

Barnham Court Farm, Barnham

Flood Risk Assessment

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Client Name: BNRG Heather Ltd

Client Address: Festival House, Jessop Avenue, Cheltenham, GL50 3SH

Site Address: Barnham Court Farm, Barnham, West Sussex,

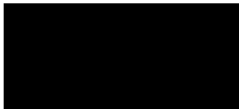
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1.0 Introduction

1.1 Project Background

Curtins Consulting Limited has been appointed by BNRG Renewables to prepare a site specific Flood Risk Assessment (FRA) for the proposed solar panel array at Barnham Court Farm, Barnham, near Bognor Regis, West Sussex.

The development comprises the installation of solar panels erected on ground-mounted frames, fixed to pile-driven steel supports and arranged in rows, complete with control kiosk and sub-station buildings.

This report is based on currently available information and pre-planning liaisons.

Proposals contained or forming part of this report represent the design intent and may be subject to alteration or adjustment in completing the detailed design for this project. Where such adjustments are undertaken as part of the detailed design, and are deemed a material derivation from the intent contained in this document, prior approval shall be obtained from the relevant authority in advance of commencing such works.

Where the proposed works, to which this report refers, are undertaken more than twelve months following the issue of this report, Curtins Consulting shall reserve the right to re-validate the findings and conclusions by undertaking appropriate further investigations at no cost to Curtins Consulting.

1.2 Scope of Flood Risk Assessment

The assessment has been undertaken in accordance with the standing advice and requirements of the Environment Agency for Flood Risk Assessments as outlined in the Communities and Local Governments Technical Guidance to the National Planning Policy Framework (NPPF).

The assessment has:

- Investigated all potential risks of current or future flooding to the site
- Considered the impact the development may have elsewhere with regards to flooding risk
- Considered design proposals to mitigate any potential risk of flooding determined to be present
- Considered outline design proposals for foul and storm water drainage of the site

2.0 Existing Site Details

2.1 Location and Description

The site is situated approximately 1.2 kilometres to the south west of the village of Barnham, with Bognor Regis located some 5 kilometres to the south of the proposed development. The proposed development area comprises circa 2 hectares of agricultural grassland roughly triangular in shape. It is bounded by a railway line embankment to the west and further agricultural land to the south and north. Woodland forms the eastern extent of the site. Along part of the northern boundary runs a drainage ditch.

The site location plan is included in Appendix A.

2.2 Topography

The site generally forms a depression due to the presents of some degree of banking along each of its boundaries. Levels are lowest in the sites centre at circa 1.0mAOD and generally rise no more than 0.2m over the majority of the plan area. Towards the eastern corner levels ramp up gradually to around 5.00mAOD. Along the northern edge is a steep bank up to levels closer to 6.0mAOD. The banking to the southern boundary is least pronounced reaching level circa 2.0mAOD to the west and circa 5.0mAOD to the east. Towards the southern edge of the site is pond, which is in the order of 20m diameter and 1m deep. The watercourses along the northern boundary lies at around the 0.4m AOD level.

The topographical survey drawing is included in Appendix A.

2.3 Existing Watercourses

The nearest watercourse is the ditch along the northern boundary. This is referred to as Barnham Rife on the Environmental Agency's mapping, and flows in a general east to west direction. Some 300m west of the site it joins the Lidsey Rife which flows south east before merging with the Yapton Rife some 1km to the south of the site. These three Rife's are all demarcated as Main Rivers on the Environment Agency's mapping.

2.4 Public Drainage

The sites rural location would suggest that there are no public sewers nearby. As it is not proposed to positively drain either foul or storm water flows from the site into public sewers, an assessment of existing public sewers has not been carried out.

2.5 Private Drainage

The sites rural location would suggest that there is no private drainage on the site. There are no drainage covers or other features indicated on the topographical survey.

3.0 National Planning Policy Framework

3.1 National Planning Policy Framework

In March 2012 the Department of Communities and Local Government published the National Planning Policy Framework document (NPPF) which provides guidance on how flood risk should be assessed during the planning and development process. The main Framework is supplemented by a technical guidance document ("Technical Guidance to the National Planning Policy Framework" - TG2NPPF) which advises specifically with respect to flooding. The most critical aspects are extracted below.

3.2 Flood Zone Classification (Table 1)

Zone 1 Low Probability

Definition

This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

Appropriate Uses

All uses of land are appropriate in this zone.

Zone 2 Medium Probability

Definition

This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.

Appropriate uses

Essential infrastructure and the water-compatible, less vulnerable and more vulnerable uses, as set out in table 2, are appropriate in this zone. The highly vulnerable uses are only appropriate in this zone if the Exception Test is passed.

Zone 3a High Probability

Definition

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Appropriate uses

The water-compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone.

The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

Zone 3b The Functional Floodplain

Definition

This zone comprises land where water has to flow or be stored in times of flood.

SFRAs should identify these Flood Zone areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

Appropriate uses

Only the water-compatible uses and the essential infrastructure listed in table 2 that has to be there should be permitted in this zone. It should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

3.3 Flood Risk Vulnerability Classification (Table 2)

Essential Infrastructure

- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.
- Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood.
- Wind turbines.

Highly Vulnerable

- Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding.
- Emergency dispersal points.
- Basement dwellings.
- Caravans, mobile homes and park homes intended for permanent residential use.
- Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”).

More Vulnerable

- Hospitals.
- Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non-residential uses for health services, nurseries and educational establishments.
- Landfill and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, *subject to a specific warning and evacuation plan.*

Less Vulnerable

- Police, ambulance and fire stations which are not required to be operational during flooding.
- Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in “more vulnerable”, and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).

Water Compatible

- Flood control infrastructure.
- Water transmission infrastructure and pumping stations.
- Sewage transmission infrastructure and pumping stations.
- Sand and gravel working.
- Docks, marinas and wharves.
- Navigation facilities.
- Ministry of Defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water-based recreation (excluding sleeping accommodation).
- Lifeguard and coastguard stations.
- Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, *subject to a specific warning and evacuation plan.*

3.4 Flood Zone and Flood Risk Vulnerability Compatibility (Table 3)

Table 3: Flood risk vulnerability and flood zone 'compatibility'

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	✗	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	✗	✗	✗

Key: ✓ Development is appropriate.
 ✗ Development should not be permitted.

4.0 Development and Flood Risk

4.1 Proposed Development Vulnerability Classification

The proposal includes for a solar farm and therefore is not explicitly included within Table 2 of TG2 NPPF. The development is for power generation; however it should not be classified as a power plant in the traditional sense. As the development does not require the constant presence of personnel, does not include for habitation, nor does it include hazardous substances then it should be classified as Less Vulnerable. To a large extent the panels are of a form which is not affected by low level flooding, however they are not Water Compatible in the NPPF classification.

4.2 Environment Agency Flood Data

Environment Agency flood mapping data is provided within Appendix B.

This mapping indicates that the site is almost completely within Flood Zone 3, with some areas around the boundaries being Flood Zone 2 and 1.

The site is also exposed to tidal flooding for a 1 in 100 year event with a similar flood extent to the fluvial event.

The model nodes giving flood levels for the site are for the 1 in 200 year plus climate change event and are a consistent 4.44mAOD across the site, giving an approximate flood depth of 3.4m. However from the topographical survey there would be areas of no flooding to the eastern extreme of the site for this water level.

Therefore the development is considered to be at high risk of fluvial flooding, and appropriate mitigation and resilience measure will need to be provided. As the site is un-manned the structures will be designed with flood resilient measures preventing damage to the components and the environment. As such whilst there is a high probability of an event occurring the magnitude of the consequences will be small, and therefore the mitigated risk will be low.

4.3 Historic Flooding

The Environment Agency historic flood mapping notes an event that flooded the site in 1987. The extents of this event are similar to the flood risk mapping, however as reflected by the levels on the topographical survey the area to the eastern extreme of the site was not flooded.

4.4 Flood Defences

No formal flood defences are recorded on the Environment Agency maps which would affect the proposed development.

4.5 Flooding from Climate Change

The Environment Agency flood maps for the tidal event already include a 20% allowance for climate change and therefore this has been taken in to account in the assessment.

4.6 Flooding from Groundwater

The location of the development immediately adjacent to a watercourse which is at risk of flooding means that flooding from groundwater would not be the primary source of risk, and it is very unlikely to have a groundwater flooding event without a fluvial event. The development, however, is of a form which is not susceptible to groundwater flooding and therefore the risk is considered to be low.

4.7 Flooding from Adopted Sewers

Due to the undeveloped nature of the site and its surroundings it is unlikely that there are adopted sewers running across the development and therefore the risk of flooding from adopted sewers is considered to be low.

4.8 Flooding from Private Drainage

Due to the undeveloped nature of the site and its surroundings it is unlikely that there is any private drainage running across the development and therefore the risk of flooding from private drainage is considered to be low.

4.9 Flooding from Surface Water

Due to the location of the proposed development immediately adjacent to a watercourse it is unlikely that there will be a pluvial flood risk event without a corresponding fluvial event. There is a pond on the site but this is very small and therefore unlikely to be a significant source of risk. Therefore the risk of surface water flooding is considered to be low.

4.10 Flooding from Reservoirs, Canals and Artificial Sources

The Environment Agency maps do not indicate that this site is at risk from reservoir flooding. There are no other significant features in the local area.

Therefore the flood risk from other sources is considered to be low.

4.11 Development Flood Resilience

Due to the location of the development within Flood Zone 3 a range of flood resilience and mitigation measure will be included within the proposals. These are:

- Maintenance operations are only to be scheduled when the risk of flooding to the site is low;

- All cabling installed is to be watertight so as not to be affected by flood waters.
- Solar panel foundations will be designed so as to prevent the panels from being washed away during a flood event.
- Kiosks are to be water tight, and to include suitable foundations to prevent them from being washed away.
- Power generation to be stopped when there is a risk of flooding to the development, and this should include a safety cut-off to the kiosks, substations, and inverted such that once the water has reached a level where the components may get affected the system is shut down.
- Any particularly vulnerable equipment can be located on the higher ground to the east of the site which is located within Flood Zone 1.
- Compound fencing will be permeable so as not to impede the flooding characteristics of the site.

4.12 Overall Flood Risk

As noted in the previous sections the flood risk to the proposed development is considered to be at high risk of fluvial and tidal flooding, but low risk from all other sources. As the site is to be un-manned, and maintenance operations can take in to consideration flood forecasting, as long as the structures are designed to be flood resistant and features are included to prevent environmental damage the development is suitable in this location. As such whilst there is a high probability of an event occurring the magnitude of the consequences will be small, and therefore the mitigated risk will be low.

5.0 Drainage Strategy

5.1 Existing Drainage

As noted in section 4 there is currently no drainage across the site that would be affected by the proposed development.

5.2 Surface Water Drainage

The form of the development is that the site is largely covered with solar panels as shown in the proposed layout in Appendix A.

As can be seen on the drawing whilst the panels cover a large area they are only supported by small posts in natural ground. Therefore whilst one panel intercepts the precipitation which would otherwise land on the ground beneath the panel it is directed underneath the adjacent panel. In this way all of the precipitation still lands on natural ground and the run-off characteristics of the site are essentially retained. During extreme rainfall events the site is prone to flooding and therefore the area effectively has a run-off coefficient of 1.0 and therefore is not effected by the presence of the panels.

In terms of any small private switchgear buildings, these will drain to a small soakaway area. Whilst the ground is not likely to have properties appropriate for soakaway design compliant with BRE 365 the area will essentially be a replacement for the natural soakage volume that would otherwise be present under the kiosk. Whilst this method is not desirable for larger developments it is appropriate for the scale and rural location of this building.

In a similar manner the site access roads will either be fully permeable, have a fully permeable subgrade construction linked to the surface run-off in some manner, or a filter trench/French drain will be provided adjacent to the road. In this way the natural drainage characteristics of the site are maintained and, potentially, enhanced.

As no traditional drainage has been included and the natural behaviour of the site is to be retained then the site will respond to climate change in the same way as a Greenfield site and therefore no additional features are required.

6.0 Conclusions and Recommendations

6.1 Flood Risk

As determined within section 4 the development lies in Flood Zone 3 from tidal and fluvial sources. However, the development is to be un-manned and the features noted within section 4.11 mitigate against the risk to the development and the environment. As such the mitigated risk to the development is considered to be low.

The classification of the development is Less Vulnerable and therefore is appropriate for this location.

6.2 Mitigation Measures

As noted in section 4.11 the following measures will be included in the development:

- Maintenance operations are only to be scheduled when the risk of flooding to the site is low;
- All cabling installed is to be watertight so as not to be affected by flood waters.
- Solar panel foundations will be designed so as to prevent the panels from being washed away during a flood event.
- Kiosks are to be water tight, and to include suitable foundations to prevent them from being washed away.
- Power generation to be stopped when there is a risk of flooding to the development, and this should include a safety cut-off to the kiosks, substations, and inverted such that once the water has reached a level where the components may get affected the system is shut down.
- Any particularly vulnerable equipment can be located on the higher ground to the east of the site which is located within Flood Zone 1.
- Compound fencing will be permeable so as not to impede the flooding characteristics of the site.

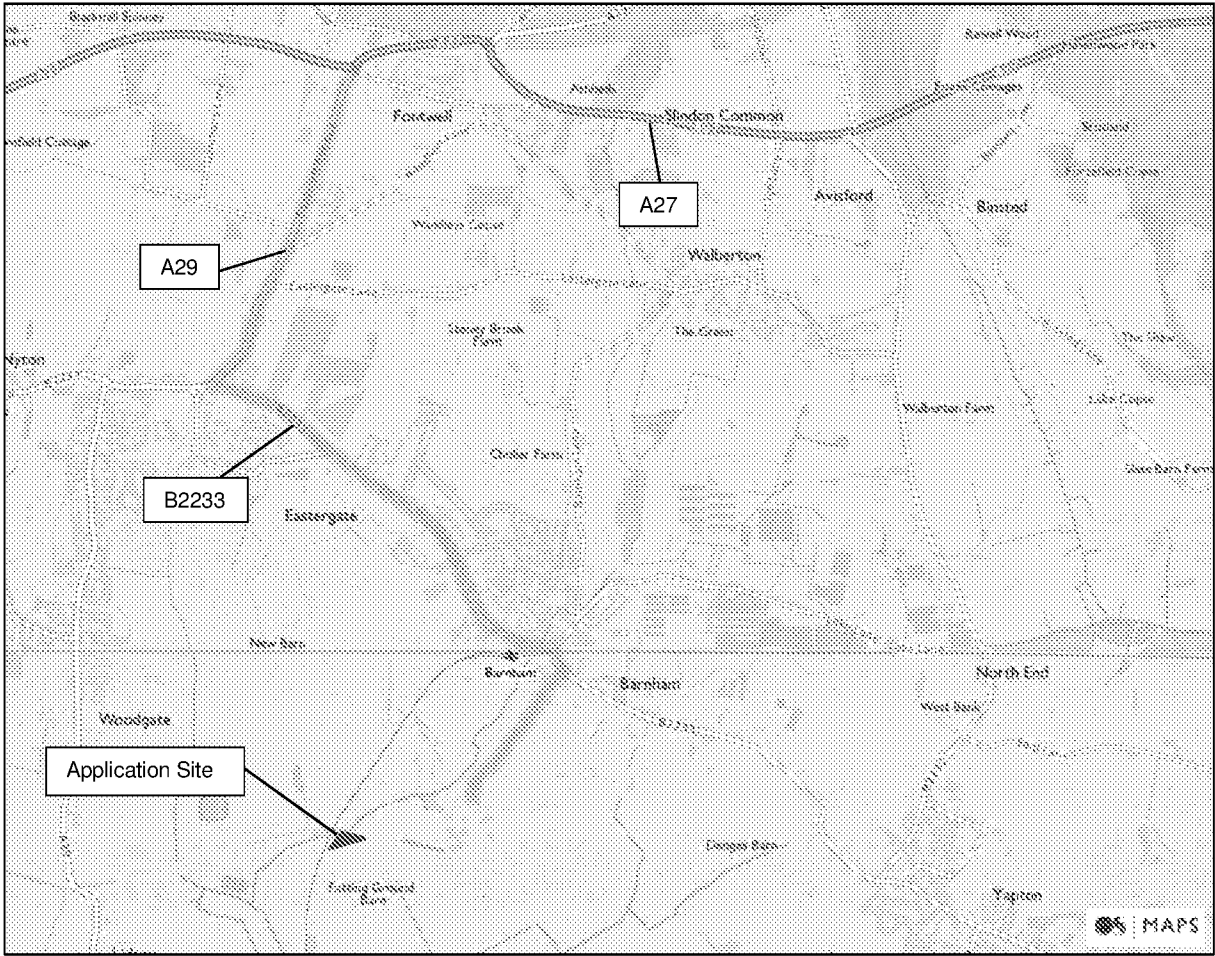
6.3 Drainage Strategy

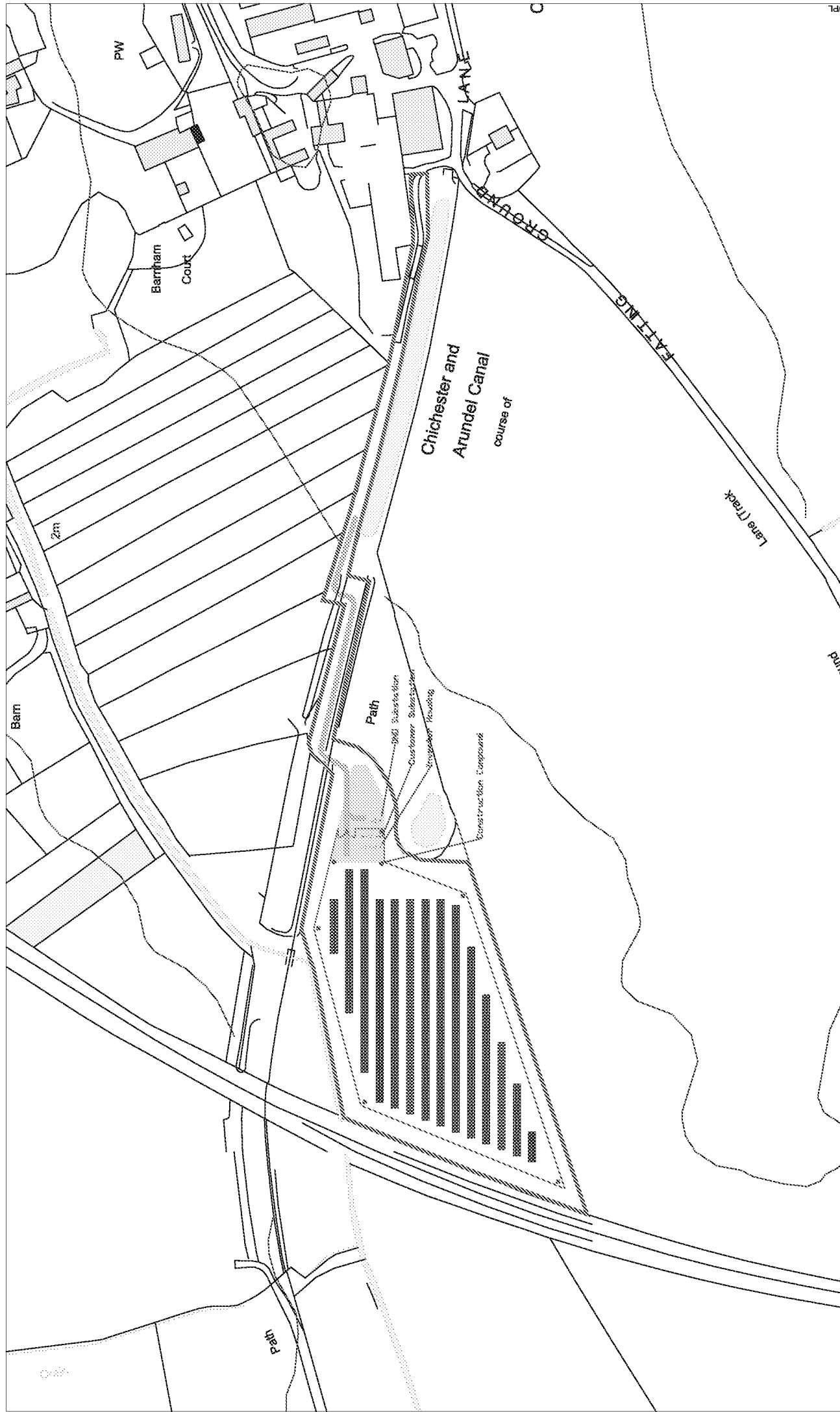
The development does not require traditional drainage as the site is still largely Greenfield as the panels are just supported on posts. The roads are either permeable or are to drain to permeable areas intended to enhance the natural storage capacity of the ground. Therefore there is not a proposed discharge point and the site will essentially behave hydraulically similar to the existing conditions.

Appendix

Appendix A – Site Drawings

Site Location Plan





DRAWING NOTES:

1. GENERAL NOTES
2. CONDITIONS AND LEVELS SHALL BE CHECKED ON SITE PRIOR TO CONSTRUCTION WORK COMMENCING.
3. ALL DIMENSIONS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS AND ARCHITECTS' DRAWINGS AND SPECIFICATIONS TO BE READ IN CONJUNCTION WITH THE LANDSCAPE SPECIFICATION.
4. ANY DISCREPANCY CONCERNING THE DRAWINGS SHALL BE REPORTED IMMEDIATELY.
5. ALL DIMENSIONS IN MILLIMETERS UNLESS NOTED OTHERWISE.
6. ALL SOIL TO BE OFF THIS DRAWING.
7. EXISTING SERVICE ALIGNMENTS SHALL BE SHOWN ON SITE MAPS FOR CONSIDERATION PRIOR TO CONSTRUCTION.
- 8.

DRAFT
for comment

[illegible]

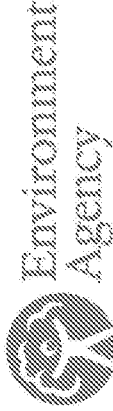
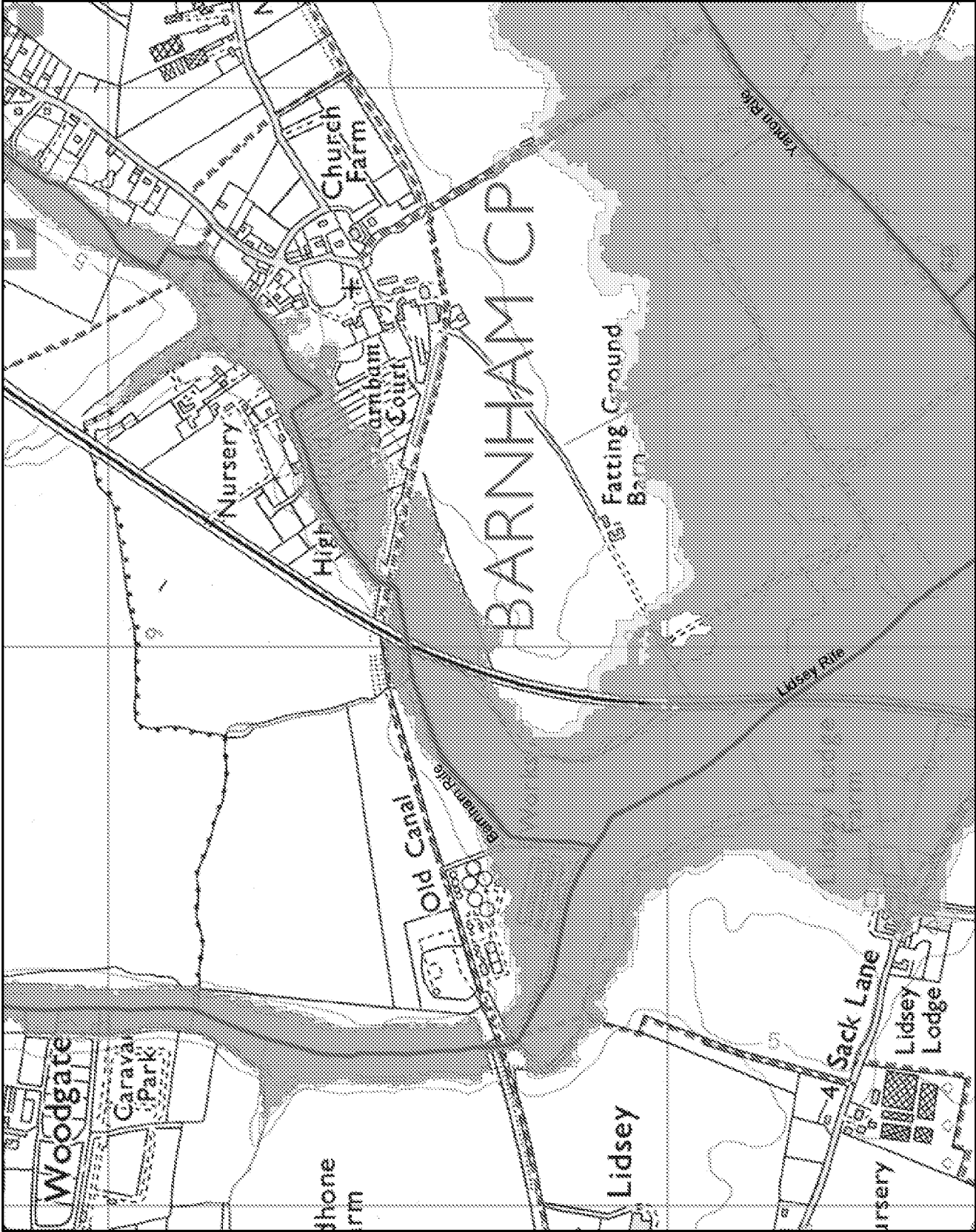
Yelp

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APPROVED				

Appendix

Appendix B – Flooding Data

Flood Map for Planning Centered on Barnham Court Farm, Barnham -
Created 15/07/2015 [Ref: SSD/6744]



Legend

- Main River
- Flood Zone 3
- Flood Zone 2

Flood Map for Planning
(assuming no defences)

Flood Zone 3

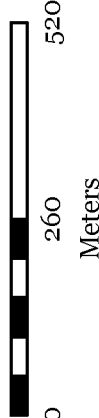
Shows the area that could be affected by flooding:
- from the sea with an 1 in 200 or greater chance of happening each year.
- or from a river with a 1 in 100 or greater chance of happening each year.

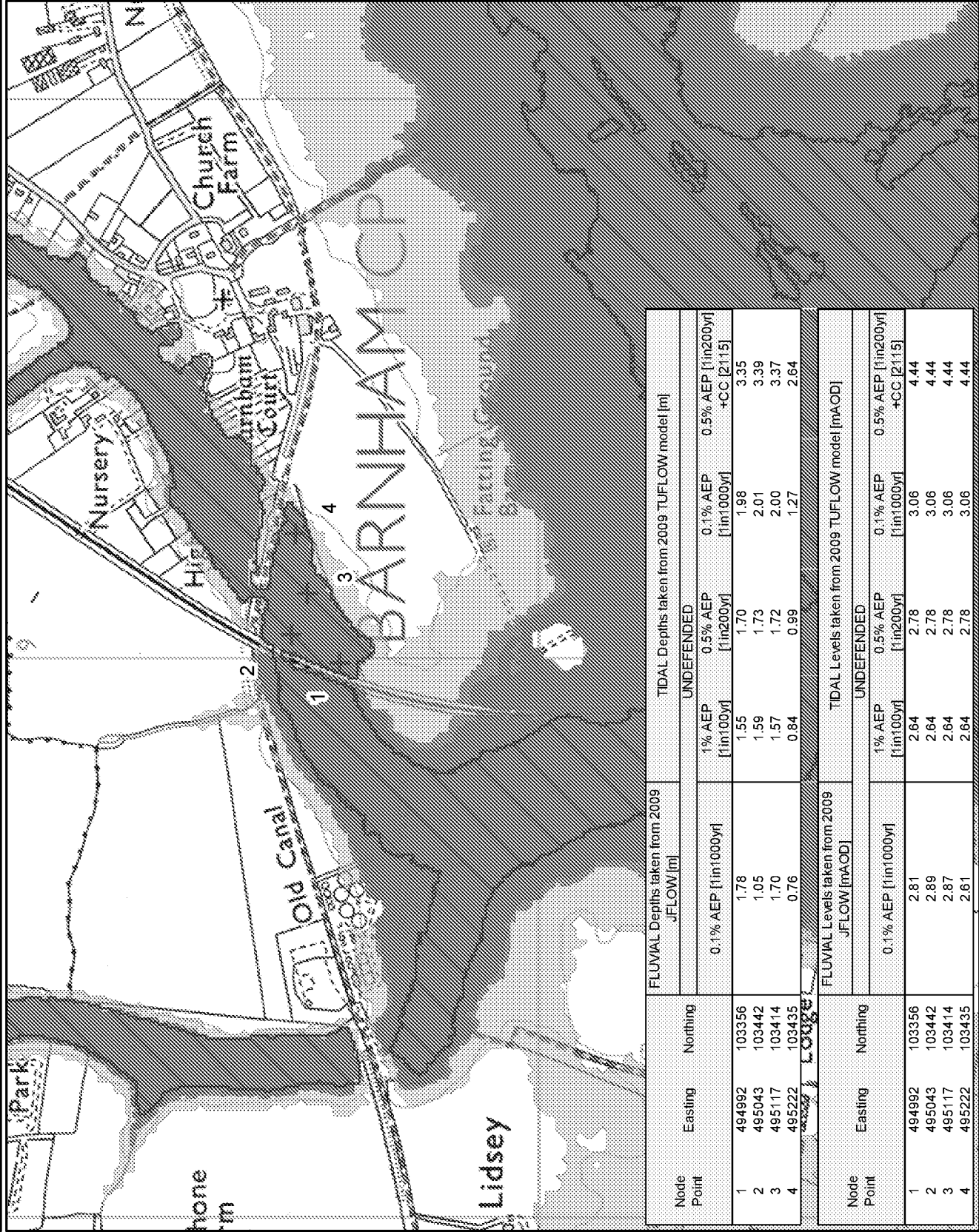
Flood Zone 2

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 *

*when printed at A4.







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Legend
 Flood Event Outlines



0 225 450 675 900 m.

Appendix

Appendix C – Correspondence

Toby Nicks
Curtins
Quayside
40-58 Hotwell Road
Bristol
BS8 4UQ

Our ref: SSD/6744
Your ref:
Date: 15/07/2015

Dear Mr Nicks

Provision of Product 4 for Barnham Court Farm, Barnham

Thank you for your request to use Environment Agency data. The information is attached.

If you have requested this information to help inform a development proposal, then you should note the detail in the attached advisory text on the use of Environment Agency Information for Flood Risk Assessments / Flood Consequence Assessments.

Supporting Information

This information is provided subject to the enclosed notice, which you should read.

Flood History

Please see the attached map for recorded flood event outlines in the area. I would suggest contacting Arun District Council for a more comprehensive flood history check.

Flood Defences

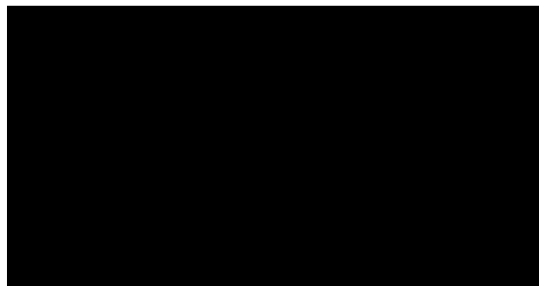
There are no formal raised flood defences to protect this area from river flooding. Coastal flood defences offer a standard of protection of approximately 1in200 (0.5%).

Guildbourne House, Chatsworth Road, Worthing, West Sussex BN11 1LD


www.environment-agency.gov.uk

If you have any queries or would like to discuss the content of this letter further please don't hesitate to contact me.

Yours faithfully

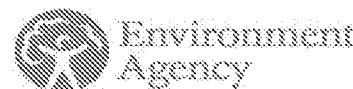


Jon Denman
FCRM Officer
Partnership and Strategic Overview Team – West Sussex



Enc. Detailed FRA/FCA Map, Modelled Levels and extents
[Standard Notice]

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Use of Environment Agency Information for Flood Risk / Flood Consequence Assessments

Important

If you have requested this information to help inform a development proposal, then we recommend that you undertake a formal pre-application enquiry using the form available from our website:-

<http://www.environment-agency.gov.uk/research/planning/33580.aspx>

Depending on the enquiry, we may also provide advice on other issues related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

In **England**, you should refer to the Environment Agency's Flood Risk Standing Advice and PPS25 and its associated Practice Guide for information about what flood risk assessment is needed for new development in the different flood zones. These documents can be accessed via:

<http://www.environment-agency.gov.uk/research/planning/82587.aspx>

<http://www.communities.gov.uk/publications/planningandbuilding/pps25floodrisk>

<http://www.communities.gov.uk/publications/planningandbuilding/pps25practiceguide>

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

In **Wales**, you should refer to TAN15 for information about what flood consequence assessment is needed for new development in the different flood zones

<http://new.wales.gov.uk/splash.jsessionid=8yiGTfGZlhmB0t2vhp6hS1GcB1LXvZzB3Ylczf20Xn7LK3zK0nMkl981825250?orig=/topics/planning/policy/tans/tan15/>

You should also consult the Strategic Flood Consequence Assessment if one has been produced by your local planning authority.

In both **England and Wales** you should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk / Consequence Assessment (FRA / FCA) where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as

groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.

3. Where a planning application requires a FRA / FCA and this is not submitted or deficient, the Environment Agency may well raise an objection.
4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with your local planning authority.

Our Locations

