



J.G. Pears Ltd  
Spicer Hill Wind Farm  
Flood Risk Assessment

Prepared By:

Arcus Renewable Energy Consulting Ltd  
Suite 2F, Swinegate Court East  
3 Swinegate  
York, YO1 8AJ  
T. 01904 715 470  
F. 01904 655 831

E. [info@arcusrenewables.co.uk](mailto:info@arcusrenewables.co.uk)  
W. [www.arcusrenewables.co.uk](http://www.arcusrenewables.co.uk)

April 2009

Spicer Hill Wind Farm Flood Risk Assessment

Table of Contents

1	Introduction .....	1
1.1	Development Description and the Need for FRA .....	1
2	Methodology.....	1
3	Site Characteristics.....	2
4	Greenfield Rainfall Run-off .....	2
5	Required Storage Volumes and Implementation .....	2
6	Conclusion.....	4



## 1 INTRODUCTION

J.G. Pears Ltd, ("the Developer") is proposing to develop a wind farm (on land adjacent to Spicer Hill (the Development), approximately 2.5 kilometres (km) south west of Ingbirchworth in South Yorkshire.

Arcus Renewable Energy Consulting Ltd ("Arcus") has been commissioned to undertake a Flood Risk Assessment (FRA) for the Development. This FRA is intended to meet the requirements of the Environment Agency (EA) and specifically Planning Policy Statement 25 (PPS 25)<sup>1</sup>.

The EA has no records of flooding at the site and the Flood Map shows that the site is located in Flood Zone 1, an area described as "*low probability*" of flooding in PPS 25, Annex D. This zone is categorised as being the lowest flood risk and comprises land assessed as having a less than 1 in 1000 (0.1%) annual probability of river or sea flooding in any year. Flooding at the site has therefore not been considered further, and this report focuses on the potential effect of the Development on off-site flooding.

Within PPS 25, the EA advises that developments located in such areas should be subject to FRA that "*need only be brief unless the factors above or other local considerations require particular attention*". Consequently, this report focuses on the run-off from the site in extreme rainfall events, the changes that development of the site would bring and appropriate mitigation of any effects.

### 1.1 DEVELOPMENT DESCRIPTION AND THE NEED FOR FRA

The Development involves the installation of three turbines over a catchment site of 17 hectares (ha) together with associated access tracks, crane hard-standings, a substation compound and a permanent anemometry mast. The remainder of the land would remain as open farmland. A construction compound would be created and used during the 9-month construction phase, then covered with topsoil for continued farmland use. This area has been included in the FRA, although it would represent an area of hard-standing for a limited period only.

The total area of new hard-standing associated with the Development would be approximately 1.4 ha. This will generally be formed of crushed stone topped with fines and would be pervious to a limited extent, however, for the purposes of this FRA it has been assumed to be completely impervious as a conservative approach.

PPS 25 identifies that an FRA be undertaken for developments greater than 1 ha in size. The physical footprint of the Development is approximately 1.4 ha and, therefore, an FRA is required, as fulfilled by this report.

## 2 METHODOLOGY

The introduction of areas of hard-standing on a greenfield site will increase the discharge of water from the developed area relative to the current state. This effect could, in principle, lead to increased probability of down-stream flooding, especially in extreme rainfall events. The EA/DEFRA guidance document<sup>2</sup> identifies that suitable mitigation of this effect is to provide storage for the excess discharge to allow it to infiltrate into the ground, where possible, or otherwise to discharge to watercourse at less than 2 l/s/ha above that of the greenfield run-off rate.

The method set out in the EA/DEFRA guidance document has been followed to identify approximate rainfall storage volumes required on site. As set out in the guidance, details of this would be designed and agreed with the EA at detailed design stage, and the method applied here is approximate, but appropriate to this phase of the Development.

---

<sup>1</sup> Planning Policy and Statement 25 (PPS 25):

<http://www.communities.gov.uk/documents/planningandbuilding/pdf/planningpolicystatement25.pdf>

<sup>2</sup> Environment Agency/DEFRA (2005). "Flood Risk Assessment Guidance for New Development". R&D Technical Report FD2320/TR2. [http://sciencesearch.defra.gov.uk/Document.aspx?Document=FD2320\\_3364\\_TRP.pdf](http://sciencesearch.defra.gov.uk/Document.aspx?Document=FD2320_3364_TRP.pdf)

Approximate greenfield run-off flow rates have been calculated, and used to estimate appropriate storage volumes required.

### 3 SITE CHARACTERISTICS

The Development is located at national grid reference E 405000 N 405000 on land adjacent to Spicer Hill, which is situated south west of Ingbirchworth in South Yorkshire. The site is predominantly undeveloped and currently comprises several fields of arable farmland. The Development is situated within an area comprising approximately 17 ha in which slopes are shallow (approximately 1:22).

The Development is primarily drained by an unnamed watercourse that runs from south to north along the western section of the application boundary.

The British Geological Survey 1:50,000 Series Solid and Drift Edition (sheet 86) shows the dominant superficial geology to comprise of undifferentiated mudstones, silt, weathered clay and Alluvium from the Quaternary period. Trial pit investigations, undertaken by Donaldson Associates, revealed sandy gravel and cobbles to overlay sandstone to a depth of 0.7 m at the proposed location of Turbine 2. Stiff slightly sandy clay to depths of approximately 2 m was encountered at Turbine 1. The trial pit at Turbine 3 contained stiff slightly sandy clay with occasional sandstone and shale gravel to a depth of 1.75 m. Very weak weathered shale was encountered underlying the clay.

### 4 GREENFIELD RAINFALL RUN-OFF

The method set out in the Institute of Hydrology report 124, as described in the EA/DEFRA guidance document, was used to calculate annual mean peak flow run-off for the existing greenfield site, indicated in the EA/DEFRA guidance document as being appropriate for sites of area less than 50 ha.

The Development lies with Hydrological region 3 of the UK, and Soil Type 4 (from the Wallingford Soil WRAP map) has been used as this most accurately represents the soil underlying the Development. The Flood Estimation Handbook identifies that the Development receives average annual rainfall of 800mm. A total of 1.4 ha of hard-standing will be introduced and is assumed to be 100% impervious in order to represent a worst case scenario.

Application of this approach leads to mean peak greenfield flow rates from the area to be developed for the 1-year, 30-year and 100-year return periods, as shown in Table 1.

**Table 1:** Greenfield Run-off Flow Rates (Q) for 1, 30 and 100 year return periods

Return Period	Q (l/s/ha)
1	4.8
30	9.6
100	11.8

### 5 REQUIRED STORAGE VOLUMES AND IMPLEMENTATION

The temporary storage required for the increased run-off from the site is shown in Table 2 for the 1-year, 30-year and 100-year return periods, as calculated using the method set out in the EA/DEFRA guidance document. A 10% increase in the rainfall during these events has been included to account for the potential effects of climate change.

**Table 2:** Calculated required storage volumes for 1, 30 and 100 year return periods (m<sup>3</sup>).

Return period (Year)	Required Storage Volume (m <sup>3</sup> )
1	185
30	442
100	685

In accordance with the EA guidance, volumes are proposed to provide storage for the 100 year return period.

It is proposed that the required storage volume could be provided in the form of swales, allowing the stored water to infiltrate the ground. These would generally be located along the side of the access tracks, with a nominal width and depth of 1 m (a cross-sectional area of 1 m<sup>2</sup>).

The total length of swale required, calculated as the required volume divided by the cross-sectional area, is therefore 685 m for the whole site. The total length of new site access tracks is 1,164 m, and hence the use of such swales is considered practicable.

Detailed proposals for the drainage design will be developed during the detailed design phase, post-consent. The above calculations have demonstrated that the required storage could be provided by the use of track-side swales, however, additional measures may be considered at detailed design stage. General mitigation measures are discussed in Section 8.6 of the Environmental Statement, including:

- Drainage ditches and balancing ponds will be implemented around any excavation works to reduce the possibility of runoff entering the unnamed watercourse during construction. All balancing ponds will be actively managed to control water levels and ensure that any runoff is contained, especially during times of rainfall; and
- Active management of runoff from all access tracks leading to turbines will reduce the potential of runoff entering the ephemeral watercourse that drains the Development. Measures will include placing semi-permeable obstructions (*e.g.*, straw bales) on the upslope of the tracks and drainage ditches on the downslope. Outfall pipes will drain into a bunded section of the drainage ditch to allow the attenuation of runoff flow before entering the wider catchment.

The SUDS Manual<sup>3</sup> states that infiltration trenches are appropriate when groundwater is located at depths greater than 1m below the base of the trench. Trial pits at the Development, excavated as part of the preliminary geotechnical investigation, revealed that groundwater was not encountered at depths of 1 to 2 m. This would be confirmed during the detailed site investigation to be conducted prior to commencement of construction activities.

Due to time constraints and land management practices, it is not considered practical to conduct soakage tests at the Development at this stage. However, the Developer is willing to commit to undertaking infiltration trench permeability tests at locations along the proposed trench, prior to the construction phase of the Development. All field results will be made available to the EA. A desk based study has been undertaken to provide an estimated soakaway time for the 100 year return period rainfall event. A conservative infiltration rate of 0.005 m/hour has been assumed for the Development due to the clay and sand content of the superficial geology. Using calculation methods in accordance with the BRE 365 "*Outflow from Soakaway*"<sup>4</sup> and assuming an infiltration trench of 1 m width and depth as described in the FRA, the storage volume of runoff required for the 100 year return period (685 m<sup>3</sup>) will take 200 hours to fully infiltrate. Given the low frequency of such an event, this is considered appropriate.

All infiltration trenches will be designed in accordance with BRE 365 and the Developer will seek guidance from the EA.

---

<sup>3</sup> CIRIA c697, The SUDS Manual (2007)

<sup>4</sup> BRE Digest 365, Soakaway Design (2007)

## **6 CONCLUSION**

Following implementation of the proposed mitigation measures, the introduction of hard-standing associated with the Development will not lead to an increase in discharge rates from the site above greenfield levels, for a 100-year return period. The residual effect of the Development on flood risk is therefore considered to be negligible.

For lower return periods, the implemented mitigation measures will act to reduce any effects of run-off from the site in the wider catchment relative to the greenfield levels, and therefore provide a beneficial effect.

This report has been written to meet the requirements of the EA, as set out in PPS25 Annex E.