Rampion Offshore Wind Farm

ES Section 23 – Surface Water, Hydrology & Flood Risk

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23.1 Introduction

23.1.1 This section of the Environmental Statement (ES) considers the water resources and drainage conditions in relation to the proposed onshore cable route and onshore substation for the Rampion Offshore Wind Farm (the Project), and assesses factors such as flood risk, drainage design and water resource management which will affect the proposed development in terms of its sustainability, safety and integrity. This in turn will have direct and indirect impacts on the environment.

23.1.2 A desk-based study of the hydrology and hydrogeology has been undertaken, which includes watercourses, areas prone to flooding, aquifers, water abstraction and discharge points.

23.2 Legislation and Policy Context

Key Legislation

23.2.1 **The Water Resources Act 1991 and The Water Act 2003**: The Water Resources Act 1991 (the 1991 Act) sets out the relevant statutory regulatory controls that provide protection water bodies and water resources. The 1991 Act was modernised by the introduction of the Water Act 2003 (the 2003 Act). The 2003 Act governs the control of water abstraction, discharge to water bodies, water impoundment, conservation and drought provision. The 2003 Act has changed six key areas of the 1991 Act and of relevance to the proposed elements of the Project is the need to obtain a licence for any dewatering for engineering works, which was previously exempt.

23.2.2 **Flood and Water Management Act 2010**: This legislation was formally ratified in April 2010 with the aim to implement the findings of the 2007 Pitt Review and co-ordinate control of drainage and flood issues. There are a number of increased responsibilities within the act that affect adoption of Sustainable Drainage Systems (SuDS) features and the role of the Environment Agency to expand on the mapping data they provide. The implementation of SuDS features has many beneficial impacts on the treatment of surface water during remediation works.

23.2.3 **The Water Framework Directive (WFD) 2000:** The WFD which came into force in 2000; is the most substantial piece of EU water legislation to date. All new activities in the water environment will need to consider the Directive. The WFD was transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. The WFD requires that environmental objectives be set for all surface and ground waters in England and Wales to enable them to achieve Good Status (or Good Ecological Potential for Heavily Modified and Artificial Water Bodies) by a defined date. These environmental objectives are listed below:

- Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;
- Aim to achieve at least good status for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status by 2021 or 2027;
- Meet the requirements of Water Framework Directive Protected Areas;
- Promote sustainable use of water as a natural resource;
- Conserve habitats and species that depend directly on water;
- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment; progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- Contribute to mitigating the effects of floods and droughts.

Other relevant legislation that has been taken into account includes the following:

- Contaminated Land (England) Regulations 2006, SI 1380;
- Environmental Protection Act 1990;
- Environment Act 1995;
- Groundwater Regulations 1998;
- Environmental Permitting Regulations 2010 (as amended);
- Site Waste Management Plans Regulations 2008, SI 314;
- Environmental Protection (Duty of Care) Regulations 1991, SI 2839 (as amended);
- Wildlife and Countryside Act 1981 (as amended); and

- Environmental Damage (Prevention and Remediation) Regulations 2009, SI 153.

National Policy Context

23.2.4 National Policy Statements (NPS) provide the primary basis on which the Secretary of State is required to make its decisions. The specific assessment requirements for geology, hydrogeology, land quality and flood risk, as detailed within the NPSs, are set out below.

23.2.5 NPS EN-5 (Electricity Network Infrastructure) and EN-3 (Renewable Energy) do not specifically consider geology, hydrogeology, land quality or flood risk impacts. However, EN-1 (Overarching NPS for Energy) does include generic requirements.

23.2.6 Paragraph 5.3.3 states that: "*Where the development is subject to EIA the applicant should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance….*"

23.2.7 Paragraph 5.14.6 states that: "*The applicant should set out the arrangements that are proposed for managing any waste produced and prepare a Site Waste Management Plan. The arrangements described and Management Plan should include information on the proposed waste recovery and disposal system for all waste generated by the development, and an assessment of the impact of the waste arising from development on the capacity of waste management facilities to deal with other waste arising in the area for at least five years of operation. The applicant should seek to minimise the volume of waste produced and the volume of waste sent for disposal unless it can be demonstrated that this is the best overall environmental outcome*."

23.2.8 Paragraph 5.15.2 states that: "*Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent*."

23.2.9 Paragraph 5.15.3 states that: "*The ES should in particular describe:*

- *The existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed changes to discharges.*

- *Existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Catchment Abstraction Management Strategies).*

- *Existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics.*

- *Any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones (SPZs) around potable groundwater abstractions."*

23.2.10 Paragraph 5.7.4 states that: "*Applications for energy projects of 1 hectare or greater in Flood Zone 1 in England or Zone A in Wales and all proposals for energy projects located in Flood Zones 2 and 3 should be accompanied by a flood risk assessment (FRA)." Paragraph 5.7.6 also states that: "Further guidance can be found in the Practice Guide which accompanies Planning Policy Statement 25 (PPS25)*".

National Planning Policy Framework

23.2.11 The assessment has been prepared in accordance with the National Planning Policy Framework (NPPF) and its accompanying guidance document.

23.2.12 The NPPF sets out the criteria for development and flood risk by stating that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. The key definitions (DCLG, 2012) are:

- "Areas at risk of flooding" means land within flood zones 2 and 3 or land within flood zone 1 that has critical drainage problems and has been notified to the local planning authority by the Environment Agency; and

- "Flood risk" means risk from all sources of flooding, including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

Pollution Prevention Guidance

23.2.13 The Environment Agency (EA) has published a number of Pollution Prevention Guidelines (PPGs) many of which apply to the proposed onshore works. These are:

- PPG 1: General guide to the prevention of water pollution;

- PPG 2: Above ground oil storage tanks;

- PPG 3: Use and design of oil separators in surface water drainage systems;

- PPG 4: Treatment and disposal of sewage where no mains drainage is available;

- PPG 5: Works in, near or liable to affect watercourses;
- PPG 6: Working at construction and demolition sites;
- PPG 8: Safe storage and disposal of used oils;
- PPG13: Vehicle washing and cleaning;
- PPG 18: Managing fire water and major spillages;
- PPG 20: Dewatering of underground ducts and chambers;
- PPG 21: Pollution incident response planning;
- PPG 26: Drums and intermediate bulk containers;
- Pollution Prevention: Major cable routes;
- CIRIA guidelines: Control of Water Pollution from Linear Construction Projects;
- CIRIA and Environment Agency joint guidelines: Masonry Bunds for Oil Storage Tanks; and
- CIRIA and Environment Agency joint guidelines: Concrete Bunds for Oil Storage Tanks.

23.3 Assessment Methodology

Establishment of Baseline Environment

23.3.1 Information on surface water and flood risk within an area of search comprising a 2km wide corridor around the proposed onshore works, including the onshore cable route and the substation, was collected from the following sources:

- British Geological Survey (BGS) 1:50,000 scale geological mapping provided in digital format (where available);
- Information from the Environment Agency and local authorities on abstractions and discharges to watercourses;
- Hydrogeological maps;
- Groundwater vulnerability maps;
- Soil survey maps;
- Environment Agency water quality and discharge records;

- Local Authority private water supply records; and
- Relevant publications including the Strategic Flood Risk Assessment (SFRA), Catchment Management Plan (CMP), South West River Basin Management Plan (RBMP) and Shoreline Management Plan 2 (SMP2).

23.3.2 In addition, site visits to specific locations along the cable route and substation site were undertaken by an RSK hydrologist in June and October 2011, and discussions were held with the Environment Agency (Solent and South Downs Area).

Scoping

23.3.3 As part of the scoping phase of the Environmental Impact Assessment (EIA), a Scoping Report (E.ON/RSK, September 2010) was prepared to set out the proposed approach to EIA in respect of the proposed development, including the identification of assessment methodologies for each of the EIA topic areas to be assessed. The Scoping Report was submitted to the Infrastructure Planning Commission (IPC) in September 2010. A Scoping Opinion (IPC, October 2010) was received from the IPC in October 2010 incorporating comments from a wide range of consultees. A copy of the Scoping Report and Scoping Opinion including consultee comments are included in Appendix 5.1 and 5.2.

23.3.4 The information and advice received during the scoping process with regard to hydrology and flood risk is summarised in Table 23.1.

Table 23.1: Relevant Scoping Responses

Date	Consultee	Summary of issues	Where addressed
11/10/2010 and 12/10/2010	Adur District Council	Adur District Council's Strategic Flood Risk Assessment should be used for Adur District, not Environment Agency info.	Flood Risk Assessment. Paragraphs 23.3.1
08/10/2010	Environment Agency	We would expect the following to be included in the assessment methodology: The Shoreham to Lancing Sea Defences fall under the jurisdiction of the Environment Agency. Under the Water Resources Act 1991 the integrity of these defences must be ensured. All watercourses along the proposed route must be identified, including ditches and drains. Several of these watercourses have status under the Water Framework Directive (WFD). It will be necessary to demonstrate how this development will contribute to the delivery of WFD actions on impacted water bodies. A number of main rivers will be crossed, including the tidal Adur. The method of	Flood Risk Assessment, Paragraphs 23.4, 23.5.4-23.5.5

Date	Consultee	Summary of issues	Where addressed
		crossing these must be appropriate to the type and size of watercourse. All crossings must be below bed level. The impacts on flood storage and flow routes from excavation and storage of material in the flood plain in accordance with the principles of Planning Policy Statement 25 - "Development and Flood Risk (PPS25). The construction impacts across the beach areas may have an impact on water quality through pollution, specifically affecting bathing water quality for which there are statutory water quality standards. This risk should be considered within the EIA. Where any works are proposed near or crossing a watercourse, this may require prior flood defence consent from the Environment Agency.	

23.3.5 The scope of the assessment was modified accordingly to take account of the above consultee responses and the opinions of the IPC, the findings of which were reported in draft form in the Draft ES.

Formal Pre-application Consultation

23.3.6 As detailed in Section 5 (EIA Methodology), an extensive programme of engagement has been undertaken with regard to the Project, details of which are provided in the Consultation Report (which accompanies the Development Consent Order (DCO) application) Document 5.1. This included publication of the Draft ES as part of the Section 42 and Section 48 consultation in June 2012.

23.3.7 Following a review of consultee feedback on the Draft ES, and discussions with consultees including the Environment Agency the following modification has been made to the Project and overall assessment scope:

- Change to the cable routing in the vicinity of Teville Stream to account for the Environment Agency's proposal for realignment of this watercourse.

Hydrology Assessment

23.3.8 This has been undertaken through a desktop study based on information provided above, site visits and liaison with relevant consultees. The assessment includes consideration of potential impacts that could cause deterioration in the status of a water body or could hinder the water body from meeting its WFD objectives.

23.3.9 For the purpose of the WFD assessment the EA RBMP has been used. The aim of this process is to determine whether the proposed onshore works could have an impact upon the water quality criteria for the water bodies located within the area of search (see section 24 Ecology, paragraph 24.3.6).

Flood Risk Assessment

23.3.10 RSK was commissioned to undertake a FRA of the proposed onshore cable route and substation site (see Appendix 23.1 and 23.2).

23.3.11 Although revoked and replaced with the NPPF, the FRA has been prepared in accordance with *PPS25: Development and Flood Risk* and the *Interim Code of Practice for Sustainable Drainage Systems* (DEFRA, 2004).

23.3.12 The publication of the NPPF has revoked PPS25 amongst others as of 27 March 2012. The Technical Guidance to the National Planning Policy Framework (DCLG, 2012) includes flood risk guidance and retains key elements of PPS25 including the Sequential and Exception Tests, climate change allowances and development classifications. The information contained in this new technical guidance along with the NPPF when combined with guidance contained in the Communities and Local Government's Planning Policy Statement 25: Development and Flood Risk Practice Guide (DCLG, 2010) and the British Standard 'BS 8533:2011 Assessing and managing flood risk in development. Code of practice' has formed the basis of the FRA.

23.3.13 The FRA has considered the effects of the proposed onshore cable route on the identified potential flood areas in the immediate locality. The FRA for the proposed substation site has been undertaken to:

- Determine the extent of new flooding provision and the influence on the site;
- Review the surface water drainage based upon the proposed layouts, and to determine the extent of infrastructure required; and
- Assess the impact on the onshore works from global warming and anticipated increases in rainfall over the lifetime of the development.

Identification and Assessment of Impacts and Mitigation Measures

23.3.14 Potential impacts have been identified from data gathered during the desk study. This data has been assessed with the knowledge and experience of the impacts from similar construction projects, leading to the development of appropriate mitigation measures.

23.3.15 An assessment has been made of the significance of impact taking into account the importance/sensitivity of the receptor, the magnitude of impact, the duration/persistence of impact and the likelihood of the impact. Examples of criteria that have been used to make judgements on the importance/sensitivity of the receptor(s) and the magnitude of change are presented in Table 23.2 and Table 23.3 respectively.

Table 23.2: Receptor Sensitivity

Receptor Sensitivity	Example of Receptor
High	Low-lying land, groundwater, and local drainage network Protected areas (e.g. SSSI, Ramsar sites, SPAs, SACs) highly sensitive to disturbance Principal aquifers Flood zone 3b and flood zone 3a - high probability Groundwater inner protection zone (SPZ1) Human receptor – public and visitors Very good and good water quality with pristine or near pristine water quality corresponding to classes A and B of the Environment Agency water quality classification Major change in the species diversity of flora and fauna due to the significant change in the water quality Highly and more vulnerable developments, including landfill and sites used for waste management facilities for hazardous waste Areas of known/confirmed contaminated land/groundwater
Medium	Areas with intermediate groundwater vulnerability Biological and chemical water quality within rivers and streams Surface water (flow patterns) Secondary (A, B and undifferentiated) aquifers Flood zone 2 - medium probability Groundwater outer protection zone (SPZ2) and total catchment (SPZ3) Human receptor – workforce and operators with prior knowledge of site conditions Fairly good and fair water quality with a measurable degradation in its water quality as a result of anthropogenic factors corresponding to classes C and D of the Environment Agency water quality classification Water quality has only limited effects upon the species diversity of flora and fauna in the watercourse Biological and chemical water quality within rivers and streams. Less vulnerable developments, including industrial properties and waste treatment (except landfill and hazardous waste facilities) Surface water drainage networks (flow patterns and capacity)
Low	Areas with low groundwater vulnerability. Non-aquifers Flood zone 1 - low probability Areas with low groundwater vulnerability Poor and bad quality resulting from anthropogenic factors, corresponding to classes E and F of the Environment Agency water quality classification Water quality does not affect the diversity of species of flora and fauna

Receptor Sensitivity	Example of Receptor
	Water compatible development, including water transmission infrastructure and pumping stations, sewage transmission infrastructure and pumping stations, and sand and gravel workings. Local drainage network (including existing private site drainage, soakaways, etc.).

Table 23.3: Magnitude of Impact

Magnitude	Definitions
Large	The proposals could result in a significant change in terms of flooding, surface water drainage, hydrology or hydrogeology, which may result in hardship.
Medium	The proposals could result in moderate changes to flooding, surface water drainage, hydrology or hydrogeology, which cause inconvenience, which will recover over a medium period of time (5–10 years).
Small	A slight change where the proposals could occasionally cause a minor flooding, surface water drainage, hydrology or hydrogeology change in the short term. (1–5 years).
Negligible	No effect detectable
Beneficial	Change is likely to beneficially impact on flooding, surface water drainage, hydrology or hydrogeology.

Significance of Residual Effects

23.3.16 The categories used when classifying overall significance are indicated in Table 23.4.

Table 23.4: Significance of Residual Effects

	Sensitivity/Importance		
Magnitude	**High**	**Medium**	**Low**
Large	Major	Major/Moderate	Moderate
Medium	Major/Moderate	Moderate	Minor
Small	Moderate	Minor	Minor
Negligible	Minor	Negligible	Negligible

23.3.17 An assessment has been made of the significance of residual effects, i.e. those remaining after mitigation.

Uncertainty and Technical Difficulties Encountered

23.3.18 There are no significant areas of uncertainty with regard to the assessment of hydrological environmental impacts and mitigation measures. However, further geotechnical assessment will be undertaken at the detailed design stage for construction and engineering purposes.

23.4 Baseline Conditions

Hydrology – Cable Route

23.4.1 The watercourses within the area of search include the main River Adur and its tributaries, which drain the Low Weald area through the South Downs, flowing out to sea at Shoreham, and the Teville Stream (designated as a main river) which drains the coastal area to the west of the River Adur.

23.4.2 The River Adur and its tributaries are situated in the High Weald, Low Weald and South Downs natural conservation areas (as defined by Natural England). The catchment is largely rural with a few urban centres such as Horsham and the urbanised coastal strip of Brighton and Hove, Shoreham and Worthing. The entire catchment of the River Adur is in excess of 600km^2 and extends from the south coast at Littlehampton in the west, Brighton and Hove in the east, northwards to Horsham and Haywards Heath. The upper and western branch of the Adur catchment spans most of Horsham and is underlain by the Weald Clay. As a result, the watercourses respond rapidly to rainfall causing the water to run-off the impermeable surface. There is, however, little history of flooding in this sub-catchment of the Adur and consequently there is a low risk to people and property in this area. This differs from the lower, more permeable chalk areas, which respond more slowly and can be a source of groundwater flooding from the chalk aquifers. Flooding can occur from a number of sources such as rivers overtopping their defences (fluvial flooding), urban surface water run-off and inadequate local drainage, run-off from fields and groundwater flooding as well as a mixture of tidal and fluvial flooding.

23.4.3 The River Adur to the south of Upper Beeding includes part of the Adur Estuary Site of Special Scientific Interest (SSSI) and consists of relatively flat low-lying ground in a valley between the South Downs. The defences along this stretch of river will not generally overtop unless the fluvial flooding is influenced by the tidal conditions.

23.4.4 The Teville Stream rises at allotments in Tarring, before flowing alongside Tarring Road and Teville Road for much of its length. Passing through Homefield Park and the playing fields of Davison High School, the stream continues into fields near East Worthing railway station, it meets with Broadwater Brook (also known as Sompting Brook) before turning abruptly southwards to Brooklands Lake, from where it flows into the English Channel. The Teville Stream forms a shallow valley, so land to the south of the stream rises, reaching a high point along the line of the A259 before falling again to the south, towards the sea where a flood storage lake is situated.

23.4.5 The Environment Agency also administers the internal drainage boards (IDB) to the south of the Horsham DC boundary along the River Arun and the River Adur.

Water Framework Directive

23.4.6 The South East River Basin Management Plan and the Environment Agency's web-based 'Flood Map' were used to determine which water bodies could be potentially affected by the proposed onshore works. The names, ID numbers, designation, status classification and objectives for all relevant water bodies were obtained from Annex B of the RBMP.

23.4.7 The water bodies listed in Table 23.5 have been identified within the study area (data extracted from the South East RBMP).

Table 23.5: WFD Water Bodies and Current Condition

Water Body	Current Status	Status Objective
Herrings Stream	Poor	Good by 2027
Woodsmill Stream	Moderate	Good by 2027
Hammer Stream	Moderate	Good by 2027
River Arun	Moderate	Good by 2027
Teville Stream	Bad	Good by 2027
Egerton Park Stream	Moderate	Good by 2027
Langley Sewer	Moderate	Good by 2027

23.4.8 As indicated in Table 23.5, under the WFD the Teville Stream has been designated as 'bad' ecological status and has numerous urban pressures. The WFD sets out structured mitigation measures to achieve good ecological potential. The Environment Agency is currently undertaking a project (Teville Stream Restoration) that investigates engineering options for improving Teville Stream.

Hydrology – Substation Site

23.4.9 The within a study area of 500m surrounding the proposed substation site contains a number of surface water features including approximately 23 surface water lagoons, possibly associated with water retention for irrigation purposes.

23.4.10 Within the site a small drainage ditch runs parallel to an existing north south hedge line. This ditch takes run off from the surrounding fields (see Target Note 278/271 in Appendix 24.11- referenced as a dry ditch).

Geology

23.4.11 A description of the geology along the proposed cable route is presented in Sections 22.4.7–22.4.19 and is summarised here. The solid geology beneath the first 2km from the landfall of the route comprises silty clay of the Woolwich and Reading Beds; this section of the route is also the most developed with commercial, industrial and public open space found alongside. These rocks typically have a lower infiltration rate, greater surface flow and intermediate sensitivity.

23.4.12 The underlying Chalk geology, which is found throughout much of West Sussex, underlies the majority of the proposed route (from 1.4km to 15.0km). These are overlain by generally shallow and well-drained chalk or lime dominated top soils that are often very shallow and can sustain little vegetation. Rain can easily infiltrate this geology through large fissures into the underlying chalk aquifers, which then emerges along a scarp-slope spring line further downstream towards the lower reaches of the River Adur.

23.4.13 The lower reaches of the River Adur catchment is underlain mainly by Chalk. Groundwater from the Chalk is likely to discharge into the river as base-flow at a relatively constant rate throughout the year. However, when groundwater levels rise groundwater flooding can occur, particularly in the broad chalk valleys. The upper reaches of the River Adur are underlain by silty mudstone of the Weald Clay, which retards infiltration and is further characterised by standing surface water features and higher rates of surface flow at times of heavy rainfall. Consequently, river flow rates in these geological settings can be influenced by precipitation and can be characterised by a greater range of flow conditions.

Flood Risk – Cable Route

23.4.14 The EA has available on their website flood zone maps for much of England and Wales. The latest EA flood zone map (Figure 23.1) indicates that the proposed cable route for the Project will cross all flood zone types.

23.4.15 Flooding from rivers occurs when water levels rise higher than bank levels, causing floodwater to spill across adjacent land (flood plain). The main reasons that water levels can rise in rivers are:

- Intense or prolonged rainfall causing run-off rates and flow to increase in rivers, exceeding the capacity the channel. This can be exacerbated by wet antecedent conditions and where there are significant contributions of groundwater;
- Constrictions in the river channel causing flood water to backup;
- Blockage of structures or the river channel causing flood water to backup; and

- High water levels and/or locked flood (tide) gates preventing discharge at the outlet of the river.

23.4.16 The proposed cable route will inevitably cross a number of watercourses and associated flood plains. As a result, the route will be located in all flood zone types over its course (Figure 23.1).

23.4.17 Flooding from the sea occurs when water levels in the sea rise above ground levels of coastal land. This can occur:

- During normal high tides, where land floods on a regular basis;
- When there are extreme atmospheric effects such as storm surges and tsunamis; and
- When wind action causes water levels of the sea to rise.

23.4.18 Flooding from the sea is a natural and regular occurrence in estuarine environments and coastal marshlands. All low-lying ground along the coastline of West Sussex is at risk. Where development has encroached on the coastal flood plain, flood defences have been constructed to prevent flooding from the sea.

23.4.19 The onset of flooding from the sea can be extremely rapid. Deep, fast-flowing floodwater can be extremely hazardous. The severity of flooding will depend on tide levels, wind and wave conditions and topography. The Environment Agency has provided tide levels for a range of return periods as presented in Table 23.6.

23.4.20 The coastline of West Sussex is heavily populated and sea defences mostly protect the area of low-lying land, which is at risk of flooding. However, these defences can be overtopped or can breach, which can cause extensive flooding of the land with significant flood depths and high velocities. Flooding from sea is hazardous to life, property and the environment. Significant rebuild is required after severe flood events. Flooding from sea can also last a long time in areas where gravity drainage to the sea is hindered by flood defences.

Table 23.6: Peak Tide Levels for a Range of Annual Return Periods

Annual Exceedance Probability (%)	Shoreham (m AOD*)	Brighton (m AOD*)
10	3.94	4.10
2	4.14	4.30
1	4.22	4.40
0.5	4.30	4.50

* AOD: Above Ordnance Datum

23.4.21 Flooding from land occurs when intense, often short duration rainfall is unable to soak into the ground or enter drainage systems. It is made worse when soils are saturated so that they cannot accept any more water. The excess water then ponds in low points, overflows or concentrates in minor drainage lines that are usually dry. This type of flooding is usually short-lived and associated with heavy downpours of rain. Often there is limited warning before this type of localised flooding occurs. Surface water run-off can cause localised flooding in natural valleys as normally dry areas become inundated and in natural low spots where water may collect.

23.4.22 Drainage basins or catchments vary in size and shape, which has a direct effect on the amount of surface run-off. The amount of run-off is also a function of geology, slope, climate, rainfall, saturation, soil type and vegetation. Geological considerations include rock and soil types and characteristics, as well as degree of weathering. Porous material (sand, gravel, and soluble rock) absorbs water more readily than fine-grained, dense clay or unfractured rock and has a lower run-off potential. Poorly drained material has a higher run-off potential and is more likely to cause flooding.

23.4.23 Flooding from sewers occurs when rainfall exceeds the capacity of networks or when there is an infrastructure failure.

23.4.24 Groundwater flooding is caused by the natural emergence at the ground surface of water originating from underlying permeable sediments or rocks (aquifers). The groundwater may emerge as one or more point discharges (springs) or as diffuse discharge/seepage over an extended area. Groundwater flooding tends to be more persistent than other sources of flooding, typically lasting for weeks or months rather than for hours or days.

23.4.25 Groundwater flooding does not generally pose a significant risk to life owing to the slow rate at which the water level rises; however, it can cause significant damage to property, especially in urban areas.

23.4.26 The EA has recently published flood risk mapping as a result of potential failure of reservoirs. This map shows that the Project site is not in an area at risk of flooding from this source. There are no other known structures in the vicinity of the Project site that could pose a flood risk to the cable route or the substation.

Flood Defences

23.4.27 A number of flood defences are present within the area of search (2km around the route). The main river flood defences in West Sussex typically consist of:

- Raised barriers such as walls or embankments;
- Online storage areas, which act to reduce flood peaks by attenuating flood waters prior to discharge back into the river network;

- Diversion of flows from high risk areas, or increasing channel capacity to carry greater flow through high risk areas (e.g. widening, deepening and straightening of channels); and/or

- Other structures that modify the natural flow of rivers, including weirs, sluices, culverts and bridge crossings, and bank protection works.

23.4.28 The main raised defence structures in West Sussex are earth embankments that run along the Adur and Arun rivers. The embankments run along the middle and lower reaches and protect against river and sea flooding. On the Adur there are secondary defences known as counterbanks, which are at right angles to the river. The purpose of this is to restrict flooding to a smaller, more confined area if the raised flood embankments are overtopped. There are also several small earth embankments around Selsey.

23.4.29 The Environment Agency and local planning authorities carry out annual inspections of flood defence assets and update National Flood and Coastal Defence Database (NFCDD). The data from these inspections is used to inform the owner of their duty to maintain assets to an appropriate level.

23.4.30 The management of the river and coastal defences and assets within West Sussex is divided between several different parties. The Environment Agency is responsible for the majority of the tidal and river defences and has a supervisory duty over all flood defences given under the Environment Act 1995.

23.4.31 The coastal frontage between Sea Lane, Ferring and Western Road, Lancing is managed by Worthing Borough Council under its permissive powers as the Coast Protection Authority given by the Coast Protection Act 1949. This excludes the coastline between Ferring, Sea Lane and the Borough Boundary (approx. 250m) for which the Council is only the landowner.

23.4.32 The proposed cable route crosses the following flood defences:

- Coastal sea defences (groynes) at the landfall; and

- Earth embankments that run along the River Adur.

Flood Risk – Substation Site

23.4.33 The Environment Agency has produced flood zone maps for much of England and Wales. The latest flood zone map shows the flood risk to the substation site is low, being located within flood zone 1.

23.4.34 Given the rural nature of the substation location, it is unlikely that there are any adopted sewer infrastructure serving the site; therefore, any new sewerage infrastructure will be installed in line with current best practice. Flooding at the site from this source is considered low.

23.4.35 Groundwater flooding is caused by the natural emergence at the ground surface of water originating from underlying permeable sediments or rocks (aquifers). The groundwater may emerge as one or more point discharges (springs) or as diffuse discharge/seepage over an extended area. Groundwater flooding tends to be more persistent than other sources of flooding, typically lasting for weeks or months rather than for hours or days. Groundwater flooding does not generally pose a significant risk to life owing to the slow rate at which the water level rises; however, it can cause significant damage to property, especially in urban areas. The soils around the Project's substation site are generally impermeable and therefore largely unresponsive to groundwater levels because of low infiltration. Owing to the type of development proposed, it is not thought that groundwater flooding will impact on the operations at the site.

23.4.36 If intense rain is unable to soak into the ground or be carried through man-made drainage systems, for a variety of reasons, it can run-off over the surface causing localised floods before reaching a river or other watercourse. Excess surface water flows from the site are believed to drain naturally to the local water features, either by overland flow or through infiltration. Flooding from this source is considered low and will be considered within the layout of the site by ensuring sensitive equipment is not located within a low spot on the site; this should ensure the development is not at increased risk. Flooding of the site from this source is considered low.

23.4.37 A number of small ponded areas have been identified from the Ordnance Survey (OS) mapping, and following a walkover of the site and surrounding area it has been confirmed that all these water bodies are retained below the surrounding ground levels and are not retained by embankment. Therefore flooding from these water bodies is considered low. There are no other potential sources of flood risk known to the site.

23.4.38 The substation will be designed with reference to the potential impacts of climate change. This will include incorporating the increase in rainfall over the lifetime of the Project when designing the surface-water management system.

23.5 Assessment of Impacts

Rochdale Envelope Principles

23.5.1 In line with the use of the "Rochdale Envelope" (see Section 5 – EIA Methodology), the assessment in this section has been based on a development scenario, which is considered to be the worst case in terms of impacts to surface water hydrology and flood risk. Rochdale Envelope principles relating to impacts on surface water hydrology and flood risk relate primarily to the area of temporary and permanent land take.

23.5.2 Installation of the cable will require a working width no wider than 30m (except at the locations where Horizontal Directional Drilling (HDD) is proposed), comprising 15m for the cable easement and 15m for additional areas for storage of excavated material and access along the cable trench. The cable easement will not necessarily be central to the working width. Therefore, the Development Boundary generally encompasses a working width of 40m along the cable route. A 40m working width been taken to represent the worst case scenario for the cable route assessment undertaken below.

23.5.3 The substation site covers an area of approximately 23.3 hectares. Approximately 7.01 hectares will be required for the permanent footprint of the substation, with the remainder required for site establishment, the temporary construction road, lay down areas and landscaping. For the assessment undertaken below, permanent land take of 7.01 hectares has been adopted as the worst case scenario.

Construction – Cable Route

Hydrology

23.5.4 The watercourses along the onshore cable route mainly comprise field drains and ditches. These will be diverted and reinstated on completion of the cable installation works.

23.5.5 Apart from the River Adur crossing identified for HDD, the default crossing method of watercourses will be trenching, but mini-HDD may also be employed in certain cases. Open-cut trenching through watercourses could potentially result in hydrological changes, including possible disturbance and modification to flows, and potential impacts to water users. The banks and beds of watercourses are also potentially at risk of physical damage.

23.5.6 The onshore cable route generally passes through agricultural land and, therefore, a potential impact on surface waters may arise from silt discharged from the working width during sudden rainfall events mobilising silt and materials. Suspended solids produced during construction can potentially produce adverse effects on aquatic ecology. In particular, suspended solids may have an effect on:

- The survival of fish eggs in gravel beds or spawning grounds as a result of deoxygenation caused by silt deposition;
- The survival of plants and algae by smothering;
- The survival of young fish and aquatic invertebrates such as dragonflies through gill damage from sediment particles;
- The success of angling owing to increased turbidity; and
- Amenity value through impaired visual appearance.

23.5.7 Other potential impacts to surface waters include:

- Risk of accidental spillages from oil and fuel storage facilities as well as construction materials; and
- Risk of adverse impacts to surface water quality as a result of the mobilisation of existing contaminants.

23.5.8 There is potential for the cable trenches to act as drainage channels for surface water run-off or lead to the drainage of the near surface water table water. Where trenches are constructed on slopes the flow of water could potentially lead to the erosion of soils, which could enter watercourses. These potential effects would be particularly noticeable during wet weather periods.

23.5.9 The EA will be consulted during the detailed design phase to determine the most appropriate method for each crossing and the appropriate method statements will be prepared. A number of factors will affect the choice of crossing method, including depth of water, available space, duration of works, bed conditions, accessibility and potential ingress of water. Working widths are to be reduced to 20m at specific watercourse crossings (as listed in Section 2b Project Description (Onshore), Table 2b.1) where potential risk to stream ecology has been identified.

23.5.10 Potential impacts to surface waters as a result of HDD of watercourse crossings include risk of adverse impacts to surface water quality arising from the break-out of drilling muds.

23.5.11 HDD will also be used to cross the railway in the vicinity of the Teville Stream. The HDD drill pit will be located to the east of the proposed realignment for the Teville Stream thereby avoiding any impact on the realigned channel.

Water Quality

23.5.12 During onshore construction, the greatest risk will be when works in progress expose areas of bare ground or soils. Sudden rainfall events can mobilise silt and materials held within the site and, if not controlled, these will be conveyed to the surrounding area. To a lesser degree, there is a potential risk of accidental spillages.

Geology

23.5.13 Potential impacts common to all cable route construction works are outlined below:

- Risk of pollution to groundwater from fuel and chemical spills;
- Risk of pollution to groundwater from the mobilisation of existing contaminants;

- The cable trench creating a preferential pathway for the migration of groundwater and any contaminants contained within the groundwater;
- Dewatering activities for earthworks, excavations and HDD, which may impact surface watercourse flows fed by groundwater, and cause the drawing in of mobile contaminants from off-route sources; and
- Disruption of buried field drainage systems.

Flood Defences

23.5.14 The cable route will be constructed beneath the coastal sea defences using an HDD technique, as described in Section 2b (Project Description (Onshore)). Similarly, the River Adur flood defences will also be crossed using HDD. As a result, no potential impacts are expected on the coastal defences.

Climate Change

23.5.15 The cable route will be designed with reference to the potential impacts of climate change. This will include designing the cable route to take account of potential shoreline re-alignment and future coastal inundation plans, and ensuring that water stops are inserted in the trench to prevent the cable route acting as a conduit for groundwater.

Construction – Substation Site

23.5.16 Construction impacts are considered to occur as a consequence of the actual development (preliminary earthworks and construction operations) itself, and are all considered as being potentially adverse in nature. The following potentially significant impacts are typically associated with construction works and are considered relevant to the proposed onshore substation development:

- Site drainage;
- Surface water outfalls;
- Siltation;
- Storage and handling of materials / oils / chemicals;
- Delivery / storage of construction materials;
- Concrete mixing; and
- Cross-contamination of geological strata due to piling.

23.5.17 During construction, the greatest risk will be when construction works are being undertaken prior to completion of the proposed drainage system at the onshore substation site. Sudden rainfall events can mobilise silts and materials held within the site.

23.5.18 To a lesser degree the potential risk of accidental spillages from oil and fuel storage facilities as well as construction materials would be present on site. Cement, if leached into drainage ditches, water bodies or watercourses, would potentially have detrimental effects by drawing oxygen from the water altering the pH of the water. If these effects occur prior to the construction of the drainage network then direct discharge to the watercourse, drainage ditch, water bodies or groundwater may be a consequence.

Hydrology

23.5.19 Potential longer term impacts of the Project are considered to occur both as a consequence of changes to the onshore substation site's character and also future use of the development.

23.5.20 The following impacts are likely to be associated with the substation development:

- Run-off from roads, parking areas and other exposed processing areas potentially containing elevated levels of hydrocarbons (oils) and heavy metals;
- Increase in surface run-off from site leading to overloading of local drainage infrastructure during intense rainstorms;
- Development of the site should not affect the surrounding surface water features owing to the lack of hydraulic connectivity;
- Ditch diversions or culverting may be required to allow development of the substation; and
- The development will not affect the existing flooding regime, subject to suitable provision of drainage infrastructure on the site.

Water Quality

23.5.21 During onshore construction, the greatest risk will be when works in progress expose areas of bare ground or soils. Sudden rainfall events can mobilise silt and materials held within the site and, if not controlled, these will be conveyed to the surrounding area. To a lesser degree, there is a potential risk of accidental spillages of construction materials. Cement, if leached into surface-water features, could have detrimental effects by drawing oxygen from the water and altering the pH of the water. However, much of the works will be carried out below the level of the surrounding ground, thus any surface water run-off will be retained on site and will drain to the existing sewer network.

Operation – Cable Route

23.5.22 There are no planned maintenance activities that will impact on water resources during the operation of the onshore cable. Once constructed the cable route will not impede existing flood flow routes or impact on the volumetric attenuation of functional flood plains.

Operation – Substation Site

23.5.23 It is intended that surface water run-off from the proposed development once constructed will be discharged to groundwater through infiltration techniques or off-site at a controlled rate designed to closely mimic the existing situation.

23.5.24 Both the latest Sustainable Urban Drainage systems (SUDs) guidance and the Environment Agency recommend that SUDS, in whole or part, should be considered for all new development sites. It is therefore proposed to incorporate SUDs into the development and this can be a combination of both physical structures and techniques used to control surface water run-off as close to its origin as possible.

23.5.25 A wide variety of sustainable drainage options are available that can be applied in different ways to help manage both surface and groundwater in a sustainable manner. Specific solutions need to be developed for each site individually, the choice of which will depend on factors such as the nature of the site, the type of pollutants present and the hydrology of the area – the substation site is not located within a groundwater source protection zone.

23.5.26 The effectiveness of infiltration-based SUDs depends on the 'infiltration potential' of the soil, protection of such systems from siltation and avoidance of compaction of the ground during construction. There are currently no points of discharge off the substation site and it is assumed that any rainfall on the site either infiltrates into the soils or ponds on the surface. The proposed development will increase the impermeable area on the site and therefore reduce the potential area for infiltration; as a result the surface water run-off from the site is expected to increase unless mitigation measures are incorporated into the development. The site currently comprises 100% soft landscaping, so it is assumed that, where possible, the site will be covered by a suitable aggregate to allow for vehicle movements while allowing for infiltration to occur.

23.5.27 The effectiveness of infiltration devices can diminish with the silting up of the receiving substrata. This will need to be considered within the structures to provide attenuation for additional volume (approximately 20%), should this be the case. Silt traps and catch pits will be provided on-site to reduce the potential of siltation of the storage structure; these will be subject to a suitable maintenance programme.

Decommissioning – Cable Route

23.5.28 At decommissioning it is anticipated that the onshore cables will be left buried in situ, unless lifted to be replaced by new cables to be run along the same route as part of future developments or wind farm repowering. Details of the decommissioning of the cable route will be investigated in detail at the end of its service life. It is likely that ducting will remain in place; however, the cables may be pulled out of the ducts via the jointing bays. If the cables are removed, residual impacts on water resources and drainage would be of smaller scale than impacts described in this section for construction as works would only occur at specific locations.

Decommissioning – Cable Route

23.5.29 The onshore substation may continue to be used as a substation site after the original offshore wind farm has been decommissioned. It is quite possible that the substation will be upgraded for use by future offshore renewable developments. The decommissioning methodology cannot be finalised until immediately prior to decommissioning; the substation will be decommissioned inline with relevant policy at that time.

23.6 Mitigation Measures

Construction – Cable Route

Hydrology and Water Framework Directive

23.6.1 The majority of the minor watercourses along the cable route comprise field drains and ditches, and are likely to be diverted and reinstated on completion of the cable installation.

23.6.2 Mitigation measures to minimise physical damage to watercourses and prevent pollution, flooding and erosion during construction are described below:

- Watercourses will be temporarily flumed (by the installation of pipes) and ramped over where necessary to allow uninterrupted flow of water within the watercourse and a continuous running track for vehicles. Crossings will be timed, where possible, to coincide with periods of low flow;
- Method statements for the crossing and reinstatement of the watercourses along the cable route and for flume pipe installation will be agreed with the Environment Agency before the start of construction;
- A vegetated strip will be left adjacent to the watercourse, where possible, during construction;
- Banks will be reinstated following construction. Soft revetment materials will be used wherever possible to stabilise banks, where necessary;
- The cable will be buried at sufficient depth, to prevent scour and to allow a natural substrate to develop;
- Bank-side vegetation will be reinstated subject to restrictions on the replanting of large tree species in close proximity to the cable route;
- Fuels, lubricants, solvents, etc. will be stored in appropriately bunded areas and a range of other pollution prevention measures taken;
- All soils will be stored away from watercourses and any potentially contaminated soil will be stored on an impermeable surface and covered to reduce leachate generation and potential migration to surface waters;
- Limited sections of the trench line will be excavated at any one time; and
- Any dewatering will have appropriate treatment and disposal.

23.6.3 Unless otherwise agreed in writing there is no intention to abstract water from or discharge water into watercourses or water bodies adjacent to the working areas including groundwater. All existing ditches and field drains in close proximity to the working areas will be maintained and kept free from potential obstruction.

23.6.4 Any existing drains affected as part of the construction works will be restored following the duct laying and backfilling operations. This will be in accordance with landowner agreements. Furthermore, in areas of steep slopes or where there is a risk of flood risk areas becoming linked appropriate measures will be employed to prevent the flow of water along the trench – for example baffles being installed in trenches at regular intervals to disperse water evenly across the slope.

23.6.5 As required by the Water Resources Act 1991, river crossings will require appraisal from Environment Agency under flood defence consent process. The following activities on a main river (River Adur, Teville Stream and Cutlers Brook) require Environment Agency consent under Section 109 of the Water Resources Act 1991:

- The erection of any structure in, over or under a watercourse which is part of a main river;
- The alteration or repair of any structure in, over or under a main river if the work is likely to affect the flow of water in the main river or impede any drainage work; and
- The erection or alteration of any structure designed to contain or divert floodwaters of any part of the main river.

Groundwater

23.6.6 To mitigate potential impacts to groundwater resources the following measures will be implemented:

- Fuels, lubricants, solvents etc. will be stored in appropriately bunded areas and a range of other pollution prevention measures taken;
- Water stops will be installed to prevent the cable route trench altering groundwater flows;
- If the cable route encounters areas of contamination, and the trench has the potential to act as a conduit, water stops (e.g. clay plugs) will be placed in the trench when backfilling to prevent the formation of a preferential flow path;

- Temporary cut-off drains will be installed parallel to the trench-line, before the start of construction, to intercept soil and groundwater before it reaches the trench. These field drains will discharge to local drainage ditches through silt traps, as appropriate, to minimise sediment release; and

- Following cable installation, existing drains will be reinstated any pre-existing field drainage systems to pre-construction condition.

23.6.7 Unless otherwise agreed in writing there is no intention to abstract water from or discharge water into watercourses or water bodies adjacent to the working areas including groundwater. In the event that dewatering is required, the Environment Agency will be consulted and any necessary abstraction licence and environmental permit for discharge obtained. Prior to discharge it will be necessary to ensure that the water meets appropriate quality criteria. Discharge of water pumped out from excavations will, wherever possible, be to land after filtration to remove sediment and will be controlled under a 'permit to pump' that will define pump location, discharge point and filtration measures in advance and in accordance with best practice. This requirement will be incorporated into a Construction Environmental Management Plan (CEMP).

Flood Risk

23.6.8 In the vicinity of designated flood zone 3 (1-in-100-year flood extent, see Figure 23.1) the following measures to reduce the potential impact of the works in the event of a flood will be implemented:

- Where possible, stockpiles of excavated materials will be placed outside the flood plain, to avoid impeding any flood flows;

- If, because of constraints on available working areas, stockpiles must be sited within the flood plain, they will be set back from the edges of the watercourse to reduce the risk of silt run-off from the stockpiles to the watercourse;

- Gaps will be provided at intervals in the stockpiles to act as water pathways to ensure that floodwater movement is not hindered and flooding exacerbated;

- Any surplus excavated materials will be disposed of off-site as early as possible, to minimise the size of stockpiles and the consequent risk of obstructing water flows;

- No fuel or other hazardous substances will be stored within the flood plain and, where possible, mobile plant will be parked out of the flood plain at night or when not in use; and

- The flood plain area will be reinstated as early as possible during the summer growing season to ensure that vegetation can become established over the reinstated area before flooding is likely to occur to minimise the risk of unprotected topsoil being lost by scour during flooding.

23.6.9 The requirement for any further measures to reduce the potential impact of the works in the event of a flood will be discussed with the Environment Agency and implemented as agreed. Pollution Prevention and Emergency Response Plans will be developed to control construction works and will include a requirement to monitor weather forecasts and flood warnings. This requirement will be incorporated into a CEMP.

Flood Defences

23.6.10 At the landfall the cable route will be constructed beneath the coastal flood defences and River Adur flood defences using an HDD technique.

23.6.11 The defences will be maintained during construction with the detailed methodology. Crossings will be discussed and agreed with the Environment Agency, and the necessary consents obtained. Where the cable route has been completed in close proximity to flood defences a structural assessment will be carried out to ensure the defences remain operational with no detrimental impact.

Construction – Substation Site

On-site Hydrology

23.6.12 Many of the short-term impacts arising from the construction at the onshore substation site can be mitigated effectively by the utilisation of good construction techniques and the implementation of a CEMP. Where feasible, suitable construction techniques will be adopted to ensure that no migration pathways are created that could jeopardise groundwater quality. Where deeper foundations may be required, appropriate piling techniques will be used to minimise the associated risk.

23.6.13 A drainage ditch and farm track running parallel to the north to south tree line will also require diverting to allow for the development of the substation. This ditch is a field drain taking little more than localised run-off from the surrounding land and therefore falls under riparian ownership. Any works will ensure that any conveyance route (from other ditches) is maintained and that flows are not reduced from that at present.

23.6.14 Mitigation will include the use of appropriate measures as outlined in the Environment Agency PPGs to prevent spillage of potentially polluting substances, including the following guidance.

23.6.15 Guidance for storing and handling materials and products:

- PPG2: Above ground oil storage tanks;
- PPG 6: Working at construction and demolition sites;
- PPG 7: Refuelling facilities; and
- PPG 26: Drums and intermediate bulk containers.

23.6.16 Guidance for site drainage, dealing with sewage and trade effluents:

- PPG 3: Use and design of oil separators in surface water drainage systems;
- PPG 4: Disposal of sewage where no mains drainage is available; and
- PPG 13: Vehicle washing and cleaning.

23.6.17 Guidance on general good environmental practice:

- PPG 1: General guide to the prevention of pollution;
- PPG 5: Works in, near or liable to affect watercourses; and
- PPG 21: Incident response planning.

23.6.18 In applying the abovementioned PPG, the CEMP will incorporate the following:

- Appropriate storage and handling measures for all hydrocarbon fuels and lubricating oils, including the use of bunded storage areas or the use of double-skinned storage tanks;
- All wastes must be stored in designated areas that are isolated from surface water features and bunded to contain any spillages. Rubbish compactors should be covered to prevent the build-up of contaminated rainwater and drained to the foul sewer to prevent polluting liquid entering the surface water drains;
- The use of drip trays for static plant and designated refuelling areas for mobile plant. The implementation of appropriate spillage contingency measures to mitigate the impact of such spillages on the surface water network; and
- Appropriate personnel awareness training of the potential environmental implications of all construction work on-site.

Flood Risk and Drainage

23.6.19 To reduce the impact of uncontrolled run-off from the site during construction the following measures to reduce the potential impact of the works in the event of an extreme rainfall event will be implemented:

- Where possible, stockpiles of excavated materials will be placed away from the drainage system to minimise the potential for silt that may be mobilised entering the drainage network;

- Gaps will be provided at intervals in the stockpiles to act as water pathways to ensure that floodwater movement is not hindered and surface water flooding is not exacerbated;

- Any surplus excavated materials will be disposed of off-site as early as possible to minimise the size of stockpiles and the consequent risk of obstructing water flows; and

- No fuel or other hazardous substances will be stored within close proximity to the drainage network and where possible mobile plant will be parked within designated compounds at night or when not in use.

Operation

23.6.20 No mitigation measures are required during cable operation.

23.6.21 The surface water drainage scheme for the onshore substation site will be designed to meet the requirements of the NPPF by limiting the post-development off-site run-off to the equivalent predevelopment rate for the site while providing sufficient on-site attenuation for rainfall events up to the 1-in-100 year rainfall event, including a suitable allowance for climate change over the lifetime of the Project.

23.6.22 The reduction in groundwater recharge due to an increase in impermeably surfaced area will have a small impact. Subject to further investigations there is potential for clean surface water run-off to discharge to groundwater through infiltration, thus limiting the impact.

23.6.23 The proposed surface-water drainage network will require a programme of maintenance to ensure that siltation does not reduce the efficiency of the network. It has been assumed that the on-site drainage will be privately owned and operated; therefore, this will need to be carried out by the site owner/operator.

Decommissioning

23.6.24 During decommissioning of the cable the ducts will remain in position and therefore mitigation would relate to those areas where the cable will be pulled from the ducts. Mitigation measures at these specific location are likely to be similar to that during construction.

23.6.25 During decommissioning of the substation, similar mitigation measures to those described for the construction phase are likely to be required to prevent contamination, such as from silt laden run-off arising from vehicle movements on site. Any new legislation or guidelines published prior to decommissioning will be adhered to and incorporated into mitigation design prior to any decommissioning taking place.

23.7 Residual Effects

23.7.1 The proposed development has a number of mitigation measures that will reduce its impact on the water environment. The residual effects, i.e. those likely to remain following adoption of mitigation measures, are summarised in Table 23.7 below.

23.7.2 The greatest impact is to the surrounding area. However, the proposals include the control and attenuation of rainfall run-off from the onshore substation site during most storm events. These proposals can also add increased ecological variety and the opportunity to enhance the wildlife habitat around the substation site.

23.7.3 Impacts resulting from spillages of oils and operational compounds would be minimised by appropriate site management procedures.

23.7.4 The cable route crosses area of known floodplain, therefore placing plant and the workforce at potential risk. Works within the flood plain should be avoided where possible, however where this is unavoidable a flood plan should be established to inform the workforce what actions should take place should a flood event occur, this plan should also consider a safe egress route away from the source of flooding.

23.8 Cumulative Impacts

23.8.1 Although a final option for the Teville Stream Restoration scheme has not been commissioned, the Environment Agency has indicated that construction of the final Teville Stream Restoration option is to commence within the 2012/2013 financial year. Should this occur, the proposed Project cable route will follow the completion of the restoration scheme, paying due attention to the new route of the stream and implementing mitigation. Should the Teville Stream project be delayed, the timing of the construction works could coincide with the construction of the cable route. Should this be the situation it could be advantageous to carry out ground works in conjunction with each other to avoid additional groundworks and diversion of the watercourse.

23.8.2 Once in situ and the working areas have been restored, the cable route will have no residual impact on the Teville Stream.

23.8.3 The following planned developments are noted in the vicinity of the proposed substation:

- Modifications to the existing National Grid Bolney substation (associated with Rampion connection).
- Modifications to the existing National Grid Bolney substation (not associated with Rampion).

23.8.4 Recent discussions between National Grid and E.ON have indicated that the works associated with the Rampion connection would fall outside NGET's permitted development rights and therefore planning consent would be required. E.ON intends to apply for planning permission from Mid Sussex District Council for these works.

23.8.5 It is understood that National Grid will undertake the works not associated with Rampion as Permitted Development with pre-application consultation with the LPA expected in 2013.

23.8.6 The National Grid Bolney substation modifications will be located in close vicinity to the works required as part of the Rampion Project. The Bolney modifications will be located on land immediately adjacent to the existing National Grid operational land at Bolney.

23.8.7 Should the timing of the Bolney construction works coincide with the construction of the Rampion substation precautions should be taken to ensure surface water run-off from both development sites do not impact on the surrounding hydrology. Any drainage solution should ensure silt and other pollutants do not enter the existing watercourses.

23.9 References

Department for Communities and Local Government (DCLG), 2010 “Planning Policy Statement – Development and Flood Risk” PPS 25, Mar 2010.

Department for Communities and Local Government (DCLG), 2012“Technical Guidance to the National Planning Policy Framework”, Mar 2012.

DEFRA, 2004 “Interim Code of Practice for Sustainable Drainage Systems” National SUDS Working Group, July 2004.

Department for Communities and Local Government (DCLG), 2012 *National Planning Policy Framework* Available from:
http://www.communities.gov.uk/documents/planningandbuilding/pdf/2116950.pdf

Table 23.7: Summary of Impacts, Mitigation Measures and Significance of Effects

Aspect	Impact	Proposed Mitigation Measures	Sensitivity	Magnitude	Residual Effect
Construction Phase					
Surface Water Hydrology	Disruption of soil drainage leading to potential soil saturation and/or field flooding.	Land drainage systems will be maintained during construction and reinstated on completion	Medium	Medium	Moderate
Surface Water Hydrology	Risk of pollution from spills during construction	Fuels, lubricants, solvents, etc. will be stored in appropriately bunded areas and should not be stored near watercourses if possible	Medium	Medium	Moderate
Surface Water Hydrology	Physical damage to watercourses	Watercourses will be temporarily flumed to allow the passage of plant and machinery A vegetated strip will be left adjacent to the watercourse, where possible, during construction Banks will be reinstated following construction. Soft revetment materials will be used wherever possible to stabilise banks, where necessary The cable will be buried at sufficient depth, to prevent scour and to allow a natural substrate to develop Bank-side vegetation will be reinstated subject to restrictions on the replanting of large tree species in close proximity to the cable route Method statements for the watercourse crossings will be agreed with the Environment Agency before construction begins	Medium	Medium	Moderate
Surface Water Hydrology	Risk of pollution to surface watercourses from silt run-off or discharges of water pumped from excavations	Discharges to watercourses and sediment run-off will be controlled, to prevent pollution. In addition, where practicable, vegetated strips will be retained adjacent to watercourses to impede surface water run-off and to catch sediment	Medium	Medium	Moderate

Aspect	Impact	Proposed Mitigation Measures	Sensitivity	Magnitude	Residual Effect
Surface Water Hydrology	Risk of pollution to surface water from fuel and chemical spills and leachate from contaminated soils	Fuels, lubricants, solvents etc. will be stored in appropriately bunded areas All soils will be stored away from watercourses and any potentially contaminated soil will be stored on an impermeable surface and covered to reduce leachate generation and potential migration to surface waters	Medium	Medium	Moderate
Surface Water Hydrology	The stockpiling of excavated materials could hinder water flows and exacerbate flooding in flood risk areas	Gaps will be provided at intervals within soil stockpiles to act as drainage pathways Stockpiles will be set back at least 10m from watercourses Surplus materials will be disposed promptly off-site	Low	Small	Minor
Surface Water Hydrology	The cable route trench could act as a preferential pathway for groundwater flow, potentially resulting in down-slope flooding	Water stops will be placed in the trench to ensure that groundwater flows are not significantly altered by the presence of the cable	Low	Small	Minor
Groundwater	Potential for the cable route to create a migration pathway for contaminated groundwater	If the cable route encounters areas of different chemical composition, and the trench has the potential to act as a conduit, water stops (e.g. clay plugs) will be placed in the trench when backfilling to prevent the formation of a preferential flow path	Medium	Small	Minor
Groundwater	Pollution from fuels and lubricants	Fuels, lubricants solvents, etc., will be stored in appropriately bunded areas	Medium	Medium	Moderate
Groundwater	Disruption of buried field drainage systems	Land drainage systems will be maintained during construction and reinstated on completion	Medium	Small	Minor

Aspect	Impact	Proposed Mitigation Measures	Sensitivity	Magnitude	Residual Effect
Groundwater	Dewatering activities for earthworks which may impact surface watercourse flows fed by groundwater	Discharge of water pumped out from excavations will, wherever possible, be to land after filtration to remove sediment and will be controlled under a 'permit to pump' that will define pump location, discharge point and filtration measures in advance and in accordance with best practice	Medium	Small	Minor
Springs, Abstractions and Discharges	For springs and abstractions, see Groundwater and Surface Water, above Physical damage or disruption of existing discharges	Flume all minor watercourses to ensure that flows to downstream abstraction points are not affected	Low	Small	Minor
Operational Phase – Substation Site					
Surface Water Run-off	Increase in surface water run-off from new hard standing areas	On-site attenuation restricting any run-off to a rate agreed with the relevant bodies.	Low	Small	Minor
Flood Risk	Flooding of infrastructure	Flood risk is low, consideration should be given to the surface water run-off and overland flow routeing	Low	Small	Minor

Rampion Offshore Wind Farm

ES Section 23 – Surface Water Hydrology and Flood Risk - Appendix 23.1

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Revision A

E.ON Climate & Renewables UK Rampion Offshore Wind Limited

E.ON

Flood Risk Assessment

Rampion Wind Farm Proposed Onshore Cable Route

41318 FRA R1 (3)

NOVEMBER 2012

RSK

RSK GENERAL NOTES

Project No.: 41318- FRA R1 (3)

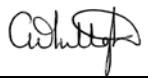
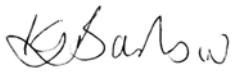
Title: Rampion Onshore Cable Route Flood Risk Assessment

Client: E.ON

Date: November 2012

Office: Helsby

Status: Final

Author	C Whittingham	**Technical reviewer**	I Clark
Signature		Signature	
Date:	27/11/12	Date:	27/11/12
Project manager	K Barlow		
Signature			
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APPENDICES

1 INTRODUCTION

RSK Environment Ltd has been commissioned by E.On to undertake a flood risk assessment for the proposed onshore cable routing between a landfall near Worthing and a substation located near to Bolney, West Sussex. This report assesses the flood risk associated with the development of the proposed onshore cable route and is included as an addendum to the hydrology chapter of the Environmental Statement.

The publication of the National Planning Policy Framework (NPPF, Ref. 1) has revoked PPS 25 (Ref. 2) amongst others on 27th April 2012. The Technical Guidance to the National Planning Policy Framework (April 2012)(Ref.3) includes flood risk guidance and retains key elements of PPS 25 (Ref. 2) including the Sequential and Exception Tests, climate change allowances and development classifications. The information contained in this new technical guidance along with the NPPF when combined with guidance contained in the Communities and Local Government "Planning Policy Statement 25: Development and Flood Risk Practice Guide", Dec 2009 (Ref. 4) and the British Standard BS 8533-2011 "Assessing and managing flood risk in development Code of practice" (Ref. 5) will form the basis of any on-going RSK flood risk documentation.

This FRA was prepared based on PPS25 and the accompanying guidance documentation as well as the BS. As a result, the publication of the NPPF containing much of the main criteria for assessing flood risk will not alter the conclusions or recommendations of this report.

The comments given in this report and the opinions expressed are subject to RSK Group Service Constraints provided in **Appendix A**.

2 CONTEXT AND SCOPE OF WORKS

A key element of project development is to prepare a Flood Risk Assessment to establish the risk associated with the proposed development and to propose suitable mitigation, if required to reduce the risk to a more acceptable level.

Although officially revoked and replaced by the NPPF the scope of work relating to a flood risk assessment is based on the guidance provided in PPS 25 (Ref. 2) and the accompanying guidance published by the Communities and Local Government Office (Ref. 4) and comprise of the following elements:

- To obtain information on the hydrology and hydrological regime in and around the site.
- To obtain the views of the Environment Agency including scope, location and impacts.
- To determine the extent of new flooding provision and the influence on the site.
- To review site surface water drainage based on the proposed route. To determine the extent of infrastructure required.
- To review information and other studies to determine the existing site conditions.
- To assess the impact on the site from global warming effects and anticipated increases in rainfall.
- Preparation of a report including calculations and summaries of the source information and elements reviewed.

3 SITE DESCRIPTION

3.1 Cable Routing

A cable route will be installed from the cable joint between the offshore and onshore cables to the substation location at Bolney (**Figure 1**). Four circuits will be installed along the route and each circuit will comprise of three single core XLPE insulated copper cables as well as associated communications cables. Ducting will be put into the ground prior to the installation of the cables. The ducts will primarily be installed in trenches, which will be backfilled before the cable is installed. At regular intervals along the ducted route there will be a joint bay in order that the cables may be pulled through the ducts and connected to the previous installed cable.

It is expected the when installing the cable using a trenching method that each of the circuits will have to placed approximately 3m apart, therefore a permanent 15m wide easement strip is being sought with all the landowners. In addition to the permanent easement strip and additional area of land up to 15m wide will be required to enable the installation of the ducting and cables, this land will be used to place spoil and to track vehicles.

At various points along the route there will be a requirement to install temporary site compounds which will provide site facilities for the workforce as well as to provide a secure area for site equipment.

Where it is not possible to install the ducting in open cut trenches the cable will have to be installed using trenchless techniques, this is typically required to install ducting under obstacles e.g. river or rail crossings. This will require the use of specialist equipment to install ducting without the need for digging a trench along the whole cable route.

To install ducting using trenchless techniques will require additional land at the point where the ducting is installed and where it rises on the other side of the obstacle. The working width will be extended at these locations.

3.2 Onshore Substation

An onshore substation will be required to transform the voltage from the transmission voltage up to the connection voltage of 400kV. A new substation will be constructed in the vicinity of the existing national grid substation at Bolney. This assessment has not considered the flood risk associated with the proposed substation (See Flood Risk Assessment prepared for the proposed substation 41318.FRA.R2).

4 SOURCE OF FLOOD RISK

In accordance with NPPF (Ref. 1) and advice from the Environment Agency, a prediction of the flood sources and levels is required along with the effects of climate change from the present for the design life of the development (in this case assumed to be 100 years). To consider these effects of climate change, NPPF Technical Guidance Table 5 recommends consideration of a 30% increase in rainfall intensity and 20% increase in peak river flows over this timeframe.

The flood risk elements that need to be considered for any site are defined in BS 8533 as the "Forms of Flooding" and are listed as:

- Flooding from Rivers (fluvial flood risk)
- Flooding from the Sea (tidal flood risk)
- Flooding from the Land
- Flooding from Groundwater
- Flooding from Sewers (sewer and drain exceedance, pumping station failure etc)
- Flooding from Reservoirs, Canals and other Artificial Structures

The following section reviews each of these in respect of the proposed cable route.

4.1 Environment Agency Flood Zone

The Environment Agency has available on their website flood zone maps for much of England and Wales. The latest Environment Agency floodzone map (**Figure 1**) indicates that the proposed cable route will cross all Flood Zones.

4.2 Fluvial Flood Risk

Flooding from rivers occurs when water levels rise higher than bank levels, causing floodwater to spill across adjacent land (floodplain). The main reasons that water levels can rise in rivers are:

- intense or prolonged rainfall causing runoff rates and flow to increase in rivers, exceeding the capacity the channel. This can be exacerbated by wet antecedent conditions and where there are significant contributions of groundwater;
- constrictions in the river channel causing flood water to backup;
- blockage of structures or the river channel causing flood water to backup;
- high water levels and/or locked flood (tide) gates preventing discharge at the outlet of the river.

The proposed cable route will inevitably cross a number of watercourses and associated floodplains. The cable route will not be impacted by or cause an impact on this source of flooding. Once constructed the route will not impede existing flood flow routes or impact on the volumetric attenuation of functional floodplains.

4.3 Tidal Flood Risk

Flooding from the sea occurs when water levels in the sea rise above ground levels of coastal land. This can occur:

- during normal high tides - where land floods on a regular basis;
- when there are extreme atmospheric effects such as storm surges;
- when wind action causes water levels of the sea to rise.

Flooding from the sea is a natural and regular occurrence in estuarine environments and coastal marshlands. All low-lying ground along the coastline of West Sussex is at risk. Where development has encroached on the coastal floodplain, flood defences have been constructed to prevent flooding from the sea.

The onset of flooding from the sea can be extremely rapid. Deep fast flowing flood water can be extremely hazardous. The severity of flooding will depend on tide levels, wind and wave conditions and topography.

The coastline of West Sussex is heavily populated and the area of low lying land which is at risk of flooding is mostly protected by sea defences. However, these defences can be overtopped or can breach, which can cause extensive flooding of the land with significant flood depths and high velocities. Flooding from sea is thus hazardous to life, property and the environment. Significant rebuild is required after severe flood events. Flooding from sea can also last a long time in areas where gravity drainage to the sea is hindered by flood defences.

Extreme water levels have been determined along the West Sussex coastline:

AEP (%)	Shoreham (m AOD)	Brighton (m AOD)
10	3.94	4.1
2	4.14	4.3
1	4.22	4.4
0.5	4.3	4.5

Tidal flooding may occur at the landfall location, however the cable route will not be impacted by or cause an impact on this source of flooding.

4.4 Flooding From the Land

Flooding from land occurs when intense, often short duration rainfall is unable to soak into the ground or enter drainage systems. It is made worse when soils are saturated so that they cannot accept any more water. The excess water then ponds in low points, overflows or concentrates in minor drainage lines that are usually dry. This type of flooding is usually short lived and associated with heavy downpours of rain. Often there is limited warning before this type of localised flooding occurs. Surface water runoff can cause localised flooding in natural valleys as normally dry areas become inundated and in natural low spots where water may collect.

Drainage basins or catchments vary in size and shape, which has a direct effect on the amount of surface runoff. The amount of runoff is also a function of geology, slope, climate, rainfall, saturation, soil type and vegetation. Geological considerations include rock and soil types and characteristics, as well as degree of weathering. Porous material (sand, gravel, and soluble rock) absorbs water more readily than fine-grained, dense clay or unfractured rock and has a lower

runoff potential. Poorly drained material has a higher runoff potential and is more likely to cause flooding.

Flooding from this source may occur in localised pockets, however the cable route will not be impacted by or cause an impact on this source of flooding.

4.5 Sewer Exceedance

Flooding from sewers occurs when rainfall exceeds the capacity of networks or when there is an infrastructure failure.

Although there maybe issues with sewer flooding along the cable route, the cable route will not be impacted by or cause an impact on this source of flooding.

4.6 Groundwater Flooding

Groundwater flooding is caused by the natural emergence at the ground surface, of water originating from underlying permeable sediments or rocks (aquifers). The groundwater may emerge as one or more point discharges (springs) or as diffuse discharge/seepage over an extended area. Groundwater flooding tends to be more persistent than other sources of flooding, typically lasting for weeks or months rather than for hours or days.

Groundwater flooding does not generally pose a significant risk to life due to the slow rate at which the water level rises; however, it can cause significant damage to property, especially in urban areas.

Due to the type of development proposed, it is not thought that groundwater flooding will impact on the cable route.

4.7 Flooding from Reservoirs, Canals and other Artificial Structures

The Environment Agency has recently published flood risk mapping as a result of potential failure of reservoirs. This map shows that the site is not in an area at risk of flooding from this source. There are no other known structures in the vicinity of the cable route, which could pose a flood risk to the route.

The cable route is not thought to be at risk from this source.

4.8 Flood Defences

A number of flood defences are present over the length of the study area. The main river flood defences in West Sussex typically consist of

- Raised barriers such as walls or embankments;
- Online storage areas which act to reduce flood peaks;

- Diversion of flows from high-risk areas, or increasing channel capacity to carry greater flow through high risk areas (e.g. widening, deepening and straightening of channels); and
- Other structures that modify the natural flow of rivers, including weirs, sluices, culverts and bridge crossings and bank protection works.

The main raised defence structures in West Sussex are earth embankments that run along the Rivers Adur and Arun. The embankments run along the middle and lower reaches and protect against river and sea flooding. On the Adur there are secondary defences known as counterbanks, which are at right angles to the river. The purpose of this is to restrict flooding to a smaller, more confined area if the raised flood embankments are overtopped. There are also several small earth embankments around Selsey.

The Environment Agency and LPA carry out annual inspections of flood defence assets and update the National Flood and Coastal Defence database (NFCDD). The data from these inspections is used to inform the owner of their duty to maintain assets to an appropriate level.

The management of the river and coastal defences and assets within West Sussex is divided between a number of different parties. The Environment Agency is responsible for the majority of the tidal and river defences and has a supervisory duty over all flood defences given under the Environment Act 1995.

The coastal frontage between Sea Lane Ferring and Western Road, Lancing is managed by Worthing Borough Council under its permissive powers as the Coast Protection Authority given by the Coast Protection Act 1949. This excludes the coastline between Ferring, Sea Lane and the Borough Boundary (approx. 250m) for which the Council is only the landowner.

4.9 Historic Flood Events

There have been many recorded flooding incidents across West Sussex. Two of the largest events occurred in 1974 and 2000 where widespread flooding was observed across the County. River flooding affects many of the watercourses, in particular the Lavant through Chichester and the Adur through Steyning, Upper Beeding, Shoreham and surrounding villages. **Appendix B** summarises the known historic flood events.

The coastline from Selsey to Beachy Head has been protected from flooding for a long period of time using various flood defences. These defences now provide protection to high density, urban developments in low-lying areas along the coast. The removal / failure of these defences would result in erosion of the beach and extensive flooding.

Flooding from Brighton Marina to River Arun is mainly due to overtopping of coastal defences due to wave action. The Coastal Defence Strategies identify that the coastline is mostly at risk of coastal erosion rather than flooding, as water tends to only overtop the existing defences during severe storm events. Locations that have experienced wave overtopping during storms are Aldrington, where houses are located on the beach crest, and Portslade-by-Sea.

4.10 Groundwater Source Protection Zones (SPZ)

Groundwater Source Protection Zones (SPZs) are zones designated by the Environment Agency to protect groundwater around registered abstraction points from contamination; **Figure 2** shows the location of the Source Protection Zones. The proposed cable route crosses a

number of SPZ 3 near Upper Beeding. A SPZ 3 is defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75.

The majority of the route is not located within a SPZ.

4.11 Surrounding Geology

Much of West Sussex is underlain by chalk. The chalk strata of the South Downs are overlain by generally shallow and well-drained chalk or lime dominated topsoils that are often very shallow and can sustain very little vegetation. Rain can easily infiltrate this geology through large fissures into the underlying chalk aquifers and is released slowly through springs further downstream. A characteristic of the South Downs is the spring line along the escarpment. Rain soaks through the shallow soils of the Downs into the chalk and will eventually emerge at the base of the scarp slope as springs.

The River Adur catchments are underlain by chalk. Streams respond to seasonal groundwater variations and groundwater flooding occurs in the broad chalk valleys. The deeper soils in the chalk valley bottom have a large storage capacity. Large areas of the county have relatively impermeable soils, the parent material of which is the dominant bedrock of the Weald, Sandstone. This bedrock weathers quickly in geological terms, leaving clay-rich soils, which generate a large amount of runoff quickly. The upper River Ouse, the upper River Adur and the Sussex Rifes are underlain by impermeable geology.

4.12 Impact of Flooding to the Development

Due to the type of cabling used, a flood event should not have an adverse impact on the function of the infrastructure and should remain operational during a flood event.

5 MITIGATION MEASURES

Small trenches will be dug for the laying of electric cables linking the landfall site to the substation. These small trenches could act as drainage channels for surface water runoff or lead to the drainage of the near surface water table water. Where trenches are constructed on slopes the flow of water could lead to the erosion of soils, which could enter watercourses. These potential effects would be particularly noticeable during wet weather periods. Mitigation measures are therefore required to avoid damage to soil drainage or soil erosion during this short-term activity.

The cables in the grid connection corridor will predominately be buried in underground trenches. It is proposed to cross all major watercourses via directional drilling, the exact method will be agreed with the Environment Agency before construction.

Stream crossings can be identified along the route as those that permanently contain flowing waters throughout the year and as such they differ from drainage ditches around farmland. The cable route haul road will traverse across the stream using a temporary bridge, which will lie within the working width. The exact methodology to achieve an open trench across each stream and the temporary bridge arrangements required will be decided by the works contractor. The required cover underneath the streambed determines the profile of the trench running through the stream, surrounding stream bank profiles and minimum bend radii of the ducting trefoil.

The Environment Agency will be consulted during the detailed design phase to determine the most appropriate method for each crossing and the appropriate method statements will be prepared. A number of factors will affect the choice of crossing method including: depth of water; available space; duration of works; bed conditions; accessibility; and potential ingress of water. The default crossing method of watercourses will be trenching, but mini-HDD may also be employed in certain cases.

Open cut crossings can either be wet or dry. One dry technique involves damming the watercourse upstream and downstream of the crossing, thus creating a dry area where the cable will cross. Water is then pumped from where it has been impounded upstream and discharged downstream of the crossing area. In the wet open cut technique, construction takes place within flowing water. The cable trench is typically constructed across the watercourse by equipment operating from either the banks laid in the river to maintain flow and provide an equipment crossover from one bank to the other. After excavation of the trench, a section of ducting will be placed into the trench.

Timing of the works is important – periods of low flow will be chosen wherever practicable. This will result in a quicker deposition from the water column of any sediment released.

The effects of trenching could result in an increase of surface runoff causing water contaminated with elevated suspended solids to enter nearby watercourses. All effects would be particularly noticeable in wet periods. Mitigation measures are therefore required to avoid damage to soil drainage or soil erosion during this short-term activity. Where the cable crosses watercourses there is the potential of pollution to watercourses from disturbed sediments. Mitigation measures will need to address these effects.

Mitigation measures associated with the cable trenches in the cable route corridor will include:

- a suitable stand-off applied to all watercourses (8m for main rivers);
- soil movement undertaken with reference to best practice guidelines;
- limited sections of the trench line excavated at any one time; and

- any dewatering to have appropriate treatment and disposal.

Measures will be taken to safeguard both groundwater and aquifers through the implementation of appropriate site design and drilling techniques.

Should dewatering of the trenches be required, this will involve pumping the water into settlement tanks prior to discharge to a local watercourse, with the approval of the Environment Agency. All existing ditches and field drains in close proximity to the working area will be maintained and kept free from potential obstruction.

6 CONCLUSIONS AND RECOMMENDATIONS

A flood risk assessment for the proposed onshore cable route confirms that the proposed development meets the requirements of PPS 25 in relation to flood risk to the development and the impact posed by development.

The proposed mitigation measures incorporated into this report will ensure that the installation of a cable route will pose little threat to the existing hydrology of the area. There will be no impact on the hydrology of the watercourses along the proposed route once complete.

7 REFERENCES

1. Communities and Local Government “National Planning Policy Framework” NPPF, Mar 2012.
2. Communities and Local Government “Planning Policy Statement – Development and Flood Risk” PPS 25, Mar 2010.
3. Communities and Local Government “Technical Guidance to the National Planning Policy Framework”, Mar 2012.
4. DEFRA “Interim Code of Practice for Sustainable Drainage Systems” National SUDS Working Group, July 2004.
5. BS 8533-2011 Assessing and managing flood risk in development Code of practice, Nov 2011.

FIGURES

110000 N

105000 N

100000 N

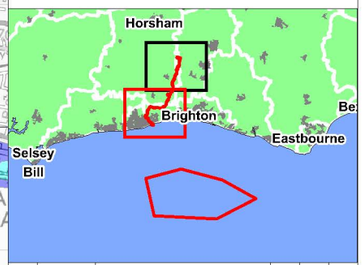
515000 E

520000 E

525000 E

Legend :

- Development Area
- Study Area
- Flood Zone 2
- Flood Zone 3



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04	26.11.12	New Development Area	AJ	CW	KB
03	18.10.12	New Route	DL	CW	KB
02	02.04.12	Third Draft	AJ	CW	KB
01	24.10.11	Second Draft	AJ	CW	KB

Rampion Offshore Wind Farm

RSK e·on

Title :

Figure 1 - Flood Zones
(Map 1 of 2)

0 0.5 1
kilometres

Scale = 1:50,000 @ A3

N W E S

REV 04

FILE NAME: \P41318 - Hastings Offshore Wind Farm\05 - GIS\App 23.1 Flood Map 1 wor

125000 N

120000 N

115000 N

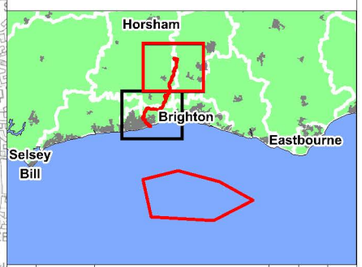
520000 E

525000 E

530000 E

Legend :

- Development Area
- Study Area
- Flood Zone 2
- Flood Zone 3



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Rampion Offshore Wind Farm

RSK e·on

Title :

Figure 1 - Flood Zones
(Map 2 of 2)

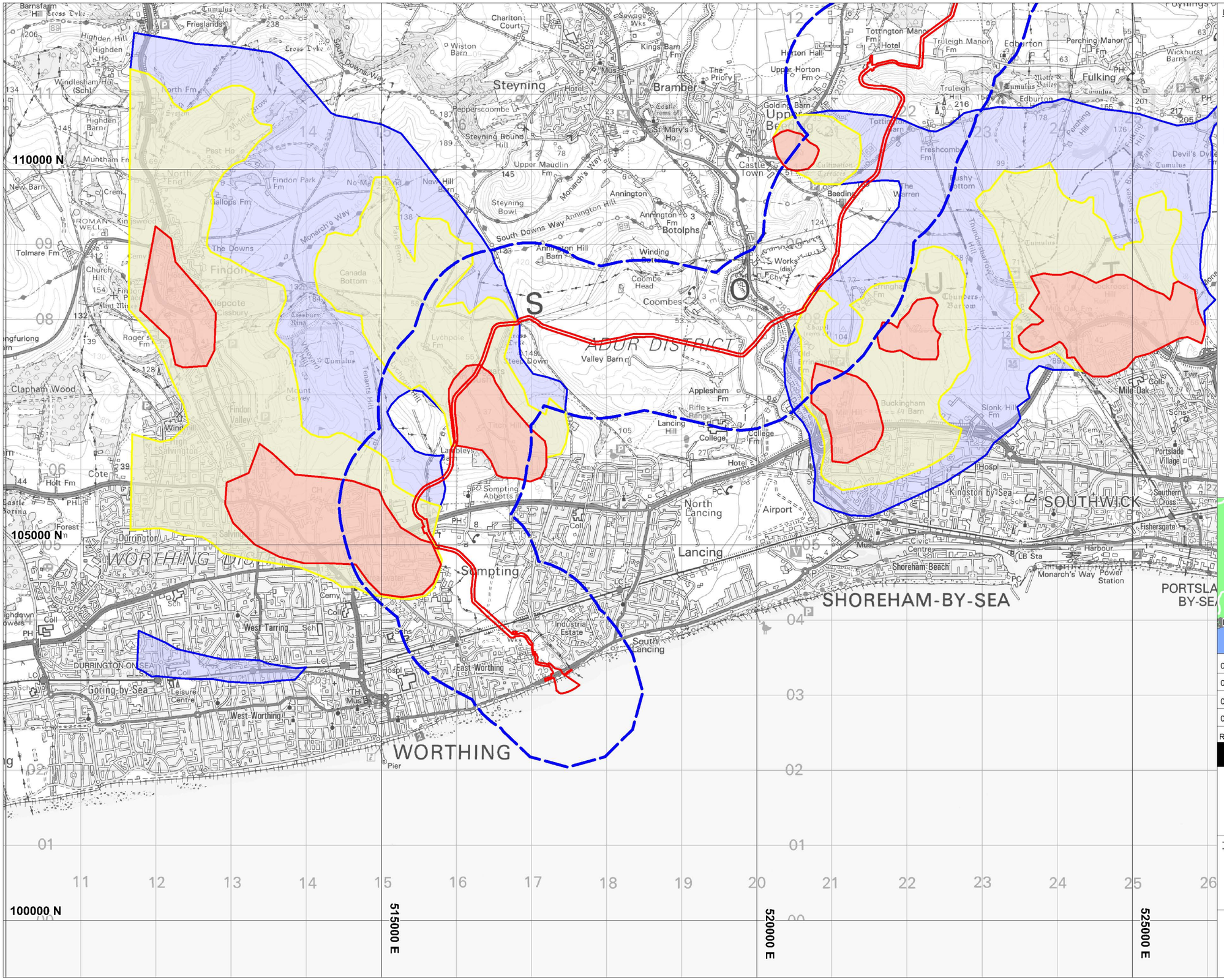
0 0.5 1
kilometres

Scale = 1:50,000 @ A3

N W E S

REV 04

FILE NAME: \P41318 - Hastings Offshore Wind Farm\05 - GIS\App 23.1 Flood Map 2.wor



Legend :

- Development Boundary
- Study Area
- Zone I - Inner Protection Zone
- Zone II - Outer Protection Zone
- Zone III - Total Catchment

Rev	Date	Description	Drn	Chk	App
04	26.11.12	New Development Area	AJ	KB	DW
03	18.10.12	New Route	DL	KB	DW
02	20.03.12	New Layout	LG	KB	DW
01	20.10.11	Second Draft	AJ	GS	KB

Rampion Offshore Wind Farm

RSK e·on

Title :

Figure 2 - Source Protection Zone (Map 1 of 2)

0 0.5 1 kilometres

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N W E S

REV 04

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125000 N

120000 N

115000 N

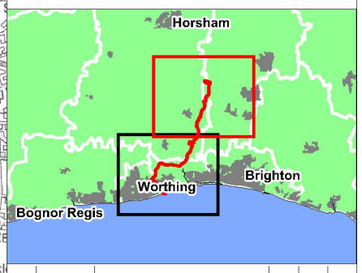
520000 E

525000 E

530000 E

Legend :

- Development Boundary
- Study Area
- Zone I - Inner Protection Zone
- Zone II - Outer Protection Zone
- Zone III - Total Catchment



Rev	Date	Description	Drn	Chk	App
04	26.11.12	New Development Area	AJ	KB	DW
03	18.10.12	New Route	DL	KB	DW
02	20.03.12	New Layout	LG	KB	DW
01	20.10.11	Second Draft	AJ	GS	KB

Rampion Offshore Wind Farm

RSK e·on

Title :

Figure 2 - Source Protection Zone (Map 2 of 2)

0 0.5 1 kilometres

Scale = 1:50,000 @ A3

N W E S

REV 04

FILE NAME: IP41318 - Rampion Offshore Wind Farm105 - GIS\App 23.1 SPZ map2.Wor

APPENDIX A

Service Constraints

RSK GROUP
SERVICE CONSTRAINTS

1. This report and the Drainage design carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for E.On. (the "client") in accordance with the terms of a contract between RSK and the "client" . The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable Civil Engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services, which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX B

Historic Flood Mapping

N

Point	Monitoring_Site	Ground_Level_mAO	Groundwater_Level_m/	Groundwater_Level_ml
1	Bramber	41.44	17.59	23.85
2	Broadwater	6.35	0	6.35
3	Chilgrove	77.7	0	77.7
4	Compton	81.37	8	73.37
5	East Dean	92.87	2.08	90.79
6	Lyons Farm	50.68	30.47	20.21
7	Madams Farm	144.56	35.36	109.2
8	Pyecombe	106.4	23.03	83.37
9	Sullington	166.33	55.39	110.94
10	Sussex Pad	12.55	9.12	3.343
11	Worthing, Victoria P	10.54	No record	N/A

West Sussex SFRA

Map G - Areas More Prone to Groundwater Flooding

west sussex county council

CAPITA SYMONDS

Legend

- West Sussex County Boundary
- Main River
- Groundwater flood event
- Groundwater monitoring sites
- Arun District Council boreholes
- Recorded areas of groundwater flooding
- Groundwater Emergence Zones

Potential for Groundwater Flooding

- High
- Low
- Medium

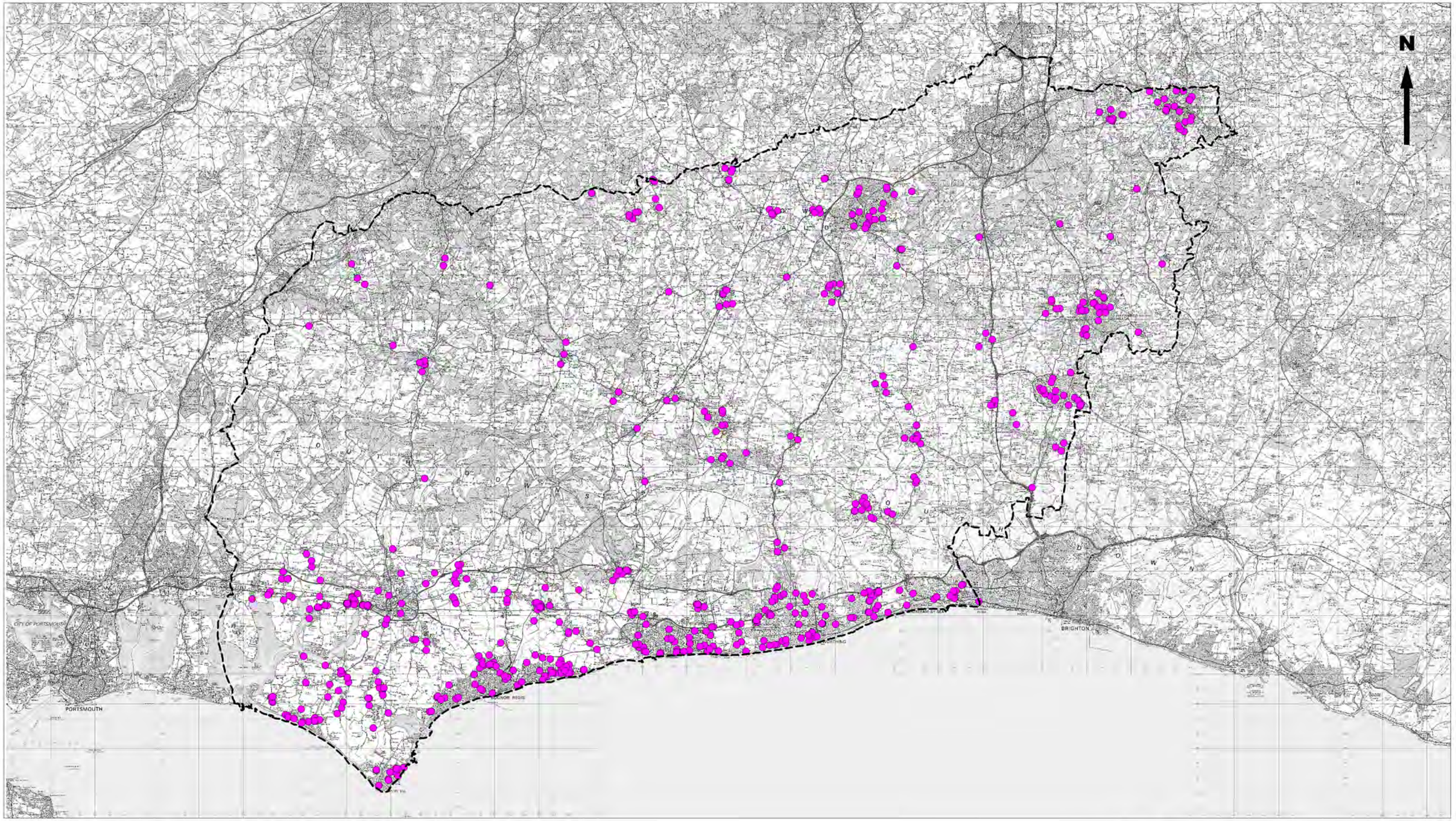
Scale at A3 1: 250000

Date 05/05/2009

0 5 10 15

kilometres

Map_G.wor



West Sussex SFRA

Map S - Areas More Prone to Flooding From Sewers

west sussex county council

CAPITA SYMONDS

Legend

- West Sussex County Boundary
- Historic Incidents of Flooding from Sewers

Scale at A3 1: 250000

Date 05/05/2009

0 5 10 15

kilometres

Map_S.wor

Rampion Offshore Wind Farm

ES Section 23 – Surface Water Hydrology and Flood Risk - Appendix 23.2

RSK Environment Ltd **Document 6.3.23ii**

December 2012 **APFP Regulation 5(2)(a)**

Revision A

E.ON Climate & Renewables UK Rampion Offshore Wind Limited

E.ON

Rampion Substation Flood Risk Assessment

41318 FRA R2 (3)

NOVEMBER 2012

RSK

RSK GENERAL NOTES

Project No.: 41318- FRA R2 (3)

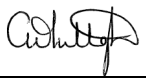
Title: Rampion Substation Flood Risk Assessment

Client: E.ON

Date: November 2012

Office: Helsby

Status: Final

Author	C Whittingham	**Technical reviewer**	I Clark
Signature		Signature	
Date:	27/11/12	Date:	27/11/12
Project manager	K Barlow		
Signature			
Date:	27/11/12		

CONTENTS

FIGURES

APPENDICES

1 INTRODUCTION

RSK LDE Limited has been commissioned by E.ON to undertake a Flood Risk Assessment (FRA) and review the constraints on a proposed substation site located adjacent to an existing National Grid Substation near Bolney. This report assesses the flood risk associated with the development of the proposed onshore substation and is included as an addendum to the hydrology chapter of the Environmental Statement.

The publication of the National Planning Policy Framework (NPPF, Ref.1) has revoked PPS 25 (Ref. 2) amongst others on 27th April 2012. The Technical Guidance to the National Planning Policy Framework (April 2012) (Ref. 3) includes flood risk guidance and retains key elements of PPS 25 (Ref. 3) including the Sequential and Exception Tests, climate change allowances and development classifications. The information contained in this new technical guidance along with the NPPF when combined with guidance contained in the Communities and Local Government "Planning Policy Statement 25: Development and Flood Risk Practice Guide", Dec 2009 (Ref. 4) and the British Standard BS 8533-2011 "Assessing and managing flood risk in development Code of practice" (Ref. 5) will form the basis of any on-going RSK flood risk documentation.

This FRA was prepared based on PPS25 and the accompanying guidance documentation as well as the BS. As a result, the publication of the NPPF containing much of the main criteria for assessing flood risk will not alter the conclusions or recommendations of this report.

The Environment Agency have confirmed the extent of the Flood Zones adjacent to the site, this confirms that the latest flood map shows that the site is located wholly within Flood Zone 1.

The comments given in this report and the opinions expressed are subject to RSK Group Service Constraints provided in **Appendix A**.

2 CONTEXT AND SCOPE OF WORKS

A key element of project development is to prepare a Flood Risk Assessment to establish the risk associated with the proposed development and to propose suitable mitigation, if required to reduce the risk to a more acceptable level.

Although officially revoked and replaced by the NPPF (Ref. 1) the scope of work relating to a flood risk assessment is based on the guidance provided in PPS 25 (Ref. 2) and the accompanying guidance published by the Communities and Local Government Office (Ref. 4) and comprise of the following elements:

- To obtain information on the hydrology and hydrological regime in and around the site.
- To obtain the views of the Environment Agency including scope, location and impacts.
- To determine the extent of new flooding provision and the influence on the site.
- To review site surface water drainage based on the proposed layout. To determine the extent of infrastructure required.
- To review architect plans and planning information and other studies to determine the existing site conditions.
- To assess the impact on the site from global warming effects and anticipated increases in rainfall over a 100 year period for residential use or 60 years for commercial uses.
- Preparation of a report including calculations and summaries of the source information and elements reviewed.

3 SITE DESCRIPTION

3.1 Site Location

The preferred location for the substation site is located to the north east of the of the existing Bolney substation located at NGR: TQ 24422 20992, see **Figure 1**. The site can be divided into two land areas; the total red line boundary which includes the areas set aside for construction, this area will be considered to be a temporary construction area, and the second is the permanent land taker area which will consist of the more permanent infrastructure of the substation itself. This report will concentrate on the permanent land take area as the temporary site area will be restored with no permanent features on the site.

The total site is bounded by:

- North –bounded by open agricultural land and woodland. A small watercourse flows in a easterly direction along the northern boundary.
- East – Directly bounded open agricultural land, the existing overhead connection to Bolney substation is located to the east of the site
- South – Directly bounded by open agricultural land (Twinham Court Farm) and the existing Bolney substation to the south west
- West – Directly bounded by the existing Bolney Substation site and open fields.

The calculations in this report are based on a maximum permanent land take area of 7.15 Ha.

Located adjacent to the site are three existing overhead line circuits; these consist of a distribution Network Operator (DNO) 11kV overhead line running north to south through the middle of the site for supplying nearby farms and local residents. To the south of the site is a DNO 132kV overhead line running west to east which is connected into Bolney 132kV Substation by a cable circuit with 2 off 132kV towers sited within the site. To the north is a 400kV overhead line double circuit and single tower connected into Bolney 400kV Substation running west to east. An underground cable circuit has recently been installed through this land to the east of the National Grid compound and the west of the 132kV terminal tower located in the west of the site.

3.2 Study Area Hydrology

The area surrounding the proposed substation site contains a number of surface water features including approximately 23 surface water lagoons, possibly associated with water retention for irrigation purposes. A small drainage ditch is located running parallel to an existing north south hedge line.

4 DEVELOPMENT PROPOSALS

The onshore substation is a key component of the project and will be required to convert electricity generated at the wind farm to a higher voltage suitable for onward transmission by National Grid's electricity transmission system.

The substation will consist of four Super Grid Transformer (SGT) bays, with each bay having a minimum capacity of 180 MVA. The transformers will step up the voltage of the offshore wind farm transmission system (which may be 132kV, 150kV or 220kV) up to the National Grid transmission voltage of 400kV for connection into Bolney substation. The substation will be directly connected to the National Grid (NGET) 400 kV substation via Gas Insulated Busbar (GIB).

5 SOURCE OF FLOOD RISK

In accordance with NPPF (Ref. 1) and advice from the Environment Agency, a prediction of the flood sources and levels is required along with the effects of climate change from the present for the design life of the development (in this case assumed to be 100 years). To consider these effects of climate change, NPPF Technical Guidance Table 5 recommends consideration of a 30% increase in rainfall intensity and 20% increase in peak river flows over this timeframe.

The flood risk elements that need to be considered for any site are defined in BS 8533 as the "Forms of Flooding" and are listed as:

- Flooding from Rivers (fluvial flood risk)
- Flooding from the Sea (tidal flood risk)
- Flooding from the Land
- Flooding from Groundwater
- Flooding from Sewers (sewer and drain exceedance, pumping station failure etc)
- Flooding from Reservoirs, Canals and other Artificial Structures

The following section reviews each of these in respect of the subject site.

5.1 Environment Agency Flood Zone

The Environment Agency (Environment Agency) has produced Flood Zone maps for much of England and Wales. The current displayed map is reproduced as **Figure 2**. The latest Flood Zone map shows the flood risk to the site from fluvial and tidal sources is low.

5.2 Flooding from Rivers (Fluvial Flood Risk)

As can be seen from the Environment Agency Flood Zone map, the site is located wholly within Flood Zone 1.

The minor watercourses located to the north of the proposed development site is not shown on the Environment Agency Flood Zone mapping, however flood risk from this source is considered low and does not pose a flood risk to the site.

5.3 Flooding from the Sea (Tidal Flood Risk)

On the coast storm surges and high tides can threaten low lying coastal areas, and can be sometimes large and rapid enough to overtop defence works, causing significantly more damage than river flooding.

Tidal flood risk is not an issue due to the location inland.

5.4 Flooding from the Land (Overland Pluvial Flood Risk)

If intense rain is unable to soak into the ground or be carried through manmade drainage systems, for a variety of reasons, it can run off over the surface causing localised floods before reaching a river or other watercourse.

Generally, where there is impermeable surfacing or where the ground infiltration capacity is exceeded, surface water runoff will occur. Excess surface water flows from the site are believed to drain naturally to the local water features, either by overland flow or through infiltration.

There is no evidence, that pluvial or overland flooding will affect the site. Flooding from this source is considered low and will be considered within the layout of the site, ensuring the development is not at increased risk and overland flow routes will be created within the design of the site to ensure properties are not at risk of flooding from this source.

Excess surface water flows from the site are believed to drain naturally to the local water features, either by overland flow or through infiltration. Flooding from this source is considered low and will be considered within the layout of the site, ensuring the development is not at increased risk.

Flooding of the site from this source is considered low.

5.5 Flooding from Groundwater

Groundwater flooding is caused by the natural emergence at the ground surface, of water originating from underlying permeable sediments or rocks (aquifers). The groundwater may emerge as one or more point discharges (springs) or as diffuse discharge/seepage over an extended area. Groundwater flooding tends to be more persistent than other sources of flooding, typically lasting for weeks or months rather than for hours or days.

Groundwater flooding does not generally pose a significant risk to life due to the slow rate at which the water level rises; however, it can cause significant damage to property, especially in urban areas. The soils around the substation site are generally impermeable and therefore largely unresponsive to groundwater levels due to low infiltration, a copy of the SFRA Groundwater flood risk map is included as **Appendix B**.

Due to the type of development proposed, it is not thought that groundwater flooding will impact on the operations on the site.

5.6 Flooding from Sewers

Most adopted surface water drainage networks are designed to the criteria set out in Sewers for Adoption (Ref. 4). One of the design parameters is that sewer systems be designed such that no flooding of any part of the site occurs in a 1 in 30 year rainfall event. By definition a 1 in 100 year event would exceed the capacity of the surrounding sewer network as well as any proposed drainage.

When exceeded, the surcharged pipework will lead to flooding from backed up manholes and gully connections. This will lead to immediate flooding within highways surrounding the site.

The site does not benefit from a formal sewerage system, therefore flood risk from this source is low.

5.7 Flooding From Reservoirs, Canals and Other Artificial Structures

A number of small ponded areas have been identified from the OS mapping, following a walk over of the surrounding area it has been confirmed that all these waterbodies are retained below the surrounding ground levels and are not retained by embankment. Therefore flooding from these waterbodies is considered to be low.

There are no other potential sources of flood risk known to the site.

5.8 Historic Flooding

There have been no recorded incidence of flooding in close proximity to the proposed substation site, **Appendix C**.

6 SURFACE WATER DRAINAGE

6.1 Scope

An outline drainage strategy has been carried out to identify the options for the design of the surface water drainage system and how it will affect the site layout using the following data:

- estimate the discharge rate for the site. Greenfield discharge rates should be sought on greenfield sites, and also on brownfield sites (where possible)
- estimate the volume of 1 in 100 year attenuation to be provided
- take into account NPPF's climate change requirements.

PPS25 states that SuDS should be considered wherever practical. In addition, Building Regulations Part H requires that the first choice of surface water disposal should be to discharge to an adequate soakaway or infiltration system, where practicable. If this is not reasonably practicable then discharge should be to a watercourse, the least favourable option being to a local sewer. Infiltration techniques should therefore be applied wherever they are appropriate.

The proposed development site currently comprises of open grassland. The site will be developed to include a substation and will incorporate a substantial area of hardstanding. Without the inclusion of appropriate mitigation measures the proposed development could, therefore, increase surface water runoff rates and volumes from the site as a consequence of increasing the area of built infrastructure and hard landscaping. It is intended that the proposed development will attenuate surface water run-off rates and volumes from hardstanding and impermeable roof areas by incorporating SuDs into the design when the scheme progresses to a more detailed design stage.

6.2 Existing Site Run-off

The site does not benefit from a formal drainage system; it is proposed to design a surface water system to ensure that discharge from the post development site does not exceed that of the pre-development situation, whilst managing any potential exceedance of the drainage network. In addition, PPS 25 (paragraph 5) makes it clear that off-site impacts should not increase flood risk elsewhere. The Practice Guide (Ref. 5) States:

> *For the range of annual flow rate probabilities up to and including the one per cent annual exceedance probability (1 in 100 years) event, including an appropriate allowance for climate change, the developed rate of run-off into a watercourse, or other receiving water body, should be no greater than the existing rate of run-off for the same event. Run-off from previously developed sites should be compared with existing rates, not greenfield rates for the site before it was developed. Developers are, however, strongly encouraged to reduce run-off rates from previously developed sites as much as is reasonably practicable. Volumes of run-off should also be reduced wherever possible using infiltration and attenuation techniques. Interim guidance on calculation of site run-off rates can be found* at
>
> http://www.ciria.org/suds/pdf/preliminary_rainfall_runoff_mgt_for_development.pdf

In terms of estimating the potential runoff from the site, the pro-rata IOH method (Ref. 6) has been used to estimate the existing runoff from the site based on a greenfield site. The following table highlights the results (**Appendix D** details the WinDes Calculations sheet).

RETURN PERIOD	PEAK FLOW
QBAR	36.0 l/sec
1 in 1 year peak flow	30.6 l/sec
1 in 30 year peak flow	81.6 l/sec
1 in 100 year peak flow	114.9 l/sec

Table 1: IoH Surface Water runoff calculations

6.3 Impact of Proposed Development

It is intended that surface water runoff from the proposed development will be discharged to groundwater through the infiltration techniques should ground conditions permit, or off site at a controlled rate designed to closely mimic the existing situation.

Both NPPF and the Environment Agency recommend that SuDS, in whole or part, should be considered for all new development sites. It is therefore proposed to incorporate SuDS into the development. SuDS can be a combination of both physical structures and techniques used to control surface water runoff as close to its origin as possible. There are a wide variety of sustainable drainage options available that can be applied in different ways to help manage both surface and ground waters in a sustainable manner. Specific solutions need to be developed for each site, the choice of which will depend on factors such as the nature of the site, the type of pollutants potentially present and the hydrology of the area. It should be noted that the site is not located within a Groundwater Source Protection Zones.

The proposed development will increase the impermeable area on the site and therefore reduce the potential area for infiltration; as a result the surface water run-off from the site is expected to increase unless mitigation measures are incorporated into the development. Without mitigation, the proposed development would reduce the permeable area. It is assumed that, where possible the site will be covered by a suitable aggregate to allow for vehicle movements whilst allowing infiltration to occur as per the predevelopment situation.

6.4 Climate Change

Table B.2 of PPS 25 (Ref. 1) suggests that peak rainfall intensities are expected to increase by 10% to 2055 and by 20% to 2085. Within the design of drainage networks for new developments, the incorporation of an appropriate allowance for future climate change impacts on peak rainfall intensities (20% increase) is recommended ensuring that the proposed development gives rise to a net reduction in runoff rates throughout its operational lifetime.

6.5 Ditch Diversion

An existing drainage ditch flows through the proposed site. It is believed that this will require diverting. Should this be required, a detailed assessment of the catchment should be carried out

and any works should ensure that the new diverted ditch can convey the flows without any additional flood risk.

7 PLANNING CONTEXT

7.1 Application of Planning Policy

NPPF includes (Section 10) measures specifically dealing with development planning and flood risk using a sequential characterisation of risk based on planning zones and the Environment Agency Flood Map. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

Within NPPF Technical Guidance on flood risk each flood zone has a list of appropriate land uses dependent on vulnerability to flooding.

7.2 Land Use Vulnerability

From the NPPF Technical Guidance, a "less vulnerable" land use could be appropriate to Flood Zone 3a (High Probability of flooding at higher than 1 in 100 annual probability) with the "more vulnerable" use only permitted if the exception test is passed. For a "more vulnerable" class, development on this site could be appropriate within Flood Zone 2 (Medium Probability of flooding at less than 1 in 100 but higher than 1 in 1,000 annual probability).

In applying the sequential test, reference is made to the following table (reproduced from Table 3 contained within NPPF);

Table 7.1 Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	Appropriate	Appropriate	Appropriate	Appropriate	Appropriate
	Zone 2	Appropriate	Appropriate	Exception Test Required	Appropriate	Appropriate
	Zone 3a	Exception Test Required	Appropriate	Should not be permitted	Exception Test Required	Appropriate
	Zone 3b functional floodplain	Exception Test Required	Appropriate	Should not be permitted	Should not be permitted	Should not be permitted

7.3 Sequential and Exception Tests

The Sequential Test is required to assess flood risk and NPPF Technical Guidance recommends that the test be applied at all stages of the planning process to direct new development to areas with the lowest probability of flooding (Flood Zone 1).

According to NPPF, if there is no reasonably available site in Flood Zone 1, the flood vulnerability of the proposed development (see NPPF Technical Guidance Table 2) can be taken into account

in locating development in Flood Zone 2 and then Flood Zone 3. Within each Flood Zone new development should be directed to sites at the lowest probability of flooding from all sources.

The site can be classified as greenfield and used as agricultural land, the proposed development of a substation will change its planning designation to wholly essential infrastructure. From NPPF, an “essential infrastructure” land use is appropriate within Flood Zone 1. As discussed above all development on this site is to be located within Flood Zone 1, therefore development will be possible. The Sequential and Exception Tests are not essential for this development.

8 MITIGATION MEASURES AND RECOMMENDATIONS

The site is not a direct risk of tidal or fluvial flooding and hence the mitigation measures relate to the provision of drainage controls as described in this report.

With the exception of access roads and roofed areas the majority of the site will be covered by a suitable aggregate to allow for vehicle movements whilst allowing infiltration to occur as per the predevelopment situation, thus limiting the impact of the development on the existing surface water regime in the area.

Unless otherwise agreed in writing there is no intention to abstract water from watercourses or waterbodies adjacent to the site. All existing ditches and field drains in close proximity to the operational site will be maintained and kept free from potential obstruction. An existing drainage ditch flows through the proposed site. It is believed that this will require diverting to allow development to occur. Should this be required, a detailed assessment of the catchment should be carried out and any works should ensure that the new diverted ditch can convey the flows without any additional flood risk.

9 CONCLUSIONS AND RECOMMENDATIONS

This flood risk assessment for the proposed substation site, located adjacent to the existing Bolney Substation site has been carried out to ascertain the level of flood risk associated with the development. This report confirms that the proposed development meets the requirements of the NPPF in relation to flood risk to the site and posed by the site following development.

The proposed site lie is within Flood Zone 1 according to the latest Environment Agency Flood Zone map. This FRA has carried out investigations into other potential sources of flood risk and concludes that the risk to the site remains low.

The surface water drainage scheme for the site should be designed to meet the requirements of the NPPF by limiting the post development off site run-off to the equivalent predevelopment rate for the site whilst providing sufficient on site attenuation for rainfall events up to the 1 in 100-year rainfall event, including a suitable allowance for climate change over the lifetime of the development.

10 REFERENCES

1. Communities and Local Government “National Planning Policy Framework” NPPF, Mar 2012.
2. Communities and Local Government “Planning Policy Statement – Development and Flood Risk” PPS 25, Mar 2010.
3. Communities and Local Government “Technical Guidance to the National Planning Policy Framework”, Mar 2012.
4. DEFRA “Interim Code of Practice for Sustainable Drainage Systems” National SUDS Working Group, July 2004.
5. BS 8533-2011 Assessing and managing flood risk in development Code of practice, Nov 2011.
6. Institute of Hydrology (IoH) “Flood Estimation for small catchments” Report 124, 1994

FIGURES

Legend :

- Substation Development Area
- Mitigation/Planting
- Permanent
- Site Access
- Temporary
- Temporary/Permanent

Westridge Place
WINEHAM LANE
BS
Priorsbush
lss
Drain
34m
Old Doctors
Sparrows
Drain
Bolney Substation
Path
Toll Copse
Coombe House
Track
The Lodge
CP Bdy
21m
lss
Track
The Gill
North Lodge
BOB LANE
26m
Twineham Grange Cottages
Twineham Court Farm
Track
Drain
Coombe Farm
Swallow Cottage
Mercers Cottage
Twineham Grange Farm
Twineham Grange
Drain
Nightingales

Rev	Date	Description	Drn	Chk	App
01	26.11.12	New Development Area	AJ	CW	KB
00	29.10.12	First Draft	AJ	CW	KB

Rampion Offshore Wind Farm

RSK e·on

Title :

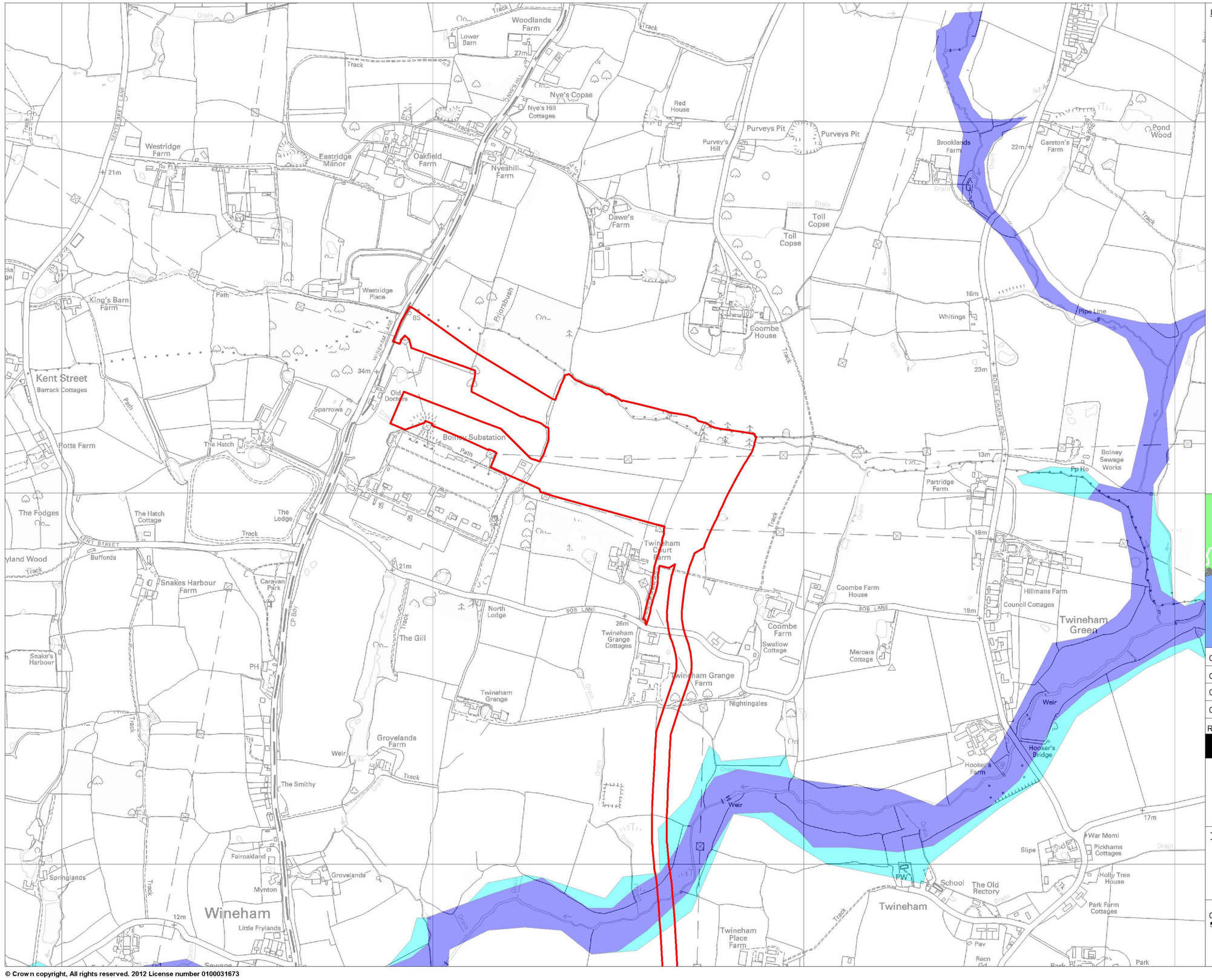
Figure 1 -
Substation Development Area

0 100 200
Metres
Scale = 1:5,000 @ A3

N W E S

REV 01

FILE NAME: P41318 - Rampion Offshore Wind Farm\05 - GIS\ES_A23.2_Fig 1 Substation Development Area wor



Rev	Date	Description	Drn	Chk	App
04	26.11.12	New Development Area	AJ	CW	KB
03	31.10.12	Development Boundary	DL	CW	KB
02	02.04.12	Third Draft	AJ	CW	KB
01	24.10.11	Second Draft	AJ	CW	KB

Rampion Offshore Wind Farm

RSK e·on

Title :

Figure 2 - Flood Zones (Substations)

0 0.2 0.4

Kilometres

Scale = 1:10,000 @ A3

N W E S

REV 04

FILE NAME: \P41318 - Hastings Offshore Wind Farm\05 - GIS\App23.1_Flood Map Substations.wor

APPENDIX A

Service Constraints

RSK GROUP
SERVICE CONSTRAINTS

1. This report and the Drainage design carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for E.On. (the "client") in accordance with the terms of a contract between RSK and the "client" . The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable Civil Engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services, which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX B

SFRA Groundwater Flood Risk Mapping

N

Point	Monitoring_Site	Ground_Level_mAO	Groundwater_Level_m/	Groundwater_Level_ml
1	Bramber	41.44	17.59	23.85
2	Broadwater	6.35	0	6.35
3	Chilgrove	77.7	0	77.7
4	Compton	81.37	8	73.37
5	East Dean	92.87	2.08	90.79
6	Lyons Farm	50.68	30.47	20.21
7	Madams Farm	144.56	35.36	109.2
8	Pyecombe	106.4	23.03	83.37
9	Sullington	166.33	55.39	110.94
10	Sussex Pad	12.55	9.12	3.343
11	Worthing, Victoria P	10.54	No record	N/A

West Sussex SFRA

Map G - Areas More Prone to Groundwater Flooding

west sussex county council

CAPITA SYMONDS

Legend

- West Sussex County Boundary
- Main River
- Groundwater flood event
- Groundwater monitoring sites
- Arun District Council boreholes
- Recorded areas of groundwater flooding
- Groundwater Emergence Zones

Potential for Groundwater Flooding

- High
- Low
- Medium

Scale at A3 1: 250000

Date 05/05/2009

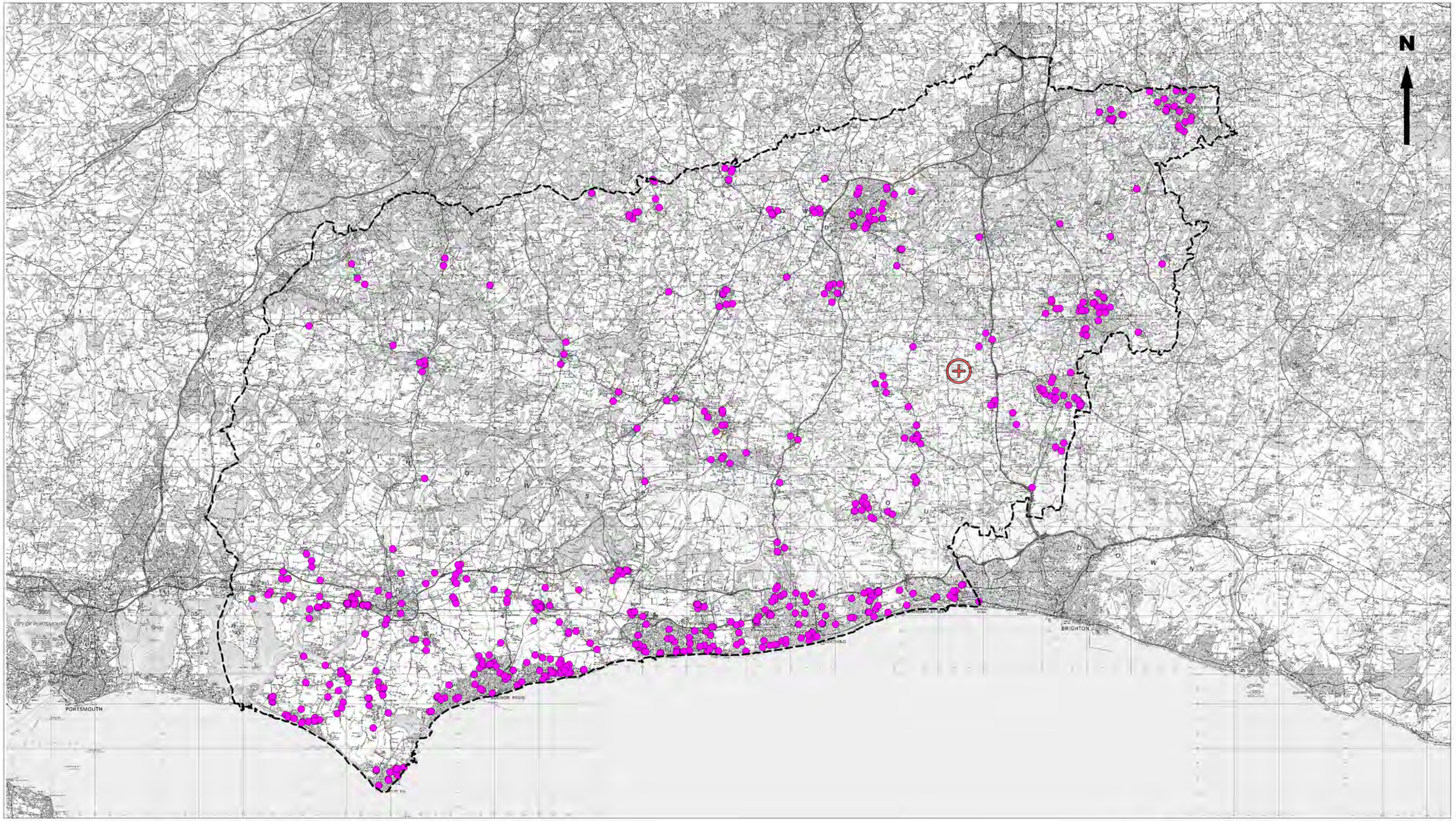
0 5 10 15

kilometres

Map_G.wor

APPENDIX C

Historic Flood Mapping



West Sussex SFRA

Map S - Areas More Prone to Flooding From Sewers

west sussex county council

CAPITA SYMONDS

Legend

- West Sussex County Boundary
- Historic Incidents of Flooding from Sewers

Scale at A3 1: 250000

Date 05/05/2009

0 5 10 15

kilometres

Map_S.wor

APPENDIX D

MicroDrainage Calculation Sheets

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	7.010	Urban	0.000
SAAR (mm)	800	Region Number	Region 7

Results	**l/s**
QBAR Rural	36.0
QBAR Urban	36.0
Q100 years	114.9
Q1 year	30.6
Q30 years	81.6
Q100 years	114.9

Rampion Offshore Wind Farm

ES Section 23 – Surface Water Hydrology & Flood Risk - Figure 23.1

RSK Environmental Ltd **Document 6.2.23**

December 2012 **APFP Regulation 5(2)(a)**

Revision A

E.ON Climate & Renewables UK Rampion Offshore Wind Limited

110000 N

105000 N

100000 N

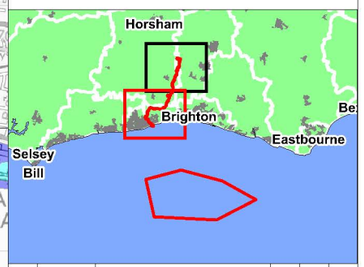
515000 E

520000 E

525000 E

Legend :

- Development Area
- Study Area
- Flood Zone 2
- Flood Zone 3



Rev	Date	Description	Drn	Chk	App
04	26.11.12	New Development Area	AJ	CW	KB
03	18.10.12	New Route	DL	CW	KB
02	02.04.12	Third Draft	AJ	CW	KB
01	24.10.11	Second Draft	AJ	CW	KB

Rampion Offshore Wind Farm

RSK e·on

Title :

Figure 23.1 - Flood Zones
(Map 1 of 2)

0 0.5 1
kilometres

Scale = 1:50,000 @ A3

REV 04

FILE NAME: \P41318 - Hastings Offshore Wind Farm\05 - GIS\ES_Fig 23-1 Flood Map 1.wor

125000 N

120000 N

115000 N

520000 E

525000 E

530000 E

Legend :

- Development Area
- Study Area
- Flood Zone 2
- Flood Zone 3

Rev	Date	Description	Drn	Chk	App
04	26.11.12	New Development Area	AJ	CW	KB
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Rampion Offshore Wind Farm

RSK e·on

Title :

Figure 23.1 - Flood Zones
(Map 2 of 2)

0 0.5 1
kilometres

Scale = 1:50,000 @ A3

N W E S

REV 04

FILE NAME: \P41318 - Hastings Offshore Wind Farm\05 - GIS\ES_Fig 23-1 Flood Map 2.wor