual tidal flood extents for the future (2106) 1 in 200 year (0.5% AEP) event, according to the information provided in the SFRA, do not affect the site or any access routes.

4.5 Fluvial Flooding

- 4.5.1 Fluvial flooding extents and levels have been provided by the EA. These were derived using JFLOW in 2009 and include fluvial extents for the 1 in 100 year (1% AEP) and 1 in 1000 year (0.1% AEP) events. The maximum predicted 1 in 1000 year flood level (0.1% AEP) in the vicinity of the site is 1.23m AOD.
- 4.5.2 As the site is not protected by fluvial defences, the flooding presented in the EA model outputs map are not dependent upon failure of defences and represent the actual risk. It is presumed that the information does not take account of predicted future increases in fluvial flows. As there are no standard recommendations for uplifts in flood levels, the potential for increased fluvial flood levels will be accounted for by applying a 150mm freeboard allowance.
- 4.5.3 The SFRA also presents flood outlines for predicted fluvial flooding. There are no reported flood levels. Given that the report was produced in 2008, the 2009 model outputs provided by the EA are considered to be more accurate and hence form the basis of this assessment in terms of fluvial flood risk.

4.6 Groundwater Flooding

- 4.6.1 The SFRA presents a high level assessment of groundwater flooding (Map G1). The PV site is shown as being within a high risk area for groundwater flooding and also as being within a groundwater emergence area.

4.7 Surface Water Flooding

- 4.7.1 The risk to the site from surface water is considered to be negligible. Due to the fairly flat nature of the topography and the extensive drainage network in the surrounding area, the site will not receive significant amounts of surface water from outside the site.

4.8 Historic Records of Flooding

- 4.8.1 Map H in the Arun District Council SFRA shows there are no records of flooding within the vicinity of the site. The EA have not provided any record of flooding within the vicinity of the site.

4.9 Summary

- 4.9.1 The most significant actual risk (the risk taking account of existing defences) is from fluvial flooding. As the site does not benefit from any fluvial flood defences, the actual risk (risk taking account of defences) of fluvial flooding, is as presented in the information provided by the EA (reproduced in Appendix A).

- 4.9.2 The most significant residual risk (the risk ignoring the presence of existing defences) at the site as defined by the information reviewed is from tidal flooding. The levels provided by the EA (reproduced in Appendix A) are the most accurate levels available and have been used to define the mitigation measures. The actual risk of tidal flooding, as presented in the Arun District Council SFRA, is assessed as being negligible.
- 4.9.3 The risk to the site from surface water is considered to be negligible. Surface water generated on site will not be obstructed by development proposals and the site topography will prevent water ponding to any significant depth in areas where PV panels and associated infrastructure will be placed. The techniques for mitigating tidal and fluvial flooding will also address these minor risks.
- 4.9.4 The site is shown as being in an area of high risk of groundwater flooding. Groundwater flooding is generally shallow in nature and consequently will not be a significant issue for the same reasons as stated above with regards to surface water flooding.
- 4.9.5 No other sources of flooding (e.g. reservoirs) have been identified.

5 Managing Flood Risk

5.1 Requirements under NPPF

Vulnerability

- 5.1.1 The criteria for a development's acceptability with respect to flood risk are set out in the National Planning Policy Framework and accompanying guidance. Instrumental in defining the requirements is the vulnerability of the proposed development.
- 5.1.2 Flood risk vulnerability classifications are provided in the Technical Guidance to the NPPF, Table 2. proposed development classed as 'Essential Infrastructure' is compatible within Flood Zones 3a and 3b subject to the requirements of the Sequential Test and the Exception Test being met.

The Sequential Test

- 5.1.3 The NPPF requires that all Local Planning Authorities, in allocating land for development, should apply the Sequential Test to demonstrate that there is no other land available for the proposed development that has less probability of flooding.
- 5.1.4 Analysis of potentially available land and the Sequential Test has been addressed by others, separate to this Flood Risk Assessment.

The Exception Test

- 5.1.5 For the exception test to be passed, the following must be demonstrated:
- The development provides wider sustainability benefits to the community that outweigh the flood risk.
 - That the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
- 5.1.6 For the first requirement, the sustainable benefits of solar energy are very clear. The development will help reduce the UK's dependence on fossil energy sources and will contribute to a more sustainable future delivering environmental objectives which are integral to both local and national policy.
- 5.1.7 The second requirement is demonstrated in this Flood Risk Assessment.

5.2 Mitigation Measures

- 5.2.1 As noted earlier, the designation of Flood Zones ignores the presence of existing defences. This reflects the conservative principles of the NPPF and recognises the residual risk for low-lying land situated behind flood defences. For the site at Bilsham, the residual risks include:
- Overtopping of defences in extreme tide events.
 - Breaching of defences.
- 5.2.2 For the tidal 1 in 200 year (0.5% AEP) extreme flood event, the highest flood water level shown on the site as part of the EA's Tidal TUFLOW model is 2.79m AOD. Adjustment of this level to account for predicted sea level rise to 2040 yields a level of 2.99mAOD.

- 5.2.3 The topographic survey defines existing levels around this part of the site range between 0.8m AOD and 1.1m AOD, indicating that maximum flood depths during such an event would be 2.2m. However, it should be noted that with the existing defences in place the SFRA shows no flooding at the site during the 1 in 200 year (0.5% AEP) event, including an allowance for sea level rise to 2106.
- 5.2.4 The peak fluvial flood water level for the 1 in 1000 year event is 1.23mAOD and it is proposed to allow a minimum of 150mm freeboard to account for uncertainty and the effects of climate change up to 2040.
- 5.2.5 To protect the PV equipment and preserve the operation of the development during such an event, the following mitigation measures are proposed:
- The substation will be located in Flood Zone 1 on a development platform at least 150mm above existing ground levels.
 - Inverter huts will be located outside of the 1 in 200 year (0.5% AEP) undefended tidal outline, or otherwise raised at least 150mm above the predicted flood level of 2.79mAOD.
 - Solar panels within the area identified as being at risk from a 1 in 1000 year (0.1% AEP) fluvial flood will be elevated above ground level so that the lower edge of the solar panels is set at a minimum of 1.40mAOD, significantly above the predicted 1 in 1000 year (0.1% AEP) flood level.
 - Where solar panels are located in Flood Zones 2 and 3, the connectors for panels in these areas will be set to a minimum level of 1.8mAOD.
- 5.2.6 The manufacturer has confirmed that the PV panels can be submerged for a period without damage.

5.3 Access and Egress

- 5.3.1 During a flood event access from Drove Lane to the north-east will remain flood free for all but the most extreme flood event, as depicted in the EA flood map (reproduced in Appendix A). A short section of Drove Lane is predicted to be flooded during the 1 in 1000 year (0.1%) tidal event, in the absence of existing defences. In such an extreme event, flood warnings will be issued well in advance of such an event allowing personnel time to rearrange any maintenance visits.

5.4 Flood Risk Management

- 5.4.1 The flood risk management of the PV Park will be simplified by there being no personnel permanently on site. In any case, those responsible for the site should sign-up to the Environment Agency (EA) flood warning service. The EA provides up to the minute information and can inform the site of the severity of flooding expected.
- 5.4.2 For times when personnel are expected on site, such as maintenance, the warning system can be checked in advance and the maintenance schedule adjusted to avoid any forecasted flooding issues.
- 5.4.3 The warning system will be of particular importance during construction when there will be a more significant human presence on site. Close monitoring of the warning system will ensure the site can be swiftly evacuated, of both personnel and equipment, in the event of flooding.

5.5 Managing Surface Water

- 5.5.1 The proposed development will not have a significant effect on the existing drainage characteristics at the site. The PV panel units will be mounted south-facing, on a stilt construction without concrete foundations. Precipitation on each panel will run onto the ground at the south side of the panel. During large storm events, runoff will be slightly more concentrated at this location as it falls off the panels. However, the site's flat topography and the area underneath the panels that is 'shaded' will provide adequate area for the runoff to dissipate.
- 5.5.2 Access tracks will be constructed with permeable materials so as to minimise any impact on site runoff. The small inverter huts and transformer station will be surrounded with gravel strip drains. This will need to be carefully considered as part of the construction quality control procedures.
- 5.5.3 The nature of the development will mean there is very little, if any, change to the existing drainage characteristics of the site. Therefore, there is no requirement to modify the existing surface water regime and there will be no increase in flood risk to third parties.

5.6 Residual Risk

- 5.6.1 The primary residual risk for the site is in the case of a breach or failure of coastal defences. As the site's drainage system is connected to both the River Arun and the Aldingbourne Rife, failure of defences at either these locations could lead to flooding of lower areas of the site. This could be caused by failure of a flapped outfall or a pumping station during a rare fluvial event, or breach of the shingle ridge.
- 5.6.2 The flood extents and levels provided by the Environment Agency (reproduced in Appendix A) ignore the presence of all defences and this information has been considered for defining the locations and levels of vulnerable infrastructure.

6 Conclusions

6.1 General

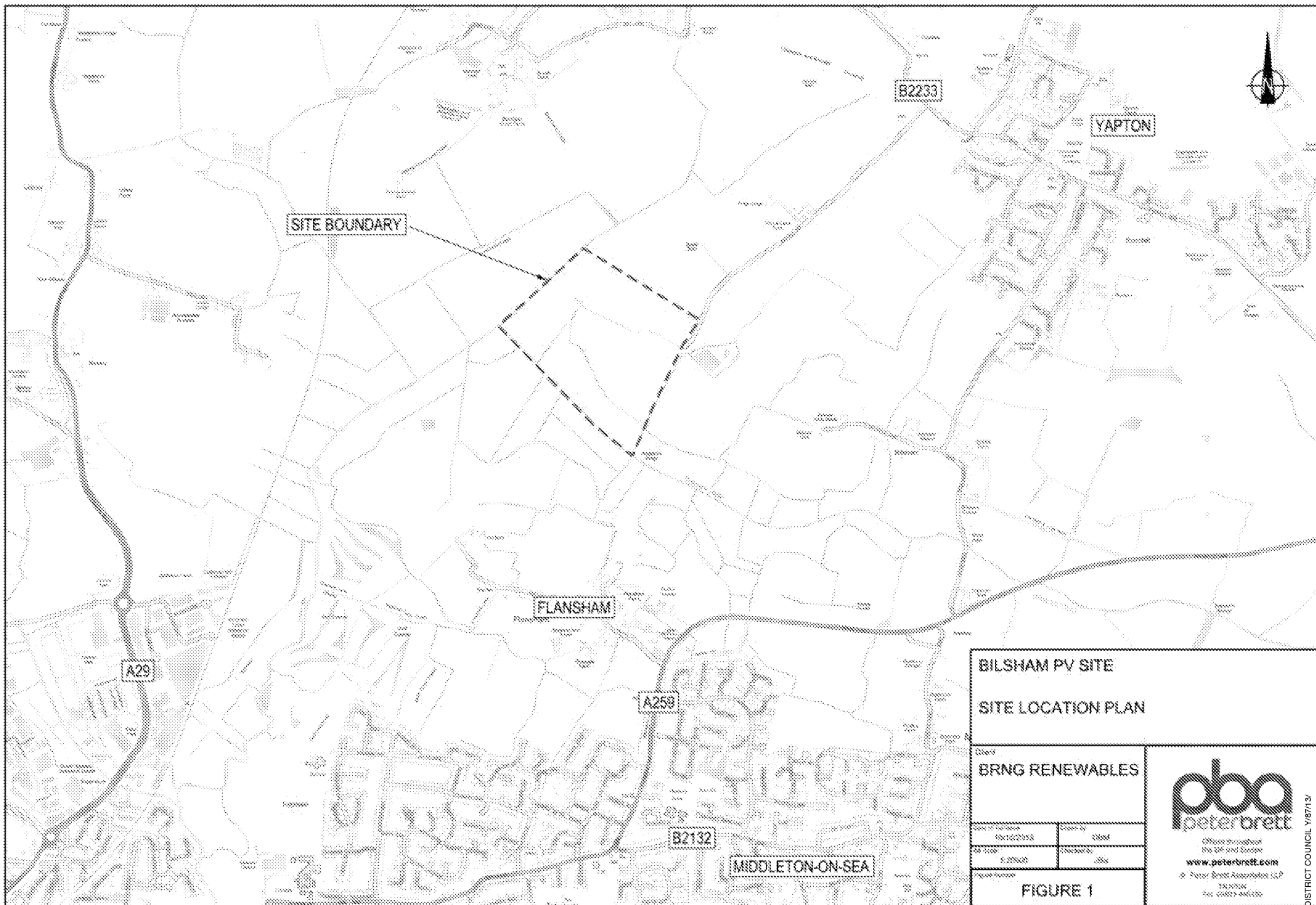
- 6.1.1 Parts of the proposed PV site are situated within Flood Zone 3 with the remainder lying within Flood Zones 1 and 2. The site is at risk from both fluvial and tidal flooding albeit that the tidal risk is mitigated by the presence of existing coastal defences.
- 6.1.2 The most significant actual risk to the site is from fluvial flooding, the site does not benefit from fluvial defences.
- 6.1.3 The most significant residual risk is from tidal flooding. Continual monitoring and maintenance schedules will minimise the risk of a breach occurring. The actual risk of tidal flooding is considered to be negligible as the site is protected by extensive coastal defences, however there can be no absolute guarantee that a breach will not occur.
- 6.1.4 In the event that flood water does impact the site, sufficient mitigation measures will be in place so that the PV Park and equipment is not significantly affected and the overall functionality of the site is not compromised by the flood water.
- 6.1.5 Human presence on the site will be limited and so the risk to human life is minimal. To further minimise the risk, those responsible for the site should subscribe to the EA flood warning system as a means of anticipating likely flooding events and acting accordingly. This measure will also provide valuable information during the PV Park construction phase when more personnel will be on site.
- 6.1.6 No significant changes will be made to the site's permeability characteristics and the existing surface water regime will be retained.
- 6.1.7 This report demonstrates that the development will meet the requirements with respect to flood risk as outlined in NPPF and associated guidance; that it will be safe over the lifetime of the development, that it will not put human lives at risk and that it will not increase flood risk elsewhere.

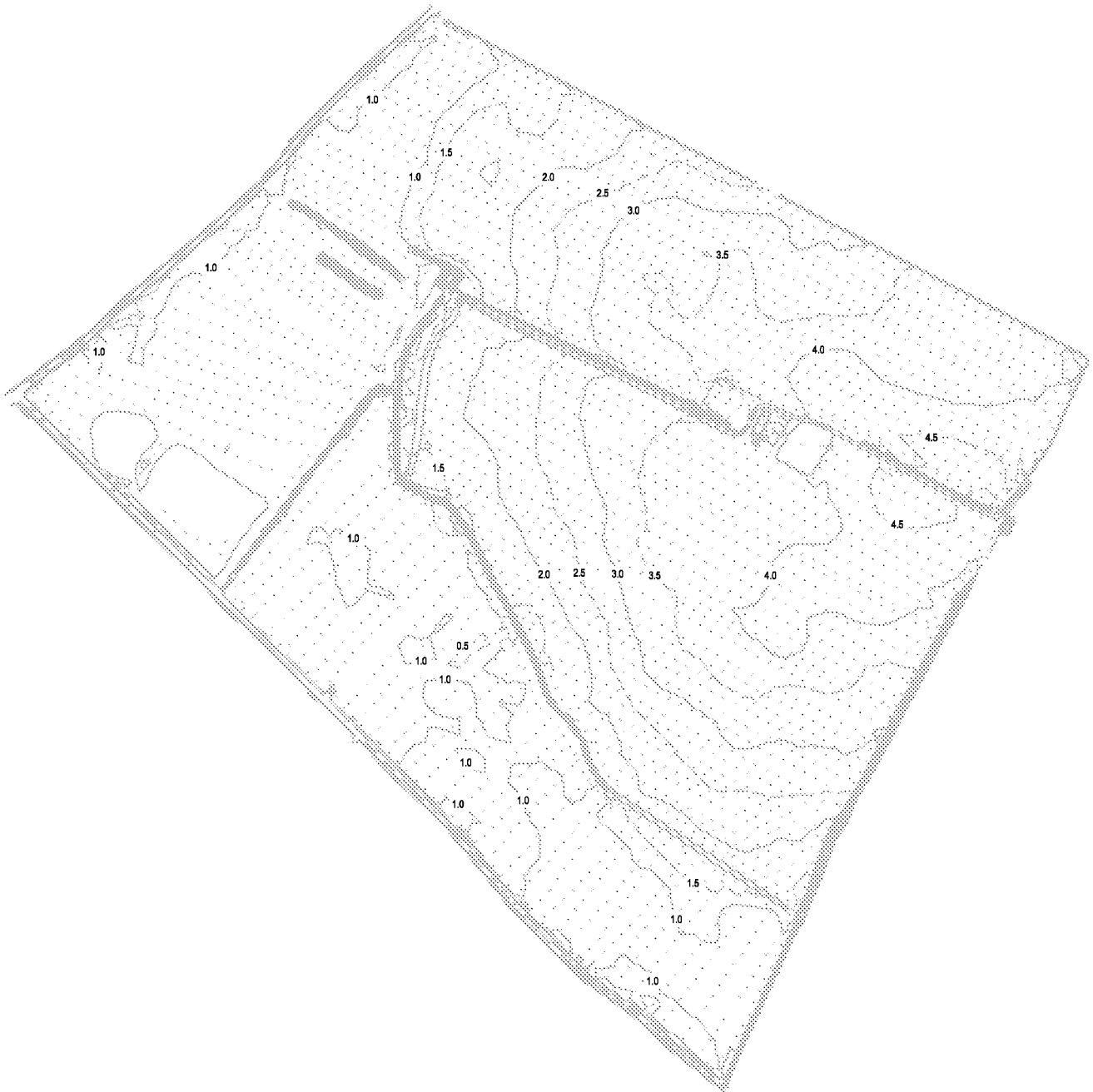
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Appendix A

- Figure 1 - Location Plan
- Figure 2 – Topographical Survey
- Figure 3 - Proposed Development Plan
- EA Flood Map
- EA Flood Extents and Levels

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Client
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BILSHAM PV SITE

**TOPOGRAPHICAL
SURVEY**

Date 10/10/2013

A4 Scale 1:5000

Drawn by DBM

Checked by JBa

Figure Number

FIGURE 2

**Flood Map Centered on SU928024 -
Created 19/09/2013 [Ref: SSD/1885/VH]**



Environment
Agency

Legend

- Main River
- Flood Zone 3
- Flood Zone 2

Flood Map Areas (assuming no defences)

Flood Zone 3

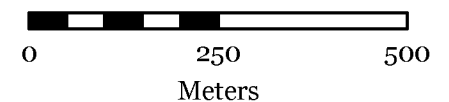
Shows the area that could be affected by flooding:
- from the sea with an 1 in 200 or greater chance of happening each year.
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2

Shows the extent of an extreme flood from rivers of the sea with up to a 1 in 1000 chance of occurring each year.

1:10,000 *

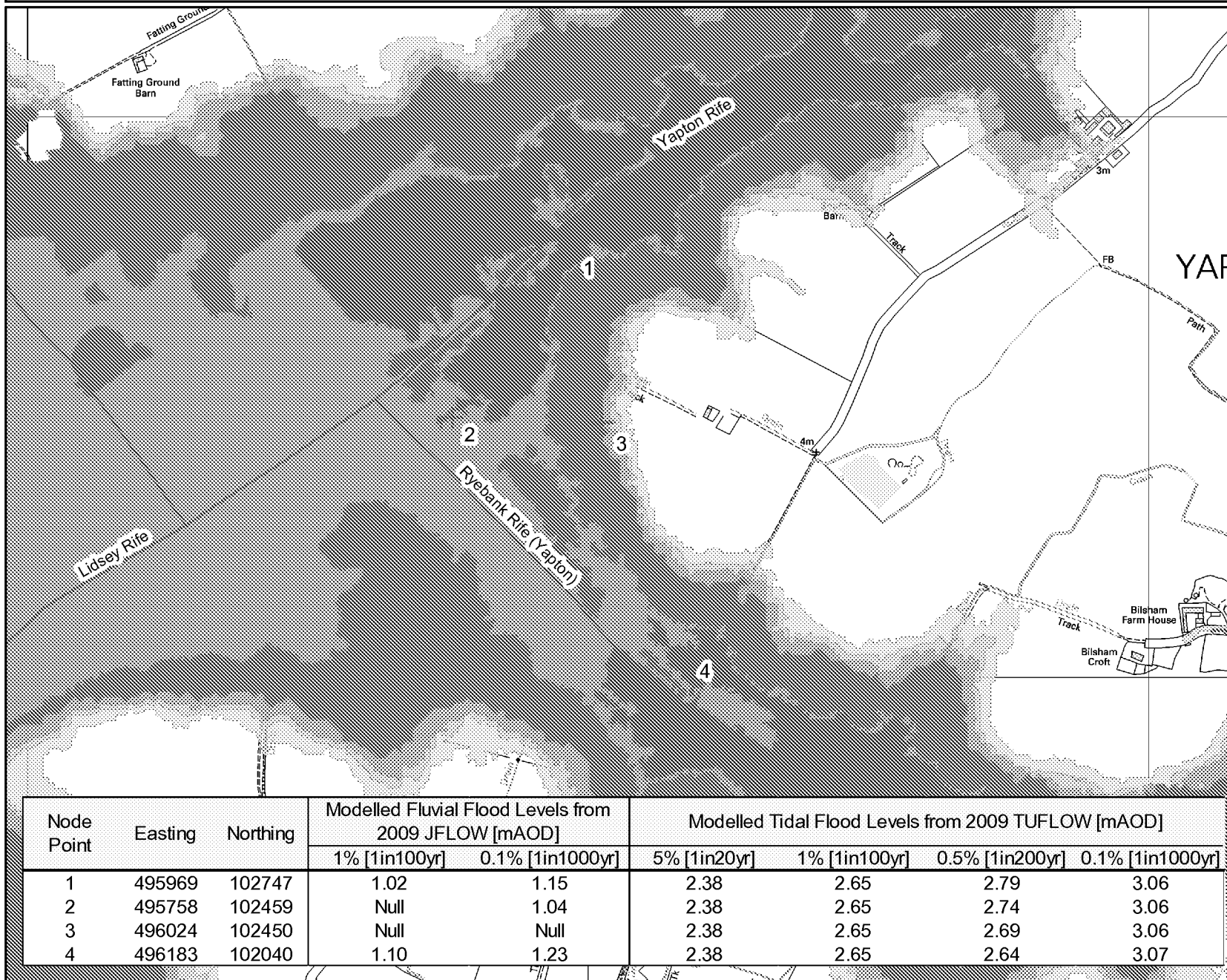
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2009 Fluvial JFLOW and 2009 Tidal TUFLOW Extents Centered on SU928024 - Created 19/09/2013 [Ref: SSD/1885/VH]



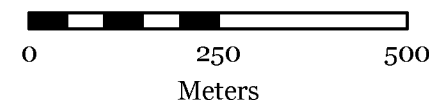
Legend

- Main River
- 1% 1in100yr FLUVIAL
- 0.1% 1in1000yr FLUVIAL
- 5% 1in20yr TIDAL
- 1% 1in100yr TIDAL
- 0.5% 1in200yr TIDAL
- 0.1% 1in1000yr TIDAL

Node Point	Easting	Northing	Modelled Fluvial Flood Levels from 2009 JFLOW [mAOD]		Modelled Tidal Flood Levels from 2009 TUFLOW [mAOD]			
			1% [1in100yr]	0.1% [1in1000yr]	5% [1in20yr]	1% [1in100yr]	0.5% [1in200yr]	0.1% [1in1000yr]
1	495969	102747	1.02	1.15	2.38	2.65	2.79	3.06
2	495758	102459	Null	1.04	2.38	2.65	2.74	3.06
3	496024	102450	Null	Null	2.38	2.65	2.69	3.06
4	496183	102040	1.10	1.23	2.38	2.65	2.64	3.07

1:10,000 *

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