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Introduction

The purpose of this Environmental Risk Report is to identify the risks involved in commissioning a 2MW wind turbine to the management team for the project.

The site of the proposed turbine is in a remote, moorside location, adjacent to a stream.

In the immediate vicinity is a Site of Special Scientific Interest and a working farm. It will be important to identify the unique challenges when building in proximity to these places of note.

Three areas will be assessed, the risks associated with the location as stated above, the risks of the construction process, and the risks of Ongoing Operations such as maintenance once the turbine is operational and in service. All high-risk activities will need to be addressed with a Risk Mitigation Strategy.

There will also be an economic risk assessment.

The management team have provided the CAPEX, OPEX, Lifetime and annual Revenue. These will be used to calculate the Net Present Value of the project at 10 and 27 years (The expected life of the project). Using these figures and by calculating the ARR over the lifecycle of the project, Positive statements are to be made on the gathered data and whether the project remains viable after appropriate management of significant risks and externalities have been assessed.

Areas of Note

Risks associated with Location.

Local Farm

The presence of a wind turbine near to a farm is potentially likely to be unpopular with the local farmer. However, there have been studies that conclude no risk to local farms from local wind turbines, especially the presence of only one.

One study in Kansas (Samson, Perry and Taylor, 2020) concludes that local agricultural property value in that state was not affected by wind farms, and that this property value alone pertains to the majority of assets held for most agricultural producers. Whilst his paper may have been written in the USA, the focus is on the economic value of farmers land which is also relevant in the UK. This means that wind turbines are unlikely to affect the land value of farms in the UK which is often a cause of concern for residents local to any major construction project.

As for risk to crop yield, Eco Energy Consultants (2023) state that wind turbines in close proximity to operational agricultural land may actually assist the production of crops by supressing the formation of dew, which “lessens the conditions which encourage the growth of mold, fungus and other pathogens which affect crops.” If this is the case, there may be benefits to the crop yield for the farmer as well as lessened risk of crops dying from certain crop diseases caused by viruses, bacteria or fungal growth.

Site of Scientific interest

A site of special scientific interest (SSSI) is defined by the Wildlife and countryside act (1981) as being of national nature conservation interest. The most likely impingement of a wind turbine in this location would be the impact of noise and potential collision on endangered wildlife species, in particular avian classification.

According to research conducted by English Nature et al. (2001), either a wind farm of more than two turbines, or one turbine with a hub height (measuring from the ground to the rotational centre of the blades) exceeding 15 Metres (2MW turbines are likely to be in the vicinity of 90-100m in height), are likely to be subject to an Environmental Impact assessment (EIA) according to the rules laid out by Schedule 2 of the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999. This regulation is more likely to apply if the output of the windfarm is set to exceed 5MW.

While it may not be deemed mandatory to complete an EIA due to the limited scale of the project, it would be wise to consider their guidance with the goal of shielding the UK's natural wildlife from potential harm even if not required by law. This in itself would be an effective way of boosting the public perception of the project, reducing the likelihood of objections to planning permission.

Specific risks to the local fauna will be elaborated on in the ongoing risks section as this is where the main concern lies to their wellbeing.

Watercourse

There are two areas of notable concern involving polluting the watercourse adjacent to the project. The construction of cable trenches and the access road. It is important to ensure that no contaminants are released into the local watercourse. If the site is within 8m of a main watercourse, it is required by the Water Resources Act (1981) that the consent of the Environment Agency is acquired before proceeding.

During the construction of any access roads, the minimum possible culverts should be created in order to maintain the natural flow of the stream as much as possible. Once this has been planned, under the Land Drainage Act (1991) and the Water Resources Act (1991), the Environment Agency must approve these plans and consent for any work to take place.

There are further concerns during the construction of any project, that there may be either particulate or chemical pollution to either groundwater or surface water (henceforth referred to as the stream). It is imperative from an ecological point of view that this mitigation is planned out before construction works begin.

Any water containing particulates that have been agitated by groundworks should not be allowed to flow directly into the stream. Instead, settling ponds are to be constructed, allowing the particulates to sink before the water re-enters the stream. It is also suggested to use Hay Bales to further filter water as it re-enters.

At the location which any chemicals or oil are stored. There is to be Bunding installed to prevent any chemical seepage into the stream or the groundwater. Any chemical spills in or out of the bund are to be cleaned up immediately and disposed of in a Control of Substances Hazardous to Health (COSHH) skip or container, separate from any non-hazardous waste.

Risks associated with Construction.

During any construction process there is a risk to the workforce and members of the general public that are near the vicinity that the works are being completed within.

One benefit of the site being remote will be a lack of members of the public frequently in the area. Therefore, a simple and effective mitigation strategy for the public risk is simply limiting site access to those who need to be there.

As for the site workers who need to be there, there are a vast possibility for risks to workers on a construction site. The following table (Figure 2) highlights examples risks to workers, as well as mitigation strategies to minimise these risks.

Management of health and Safety at Work regulations 1999 state that the minimum acceptable mitigation strategy during the construction stage of a project is as follows.

1. Identify Hazards
2. Decide the risk (Likelihood)
3. Take action to eliminate, mitigate the risk or control the risk.

To reduce the risks, the hierarchy of controls (Figure 1) is to be employed. This highlights the most to least effective strategy for mitigating risks. If it is not possible or feasible to use the most effective methods, the next most effective must be used.

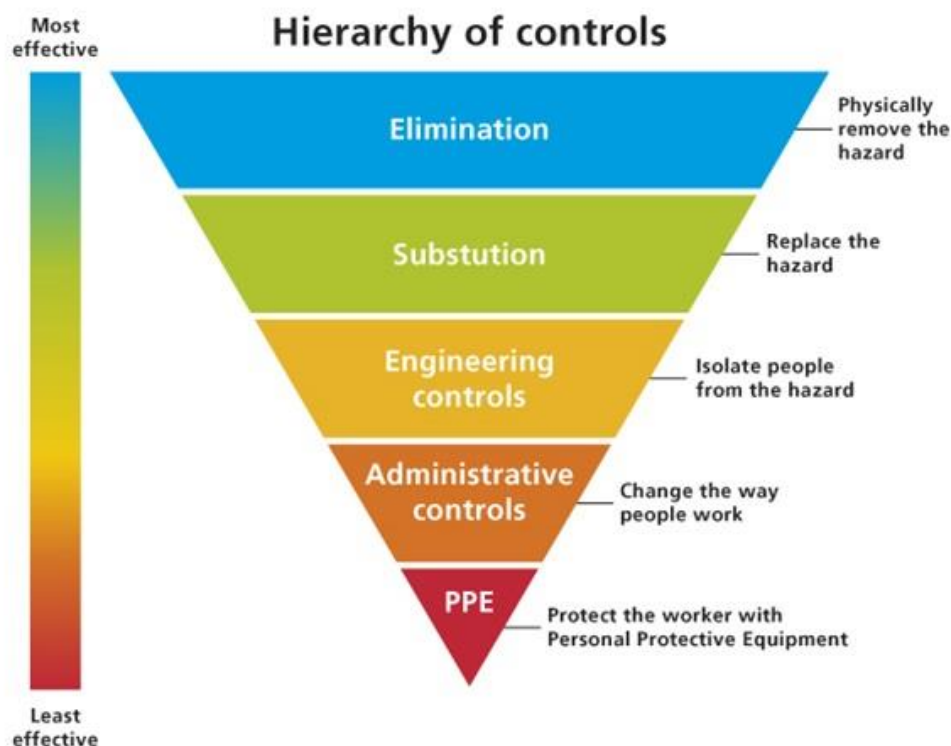


Figure 1: Hierarchy of controls. (Goodfellow-Smith, M.(2023)).

RISK ASSESSMENT TITLE										
Wind Turbine Construction										
RISK ASSESSOR NAME	UNIVERSITY INSTITUTE / DEPARTMENT			BRIEF DESCRIPTION OF ACTIVITY				DATE VALID FROM		
Oliver Turner	WISA - engineering and environmental			Construction of a Wind Turbine				First Worker Enters Site		
AUTHORISING LINE MANAGER	PERSONS AT RISK			DATE(S) / IDENTIFICATION(S) OF ACTIVITY				REVIEW DATE		
N/A	Site Personnel			Dates TBC / Project Site				In-between construction Stages		
HAZARD	POTENTIAL HARM	RISK RATING			CONTROLS				RESIDUAL RISK	
See what could cause harm from this activity.	For each hazard, identify the types of harm that could occur (e.g. biological, physical, chemical, safety, ergonomic or psychosocial)	See Risk Rating Table			For each hazard, list the measures you will be taking to minimise the risk identified.	See Risk Rating Table		Severity	Likelihood	Risk
		Severity	Likelihood	Risk						
Combined risks between multiple project areas										
Collisions Between workers and equipment	Physical	4	3	12	All workers to be trained and wear high visibility clothing at all times. Operations around a lot of workers should have additional lookouts where visibility is reduced.	4	2	8		
Hearing loss due to high noise levels	Physical	3	4	12	Hearing protection must be worn above 85 Db.	3	1	3		
Head injuries from falling Objects	Physical	4	3	12	All persons on site must wear safety helmets, unless in designated areas.	3	3	9		
Injuries From Power tools	Physical	4	3	12	Persons must receive training for any tools they are to use. Gloves must be worn by all workers on site (Unless specified otherwise, such as those using certain rotary tools). Safety Glasses must be worn by all workers working with or around power tools.	4	2	8		
Drowning	Physical	5	2	10	Watercourse should be fenced off to all workers not required to access it. Life preservers should be accessible on bank.	5	1	5		
Major Physical Injuries (At least 1 day needed off work) (Cuts, Sprains, fractures etc.)	Physical	3	3	9	All workers to attend health and safety briefings and wear relevant PPE. Only qualified workers are to use certain tools. First responders will always be on site while work is being conducted.	2	2	4		
Burns (Heat)	Physical	3	3	9	Gloves must be worn by all workers on site (Unless specified otherwise, such as those using certain rotary tools). First responders present.	2	2	4		
Heat Stress	Physical	3	3	9	Water should be provided for free to all workers. Shades should be available to all workers.	3	2	6		
Falls From Height	Physical	4	2	8	All workers at height are to be fully trained and must wear fall arrest harnesses.	4	1	4		
Electrocution	Physical	4	2	8	Only trained workers are to work with site electronics. All connections must be isolated if exposed. All wiring should be isolated while work is being conducted on them.	4	1	4		
RSI (Repetitive strain injury)	Physical	2	4	8	Gloves will be provided to those working with power tools. Regular breaks must be taken.	2	2	4		
Collisions Between Heavy Equipment	Physical	2	3	6	All workers to be trained and licenced.	2	3	6		
Minor Physical Injury (No time off needed) (Cuts, sprains bruises)	Physical	1	5	5	All workers to attend health and safety briefings and wear relevant PPE.	1	3	3		
Exposure to Hazardous Materials										
Inhalation of Particulates	Physical	3	4	12	Masks are to be worn around any activities producing dust or particulates.	3	2	6		
Burns (Chemical)	Physical/ Chemical	3	3	9	Only trained workers should use potentially harmful substances and only as required. All potentially harmful chemicals are to be stored in a secure area and checked out only as required.	3	2	6		
Chemicals/ particulates in Eyes	Physical/ Chemical	3	3	9	All persons on site must wear safety glasses, unless in designated areas. Chemical eye wash on sight and clearly sign posted.	2	2	4		
Ingestion of harmful substances	Chemical	4	2	8	All COSHH substances to be stored and identified correctly.	4	1	4		
Turbine Assembly										
Collisions Between workers and equipment	Physical	4	3	12	All workers to be trained and wear high visibility clothing at all times. Operations around a lot of workers should have additional lookouts where visibility is reduced.	4	2	8		
Trapped fingers	Physical	3	3	9	Only necessary personnel should be near parts that are being lowered into place. Training and PPE should be provided.	3	2	6		
Falls From Height	Physical	4	2	8	Fall Arrest Harnesses must be worn while ascending turbine or at height.	4	1	4		
Operation										
Electrocution	Physical	4	3	12	Workers must not touch anything they have not been trained to operate. Relevant PPE must be worn at all times.	4	2	8		
Major Physical Injuries (At least 1 day needed off work) (Cuts, Sprains, fractures etc.)	Physical	3	3	9	All workers to attend health and safety briefings and wear relevant PPE. Only qualified workers are to use certain tools. First responders will always be on site while work is being conducted.	2	2	4		
Falls From Height	Physical	4	2	8	Fall Arrest Harnesses must be worn while ascending turbine or at height.	5	1	5		
Burns	Physical/ Chemical	3	2	6	PPE to be worn when handling anything hot. Only do be done if necessary.	3	1	3		
Minor Physical Injury (No time off needed) (Cuts, sprains, bruises)	Physical	1	5	5	All workers to attend health and safety briefings and wear relevant PPE.	1	3	3		

Figure 2: Construction Risk Assessment. (See Appendix)

Risk of Ongoing Operations.

The construction period is often thought of as the main concern of a new project, especially in the eyes of the general public. However, in truth the ongoing operations of any project often pertain to the most significant effect on the locality. For example, with this proposal, the ongoing effects will be taking place for 27 years.

The following are the most critical areas of concern according to Boyle, G. (2012).

Noise

While modern turbines are more efficient and less noisy than previous generation models, other than being an “eyesore”, the most obvious complaint against wind turbines is noise. It should be noted however that wind turbines are less noisy than many equivalent sources of power. This issue affects people living and working near to wind turbines, and for wildlife which shall be discussed in the section “Wildlife” section. In this case, due to the remote location, the only affected parties are likely to be the farmer and associated agricultural workers. There are two distinct types of noise associated with wind turbines: Mechanical and Aerodynamic. The mechanical noise is typically more of an issue than the aerodynamic noise, it is inherently caused by the gearbox. If the company decide to install a wind turbine that is gearbox free, this issue would be negated entirely.

Aerodynamic noise is caused by the rotation of the blades cutting through the air. During higher wind speeds it is unlikely for this to be audible over the wind itself. If the aerodynamic noise is deemed to be an issue, the turbine can be restricted to lower rotational speeds at lower wind speeds whenever it can be heard over the sound of the wind.

In the UK, noise limits are set depending on the background noise level. The limit is normally set at 40DB. Due to the proximity to the SSSI and the farm, it is possible that this limit may be set at 35DB. At night-time, the noise limit would likely be set at 43DB. Boyle, G. (2012. pp326-329).

Electromagnetic interference

Another concern of wind turbines is the oscillations their blades cause can cause a disturbance to electronic and electromagnetic signals. If there is a wind turbine in between two points of contact, then the signal between them may be negatively impacted.

“When a wind turbine is positioned between a radio, television or microwave transmitter, it can sometimes reflect some of the electromagnetic radiation in such a way that the reflected wave interferes with the original signal as it arrives at the receiver. This can cause the received signal to be distorted significantly.” Boyle, G. (2012. p329)

This issue is more likely to have a negative effect in a built-up area or if the location was close to a radio station or signal mast. As this is not the case in this scenario, it is unlikely that significant Electromagnetic Interference will be experienced as an impact of this proposal.

Aviation

According to research by Renewable UK, half of all proposed wind energy projects in the UK will be impacted by concerns from the aviation sector.

The Ministry of Defence (MOD) have two concerns in particular; interference into airspace and interference with Radar technology (Addressed in the previous chapter). If there is an issue with MOD radars, then it would be possible to use Radar Absorbing Materials (RAMs) for the blades to mitigate this issue.

As for the issue with low flight zone interference issues with military aircraft, there are maps produced by NATS, the MOD and RESTATS which show any zones in which the MOD requires notification of wind turbine planning permission applications. Boyle, G. (2012. pp330 - 331)

Wildlife

In terms of potential impacts to fauna, Birds and Bats are those most frequently cited as being at risk from wind turbines.

Birds

The primary potential hazard for birds regarding wind turbines is the risk of impact with the blades. There are however other concerns such as habitat loss, noise and general disturbance. Drewitt and Langstone. (2006).

According to Natural England, (2010), there is little evidence suggesting wind farms in England have a significant impact on birds. They do however provide guidance regarding birds and wind turbines that should be followed, including the monitoring of bird populations and bird strikes during the operation of the turbine.

If the turbine lays withing the migratory path of any birds, Bird Control Radar Systems are available which on the detection of incoming birds can either deter the approach on oncoming birds or temporarily shut down the turbine. (Boyle, G. 2012. P332)

Bats

There is particular concern for bats around their migration routes. It appears at this time that micro wind turbines are more of a concern to bats than commercial projects.

The suggested course of action for this project is to follow the guidance set out by Natural England (2009). Boyle, G. (2012. p333)

Economic Evaluation

Economic Projections

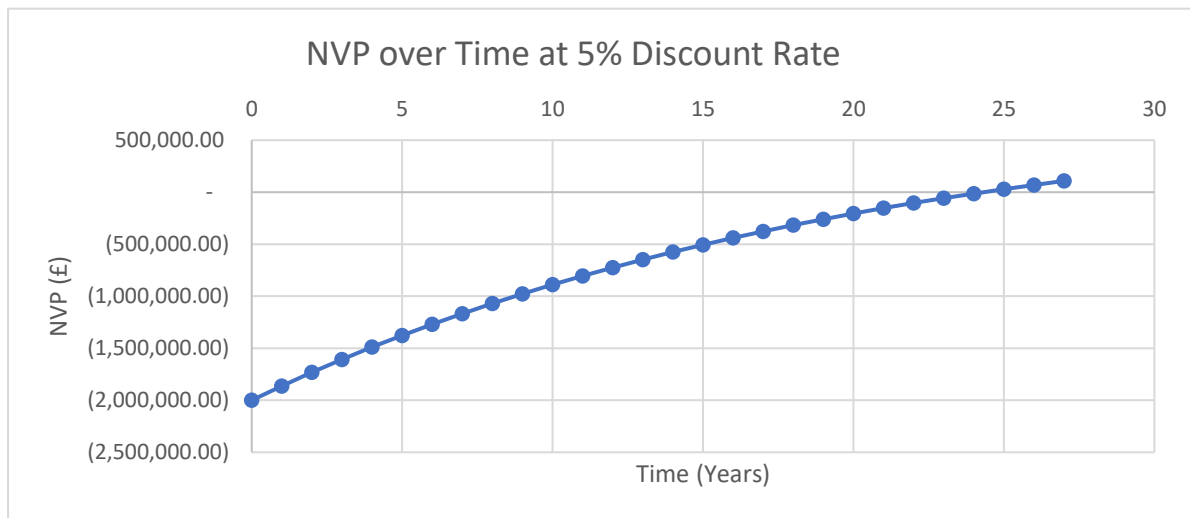


Figure 3. NVP over time (without decommissioning costs).

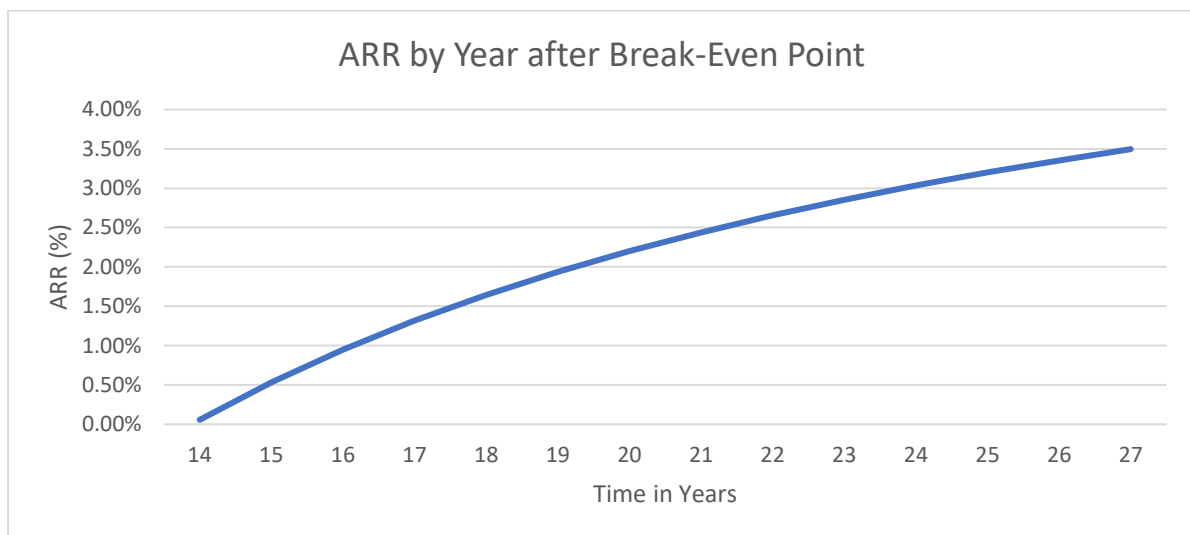


Figure 4. ARR post break-even point.

Economic Statement

An NVP calculation was conducted on the project at 10 and 27 years (The expected life of the project). After 10 years, there are significant losses yet to be regained. At the 10 years mark the NVP for the project is approximately -£888,070.17. This would clearly not be a viable project to undertake. Refer to Figure 3 to view the expected change in NPV over time.

At 27 years, the NVP is positive without factoring potential decommissioning costs at £108,596.84. Assuming a life cycle of 27 years however, decommissioning costs must be factored in at this point. According to research by Blattner, H. (2017), Wenck Associates. (2017), and Zelenak, B.R. (2011), a proposed conservative estimate for the decommissioning costs of the wind turbine will be £300,000, given that the costs of decommissioning are likely to be reduced over the course of the next 27 years. Once this has been factored in, the new NPV for the project after 27 years, even without considering externalities is -£10,327 making the project unviable unless its primary objective is offsetting carbon for the company.

Referring to Figure 4, the expected ARR for the project is 3.5%. Once the estimated decommissioning costs of £300,000 are factored in at the end of the project then this is reduced to 2.94%.

If the company can make more than a 2.94% ARR on another project, then this project is not worth investing in. If the company does not have another opportunity for a project to make a higher return than this, or they deem the carbon offset to be worth the lost revenue then this project is worth the investment.

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Appendix

For a larger version of figure 2, please refer to the attached excel document. If this is not submittable on Turnitin it shall be emailed to relevant parties and available on request.