Derrybrien Wind Farm Project

Gort Windfarms Ltd.

Remedial Environmental Impact Assessment Report
Chapter 3 – Alternatives

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3.1 Introduction

3.1.1 Chapter Scope

This chapter describes the alternatives to the project that have been considered taking into account the key objectives of the project and how these would be met by alternative options.

The requirement in relation to consideration of alternatives is set out in the EIA Directive[1]: The information in relation to consideration of alternatives to be included in an Environmental Impact Assessment Report (EIAR) is set out in Article 5 (1) (d) as *follows:*

> *"1. Where an environmental impact assessment is required, the developer shall prepare and submit an environmental impact assessment report. The information to be provided by the developer shall include at least:(d) a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment…"*

3.1.2 Statement of Authority

The chapter was compiled by Roisin O'Donovan B.E. (Civil), C. Eng., MIEI; PgDip (Environmental Engineering); PgDip (Physical Planning); LLM (Environmental Law and Practice) and

Paddy Kavanagh, BSc , PhD. Dr. Kavanagh has over 39 years of experience in the field of chemistry, environment and environmental assessment both in Ireland and internationally. He has led and contributed to the preparation of environmental impact statements/environmental impact assessment reports and environmental management for power generation, transmission systems including the Donegal and Connemara 110 kV overhead lines and substations, Interconnector and wind farm projects including Oweninny, Grousemount, Lissycasey wind farms for example.

Specific assessments of the alternatives in relation to the key factors has been prepared with inputs from the individual chapter authors of the rEIAR.

3.1.3 Objectives of Derrybrien Wind Farm Project

The objectives of the project are stated in Chapter 2, Section 2.2.1 and are:

[1] Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014

Objective 1: To continue to operate the Derrybrien wind farm project to circa 2040 contributing to renewable electricity input to the national grid.

Objective 2: To contribute to and continue to meet the EU and Ireland's stated policy and legally binding targets with respect to Renewable Energy Generation and displacement of fossil fuel energy production.

Objective 3: To contribute to and continue to meet the renewable wind energy targets set in the County Galway Wind Energy Strategy (WES) which was originally developed in 2011 to meet a target of 500 MW to be installed in Co. Galway by 2017.

Derrybrien Wind Farm has been in operation since 2006 and since that time has contributed to meeting Objectives 1, 2 and 3 of the project. In 2006 the installed wind capacity in the country was circa 700MW[2] . From the time the Derrybrien Wind Farm became operational with an installed capacity of 59MW , it constituted circa 8% of installed capacity nationally and circa 11.8% of the capacity for County Galway - a significant contribution at that time. The purpose of the substitute consent application - of which this rEIAR is part, is the full realisation of Objective 1, and the continued realisation of Objectives 2 and 3 as the project will continue to contribute to the achievement of EU, national and county wide renewable energy targets.

3.2 Methodology

The consideration of reasonable alternatives was undertaken in accordance with the requirements of Annex IV(2) of the amended EU Directive and in accordance with Section 3.7 Consideration of Alternatives set out in the Environmental Protection Agency's Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports which states:

> "The objective is for the developer to present a representative range of the practicable alternatives considered. The alternatives should be described with 'an indication of the main reasons for selecting the chosen option'. It is generally sufficient to provide a broad description of each main alternative and the key issues associated with each, showing how environmental considerations were taken into account is deciding on the selected option. A detailed assessment (or 'mini-EIA') of each alternative is not required"

The assessment has been undertaken based on guidance, published risk assessment methodologies and professional judgement.

[2] SEAI, renewable Energy in Ireland, 2019 Report, Figure 15: Installed wind-generation capacity, 2000 to 2017

3.2.1 Guidance

In undertaking this assessment, regard has been had to the following guidance:

- European Commission, "Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU)", 2017[3],
- Draft EPA Guidelines on the Information to be contained in Environmental Impact Assessment Reports, 2017[4],
- Wind Energy Planning Guidelines for Planning Authorities (Department of the Environment, Heritage and Local Government, 2006)[5],
- Draft Wind Energy Development Guidelines (Department of Housing, Planning and Local Government, December 2019)[6].

It is noted that the peat slide that occurred during construction of the Derrybrien Wind Farm Project is cited as an example in EC Guidance[7] of the need to consider the adverse impacts of natural disaster/risks when constructing a Project. The consideration of ground stability in EIA Guidance is outlined below.

3.3 Difficulties Encountered

No significant difficulties were encountered in undertaking this assessment. However, all alternatives proposed would require planning and environmental consenting to enable these to be developed realistically. This would entail a much greater degree of in-depth assessment which could potentially identify additional constraints.

3.4 Alternatives Considered

There is no termination date attached to the planning permissions granted for the development of the Derrybrien Wind Farm and associated ancillary development. The identification of reasonable alternatives has taken this into account.

The relevant alternatives considered in relation to this application are therefore:

- Do-Nothing,
- Continued operation and later decommissioning,
- Alternative Renewable Energy Projects on site,

[3] European Commission, "Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU)", 2017

[4] EPA, "*Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports",* August 2017

[5] DOEHLG, "*Wind Energy Development Guidelines for Planning Authorities"* 2006

[6] DHPLG, *"Draft Wind Energy Development Guidelines"* , December 2019

[7] European Commission, "Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU)", 2017

- Decommissioning and remediation alternatives for the wind farm site.

These options are discussed in more detail in the following sections.

3.4.1 Do-Nothing

The do-nothing alternative is to cease operation of the wind farm and to move to immediate decommissioning. This alternative would still necessitate the application for substitute consent but with an advanced earlier termination date of the project, circa 2020 -2021 e.g. as opposed to circa 2040, with decommissioning as described in the rEIAR, Chapter 2, occurring thereafter within a two year period.

Under this alternative the wind farm would cease generation of renewable electricity to the national grid and would constitute a reduction in the wind energy capacity generation nationally and in County Galway.

In contrast the benefit of retaining the existing project would be the continued provision of renewable energy without further works other than maintenance works and ultimate decommissioning works being required to circa 2040.

Decommissioning of the site would take circa 18 to 24 months

Objective 1 of the Project would be prevented from being met and the Project would make no contribution to achieving Objectives 2 and 3.

3.4.2 Continued Operation and Later Decommissioning

This alternative involved the continued operation of the development and – at end of life (circa 2040), the undertaking of decommissioning works.

Under this alternative the application for substitute consent is made in compliance with the Notice from the Planning Authority (Galway County Council) and the project would continue to operate, generating renewable electricity into the national grid until decommissioning is carried out. This is then the proposal which will be facilitated by approval of this substitute consent application, which is accompanied by the rEIAR and rNIS for the project.

This option would meet all three objectives of the Project.

3.4.3 Alternative Renewable Energy Projects

Renewable energy technologies have developed significantly in recent years - particularly in the areas of wind energy - with wind turbine generators increasing in size and scale, and in respect of other renewable energy technologies - such as energy storage (batteries and synchronous condensers) and solar farms .

The Derrybrien Project is a 110kV grid connected project and therefore the site potentially lends itself to development post cessation and operation of the current Project with new or more advanced renewable energy technologies which could be installed on site. Some of the advantages of this alternative would be the re-use (to

varying degrees) of the existing infrastructure - such as the access track infrastructure, substations and grid connection, thereby minimising potential environmental impacts associated with new development. The main options under this alternative would be:

- Repowering of the wind farm site
- Development of a solar farm project on site
- Development of battery energy storage systems on site
- Development of a synchronous condenser on site
- Co-location of the above options within a repowered wind farm

It should be noted none of the above options would have been available at the time of the Project Development i.e. the early 2000's, as these technologies rely on recently advanced technologically and / or the need for them has occurred due to greater renewable electricity generation onto the national grid which in itself requires increasing grid stabilisation services.

The alternative renewable energy options are outlined in more detailed in the following sections.

3.4.3.1 Repowering of the wind farm site

Replacement of the existing turbines could be considered at the end of the lifetime of the Project and would require decommissioning of the existing project. During the decommissioning and repowering construction, Derrybrien would no longer produce renewable electricity for export to the grid and this benefit would be lost until such time as the repowered wind farm became operational, a period of 2 to 3 years.

Repowering would then include replacement of existing turbines with fewer, larger, more efficient wind turbines - likely at different locations on the site to ensure separation distance and efficiency of operation.

The Irish Wind Energy Association (IWEA) recently published a guide to repowering wind farms in Ireland[8]. The Report indicates that repowering has:

"..the ability to continue using productive wind farm sites that were commissioned first. Installing modern technology on these sites can also vastly increase their installed capacity and annual energy production. Repowering can also; be cheaper than new builds, reduce the number of turbines in a wind farm, result in lower energy costs and prices, and increase our energy security"

The IWEA Guide also indicates that in the UK repowering has typically seen a reduction of 40% in the numbers of wind turbines on site with significantly increased capacity and renewable energy production. A further example provided was that of a planned repowering project in Donegal which will see the replacement of 25 WTGs (Wind Turbine Generator's) with just 12, while increasing capacity from 15 MW to

[8] IWEA, More Power to You, A Guide to Repowering in Ireland, 2019

around 60 MW[9]. Typically, modern wind turbines would have a rating output of between 3.0 and 4MW and up to 180m tip height with 120m tower height (a ground clearance of circa 40m).

Significant positive benefits, in terms of meeting renewable electricity generating targets, increasing renewable electricity production and displacement of fossil fuel generated electricity, with associated positive impacts on greenhouse gases are achieved by this alternative.

However, repowering requires the decommissioning of the site and - though existing infrastructure can be used to some extent, significant upgrades would be required. The existing access tracks on the wind farm site could be used but would require widening and strengthening to facilitate construction and delivery of larger WTG component with some additional access tracks constructed also. The existing foundation bases would not be suitable for use and may not be in the optimum locations. They would either need to be removed or left in-situ with new, larger and deeper foundations constructed at different locations, necessitating additional earth works and drainage. Similarly, hardstands for cranes could be re-used if suitably located, but would need to be increased in size to accommodate the larger equipment associated with larger turbines - otherwise additional hardstands would be required.

The construction required by repowering would pose geotechnical risks which could be managed on the site given the larger dimensions of the required infrastructure and the delivery and erection of larger turbine components.

Associated with the larger infrastructure requirements, the footprint of the windfarm would also likely increase - but this would depend on the extent of existing infrastructure removed and associated ground restoration works.

The impact on biodiversity would also change. There could be physical loss of habitat due to increased footprint. Larger wind turbines have greater blade swept paths and higher tip velocities than the existing turbines but they would also have greater clearance between ground level and blade tip and there would be fewer turbines. This could have positive effects on bird and bat collision risk.

External to the site, modifications to the road network would potentially be required to facilitate delivery of large component loads, with implications for the local road network users. However, these impacts would be temporary.

Modifications to the existing substation and grid connection would also potentially be required due to increased export capacity potential - but these would be localised to the existing footprints or immediate adjacent areas.

The larger turbines would likely be more visible - but the visual effect would be different as there would be fewer of them.

[9] Keadow Upper, Barnesmore, Co. Donegal An Bord Pleanála, http://www.pleanala.ie/casenum/304023.htm

In summary, repowering would not be undertaken until after the existing project has been decommissioned. It would in effect be an entire new project entailing extensive construction works including excavation for foundations, strengthening and replacement of internal access roads together with provision of new roads. The potential environmental effects would be in addition to decommissioning effects. Although a high level assessment of potential impacts is provided here sufficient for the assessment of alternatives, any new proposal for repowering would be subject to a full detailed assessment under the EIA, Birds and Habitats Directives to determine its acceptability for this site requiring much more in-depth site analysis and assessment of effects.

Decommissioning and repowering of the site would take circa two years. During this time the site would not generate renewable energy.

The Repowering Alternative would likely meet all three objectives of the project.

3.4.3.2 Solar Farm

Solar technology, powered by solar radiation, is well developed and is capable of operating to produce electricity on cloudy days as the photovoltaic (PV) cells are powered by daylight. A solar farm generally consists of an array of panels ground mounted on steel frames, in arranged rows - usually running east west across the site, with a separation distance of between 6-10m between arrays. Solar farms generate electricity in direct current (DC) and this is then changed into alternating current (AC) for transmission on the electricity grid. Hence a substation, inverter cabins to convert from DC to AC, underground cable ducts, temporary site compound/hardstanding area, drainage and ancillary facilities, boundary security fence and landscaping, site entrance and access tracks would all be required.

Typically, 1 MW of solar panels and associated infrastructure requires up to 5 hectares of gross area with between 0.7 and 0.9 ha of solar panel area required per MW also. These figures have been derived from ESB's experience in assessing solar capacity of sites in Ireland and are typical of what area is required but requirements could be more significant depending on ground conditions. Similar figures are quoted from the UK experience with approximately 25 acres (circa 10 hectares) of land is required for every 5 megawatts (MW) of solar power array installation.[10]

If the existing wind farm were to be decommissioned then the Derrybrien wind farm site could accommodate a large-scale solar array to generate renewable electricity into the grid, which could be facilitated by the existing grid connection with some modifications.

The total area of the Derrybrien wind farm site available to the Project is circa 344 ha (the lease boundary area) but this includes felled forest areas 222 ha which have not been replanted and could potentially be available and turbary areas which are still in use and may not be available. Potentially the wind farm site could accommodate a

[10] House of Commons Library Briefing Paper *"Solar Farms: Funding, planning and impacts"*, December 2015

solar photovoltaic development of circa 68MW export capacity - if the total site area of 344ha were available, or circa 44MW excluding the turbary areas. Not all of the land may be suitable, and this would be dependent on ground conditions.

Some of the existing infrastructure on the wind farm site could potentially be re-used - such as the substation, grid connection, some existing access tracks, and the site entrance but significant additional groundworks would be required as given the depth of peat piling of foundations would likely be necessary to support the solar array panel frames. Significant assessment of the site from a geotechnical stability perspective would be required before any such development occurred. It is possible that this would determine that areas of the site would not be suitable for this development option. Furthermore, it is possible that the viability of suitable foundation solutions may be challenging in areas of the site. The development of solar arrays would necessitate changes to the drainage network on site – associated with the introduction of additional impermeable surfaces (PV panels) onto the site, likely in the form of a network of swales. This would be subject of detailed assessment and design.

The 68MW solar export capacity would cover an area of circa 47ha to 61ha alone within the site apart from ancillary infrastructure with 44MW requiring between circa 31ha and 39ha. This would represent a significant additional land take which would impact on biodiversity including habitat loss, construction disturbance and displacement of activities. Additional drainage may also be required which in the absence of mitigation, could result in impact on surface water quality with piling activities potentially impacting groundwater. Changes to the layout of existing inter-array cables installed as part of the existing project to the windfarm substation would also be required with additional cable being deployed This would lead to additional ground disturbance.

The potential also exists to co-locate solar arrays into the existing wind farm or indeed into any repowering of wind energy on the site to increase export capacity and would involve additional land take as described above with additional cabling and potential modifications to the internal windfarm substation, the grid connection and Agannygal substation. Increasing export capacity would be of benefit to meeting renewable energy targets and contributing to the reduction of greenhouse gas emissions nationally. The impacts from co-location would be additional those of the existing wind farm on site and to any repowered wind farm.

The solar option would meet Objective 1 of the Project and would contribute to achieving Objective 2 and Objective 3 but would contribute at a lower level than the existing project due to the lower capacity factor of solar (typically 10%) compared to wind (typically 28 - 30%).

Solar power would operate largely automatically and be controlled remotely with only routine maintenance visits required.

3.4.3.3 Battery Energy Storage Systems (BESS)

Battery Energy Storage Systems provide important grid stabilisation services supporting the level of renewable energy on the national grid. To meet the challenges

of operating the electricity system in a secure manner while achieving the 2020 renewable electricity targets EirGrid began a multi-year programme, “Delivering a Secure, Sustainable Electricity System”, known as the DS3 Programme. The DS3 programme is designed to ensure that the power system can securely operate with increasing amounts of variable non-synchronous renewable generation over the coming years. As stated by EirGrid “Non-synchronous generation produces a different amount of electricity depending on the energy available. It does not produce the same amount of electricity all of the time. This makes it less reliable, and more difficult to bring onto the grid. Most renewable forms of energy, such as wind and solar, are types of non-synchronous generation. This is because the amount of wind and light is always changing and therefore, they cannot produce power predictably”[11]. BESS developments allow for increased renewable energy generation connecting onto the electricity grid. They operate by importing power– effectively ‘charging the battery’, during periods of excess capacity. The power is stored for future-use and discharged onto the grid during periods of excess customer demand.

Battery energy storage systems (BESS) generally comprise battery modules contained within steel containerised units with typical dimensions of up to 16.6 m x 2.9 m x 3.7 m high. The enclosures are similar in appearance to standard shipping containers and are usually placed on concrete foundations circa 600 mm above the general site level. These dimensions vary dependent on manufacturer. BESS facilities also include electrical plant such as transformers, inverters and other containerised plant. The batteries themselves are generally lithium-ion batteries connected to inverters that convert direct current (DC) to alternating current (AC), which are in turn connected to step up/down MV/LV (medium voltage/low voltage) unit transformers feeding a substation. The transformer, likely containing less than 1,000 litres of oil, would be connected to the existing wind farm substation via 38kV import/export cables.

Much of the infrastructure to accommodate BESS units is already in place at Derrybrien, including access tracks, hard stand areas and substations and grid connection. The battery energy storage units themselves could be located on the existing hardstand areas which are already cabled - but reinforced concrete foundations would be required on these areas to support the battery units. With efficient design, it is likely that no - or minor, additional land take would be required to accommodate the units.

The existing wind farm would not be operational in this scenario and would be decommissioned in line with the description in Chapter 2, except for the continued use of the existing access tracks, hardstands, substations, grid connections and some other infrastructure, such as cables, lighting etc.

[11] EirGrid DS3 Programme http://www.eirgridgroup.com/how-the-grid-works/ds3-programme/

The BESS Units would be remotely operated with only routine maintenance visits required.

Co-location of BESS units with the existing wind farm - or as part of any repowering of the site (see Para. 3.4.3.1) is also a possibility. However, if co-location were to take place with the existing wind farm this would likely require additional land take as the existing hard stand areas would need to be maintained for maintenance purposes and new foundation areas would be required for the BESS units. In the case of repowering only some of the existing hardstand areas would potentially be reused for construction and maintenance associated with the repowering layout leaving the remainder available for BESS units.

It is noted that BESS facilities do not generate renewable electricity, but it does support the renewable energy sector as described above. As a stand-alone development the BESS option would partially meet Objective 1 of the Project and would contribute to meeting Objective 2 in the sense that it would facilitate renewable energy penetration onto the national grid through providing grid stabilisation services and would also extend renewable generation through storage and reuse of excess power. It would not meet Objective 3 as the wind farm would likely be decommissioned. Co-location of a BESS and renewable generation facility (e.g. repowered wind farm) would meet Objectives 1,2 and 3.

3.4.3.4 Synchronous Condenser

Synchronous condensers are a very mature technology and have been used since the 1950s. A synchronous condenser is a rotating electrical machine that resembles a generator/motor in design. Its purpose is to support the transmission system voltage by supplying/absorbing reactive power to and from the grid and providing synchronous inertia. There is no combustion in a synchronous condenser and no emissions. Occasionally, an additional rotating mass called a flywheel is added to the Synchronous condenser to provide increased kinetic energy to the transmission system which is very important during system faults.

Synchronous condenser developments allow for increased renewable energy generation connecting onto the electricity grid thereby supporting the network. They do not generate electricity.

Typically, such a development would comprise a generator and flywheel building of circa 1,200m^2 and dimensions 40 m x 30 m x 15 m in height to house the generator, flywheel, lube oil skid, air compressor and pumps located on a circa 1hectare site. The building and ancillary services would require a reinforced concrete foundation to support the structure and would be located adjacent to the substation to which it would be connected by an export cable.

The typical lifespan for synchronous condensers is twenty years.

There would be no requirement for personnel at the synchronous condenser site (except during maintenance) as the machine will be operated remotely.

This option assumes that the wind farm would be decommissioned but existing infrastructure such as access tracks, existing substation and grid connection would

likely be reused. An additional land take of circa 1 to 2 hectares near the existing substation would be required which would result in the loss of habitat area - but this could be offset by restoration of some decommissioned areas on the site.

Co-location of a synchronous condenser on site with the existing wind farm, or as part of any repowering option would also be possible.

It is noted that a synchronous condenser does not generate renewable electricity, but it does support the renewable energy sector as described above. As a stand-alone project, the synchronous condenser option would partially meet Objective 1 of the Project and would contribute to meeting Objective 2 in the sense that it would also facilitate renewable energy penetration onto the national grid through providing grid stabilisation services. It would not meet Objective 3 as the wind farm would likely be decommissioned. Co-location of a synchronous condenser and renewable generation facility (e.g. repowered wind farm) would meet Objectives 1, 2 and 3.

3.4.4 Alternative Land-use

The Derrybrien project site was originally used mainly for commercial forestry and for turbary use. The commercial plantations of Sitka Spruce and Lodgepole pine within the wind farm boundary, along with the 110kV overhead line and at the Agannygal substation were clear-felled at the time of construction and the areas were not replanted during the operational period to date but left bare. Turbary continued in operation within the wind farm boundary area itself but the land-use was essentially that of a commercially operating wind farm with some turbary operations.

Post decommissioning, an alternative use would be to re-establish commercial forest plantation on most of the 222 hectares where clear-felling took place. There would likely be a negative impact on carbon balance in the initial period due to ground preparation for replanting but, within two to four years, it would give rise to significant carbon sequestration which would increase as the plantations matured over a forty-year period.

As the site had already been drained for commercial plantation prior to the development of the Project, it is likely that only limited ground preparation would be required, which could potentially include the use of some herbicides to clear existing vegetation which would compete with the young trees. Fertilisation of the site may also be required to nourish growing plants.

However, post development of the Project, the site was designated as an SPA for the Hen Harrier, with the open areas providing a significant positive effect on their population through provision of foraging areas. With the re-establishment of commercial forestry, this benefit would be lost as the forests mature and forest canopy closure occurs. This would likely lead to a potentially significant negative effect on the hen harrier population.

This option would not meet Objectives 1, 2 or 3.

3.4.5 Alternative Decommissioning Options

In addition to the decommissioning and re-use options described in the sections above there are two main options for final decommissioning of the project when it has reached the end of its operational life. Although described below these have been considered throughout the rEIAR and the option of decommissioning and leaving the subsurface structures in situ has been considered the most appropriate. For the purpose of assessment of alternatives, it has been assumed that decommissioning as described in Chapter 2 Section 2.10 which entails mainly removal of above ground structures only, will take place.

3.4.5.1 Decommissioning including removal of subsurface structures

The first is the decommissioning of the project with the removal of all structures both above ground and below ground with site restoration works and subsequent landscaping. This would also include bog rehabilitation with active drain blocking where feasible. Decommissioning of the project in this manner would involve significant works to remove turbine foundations, meteorological mast, tower foundations on the overhead line and substation foundations requiring mechanical breakers, excavators and transport vehicles - at a level similar to that during the project construction phase. Hardstand areas and some access tracks would also potentially be removed or reduced in level to allow landscaping. Demolition of concrete foundations and surface buildings would be done mechanically using hydraulic rock breakers.

There would be impacts from these activities arising from noise and vibration, potential sediment generation and hydrocarbon loss and disturbance and displacement of avifauna and fauna in general. Replanting of previously planted forest areas could also be considered.

3.4.5.2 Decommissioning leaving sub surface structures in-situ

The second alternative, and that which is proposed for the Project (see Chapter 2, Section 2.10) is to remove only the above ground structures, leaving the wind turbine foundations, meteorological mast foundations and substation foundations in situ. Above ground concrete structures would require the use of mechanical rock breakers to remove. No active drain blocking would occur and the drainage would be left to naturally rehabilitate. Access tracks and hardstands would also be left in place and no replanting of forest would occur although some natural regeneration would be likely. This approach minimises ground disturbance and reduces the duration of decommissioning activities. Noise generated would be of shorter durations as would disturbance of fauna in general. It would also entail a lower geotechnical risk as there would be less and shallower ground disturbance

3.5 Summary of Alternative Assessment and Environmental Considerations

The key considerations in assessing the alternatives to the proposed development are provided in the following sections. Each factor is considered in terms of the potential impacts that could occur, the effect of these and the significance and likelihood of their occurrence. This includes an assessment of all topics for comparison purposes.

3.5.1 Population and Human Health

This section looks at the potential impacts and effects only on population and human health that would likely occur if alternative uses of the site were availed of. In all cases decommissioning of all or part of the site would occur to facilitate the alternative development.

3.5.1.1 Analysis of Alternatives

The effects of the 'Continued Operation and Later Decommissioning' Option would be as described in detail in Chapter 4, Section 4.3.2 and Section 4.3.3 whereby the Project would continue in operation to circa 2040 and would then be decommissioned. This would entail no change in population or employment (maintenance on site) as a result of the project's continued operation with a temporary increase in employment during decommissioning. There would be continued socio-economic benefits in terms of continued contribution to the Community Benefit Fund and rate payments to the local authority. The Project would continue to generate renewable electricity into the grid at circa the same level (121,800MWh per annum) displacing greenhouse gases from thermal electricity generation plant and also reducing emissions of transboundary air pollutants. This would have continued positive benefits towards reducing climate change and improving air quality with beneficial effects on human health.

The decommissioning impacts and effects would be as described in Chapter 4 Section 4.3.6.

The 'Do Nothing' alternative involves early decommissioning. This alternative would move the impacts associated with decommissioning forward to circa 2020-2021. There would be a short-term increase in employment during decommissioning but with immediate cessation of the generation of renewable electricity and the positive benefits associated with this. There would be no employment post decommissioning. Contributions to the Community Benefit Fund would cease immediately and there would be no rate payment to the local authority.

The analysis of alternatives in terms of effect on Population and Human Health is presented in Table 3-1 to Table 3-6.

Table 3-1: Population & Human Health – 'Do Nothing' (Early cessation & Decommissioning Alternative) [circa 2020-2021]

Source	Potential Impact	Potential Effect	Likelihood and Significance
Population	Change in population	Increase/Decrease in population	The early cessation and decommissioning of Project would be unlikely to have any impact on population in the general area. **No impact on population would likely occur.**
Employment and Socio-economics	Changes to employment and socio-economic benefits. Changes to renewable energy generation and displacement of imported fossil fuel. Loss of contribution to Galway County Council	The employment levels would increase over the short-term decommissioning period and all employment would cease thereafter. The contribution of renewable energy into the grid would cease and there would be no contribution to displacement of imported fossil fuel related electricity generation costs. Potential increased costs nationally. Rate payments to Galway County Council would cease.	Th effects would occur in circa 2021 as opposed to 2040. There would therefore be a **positive, slight and temporary effect** on employment and on the local economy during the decommissioning process. Thereafter, there would be no employment associated with O&M activities or routine engineering and administrative inputs to the Project. The impact would be **negative, permanent and slight in nature**. Th effect on displacement of fossil fuel imports would be **slight, negative and permanent.** There will be no rate payment to the Local Authority which effect would be **negative, locally significant and permanent.**
Community Benefit	There would be an immediate cessation of Community Benefit funding.	No further community benefit funding would be available to support projects	The impact of this would be **negative, significant and permanent**.
Air Quality	Reduced contribution to maintaining air quality for human being sand combatting climate change	Early cessation of the project would see no continued benefit on air quality and no contribution to reduction of greenhouse gas emissions	**Likely immediate minor negative impact** on human health overall
Wind Turbine Noise	Early cessation of the Project would see the removal of the wind turbines and no	No wind turbine operational noise or substation noise. Short term noise during	No significant impact is predicted for the continued operation of the Project. The

Source	Potential Impact	Potential Effect	Likelihood and Significance
	operational noise from the project would occur.	decommissioning. This impact would be similar to the continued operation and decommissioning of the project but would occur in 2021 as opposed to 2040	effect of early decommissioning would be **neutral permanent and long term**.
Shadow flicker	Removal of wind turbine would remove any potential source of shadow flicker	There would be no shadow flicker possibility	**No effect on human health** was predicted from the continued operation of the project and the early decommissioning would be neutral and immediate in significance.
Visual Impact	Landscape change due to removal of visible structures and works to remove those	Visual effects are likely to include temporary visual effects as a result of the operation of machinery to facilitate the removal of the wind farm elements referred to above. Permanent visual effects resulting from the decommissioning of the project are considered to range from imperceptible to slight. There would be no wind farm visible to residents in the area.	**No effect on human health** would likely occur.
Electric and Magnetic Fields	Following decommissioning there would be no electric or magnetic fields emanating from the project (wind farm, grid connection or substations)	No potential interaction with human receptors or human health would occur	**No effect on human health** would likely occur
Pollution of surface waters	Potential for early decommissioning to impact on surface water from hydrocarbons and suspended solids	Pollution of surface water could potentially lead to impact on drinking water supply impacting human health	Decommissioning only involves limited ground disturbance and potential impacts on surface water would be unlikely and **no effect on human health would likely occur.**

Source	Potential Impact	Potential Effect	Likelihood and Significance
Pollution of groundwater by wastewater	Contamination of groundwater by hydrocarbon spills and suspended matter	Potential impact on groundwater body and water abstractions impacting human health	Unlikely given the limited decommissioning and ground works. **No impact on human health** would be likely.
Ice throw	Potential for ice throw would no longer exist.	No potential to impact on human beings	No ice throw would be possible and **no impact of human health** would occur.

Table 3-2: Population & Human Health - Alternative Land-use

Source	Potential Impact	Potential Effect	Likelihood and Significance
Population	Change in population	Increase or decrease in population	The proposed alternative land use would likely not give rise to increased population in the area. **No impact on population would likely occur.**
Employment and Socio-economics	Changes to employment and socio-economic benefits Loss of renewable energy generation and displacement of imported fossil fuel. Loss of rates to the local authority	Short term increase in employment due to decommissioning. Loss of contribution to displacement of imported fossil fuel. No rate payments. Limited employment in the forestry sector through ground preparation works, replanting, activities, thinning operations and harvesting at the end of the crop rotation period followed by further replanting in a normal forest rotation cycle. Replanting would also produce a commercial timber crop on thinning and harvesting which would be of significant financial value to the forest estate.	Loss of rates, potential displacement of fossil fuel would be **negative, permanent and minor**. Short term employment from decommissioning would be **positive but temporary and of minor significance** Likely there would be a **slight but positive effect** on employment in the long term. **Positive economic benefit** from future forest operations but one which would generally not materialise until **circa 20 years after replanting** (Thinning) and **circa 40 years** (harvesting).

Source	Potential Impact	Potential Effect	Likelihood and Significance
Community Benefit	Immediate loss of Community Benefit Fund to the general area.	No community projects supported	Likely to be **permanent and negative and locally significant**
Air Quality	Immediate loss of greenhouse gas emission displacement. Reduction in displacement of transboundary air pollutants	Loss of reduction in level of greenhouse gas emissions from electricity production and loss of impact on limiting climate change. Transboundary air quality would be impacted.	Replanting of 222ha of forest plantation would give rise to an initial likely loss of carbon from ground preparation activities but within a period of two to 4 years carbon sequestration from the growing plantation would likely commence giving a net positive, medium term effect on climate change reduction and therefore on human health. There would be **slight negative and long-term impact** from loss of displacement of transboundary gas emissions.
Noise	Decommissioning noise would occur in circa 2020-2021 as opposed to 2040.	Short term decommissioning noise associated with the project. Noise associated with alternative land use would occur during ground preparation, planting, thinning and harvesting operations.	The proposed replanting and bog rehabilitation will not give rise to noise and **no effect on population would likely occur**.
Shadow flicker	Alternative land use would not give rise to shadow flicker	No effect or impacts form shadow flicker	There would be no shadow flicker associated with change of land use and **no effect on human health would occur**.
Visual Impact	There would be a change in the landscape from wind farm to forest plantation and open turbary areas.	Visually the landscape would appear different.	**No effect on human health will likely occur** from this change given the remoteness of the site.
Electric and Magnetic Fields	There would be no EMF associated with the proposed land use change	The alternative land-use would not give rise to electric and magnetic fields.	**No impact on human health would occur.**

Source	Potential Impact	Potential Effect	Likelihood and Significance
Pollution of surface waters	The establishment of forest plantations on the site could give rise to sediment and hydrocarbon spill runoff.	Pollution of surface water with sediment and hydrocarbon could potentially impact drinking water quality.	The likelihood of this occurring would be low when modern forest plantation methods are used and **no impact on** human health would be likely to occur.
Pollution of groundwater by wastewater	There would be no sanitary facilities associated with the land use change	There would be no permanent wastewater facilities on site No potential impact would likely occur	**No impact on human health** would occur.
Ice throw	Ice throw would not be a possibility	No impact from ice throw would be possible	**No impact of human health** would occur.

Table 3-3: Population & Human Health - Repowering of the Wind Farm

Source	Potential Impact	Potential Effect	Likelihood and Significance
Population	The land use of the project site would not change but there would be fewer and larger turbines on site.	There would be no residential component (no housing or accommodation development) as part of a repowered wind farm on the site.	Unlikely to give rise to changes in population in the general area. **No impact** on population would occur
Employment and Socio-economics	Increased employment during decommission of existing wind farm, construction of repowered wind farm and final decommissioning. On commissioning of the repowered wind farm with larger more efficient turbines, with likely increased renewable electricity output.	Short-term employment during the decommissioning of the project but without the demolition of the grid connection and substations. Employment during the construction phase of the repowering project for a period of circa two years Local socio-economic benefit from the supply and delivery of construction materials to the site and to the labour force residing within 30km of the project. Larger displacement of imported fossil fuels for electricity generation Final	The effect of the decommissioning and construction would likely be **positive, short term and medium in scale in terms of socio-economic impact.** Limited employment in routine operation and maintenance activities. The effect of this would be **positive, slight and medium term in duration.** **Short, term temporary positive benefits** to employment on final decommissioning of the site over a two-year period.

Source	Potential Impact	Potential Effect	Likelihood and Significance
		decommissioning would generate short term employment over a two-year period. Rate payments to Galway County Council occur	Displacement of fossil fuel costs would likely bet **of moderate significance, positive and medium term**. Payment of rates would be **positive, locally significant and of medium term**.
Community Benefit	As repowering would entail a new build which is likely to enter into a competition for power purchase, it will come under the requirements of the Renewable Energy Support Scheme (RESS) which requires a mandatory Community Benefit Fund with contributions set at €2/MWh for all RES-E generation produced and seeking support via RESS auctions.	This would mean that a new and larger Community Benefit Fund would be established increasing the support available for local project development. Under the draft Wind Energy Development Guidelines and RESS local communities and private individuals would also have the opportunity to invest in the development bringing potentially significant economic benefit to the area	The impact of this would likely be **positive, significant locally and of medium duration.**
Air Quality and Climate	The decommissioning of the existing wind farm and construction of the repowered wind farm would give rise to local emissions of dust and exhaust fumes. Repowering would lead to increased renewable generation from the development. There would be a lag period of circa 24 months during decommissioning of the existing wind farm and construction of the repowered wind farm when no renewable electricity would be produced. Final decommissioning would also generate dust ad exhaust emissions	Impacts on air quality could arise which could potentially impact human health. Displacement of fossil fuel emissions would likely give rise to improved air quality, as a result of reduction in greenhouse gas emissions and reduction in emissions of transboundary air pollutants.	Mitigation measures such as dust management plans during these activities, coupled with the distance to the nearest occupied dwellings (circa 2.1km) would mean that **no significant effects on air quality or human health would be likely to occur.** Increased positive benefits from reduction in greenhouse gas emissions and transboundary emissions likely to occur would be **positive, moderate in scale and medium term on human health**
Noise	Decommissioning noise would occur over a short-term period	Potential impacts during decommissioning and construction could impact on noise sensitive locations but	Decommissioning and construction noise would likely be audible but would be within recommended noise guidance

Source	Potential Impact	Potential Effect	Likelihood and Significance
	Construction noise would occur for a short-term period and would likely coincide to some extent with decommissioning. Operational noise would occur. Noise would be generated from fewer large wind turbines which could potentially impact on noise sensitive locations (dwellings, amenity areas, public buildings). Final decommissioning noise would occur.	the level of these would be similar to that described for the existing wind farm in Chapter 5. Modern wind turbine generators, such as those which would likely be deployed under repowering of the site would be generally less noisy than earlier models such as those at Derrybrien. They would also be capable of multiple modes of operation to reduce noise output if required. Repowering layout design would take account of the requirements of the updated version of the Draft Wind Energy Guidelines 2019 ensuring that no significant noise impact would occur on any occupied noise sensitive location during the operational period.	levels and impacts would be of short duration. **No significant impact on human health** would likely occur given the distances to the nearest noise sensitive receptors Given the separation distance between the wind farm and the nearest noise sensitive locations it would be unlikely that significant noise impacts would occur and **no significant impact on human health would be likely to occur**. .
Shadow flicker	A repowered wind farm would have larger and longer blades and as such would have a greater rotor diameter than those currently in place.	Potential for increased shadow flicker impact would occur with possible impacts on human beings.	For any repowered wind energy development on the site compliance with the revised Draft Wind Energy Guidelines 2019 would be required. This requires no Shadow Flicker at sensitive locations. Modern wind turbines are more readily controllable with numerous operational modes and coupled with the distance to the nearest occupied dwelling no shadow flicker effects would be expected to occur from a repowered wind farm and **no impact on human health** would be likely.
Visual Impact	The landscape would change as there would be fewer but larger wind turbine generators on site.	The introduction of taller turbines could give rise to increased visual presence in areas close to the site, and increased visibility from more distance viewpoints. This could result in more pronounced	Given the distances to the nearest occupied dwelling, **no impact on human health** would be likely to occur.

Source	Potential Impact	Potential Effect	Likelihood and Significance
		effects on the landscape character as well as other landscape character areas. The visual effects would depend very much on the turbine layout, size, and overall siting of the development, but there could be an increase in the extent of visibility, resulting in visibility from locations where there currently is no visibility.	
Electric and Magnetic Fields	EMF effects on human beings	A repowered wind farm would export electricity through the existing substation and grid connection to the National Grid. Electric and Magnetic field strengths would be similar to those of the existing Derrybrien Project and would be compliant with the requirements of the International Commission of Non Ionising Radiation Protection Guidelines	**No impact on human health** would be likely to occur.
Pollution of surface water quality by sediment and hydrocarbons from the site	Release of sediment and hydrocarbon during decommissioning and construction activities	Pollution of drinking water supply used by the Local Population and also the Gort Regional Water Supply. Potential impacts would be of short duration	Decommissioning and construction activities would be of short duration controlled by mitigation measures on site. The extent of decommissioning would be limited and construction would be less than that for the original project. It would be unlikely that significant impact would occur and **no effect on human health** would be likely to occur.
Pollution of groundwater by wastewater	Sanitary services facilities would be required for the construction and operation of the repowered wind farm which could give rise to discharges of untreated wastewater o groundwater	Potential to pollute drinking water and effect human health	The existing sanitary facilities would be left in situ and would continue to be maintained and operated No significant impact on groundwater would occur and **no impact on human health would be likely to occur**.

Source	Potential Impact	Potential Effect	Likelihood and Significance
Ice throw	Larger wind turbines would increase the ice throw distance with potential impact on human beings	The potential ice throw distance for larger turbines in a repowering scenario would be circa 360m (assuming a tower height of 120m and a rotor diameter of 120m also).	The nearest occupied dwelling would be well outside the ice throw distance and **no effect on human health** would be likely to occur.

Table 3-4: Population & Human Health - Solar Farm

Source	Potential Impact	Potential Effect	Likelihood and Significance
Population	Potential change to the population of the area from change of land use	Reuse of the site as a solar farm to generate renewable electricity would be unlikely to give rise to any population effect. There would be no residential component (no housing or accommodation development) as part of a solar farm on the site.	**No effect** on population would likely occur
Employment and Socio-economics	Employment opportunities would arise from change of wind farm use to a solar farm. Although much of the infrastructure would continue to be used significant new construction would also occur The site could accommodate a solar farm of up to 68MW which on commissioning of and generation of renewable electricity would give rise to displacement of imported fossil fuel related electricity generation costs. Rates would also be payable to the Local Authority. which would be a positive benefit to the County overall	Development of a solar farm on site would entail removal of the wind turbines and continued use of access tracks, substation, underground cables and grid connection. Significant new construction would likely be required also. During the operational period there would be some employment in routine operation and maintenance activities, but generally solar farms are unattended. The capacity factor of solar is less than that of the project (10% compared to 25%) and less renewable electricity will be produced than	Decommissioning and construction employment would be **positive, but minor and of medium term.** Employment effect would be **positive, slight and medium term in duration**. There would also be short, term temporary positive benefits to employment on final decommissioning of the site over a two-year period. The effect of displacement of fossil fuel generation **would be slight positive and medium term.** Rate payments would be of slight **significance and of medium duration**.

Source	Potential Impact	Potential Effect	Likelihood and Significance
		The rate payment would likely be higher than for the existing wind farm as the physical area of the panels would be greater than the footprint of the wind farm itself.	
Community Benefit	Solar projects would come under the requirements of the Renewable Energy Support Scheme (RESS) which requires a mandatory Community Benefit Fund with contributions set at €2/MWh for all RES-E generation produced and seeking support via RESS auctions.	The Community Benefit Fund would be less than that from the Project due to capacity factors and lower MWh output. An opportunity to invest in the development bringing potentially significant economic benefit to the area.	The Community benefit would still be **positive, locally significant and of medium duration.** The impact of the investment opportunity would likely be **positive, significant locally and of medium duration**.
Air Quality & Climate	Air quality impacts would likely arise during the decommissioning of the existing wind farm and construction of the solar farm from dust and vehicle exhaust emissions. The capacity factor of solar is less than that of the project (10% compared to 25%) and less renewable electricity will be produced than	Air quality impacts from dust and hydrocarbon emissions could impact air quality and impact human health. In terms of displacement of greenhouse gases and transboundary gases these would be less than the existing project due to the lower capacity factor of the solar farm.	Given the separation distances to the nearest occupied dwellings and use of appropriate mitigation. **no significant** effect would likely occur on air quality or human health. Greenhouse gasses and transboundary gases would be displaced by the solar farm operation but to a lesser extent than the project. The effect would be **positive, of minor significance and of medium term.** There will be **no significant impact** on human health from initial decommissioning of the wind farm, construction of the solar farm or final decommissioning.
Noise	Decommissioning and construction noise would occur periodically over an 24month period. Construction noise	Noise could impact on the nearest noise sensitive receptors giving rise to compliant, disturbance and health issues	Given the distances to the nearest noise sensitive locations and periodic short-term nature of decommissioning and

Source	Potential Impact	Potential Effect	Likelihood and Significance
	would occur on site from piling operations, earth moving equipment and Heavy Goods Vehicles deliveries to site.	Solar panels produce direct current electricity which is converted to alternating current by on-site inverters located at intervals throughout the solar farm. Noise from the inverters and substation would occur during daylight hours when the solar farm is operational and there would be no noise during the hours of darkness.	construction noise **no effect on human health would likely occur.** Operational noise would be low and would dissipate with distance from the solar equipment. Given the distances to the nearest noise sensitive location no effect on human health would likely occur Final decommissioning would also be **unlikely to give rise to significant noise effects** on human health.
Shadow flicker	There would be no shadow flicker from the solar farm	No impacts from shadow flicker	**No impact** on human health would occur.
Visual Impact	Visual impact from solar installation	Ground mounted solar panels at the Project site would not likely be visible at occupied dwellings and would be obscured from view by surrounding forests	**No visual related impact on population or human health would likely occur**.
Electric and Magnetic Fields	EMF effects on the local population	Electric and Magnetic fields associated with the solar panels and inverters would be very localised. Solar power is also not produced at night and no EMF would be generated. Export of electricity from the site would be via the existing 110kV OHL and Agannygal substation and would be at similar level to that from the existing project	**No significant impact on human health would likely occur.**
Pollution of surface water and groundwater quality by sediment and hydrocarbons from the site	Decommissioning of the existing wind farm would be similar to that described for the existing project but the substation and grid connection would also remain in place. Limited potential for hydrocarbon losses.	Hydrocarbon or other pollutant ingress into surface water could lead to contamination of drinking water supplies. Construction impacts would be confined to piling operations and new access track development with some concrete bases	Decommissioning and construction impacts would likely **not effect human health given the localised effect of the impact and their likely mitigation**. Final decommissioning impacts would be similar to that for the existing Project and

Source	Potential Impact	Potential Effect	Likelihood and Significance
	Construction would involve piling operations and new access track construction	for inverter supports. Although potential for surface and groundwater impacts exists with good mitigation no significant impact would be likely to occur	**no effects** on human beings would likely occur.
Pollution of groundwater by wastewater.	Wastewater from sanitary facilities would contaminate groundwater if untreated.	Abstraction of contaminated groundwater could impact human health.	The existing sanitary facilities would be left in situ and would continue to be maintained and operated whilst the solar farm would be in operation. No significant impact on groundwater would occur and **no impact on human health would be likely to occur**.
Ice throw	Ice throw would not occur	No impact from ice throw	**No impact on human health would occur**.

Table 3-5: Population & Human Health - Battery Energy Storage Systems

Source	Potential Impact	Potential Effect	Likelihood and significance
Population	Changes in population	Reuse of the site for BESS purposes would be unlikely to give rise to any population effect. There would be no residential component (no housing or accommodation development) as part of BESS on the site.	**No effect** on population will occur
Employment and Socio-economics	Employment opportunities and socio-economic benefits	Decommissioning either full or partial of the existing wind farm would be required modifications to the substation may also be required BESS Units operate intermittently are unmanned and operated remotely and employment during the operational	Decommissioning and construction employment would be a **positive short-term local socio-economic benefit**. Operationally the employment effect would be **positive, slight and medium term in duration.**

Source	Potential Impact	Potential Effect	Likelihood and significance
		period would be confined to routing maintenance visits Co-location of BESS units with the 'Continued Operation' alternative would be technically feasible with some likely modifications to the internal cable network and would also require additional footprint for the BESS units. BESS units would extend the degree of penetration of renewable generation onto the national grid and therefore indirectly lead to increased displacement of fossil fuel generated electricity and increased savings on imported fuel costs. Co-location with the existing wind farm could increase the displacement benefit. Where co-location was feasible this would give rise to even greater imported fossil fuel cost savings both from generation of renewable electricity onto the grid and providing supports to facilitate increased penetration Rate payments to Galway County Council would be made with respect to the BESS projects which would likely be similar to the 'Continued Operation' project as much the same footprint would be utilised	Decommissioning of the site would give rise to **short term locally moderate employment.** Employment associated with co-location construction of the BESS element would likely **be short term (circa 12 -18 months), positive and locally significant.** The effect of fuel cost displacement would likely **be positive, minor and medium in term.** This would likely be **positive medium and medium term in duration**. Where co-location occurred the effect would likely remain **positive but slight in the medium term**. Where co-location occurred rate payments would likely increase, a **positive minor effect of medium duration**.
Community Benefit	There would be no community benefit associated with the development of BESS on the site.	There would a loss of community benefit funds to the local community with a BESS project on the site	The impact on the Community Benefit would be **negative, locally significant and permanent**.

Source	Potential Impact	Potential Effect	Likelihood and significance
			Co-location would see continued contribution to the Community Benefit Fund for the site which would be **positive, locally significant and medium term in duration.**
Air Quality	Potential deterioration of air quality from dust and exhaust emissions could occur during decommissioning of the existing project and construction of the BESS units. Final decommissioning could also give rise to air quality impairment.	Air quality impacts during decommissioning of the existing wind farm would be similar to the 'Continued Operation' Alternative but with no decommissioning of the substation or grid connection elements. Poor air quality could impact human health. Construction would be confined to the existing hard stands only and some cable and minor substation work.	The degree of potential impact from decommissioning and construction would likely be below. With good mitigation and given the separation distances **no impact on human health would likely occur**. Co-location impacts would be similar to the above. Final decommissioning would be similar to the 'Continued Operation' alternative and **no significant impact would likely occur.**
Noise	Noise would occur during decommissioning, construction and operation.	Noise has the potential to impact on human health. Decommissioning noise would be as described in the 'Continued Operation' alternative. There would be some localised construction noise but for a short period and confined to the hard stand areas and locations of structures. Operationally the main source of potential noise would be from the inverters, air conditioning and transformers. Noise from the battery equipment will only occur when the battery is operational and will therefore be intermittent. It would quickly dissipate with distance from the battery units and ancillary equipment	Given the distances to the nearest noise sensitive locations **no significant noise impact** would be likely to occur during decommissioning or construction. Operational noise would be unlikely to give rise to human health effects given the distance to the nearest Noise sensitive location. Final decommissioning would also be **unlikely to give rise to significant noise effects** on human health. Noise from co-location of BESS on the operating wind farm site would be **unlikely to give rise to human health** effects given the distance to the nearest noise sensitive locations.

Source	Potential Impact	Potential Effect	Likelihood and significance
		Co-location within the wind farm would give rise to a cumulative noise impact	
Shadow Flicker	There would be no shadow flicker from a stand-alone BESS development	There would be no shadow flicker from a BESS development on its own	**No impact** on human health would occur. Co-location would result in the same existing level of Shadow flicker impacts and **no significant effect on human health would occur**.
Visual Impact	Visual effect of BESS units	BESS containerised units would not be visible from occupied dwellings and would likely be obscured by surrounding plantation	**No visual impact on population or human health would likely occur**. Co-location with the existing project would give rise to the same level of visual effect -**no significant effect on human health**.
Electric and Magnetic Fields	EMF effects on human health	Batteries would only operate intermittently, and EMF effects would only occur when the electric connection to the battery is energised. The EMF would be localised and also associated with the transmission system and would be well within existing standards.	**No significant impact on human health would likely occur.**
Pollution of surface and groundwater quality by sediment and hydrocarbons from the site	Losses of hydrocarbon and sediment from decommissioning and construction activities could give rise to pollution of surfaces and groundwaters used for abstraction for drinking water.	Potential impacts on construction activities associated with the BESS units would be limited to concrete aprons which would be located on top of the existing hardstands. With appropriate mitigation pollution impacts would be unlikely to occur.	Decommissioning effects of the existing wind farm would be as described in the 'Continued Operation' option and would likely **not effect human health.** Final decommissioning impacts would be similar would be similar to the 'Continued Operation' alternative and **no effects** on human beings would likely occur.

Source	Potential Impact	Potential Effect	Likelihood and significance
Pollution of groundwater by wastewater	Wastewater from sanitary facilities would contaminate groundwater if untreated.	Battery Energy storage systems are generally unattended, but routing maintenance would likely occur. The existing sanitary facilities would likely be left in situ and would continue to be maintained and operated. No significant impact on groundwater would occur	**No impact on human health** would be likely to occur.
Ice throw	Ice throw would not occur from a BESS project	Ice throw would not occur from a BESS project	**No impact on human health would occur**. Co-location would give rise to the same risk of ice throw as the 'Continued Operation' alternative and **no significant impact would occur**

Table 3-6: Population & Human Health - Synchronous Condenser

Source	Potential Impact	Potential Effect	Likelihood and significance
Population	Change in population	Reuse of the site to accommodate a synchronous condenser would be unlikely to give rise to any population effect. There would be no residential component (no housing or accommodation development) as part of the site use for this purpose	**No impact** on population will occur
Employment and Socio-economics	Employment opportunities during decommissioning and construction. Socio economic benefits to the general area and county.	Construction would take circa 24months. This could occur in parallel with the decommissioning of the wind farm element of the existing project or post decommissioning Operationally synchronous condensers are operated remotely with only routine maintenance visits. Co-location of a synchronous condenser with the operational repowered wind farm is also a possibility requiring separate construction but with delayed decommissioning of wind turbines which would remain operational. The synchronous condenser would provide grid services which would extend the degree of penetration of renewable generation onto the national grid and therefore indirectly lead to increased displacement of fossil fuel generated electricity and increased savings on imported fuel costs. Rate payments to Galway County Council would occur but would be less than the	There would likely be **positive short term local socio economic benefit** from the construction and limited decommissioning. During operation employment would be **positive slight and of medium duration**. On final decommissioning of the project site there would **be positive short-term local employment benefit.** Co-location construction would likely take up to 18 months and would provide **short term minor local employment.** The effect of providing grid services **would be positive, minor and medium in term.** Where co-location was feasible this would give rise to even greater imported fossil fuel cost savings. **This would be positive medium and medium term in duration**. The effect of Rate payments would **be positive, slight and of medium duration** but would be significantly less

Source	Potential Impact	Potential Effect	Likelihood and significance
			than the 'Continued Operation' alternative Where co-location occurred rate payments would likely increase, a **positive moderate effect of medium duration.**
Community Benefit	Changes to Community Benefit	There would be no community benefit associated with the development of a synchronous condenser on the site. There would be **no effect** for community benefit. Co-location would see continued contribution to the Community Benefit Fund for the site.	No community benefit would be **negative, significant locally and permanent**. In the co-location case the effect would continue to be positive be **positive, locally significant and medium term in duration.**
Air Quality	Impacts on air quality from dust and hydrocarbons Impacts on Greenhouse gas emissions and transboundary gases	Air quality impacts during decommissioning of the existing wind farm would be similar to the 'Continued Operation' alternative but with no decommissioning of the substation or grid connection elements and would be less. Construction would be confined to the synchronous condenser location within the site only with some cable and minor substation works. Synchronous condensers do not generate renewable electricity but would extend the penetration of renewables onto the grid. Co-locating a synchronous condenser with the existing wind farm would increase the effect of displacing fossil fuel energy production	With good mitigation and given the separation distances **no impact on human health would likely occur**. **During no significant impact would be likely to occur.** By extending the penetration of renewables there would be a **slight, intermittent positive effect** on greenhouse gas reduction. Co-location would lead to **moderate, medium term positive effects** on reducing greenhouse gas emissions.

Source	Potential Impact	Potential Effect	Likelihood and significance
		Final decommissioning would entail demolition of the synchronous condenser building	
Noise	Noise from the condenser could impact on noise sensitive locations	Decommissioning noise is as set out in the 'Continued Operation' alternative. Construction noise would be located close to the wind farm substation and would be similar in nature to that which occurred during its construction. Operationally the synchronous condenser would be located within a purpose-built building and noise generated would be localised and would quickly dissipate with distance.	During initial decommissioning and construction, given the distances to the nearest noise sensitive locations, **no significant noise impact** would be likely to occur. During operation, given the distances to the nearest noise sensitive locations **no significant noise impact** would be likely to occur. Final decommissioning would be **unlikely to give rise to significant noise effects** on human health also. Co-location with the wind farm would see similar noise levels as the existing Project and no significant effect on human health would likely occur.
Shadow flicker	No shadow flicker impact With co-location the existing shadow flicker would remain but there would be no impact due to the distance to receptors.	No shadow flicker effect. With co-location no shadow flicker effect would occur.	There would be no shadow flicker from a synchronous condenser development on its own and **no impact** on human health would likely occur. Co-location with the operational repowered wind farm would result in **no effect on human health likely to occur**.
Visual Impact	The synchronous condenser unit not likely not to be visible given the distance to occupied dwellings and the local road network	No visual effect on population. Co-location would likely have the same visual effect as the existing Project.	**No effect** on **human health would likely occur**. With co-location no effect on human health would likely occur.

Source	Potential Impact	Potential Effect	Likelihood and significance
Electric and Magnetic Fields	Impact from EMF associated with the synchronous condenser	The synchronous condenser will only operate intermittently and given the likely location and distance to the nearest occupied dwellings no EMF effects would likely occur When operating, EMF effects from the 110kV OHL and substation would be less or similar to that of the 'Continued Operation' option.	**No significant impact on human health would likely occur.**
Pollution of surface water quality by sediment and hydrocarbons from the site	Decommissioning generating suspended solids and potential hydrocarbon leaks. Construction generating suspended solids and hydrocarbon leaks Final decommissioning impacts would be confined to the condenser location, substations and grid connection al decommissioning	Decommissioning effects of the existing wind farm would be as described in the 'Continued Operation' option. Construction activities limited to the concrete foundation, building construction and connection to the existing wind farm substation. With appropriate mitigation pollution impacts and effects would be unlikely to occur. Final decommissioning impacts would be similar to the 'Continued Operation' alternative.	**No effect on human health during windfarm decommissioning** and construction. **No effect on human health would likely occur**. **No effects** on human beings would likely occur from final decommissioning
Pollution of groundwater by wastewater	Contamination of groundwater by sanitary facilities provided at the site	The synchronous condenser would be unattended during the operational phase but routine maintenance would likely occur. The existing sanitary facilities would likely be left in situ and would continue to be maintained and operated during the initial decommissioning, construction and operating phases ensuring no significant effect would occur. Temporary facilities would be provided during final decommissioning and no effect would occur.	No significant impact on groundwater would occur and **no impact on human health would be likely to occur**.

Source	Potential Impact	Potential Effect	Likelihood and significance
Ice throw	No potential for ice throw. With co-location the potential impact for ice throw would be the same as the 'Continued Operation' Option.	No effect from ice throw With co-location the potential ice throw distance is significantly less than the distance to the public road network or dwellings and no effect would occur.	Ice throw would not occur from a Synchronous Condenser project **no impact on human health would occur**. Co-location would give rise to the same risk of ice throw as the 'Continued Operation' alternative and **no impact would occur**

3.5.1.2 Overall Preference of Alternatives

In terms of population all of the proposed alternatives would have no effect on the population of the area and would be ranked equally. In terms of employment and socio economic benefit the 'Do Nothing' (immediate cessation and decommissioning) would be the worst alternative as it would give rise to a short term positive benefit but all employment opportunities would cease thereafter, There would also be no Community Benefit fund and no rates payable, representing a significant local and county negative effect. In contrast, these positive benefits would continue with the 'Continued Operation' option.

Repowering would require decommissioning and then significant additional construction providing local employment and material supply opportunities and works. However, there would be no community benefit or rates for a time period until the repowered facility became operational. However, community benefit would likely increase and investment opportunities would be available to the local population.

Similarly, the development of a solar farm would provide employment during decommissioning and construction on a scale comparable to repowering – whether with or without BESS or the synchronous condenser, providing employment during decommissioning and – to a lesser extent, during construction. The alternative land use would provide short term decommissioning employment with limited operational employment thereafter. There would be a loss of community benefit from BESS and the condenser type alternatives but there would be benefit associated with a solar development but less than that of the repowered wind farm and of the existing Project.

In terms of renewable generation and the positive impact on greenhouse gas displacement climate change and transboundary gases the repowered wind alternative would likely provide a higher output of renewable generation compared to the 'Continued Operation' alternative over the lifecycle of the Project (to circa 2040) with solar being less. The alternative land use would also be of benefit but would be less immediate than the existing Project and less than repowering the site. A solar farm would have a lower capacity factor (circa 10%) than either the existing Project (circa 25%) or a repowered site (circa 33%) and would produce less renewable generation, with less positive effect on human health. Co-locating a BESS project with either the 'Continued Operation' alternative or repowering alternative would also be very beneficial in terms of generating and extending renewables penetration onto the grid but additional construction would likely be required.

EMF would cease in the case of early decommissioning and would be a potential impact for a repowered and solar farm and to a lesser extent with BESS and a synchronous condenser but there are no significant health effects identified with the 'Continued Operation' alternative as described in Chapter 4 and none would be likely with any of the alternatives.

The visual impact of the wind farm would change as a result of a changing landscape and would continue in the 'Continued Operation' alternative. Repowering would lead to larger more visible wind turbine generators with fewer of them but the likely effects on the human population would be slight. No significant visual impact would occur from solar, BESS or the synchronous condenser as the site is remote and obscured by forest plantations.

Shadow flicker and ice throw would only occur with the 'Continued Operation' and Repowering alternatives but given the distances to the nearest occupied dwellings would be unlikely to impact human health.

All decommissioning and construction could potentially generate pollutants that could impact surface and groundwaters with the highest potential from new construction associated with solar and repowering and with least potential from the 'Continued Operation' project.

In terms of meeting the project objectives and potential effects on human beings the overall ranking would be:

'Continued Operation' less than 'Continued Operation' & Battery Energy Storage less than Re-Powering & Battery Energy Storage Re-Powering less than Solar Farm & Battery less than Solar Farm less than BESS less than Synchronous Condenser less than Alternative Land use less than 'Do Noting' (Early Cessation and Decommission of the Project).

3.5.2 Noise

This section looks at the potential impacts and effects from Noise from the project alternatives.

3.5.2.1 Analysis of Alternatives

The Do Nothing alternative early cessation and immediate closure of the site would be similar to that described in Chapter 5 Noise Section 5.6.3 .The noise and vibration impacts associated with early decommissioning of the site would be considered to be comparable to those of the construction of the Project (as per Section 5.6.1.1) and would be described as slight negative and of temporary to short term duration, but would occur sooner, circa 2020 to 2022. The operational noise would cease but the effect of operational noise was considered to be slight negative and long term in nature and well within Department of Housing and Local Government Wind Energy Guidelines and Draft Guidelines from 2019.

The effects of the 'Continued Operation' alternative has been dealt with in Section 5.6.3. of Chapter 5, which indicated that operational noise would remain in compliance with the Department of Housing and Local Government Wind Energy Guidelines and would continue to be slight, negative and long term in nature.

Here, each of the five renewable energy alternatives is assessed in terms of their potential impacts in terms of noise and vibration. The review is presented in tabular form under a small number of headings. Furthermore, they will be ranked in increasing order of potential risk.

In many significant respects, the repowering alternative would be the same as constructing a new windfarm with due consideration given to relevant national guidance that is commonly applied to such developments and that has been applied in the main noise assessment presented in Chapter 5 of this document. (i.e. Wind Energy Development Guidelines for Planning Authorities published by the Department of the Environment, Heritage and Local Government in 2006). Construction and vibration impacts would be expected to be comparable for the various alternatives.

In terms of operational noise and vibration, the BESS alternative would likely be the most preferable alternative due to the low noise nature of plant that would be expected to be

associated with such an operation. Construction and vibration impacts would be expected to be comparable for the various alternatives.

The solar alternative would have comparable construction noise and vibration impacts but with reduced operational noise impacts off site. Construction and vibration impacts would be expected to be comparable for the various alternatives.

A synchronous condenser project would benefit greatly from the use of existing infrastructure if the existing site were decommissioned, the turbines removed to ground level, but all the bases and access tracks retained. It could however require a certain amount of additional land take and associated works. Overall however, it would be potentially have a comparable impact to the windfarm repowering alternative and a greater impact in terms of operational noise than the solar farm alternative. Construction and vibration impacts would be expected to be comparable for the various alternatives.

The analysis of alternatives in terms of effect of noise from these developments is presented in Table 3-7 to Table 3-11.

Table 3-7: Noise - Repowering of the wind farm site

Source	Potential Impact	Potential Effect	Likelihood & Significance
Upgrading External Access Roads & Upgrade to Bridges	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**
Installing New Internal Roads	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary**.
Installation of larger turbines and crane stands	Slight increase in noise levels	Slight increase in noise levels	Site would still be required to comply with relevant national guidance in terms of wind farm noise. Limits can be readily achieved as demonstrated in Chapter 5 assessment and impacts would be similar to the existing site operations, i.e. **slight, long term.**
Additional Drainage	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**
Modification of substation	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**

Table 3-8: Noise - Solar Farm

Source	Potential Impact	Potential Effect	Likelihood & Significance
Upgrading External Access Roads & Upgrade to Bridges	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**
Installing New Internal Roads	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**
Piling for some array foundations	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**
Additional Drainage	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**

Source	Potential Impact	Potential Effect	Likelihood & Significance
Additional trenching for cables	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**

Table 3-9: Noise - Battery Energy Storage

Source	Potential Impact	Potential Effect	Likelihood & Significance
Upgrading of best access track to site to handle additional truck traffic for platform construction	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**
Large amount of concrete required for the platform	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**
General site works	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**

Table 3-10: Noise - Synchronous Condensers

Source	Potential Impact	Potential Effect	Likelihood & Significance
Possible requirement of concrete supporting plinths	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**
General site works	Additional construction and/or vibration	Slight increase in noise levels	**Likely. Slight negative, temporary.**
Installation of Synchronous Condensers	Slight increase in noise levels	Slight increase in noise levels	Site would still be required to comply with relevant national guidance in terms of industrial noise. Expect limits can be readily achieved and impacts would be similar to the existing site operations, i.e. slight, long term.

Table 3-11: Noise - Alternative Land-use

Source	Potential Impact	Potential Effect	Likelihood and significance
Replanting of forest on the project site.	Replanting equipment noise	Imperceptible increase in noise levels	Imperceptible, negative and temporary

3.5.2.2 Overall Preference of Alternatives

The continued operation of the windfarm to circa 2040 in terms of noise would be compliant with the wind energy development guidelines, including the draft proposed guidelines of 2019. The operational noise effect is rated as slight negative and long term and there would be no significant benefit compared to early cessation and decommissioning in terms of noise. No noise issues have been identified or complaints received by the wind farm relating to its operation.

Developing an alternative land use would require decommissioning of the wind farm and grid connection similar to the Do Nothing or continued operation but would involve subsequent equipment use to establish alternative forest plantation for example, although the effect of the noise would be imperceptible, slight and temporary. It would be only very marginally greater in terms of increased impact and effect in comparison to the continued operation or do nothing alternatives.

The repowering alternative would entail a new wind farm layout for a lesser number of larger turbines and would be similar to constructing a new windfarm. It would require decommissioning of the existing wind farm and construction of the new layout including upgrading of existing access roads and some crane hardstand areas. Due consideration would be given to relevant national guidance that is commonly applied to such developments and that has been applied in the main noise assessment presented in Chapter 5 of this document. (i.e. Wind Energy Development Guidelines for Planning Authorities published by the Department of the Environment, Heritage and Local Government in 2006). The additional construction, operation and decommissioning would prolong the noise effects from the site but these would be required to meet legislative requirements in any event. Repowering would represent the highest impacts and effect s of alternative renewables for the site.

In contrast, the solar alternative would have comparable construction noise and vibration impacts but with reduced operational noise impacts off site and in terms of operational noise and vibration, the BESS alternative would likely be the most preferable alternative due to the low noise nature of plant that would be expected to be associated with such an operation.

Construction and vibration impacts would be expected to be comparable for the various alternatives.

A synchronous condenser development would potentially have a comparable impact to the wind farm repowering alternative in terms of noise and a greater impact in terms of operational noise than the solar farm alternative.

Construction and vibration impacts would be expected to be comparable for the various alternatives.

In increasing scale of potential impacts on the noise and vibration receiving environment, the alternatives can be listed as follows;

‘Continued Operation’ less than Do Nothing less than Alternative Land use less than ‘Continued Operation’ & Battery Energy Storage less than Battery Energy Storage less than Solar Farm less than Synchronous Condenser less than Re-Powering less than Re-Powering & Solar Farm.

3.5.3 Shadow Flicker

This section looks at the potential impacts and effects shadow flicker that would likely occur if alternative uses of the site were availed of. In all cases decommissioning of all or part of the site would occur to facilitate the alternative development.

3.5.3.1 Analysis of Alternatives

The effects of the 'Continued Operation' Option would be as described in detail in Chapter 6, Section 6.3.2 whereby the Project would continue in operation to circa 2040 and would then be decommissioned. This would entail no change in shadow flicker as assessed during continued operation.

It should be noted that shadow flicker can only occur from the alternative wind energy developments, that is the 'Continued Operation' Project which would see continued operation and the Repowering Project and when co-location of BESS and Synchronous condensers occur with these projects.

The analysis of alternatives in terms of effect of noise from these developments is presented in Table 3-12 to Table 3-17.

Table 3-12: Shadow Flicker - 'Do Nothing' (Early cessation & decommissioning Alternative) [circa 2020-2021]

Source	Potential Impact	Potential Effect	Likelihood and Significance
Shadow flicker	Removal of wind turbine would remove any potential source of shadow flicker	There would be no shadow flicker possibility	**No effect** from shadow flicker would occur post cessation of operations.

Table 3-13: Shadow Flicker - Repowering of the Wind Farm

Source	Potential Impact	Potential Effect	Likelihood and Significance
Shadow flicker	A repowered wind farm would have larger and longer blades and as such would have a greater rotor diameter than those currently in place. Shadow flicker impacts could therefore occur out to a longer distance from the turbines than those of the 'Continued Operation' Option	Potential for increased shadow flicker impact would occur with possible impacts on sensitive locations.	For any repowered wind energy development on the site compliance with the revised Draft Wind Energy Guidelines 2019 would be required. This requires no Shadow Flicker at sensitive locations. Modern wind turbines are more readily controllable with numerous operational modes and coupled with the distance to the nearest occupied dwelling **no shadow flicker effects** would be expected to occur from a repowered wind farm although the **potential would be higher** than the 'Continued Operation' option.

Table 3-14: Shadow Flicker - Solar Farm

Source	Potential Impact	Potential Effect	Likelihood and Significance
Shadow flicker	There would be no shadow flicker from the solar farm	No impacts from shadow flicker	**No impact** would occur.

Table 3-15: Shadow Flicker - Battery Energy Storage Systems

Source	Potential Impact	Potential Effect	Likelihood and significance
Shadow Flicker	There would be no shadow flicker from a BESS development	There would be no shadow flicker from a BESS development on its own	**No impact** would occur. Co-location with the 'Continued Operation' Project would result in the same existing level of Shadow flicker impacts and **no significant effect would occur**.

Table 3-16: Shadow Flicker - Synchronous Condenser

Source	Potential Impact	Potential Effect	Likelihood and significance
Shadow flicker	No shadow flicker impact	No shadow flicker effect	There would be no shadow flicker effect from a Synchronous Condenser development on its own. Co-location with the 'Continued Operation' Project would result in **similar shadow flicker effects to the existing Project**.

Table 3-17: Shadow Flicker - Alternative Land use

Source	Potential Impact	Potential Effect	Likelihood and Significance
Shadow flicker	Alternative land use will not give rise to shadow flicker	No effect or impacts form shadow flicker	There would be no shadow flicker associated with change of land use and **no effect would occur**.

3.5.3.2 Overall Preference of Alternatives

In terms of shadow flicker, the Do Nothing, alternative land use, BESS, solar and a synchronous condenser would be on a par in terms of impact and effect as there would be no shadow flicker. Repowering with larger turbines would have larger and longer blades and as such would have a greater rotor diameter than those currently in place. Shadow flicker impacts could therefore occur out to a longer distance from the turbines than those of the 'Continued Operation' Option. The continued operation would continue to have a shadow flicker impact but the effect would remain not significant and momentary over the long term and as such ranks higher in the level of impact overall.

In terms of shadow flicker the proposed alternatives would be ranked in the following manner.

'Do Nothing' (Early cessation and decommissioning) or Alternative Land use less than BESS or Solar or Synchronous Condenser, less than 'Continued Operation' Option or Co-location with BESS or Synchronous Condenser less than Repowering.

3.5.4 Biodiversity

This section looks at the potential impacts and effects on terrestrial biodiversity (key ecological features identified for assessment include birds, habitats and bats) that would likely occur if alternative uses of the site were availed of. In all cases decommissioning of all or part of the site would occur to facilitate the alternative development.

3.5.4.1 Analysis of Alternatives

The effects of the 'Continued Operation' Option would be as described in detail in Chapter 7, whereby the Project would continue in operation to circa 2040 and would then be decommissioned. The removal of conifer plantation to facilitate the wind farm (including OHL corridor and Agannygal substation) and continued removal of the self-sown conifer trees on the site has provided suitable habitats for foraging hen harriers which has had a potentially significant positive effect on birds. The removal of the conifers has also helped maintain natural open peatland habitats of high local ecological value. The operational turbines pose a significant collision risk to bats in the absence of mitigation and the overhead line poses a significant collision risk to birds in the absence of mitigation also. The continued operation and decommission of the Project will have no significant effects on biodiversity provided the mitigation prescribed in Chapter 7 is implemented.

'Do Nothing' Early cessation and decommissioning

The removal of wind turbines and the overhead line will remove the collision risk for bats and birds respectively. However, early cessation of the Project would mean maintenance of the site and removal of self-sown conifer trees would also cease and self-sown conifer trees would eventually encroach on open peatland habitats preventing the regeneration of high value peatland habitats and high value foraging habitat for birds.

Based on the above assessment, it is concluded that overall the 'Continued Operation' scenario would be slightly preferable than 'Do Nothing' (early cessation and decommissioning) option due to the prolonged retention of higher value open habitats and suitable foraging

habitat for hen harrier in the Slieve Aughty Mountains Special Protection Area (SPA). This is provided that mitigation is implemented in the ‘Continued Operation’ scenario.

The analysis of alternatives in terms of Biodiversity (Terrestrial) is presented in Table 3-18 to Table 3-23.

Table 3-18: Biodiversity Terrestrial – 'Do Nothing' (Early cessation & decommissioning Alternative) [circa 2020-2021]

Source	Potential Impact	Potential Effect	Likelihood and Significance
Birds – Collision with WTG	Removal of turbines would eliminate the collision risk for birds. Collision risk due to WTG considered low at Derrybrien Wind Farm. Slight positive impact.	No significant effect.	**No significant effect.**
Birds – Collision with OHL	Early cessation of the Project would see the removal of the overhead line and risk of collision for birds.	Potentially significant positive effect.	**Potentially significant positive effect.**
Birds – Habitat availability	Early cessation of the Project would mean maintenance of the site would also cease. Self-sown conifer trees would gradually encroach on open peatland habitats of value for foraging and nesting birds.	Reduction in suitable open foraging and nesting habitat. . Slight to Moderate impact of moderate significance to birds.	**No significant effect**
Terrestrial Habitat	Early cessation of the Project would mean maintenance of the site would also cease. Self-sown conifer trees would gradually encroach on open peatland habitats. Moderate negative impact on habitats.	No significant effects.	**No significant effects on habitats**
Bats – Collision with WTG	Early cessation of the Project would see the removal of the wind turbines and risk of collision for bats. No impact on bats.	Potentially significant positive effect.	**Potentially significant positive effect.**
Bats – Habitat availability	Self-sown conifer trees would encroach on open peatland habitats but this would not have any appreciable impact on foraging bats.	No significant effects.	**No significant effects.**

Table 3-19: Biodiversity Terrestrial - Repowering of the Wind Farm

Source	Potential Impact	Potential Effect	Likelihood and Significance
Birds – Collision with WTG	Rotor sweep would be a lot higher than at present thus reduced collision risk to birds. Collision risk due to WTG considered low at Derrybrien Wind Farm	No significant effect.	**No significant effect.**
Birds – Collision with OHL	The OHL would remain in place and pose a collision risk to birds.	Potentially significant effects on birds in the absence of mitigation.	**Potentially significant effects** on birds in the absence of mitigation
Birds – Habitat availability	Additional loss of habitat due to reconfiguration of turbines and additional drainage measures. Disturbance effects to foraging and or breeding birds.	Loss of suitable foraging habitat for birds in particular hen harrier.	**Significant adverse effect on hen harrier** within the Slieve Aughty Mountains SPA.
Terrestrial Habitat	Additional loss of terrestrial habitat due to reconfiguration of turbines and additional drainage measures.	Potentially significant adverse effect on habitats of high local ecological value.	**Potentially significant adverse effect** on habitats of high local ecological value.
Bats – Collision with WTG	Certain species of bats are vulnerable to collision with WTG. Fewer, larger turbines would likely reduce the collision risk but would still have potential for impacts.	Potentially significant effects in the absence of mitigation.	**Potentially significant negative effects** in the absence of mitigation.
Bats – Habitat availability	The additional loss of habitat required for the new turbines is not likely to impact bats.	No significant effects	**No significant effects**

Table 3-20: Biodiversity Terrestrial - Solar Farm

Source	Potential Impact	Potential Effect	Likelihood and Significance
Birds – Collision with WTG	Removal of turbines would eliminate the collision risk for birds. Collision risk due to WTG considered low at Derrybrien Wind Farm. Slight positive impact.	No significant effect.	**No significant effect.**
Birds – Collision with OHL	The OHL would remain in place and pose a collision risk to birds.	Potentially significant effects on birds in the absence of mitigation	**Potentially significant negative effect** on birds in the absence of mitigation
Birds – Habitat availability	Loss of land that is currently used by hen harriers and other birds for foraging. Possible avoidance of site due to panels.	Loss of suitable foraging habitat for birds in particular hen harrier.	**Significant adverse effect on hen harrier** within the Slieve Aughty Mountains SPA.
Terrestrial Habitat	Solar arrays and access roads would result in additional habitat loss and disturbance within the site.	significant adverse effect on open peatland habitats of high local ecological value.	**Significant adverse effect** on open peatland habitats of high local ecological value.
Bats – Collision with WTG	Removal of turbines would eliminate the collision risk for bats.	Significant positive effect on bats.	**Significant positive effect** on bats.
Bats – Habitat availability	The solar array is unlikely to impact habitats for foraging bats.	No significant effect on foraging bats.	**No significant effect**

Table 3-21: Biodiversity Terrestrial - Battery Energy Storage Systems

Source	Potential Impact	Potential Effect	Likelihood and significance
Birds – Collision with WTG	Removal of turbines would eliminate the collision risk for birds. Collision risk due to WTG considered low at Derrybrien Wind Farm. Slight positive impact.	No significant effect.	**No significant effect.**
Birds – Collision with OHL	The OHL would remain in place and pose a collision risk to birds.	Potentially significant effects on birds in the absence of mitigation	**Potentially significant effect on birds** in the absence of mitigation.
Birds – Habitat availability	Does not require further land take. However, self-sown conifer trees would gradually encroach on open peatland habitats of value for foraging and nesting birds.	Reduction in suitable open foraging and nesting habitat. Slight to Moderate impact of moderate significance to birds.	**No significant effect**
Terrestrial Habitat	Does not require further land take. However, self-sown conifer trees would gradually encroach on open peatland habitats of high local ecological value. Moderate negative impact on habitats.	No significant effects.	**No significant effects on habitats**
Bats – Collision with WTG	Removal of turbines would eliminate the collision risk for bats.	Significant positive effect on bats.	**Significant positive effect on bats.**
Bats – Habitat availability	Self-sown conifer trees would encroach on open peatland habitats but this would not have any appreciable impact on foraging bats.	No significant effects.	**No significant effects.**

Table 3-22: Biodiversity Terrestrial - Synchronous Condenser

Source	Potential Impact	Potential Effect	Likelihood and significance
Birds – Collision with WTG	Removal of turbines would eliminate the collision risk for birds. Collision risk due to WTG considered low at Derrybrien Wind Farm. Slight positive impact.	No significant effect.	**No significant effect.**
Birds – Collision with OHL	The OHL would remain in place and pose a collision risk to birds.	Potentially significant effects on birds in the absence of mitigation	Potentially **significant negative effect** on birds in the absence of mitigation.
Birds – Habitat availability	Requirement for 1-2 ha of land. Self-sown conifers also unlikely to be removed. Resulting in additional loss of available foraging and nesting habitat for birds.	Reduction in suitable open foraging and nesting habitat. Slight to Moderate impact of moderate significance to birds.	**No significant effect**
Terrestrial Habitat	Small area of additional land take resulting in a minor loss of habitat. The continued use and maintenance of much of the site infrastructure would have slight negative impacts on terrestrial habitats.	No significant effects.	**No significant effects on habitats**
Bats – Collision with WTG	Removal of turbines would eliminate the collision risk for bats.	Significant positive effect on bats.	**Significant positive effect on bats.**
Bats – Habitat availability	Self-sown conifer trees would encroach on open peatland habitats but this would not have any appreciable impact on foraging bats.	No significant effects.	**No significant effects.**

Table 3-23: Biodiversity Terrestrial - Alternative Land-use

Source	Potential Impact	Potential Effect	Likelihood and Significance
Birds – Collision with WTG	Removal of turbines would eliminate the collision risk for birds. Collision risk due to WTG considered low at Derrybrien Wind Farm. Slight positive impact.	No significant effect.	**No significant effect.**
Birds – Collision with OHL	Removal of the OHL would eliminate the collision risk for birds in the absence of mitigation.	Potentially significant positive effect on birds.	**Potentially significant positive effect on birds.**
Birds – Habitat availability	Alteration of open peatland habitat of high value to foraging and nesting birds with low value conifer plantation.	Loss of suitable foraging habitat for birds in particular hen harrier.	**Significant negative effect on hen harrier** within the Slieve Aughty Mountains SPA.
Terrestrial Habitat	Open semi-natural peatland habitats regenerating on the site would be replaced by non-native forestry of low ecological value. Major negative Impact on habitats.	Significant adverse effect on habitats of high local ecological value.	**Significant negative effect on habitats of high local ecological value.**
Bats – Collision with WTG	Removal of turbines would eliminate the collision risk for bats.	Significant positive effect on bats.	**Significant positive effect on bats.**
Bats – Habitat availability	Conifer plantation is of negligible value for bats. Moderate negative impact.	No significant effects on foraging bats.	**No significant effects on foraging bats.**

3.5.4.2 Overall Preference of Alternatives

The Do Nothing alternative would see immediate cessation and decommissioning of the wind farm and grid connection. Although collision risk for birds would no longer be possible this was assessed as being not significant as the risk is considered low at Derrybrien. The collision risk with the 110kVoverhead line would also be removed which would be a significant positive effect but one for which mitigation is readily available and which is proposed for the continued operation of the current project. Potential for bat collision would be removed which would be a significant positive effect. The collision risk for bats is currently mitigated for the current Project through curtailment of wind turbines under certain conditions. If the wind farm closed then maintenance activities on site, such as the removal and management of self-sown conifers , which would effect efficiency of the wind farm, would also cease and encroachment of self-seeded conifers would gradually occur with loss of available habitat for foraging, a significant negative effect on the protected hen harrier population for which the SPA is designated.

A solar farm development would remove collision risk from the wind farm aspect but the potential collision risk associated with the 110kV line would remain the same in the absence of mitigation. Bats would also benefit from the removal of collision risk with turbines. A significant negative effect on the hen harrier population within the SPA would be the loss of additional habitat for foraging due to the footprint of the solar farm. The solar farm compared to alternative land use, which would see an even greater effect in terms of loss of foraging habitat in the long term, would be the second most impactful alternative for the site.

A BESS project on the site following decommissioning works would also see reduced collision risk for birds and bats similar to the do nothing alternative but the wind farm would be closed and again encroachment by self-seeded conifers would likely occur with loss of foraging habitat over time resulting in a slight to moderate negative impact of moderate significance for birds. The collision risk with the 110 kV OHL would remain in the absence of mitigation as the grid connection is required for BESS operation.

A synchronous condenser project would require some minor additional land take but would have the benefit of no bird or bat collision risk on the former wind farm site but that with the 110kV OHL would be similar in the absence of mitigation. The closure of the wind farm would also see the loss of maintenance of open areas with encroachment by conifers as described above with loss of foraging hen harrier habitat.

Overall, continued operation, with the mitigation proposed would be seen as the most preferable option as it would see continued maintenance of open habitat areas within the SPA for hen harriers which would be impacted negatively by other renewable alternatives. In terms of terrestrial biodiversity the proposed alternatives would be ranked in increasing scale of potential impacts/issues on biodiversity the alternatives can be ranked as follows;

‘Continued Operation’ scenario (with mitigation) less than ‘Do Nothing’ (Early Cessation and Decommission of the Project) less than Battery Energy Storage less than Synchronous Condenser less than Re-Powering (with mitigation) less than Solar Farm less than Alternative land-use replanting.

3.5.5 Aquatic Ecology

The ‘Continued Operation’ and the Do Nothing (Early Cessation and Decommission of the Project) as alternatives have been dealt with in Chapter 8, Section 8.3.4. Here, alternative land-use and each of the five renewable energy alternatives is assessed in terms of their potential impacts on surface waters. The analysis is presented in tabular form under a small number of headings, following which, they have been ranked in increasing order of potential risk.

3.5.5.1 Analysis of Alternatives

The analysis of alternatives in terms of Biodiversity (Aquatic) effect of noise from these developments is presented in Table 3-24 to Table 3-28.

Table 3-24: Aquatic Ecology - Repowering of the wind farm site

Source	Potential Impact	Potential Effect	Likelihood & Significance
Increase in site area	Additional felling and aquatic habitat loss	Increased nutrient run-off, increased solids runoff, loss of aquatic invertebrate & fish production	Probably enough area adjoining to east and west of site to avoid new felling areas. Aquatic habitats at farm of minor invertebrate and fisheries value. **Impact minor, temporary and readily mitigatable**.
Upgrading External Access Roads & Upgrade to Bridges	Increased sediment run-off to streams, potential for cement spills	Damage to fisheries habitats and macroinvertebrates; fish kills	**Likely. Minor negative, temporary**. Cement spill **significant adverse**. All readily mitigatable.
Installing New Internal Roads	Increased mineral and peats silt run-off	Damage to fisheries habitats and macroinvertebrates	**Likely. Minor, negative and temporary**. Readily mitigatable.
Installation of larger turbines and crane stands	Requirement for large peat excavation and de-watering. Risk of increased peat solids washout directly of via new peat repositories. Peat slide due to larger weight bearing risks	Routine installation: = damage to fisheries habitats and macroinvertebrates. Peat slide – catastrophic damage to fisheries, habitats and invertebrates.	**Likely except for peat slide, which would be unlikely. Minor to moderate, negative, temporary to short-term,** except for peat slide, which would be significant to profound, adverse and short-term. Readily mitigatable, except for peat slide
Additional Drainage	Increased peats silt run-off	Damage to fisheries habitats and macroinvertebrates	**Likely. Minor negative, temporary. Readily mitigatable.**
Modification of substation	Requirement for sub-station area might require more peat excavation and deposition and concrete pouring.	Damage to fisheries habitats and macroinvertebrates; fish kills	**Likely. Minor negative, temporary. Concrete spill significant adverse.** All readily mitigatable.

Table 3-25: Aquatic Ecology - Solar Farm

Activity	Potential Impact	Potential Effect	Likelihood & Significance
Increase in site area	Additional felling and aquatic habitat loss	Increased nutrient run-off, increased solids runoff, loss of aquatic invertebrate & fish production	Probably enough area adjoining to east and west of site to avoid new felling areas. Aquatic habitats at farm of minor invertebrate and fisheries value. **Impact minor, temporary and readily mitigated.**
Upgrading External Access Roads & Upgrade to Bridges	Increased sediment run-off to streams, potential for cement spills	Damage to fisheries habitats and macroinvertebrates; fish kills	**Likely. Minor negative, temporary. Cement spill very unlikely but significant adverse if occurred.** All readily mitigatable.
Installing New Internal Roads	Increased mineral and peats silt run-off	Damage to fisheries habitats and macroinvertebrates	**Likely. Minor, negative and temporary.** Readily mitigatable.
Piling for some array foundations	Peat slide due to larger weight bearing equipment for piling	Catastrophic damage to fisheries, habitats and invertebrates.	**Unlikely after extensive Geotech surveys beforehand. Occurrence could equate to significant to profound, adverse and short-term.**
Additional Drainage	Increased peats silt run-off	Damage to fisheries habitats and macroinvertebrates	**Likely. Minor negative, temporary. Readily mitigatable.**
Additional trenching for cables	Increased peats silt run-off	Damage to fisheries habitats and macroinvertebrates	**Likely. Minor negative, temporary. Readily mitigatable.**

Table 3-26: Aquatic Ecology - Battery Energy Storage

Source	Potential Impact	Potential Effect	Likelihood & Significance
Upgrading of best access track to site of condenser to handle additional truck traffic for platform construction	Increased mineral and peats silt run-off	Increased nutrient run-off, increased solids runoff, loss of aquatic invertebrate & fish production	**Possible. Minor, negative and temporary Readily mitigatable.**
Large amount of concrete required for the platform	Potential for cement spills	Damage to fisheries habitats and macroinvertebrates; fish kills	**Cement spill very unlikely but significant adverse, short-term impact if occurred. Readily mitigatable.**
Large peat storage area required for excavated peat	Potential for increased peat runoff	Damage to fisheries habitats and macroinvertebrates;	**Likely. Minor, negative and temporary. Readily mitigatable.**
General site works	Increased mineral and peats silt runoff	Damage to fisheries habitats and macroinvertebrates	**Likely. Minor, negative and temporary. Readily mitigatable.**

Table 3-27: Aquatic Ecology - Synchronous Condensers

Activity	Potential Effect	Potential Impact	Likelihood & Significance
Limited increase in site area if co-location required	Additional felling and aquatic habitat loss	Increased nutrient run-off, increased solids runoff, loss of aquatic invertebrate & fish production	Probably enough area adjoining to east and west of site to avoid new felling areas. Aquatic habitats at farm of minor invertebrate and fisheries value. **Impact minor, temporary and readily mitigatable.**
Possible requirement of concrete supporting plinths	Potential for cement spills	Damage to fisheries habitats and macroinvertebrates; fish kills	**Cement spill very unlikely but significant adverse if occurred.** Readily mitigatable.
General site works	Increased mineral and peats silt run-off	Damage to fisheries habitats and macroinvertebrates	**Likely. Minor, negative and temporary.** Readily mitigatable.

Table 3-28: Aquatic Ecology - Alternative Land use

Activity	Potential Impact	Potential Effect	Likelihood & Significance
Insertion of limited additional site drainage	Solids run-off	Increased silt deposition in the 1st and 2nd order streams (mainly) draining the site, resulting in possible decrease in biological water quality and potential reduction in hatching success in trout spawning areas	This impact would be **temporary and slight to minor, adverse**. It would be minimised by a careful pre-planting survey of the site's aquatic vulnerabilities, especially in relation to existing site drainage channels, with a view to optimising the implementation of the *Forestry and Water Quality Guidelines*.
Application of phosphatic fertilizer	Increased nutrient run-off	Reduction in water quality in the 1st and 2nd order streams draining the windfarm from Good to Moderate Water quality . Combined with increased silt run-off this effect might reach the upper sites of the Boleyneendorrish and Owendalulleegh Rivers with a subsequent decline from High Status to Good Status at those sites	**Likely. Minor negative, temporary impacts** which can be minimised by following the *Forestry and Water Quality Guidelines*.

3.5.5.2 Overall Preference of Alternative

Th effects on aquatic ecology of early closure and decommissioning would be similar to the continued operation and subsequent decommissioning but would occur at an earlier date. There would be no significant benefit to early closure therefore.

In terms of alternative land use this would see the decommissioned site reforested with the same conifer species, Sitka spruce and Lodgepole pine. As the site had already been drained for commercial plantation prior to Derrybrien it is likely that only limited ground preparation would occur, with some herbicides and fertiliser use. The site will benefit from existing access tracks which will be retained following decommissioning, which will limit the potential for ground damage during the site preparation and re-planting phase and will perform the same benefit during thinning and harvesting. The gentle sloping nature of much of the site is an existing benefit that helps reduce excess run-off from the site, which in turn reduces the likelihood of excessive erosion in any of the drains exiting the site and increases the likelihood of silt control measures being effective.

Repowering, in many significant respects, would be the same as constructing a new windfarm apart from a number of notable advantages when compared to the original site. In particular, there would be no need to clear-fell large tracts of forestry, a large portion of the on-site road tracks could still be used, although depending on the final layout, some would have to be significantly upgraded to manage the heaviest machinery and loads with modifications to the external road network likely required also. More drainage works, storage for large amounts of peat excavated for deeper foundations, and potentially additional land take would all be factors to be considered. One of the important risks would that of a potential peat slide. Against, that the fact that the site has been gradually drying out over the past 17 years and that there is a wealth of acquired knowledge about the site probably makes this a much lower risk project than if it were being undertaken on the original unexploited site, so that the potential impacts on aquatic habitats would therefore likely be much lower.

A solar farm project onsite would come with at least the same but probably slightly more potential impacts on the external aquatic environment as it would require a greater additional land take, groundworks would be more distributed and more extensive across the footprint of the farm. It would also carry potential for a peat slide and would therefore require intensive ground stability investigations in advance. Co-location with the existing farm or a re-powered farm could also require additional works to the Agannygal substation and the interconnector, extending further the footprint of potential aquatic impacts.

Battery Energy Storage would be the most spatially concentrated of the energy alternatives under consideration and probably the easiest to project manage in terms of pollution control measures. It would likely be least potentially problematic for the aquatic receiving environment also, and similar to but probably marginally better than the synchronous condenser alternative.

A synchronous condenser project would benefit greatly from the use of existing infrastructure if the existing site were decommissioned, the turbines removed to ground level, but all the bases and access tracks retained. It could however require a certain amount of additional land take and associated works. Overall however, it would be potentially much less impactful than the windfarm repowering and the solar farm alternatives. Of the two co-location options, that with the repowering alternative would be at least marginally better, as it wouldn’t require

additional land take and it would avail of a portion of the redundant, decommissioned infrastructure.

In increasing scale of potential impacts on the aquatic receiving environment, the alternatives can be listed as follows;

'Continued Operation' less than 'Do Nothing (Early Cessation and Decommission of the Project)' less than 'Continued Operation' & 'Battery Energy Storage' less than 'Battery Energy Storage' less than 'Synchronous Condenser' less than 'Alternative Land use Reforesting' less than 'Re-Powering' less than 'Solar Farm'.

It is important to point out that even for those alternatives and variants with potentially higher aquatic impacts, with careful site management, mitigation planning and rigorous supervised implementation, downstream risks can be very significantly reduced to acceptable, mainly temporary, levels. The single caveat, however, given the early history of the site, is the possibility of a recurrence of a peat slide. While this is far less likely to re-occur now, it is undoubtedly the one effect that must be avoided.

3.5.6 Landscape and Visual

This section looks at the potential impacts and effects from the Landscape and Visual aspects of the project alternatives.

3.5.6.1 Analysis of Alternatives

The effects of the 'Continued Operation' Option would be as described in detail in Chapter 9, Section 9.4.3 whereby the Project would continue in operation to circa 2040 and would then be decommissioned. This would entail no change in the existing landscape and visual effects of the project. Early decommissioning (circa 2020 – 2021) would see the removal of the wind turbine generators and all surface infrastructure with decommissioning at an earlier date which is regarded as a moderate landscape effect. In terms of visual, early removal would be assessed as ranging from imperceptible to slight-moderate depending on the viewpoint as the turbines are a relatively low height by today's standards which lessen the visual effects of their decommissioning. Though the long term uses of the site are not known, it is likely that natural regrowth of previously felled areas would occur.

The analysis of alternatives in terms of effect of Landscape and Visual from these developments is presented in Table 3-29

In relation to landscape effects it is noted that several alternative energy projects were considered. These would all be subject to new applications and assessments depending on the specifics of the project, and the likely landscape and visual effects are considered at a high level. The landscape and visual effects would depend very much on the layout, size, and overall siting of the development. Landscape effects of alternative renewable energy projects may in some cases result in greater effects on the landscape fabric when compared with turbines, depending on the scale of the project.

Table 3-29: Landscape & Visual – Do Nothing (Early cessation & decommissioning Alternative) [circa 2020-2021]

to Table 3-34.

In relation to landscape effects it is noted that several alternative energy projects were considered. These would all be subject to new applications and assessments depending on the specifics of the project, and the likely landscape and visual effects are considered at a high level. The landscape and visual effects would depend very much on the layout, size, and overall siting of the development. Landscape effects of alternative renewable energy projects may in some cases result in greater effects on the landscape fabric when compared with turbines, depending on the scale of the project.

Table 3-29: Landscape & Visual – Do Nothing (Early cessation & decommissioning Alternative) [circa 2020-2021]

Source	Potential Impact	Potential Effect	Likelihood and Significance
Landscape effects	Changes to the appearance of the site	Early decommissioning of the wind farm will result in similar landscape effects to the Decommissioning phase as assessed in Chapter 9. During the decommissioning phase, the movement of the machinery in and out of the site and activities described above will occur on the site and in the vicinity. The overhead line and the Agannygal tee-in sub-station would be removed. The turbines, associated buildings and elements on the site of the wind farm would be removed.	Decommissioning would give rise to **Slight to Moderate, long term landscape effects.** Effects during decommissioning would be **Temporary, Slight negative.** The removal of the overhead line would be considered **Not Significant to Slight, beneficial effect** and the removal of the Agannygal tee-in sub-station a **Slight, neutral to beneficial effect.** The removal of the turbines and associated buildings and elements on the site of the wind farm is considered a **Moderate landscape effect**. The quality of the effect is considered to range from **Neutral, to Positive,** where natural regrowth occurs. The removal of the wind farm from the landscape will result in a **Slight to Moderate change** to the character of the wider landscape also. The removal of the overhead line will result in a **Not Significant, beneficial effect.**

Visual effects	Changes to the appearance of the site	Early decommissioning of the wind farm will result in similar visual effects to the Decommissioning phase as assessed in Chapter 9. Visual effects are likely to include temporary visual effects as a result of the operation of machinery to facilitate the removal of the wind farm elements referred to above. The removal of turbines which have been in place for some time and which may be considered as a landmark in the area, may be considered to be an adverse effect by some viewers. However, in some cases where the removal of the turbines is considered to remove an element of visual clutter and result in a simpler composition of a view, this may be experienced as a beneficial or positive effect. The turbines are a relatively low height by today's standards which lessen the visual effects of their decommissioning.	Effects associated with the decommissioning works would be **Moderate adverse effects and temporary in nature.** Permanent visual effects resulting from the decommissioning of the project are considered to range from **Imperceptible to Slight** from the majority of the viewpoints. Viewpoints closer to the turbines such as Viewpoints 7 and 10 experience more pronounced visual effects (Moderate), where the viewer is in close proximity to the turbines and they are a well-known element of the view. The permanent removal of the turbines and associated development may be considered to be an **adverse effect by some viewers or beneficial or positive** effect by others. The visual effects of the removal of the other elements range from **Not Significant to Slight.** The quality of the effects varies

Table 3-30: Landscape & Visual - Repowering of the Wind Farm

Source	Potential Impact	Potential Effect	Likelihood and Significance
Landscape effects			The repowering of the site with taller turbines would likely result in more pronounced effects on the landscape character as well as other landscape character areas. However, the landscape effects would depend very much on the turbine layout, size, and overall siting of the development.
Visual effects	Changes to the appearance of the site	The visual effects would depend very much on the turbine layout, size, and overall siting of the development. Repowering of the site could result in a lower number of taller turbines being proposed. The current Derrybrien turbines are relatively low when compared to today's standards, which could give rise to increased visual presence in areas close to the site, and increased visibility from more distant viewpoints. This is also likely to result in an extended pattern and extent of visibility, resulting in visibility from locations where there currently is no visibility.	The repowering of the site with taller turbines would likely result in more pronounced visual effects the significance of which would depend on the viewing location. The visual effects would depend very much on the turbine layout, size, and overall siting of the development.

Table 3-31: Landscape & Visual - Solar Farm

Source	Potential Impacts	Potential Effects	Likelihood and Significance
Landscape effects	Changes to the appearance of the site	The introduction of a solar farm would be a very different form to the wind turbines, as solar panels are typically relatively low in height, and this type of development would not be likely to be widely visible from the surrounding areas. With regards to impacts on the landscape fabric, some of the existing infrastructure could be used, however depending on the size of the solar farm, additional land take could be considerable. Co-location of a solar farm with the existing wind farm was also considered. and would involve additional land take as described above with additional cabling and potential modifications to the internal windfarm substation, the grid connection and Agannygal substation. These are likely to result in additional effects on the landscape character of these areas though some may be temporary in nature and are not likely to be significant. Solar panels would be a new element in this landscape.	Likely to be non-visible from the surrounding areas and a significantly less impact than the continued operation. The significance of the effect would depend very much on the solar farm layout, size, and overall siting of the development.
Visual effects	Changes to the appearance of the site	As solar panels are typically relatively low in height, and this type of development would not be likely to be widely visible from the surrounding areas and thus could result in much reduced visual effects, or localised visual effects.	Likely to be much reduced visual effects compared to the continued operation. The significance of the visual effects would depend very much on the solar farm layout size, and overall siting of the development.

Source	Potential Impacts	Potential Effects	Likelihood and Significance
		The full proposal would need to be assessed and take account of proposed tree felling which may allow increased visibility. Co-location of a solar farm with the existing wind farm may increase visual effects, depending where the solar panels were located. Solar panels would be a new element in this landscape.	

Table 3-32: Landscape & Visual - Battery Energy Storage Systems

Source	Potential Impacts	Potential Effects	Likelihood and Significance
Landscape effects	Changes to the appearance of the site	Two alternatives were considered here– the location of a BESS on the site of the decommissioned windfarm, and the location of BESS along with the existing wind farm to a repowering of the site ('co-location'). The effect of the introduction of a number of BESS units (approximately 3.7m high and 17m long) on the site would depend where they were located but it is likely they could be located without affecting the landscape character of the site and surrounds, and on existing hard stands, minimising ground disturbance. Co-location of the BESS units with the existing turbines or a repowered site would require additional land take, and potential effects on the landscape fabric	For a BESS development itself it would likely have no landscape effects. Co-location with either the existing wind farm or a repowered wind farm would likely give rise to some localised landscape effects. The significance of the effect would depend very much on the overall siting of the development.

Source	Potential Impacts	Potential Effects	Likelihood and Significance
		and localised effects on the landscape character, depending on the location.	
Visual effects	Changes to the appearance of the site	The effect of the introduction of a number of BESS units (approximately 3.7m high and 17m long) on the site would depend where they were located and screening within forestry may be possible. Any visual effects, would likely be localised.	The significance of the visual effects would depend very much on the BESS layout and overall siting of the development and would likely give rise to localised visual effects only given the low height of the development.

Table 3-33: Landscape & Visual - Synchronous Condenser

Source	Potential impacts	Potential Effects	Likelihood and Significance
Landscape effects	Changes to the appearance of the site	A synchronous condenser was also considered on the site, after the decommissioning of the windfarm. This would include a generator and flywheel building (approximately 1000sqm) and 15m high. This would be located adjacent to the substation and would require a concrete foundation. The land take would be an additional 1-2 ha, and effects on the landscape fabric would be localised and not affect the wider landscape character. Should this option be pursued along with the existing turbines or a repowered site, the proposed location and land take would remain the same.	The development but would likely give rise to a localised landscape effect only and would not likely effect the wider landscape character.
Visual effects	Changes to the appearance of the site	This would include a generator and flywheel building (approximately 1000sqm) and 15m high. This would be located adjacent to the Derrybrien substation and would require a concrete foundation. It is likely to be at least partially screened by forestry however this could change over time. Visual effects would be expected to be localised. Should this option be pursued along with the existing turbines or a repowered site, the visual effects of the condenser would be similar but may result in additional visual effects.	The development but would likely give rise to a localised visual effect.

Table 3-34: Landscape & Visual - Alternative Land-use

Source	Potential impacts	Potential Effects	Likelihood and Significance
Landscape Effects	Changes to the appearance of the site	Alternative land-use considered for the site include the re-establishment of commercial forest plantation on the 222 hectares where clear-felling took place. This would involve planting of Sitka spruce and Lodgepole pine. The area to be replanted is adjacent to areas of conifer plantation and some areas of bogland.	The magnitude of change would be considered Low. This would be likely to result in **Long Term, Not Significant landscape effects** and these would be relatively localised, without affecting the wider landscape character. The quality of the effect would likely range from neutral to adverse – replanting on previously open moorland is unlikely to have adverse on the landscape fabric, at a local level.
Visual Effects	Changes to the appearance of the site	The planting of forestry on site where clear felling had taken place would result in some adverse visual effects close to the site, but would not be likely to be evident from the wider landscape and would not be a conspicuous element from more distant viewpoint, as it is adjacent to some areas of forestry and forestry activities are a major land use in the area. However visual effects of forestry planting do depend on scale, layout, form of the planting, and whether any other species/nurse species are included.	It is unlikely that the plantation would be evident from the wider landscape and the significance of the visual effects would depend on the scale, layout, form of the planting and species planted. Some adverse visual effect close to the site would likely occur.

3.5.6.2 Overall Preference of Alternative

The continued operation of the project would entail no change in the existing landscape and visual effects of the project which to date have not given rise to any formal complaint. The Do Nothing alternatives would result in slight to moderate effects on the landscape with imperceptible to slight visual effects as it would see the removal of visible structures which have been in place for a considerable time period. The significance of effect son landscape and visual for any of the alternative renewable options would be very much dependent on the layout and overall siting of the proposed development on the existing site. In general, repowering with fewer larger turbines would likely lead to the highest landscape and visual effect of the renewable alternatives considered, followed by solar, due to its larger likely footprint but significantly lower elevation in the landscape and then by a battery energy storage system or a synchronous condenser project which would likely have only localised landscape and visual effects.

In increasing scale of potential impacts from Landscape and Visual, the alternatives can be listed as follows; Continued operation, less than Do Nothing, less than alternative land use, less than a Synchronous Condenser, less than BESS which would be less than a Solar Farm, less than Repowering.

3.5.7 Land, Soils and Geology

In this section the alternatives are assessed in terms of their potential impacts Land, Soils and Geology.

3.5.7.1 Analysis of Alternatives

The 'Continued Operation' alternative, which is the continued operation of the wind farm to circa 2040 has been assessed in detail Chapter 10, Section 10.3.2.3. That assessment considered a range of potential direct impacts and site stability impacts summarised as follows:.

- The assessment of direct impacts on soils geology and land identified two slightly significant effects such as tree topping required occasionally and a specific widening of a turbary road.
- None of the impacts of site activities were predicted to have a Significant effect on soils, geology and land with respect to site stability during the operation and maintenance phase of the project between 2020 and c. 2040, with drainage improvements having a moderate positive effect.
- Slightly significant effects were identified related to the increased dead load on the floating roads from any re-surfacing or repair, live load surcharging by large mobile cranes or heavy low-loader transporters on the floating roads , on the intact peat slopes from low ground-bearing pressure (LGBP) wide-tracked harvesters or excavators carrying out tree-topping, localised drainage improvements, or repairs to existing cable ducts and trenches; and additional dead load and live load surcharge on the intact peat slopes for some specific road widening if required.
- The significance of these effects were all regarded as slight.

The analysis of alternatives in terms of effect of Land, Soils and Geology from these developments is presented in Table 3-35 to Table 3-40.

Table 3-35: Land, Soils & Geology – Do Nothing (Early cessation & decommissioning Alternative) [circa 2020-2021]

Source	Potential Impact	Potential Effect	Likelihood and Significance
Land, soils and geology	There would be no significant impact on land, soils and geology as the decommissioning would entail the removal of above ground structures only on the wind farm site and the grid connection route. Two barrages are proposed to be removed however these are substantially downstream of the site and of a number of other barrages.	No significant or moderately significant direct impact effect will arise during decommissioning activities but there will be a slight significant effect from removal of buried cables and widening of a turbary road to facilitate decommissioning.	Direct impact of cable removal and turbary road widening was assessed as **Slightly significant.** **Slight effect** from the removal of the grid components.
Site stability	Continued improvement in site conditions have occurred since construction and there is a reduced likelihood of a peat slide on the site considering the improvement of site conditions with respect to stability and the range of activities that are likely to be carried out during decommissioning. There is a lower risk of peat stability associated with the removal of the grid connection	None of the impacts of decommissioning will have a Significant or Moderately significant effect in terms of site stability during decommissioning. Slightly significant effects have been identified associated with the live loading from mobile cranes and other heavy vehicles on floating roads and possible surcharging of peat upslope of a proposed turbary road widening and live load surcharge from wide tracked equipment during removal of buried cables. The effects associated with the OHL activities are considered slight.	**Slightly significant effect on the wind farm site.** **Slightly significant effects associated with grid removal**

Table 3-36: Land, Soils & Geology - Repowering of the Wind Farm

Source	Potential Impact	Potential Effect	Likelihood and Significance
Land, soils and geology	Significantly larger laydown, foundations and hardstand areas would be required at new locations, although some existing hard stands could be used to some extent but would be increased in size. Increase in volume of excavated peat.	Increased direct impact on the peat due to excavation and requiring the deposition of further volumes of peat within the site boundary.	**Increased effect** on land soils and geology.
Site stability	Additional excavations, widening of access tracks and increase drainage.	Increased impact from widening of existing roads or construction of new roads, loading of heavy vehicles, potential additional peat repositories increasing load on peat	**Likely increased site stability issues** which would require significant assessment and mitigation.

Table 3-37: Land, Soils & Geology - Solar Farm

Source	Potential Impact	Potential Effect	Likelihood and Significance
Land, soils and geology	Piling of solar panel frame foundations. Increased layout of access roads on site.	Piling of solar frame foundations would minimise the effect on land soils and geology through minimisation of excavations	**Likely to be insignificant** in terms of land soils and geology.
Site stability	Piling of solar panel frame foundations. Increased layout of access roads on site.	Surcharging of peat from additional site roads Additional loading from piling rig platform surcharging of peat.	**Likely to be of slight significance** with appropriate mitigation in place

Table 3-38: Land, Soils & Geology - Battery Energy Storage Systems

Source	Potential Impact	Potential Effect	Likelihood and Significance
Land, soils and geology	BESS unit foundation construction	No additional land take or excavation required if existing crane hardstand areas are utilised for BESS units	**Imperceptible to negligible impact** likely
Site stability	Surcharging due to foundation and BESS unit load	BESS units would likely be placed on existing crane hardstand areas which are already constructed to bearing stratum level and no additional peat loading would occur	**Imperceptible to negligible impact** likely

Table 3-39: Land, Soils & Geology - Synchronous Condenser

Source	Potential Impact	Potential Effect	Likelihood and Significance
Land, soils and geology	Foundation construction requiring excavation and spoil disposal Additional drainage	Increased impact on land soils and geology due to excavation of material and disposal in either existing or new repositories.	**Likely to be a slight impact** on land, soils and geology.
Site stability	New foundation and structure increases loading on peat during construction. Likely to be constructed to competent bearing stratum avoiding permanent loading of the peat .	Increased site stability impacts from heavy equipment and vehicles surcharging the peat during construction	**Increased likelihood of site stability** which could be mitigated.

Table 3-40: Land, Soils & Geology - Alternative Land-use

Source	Potential Impact	Potential Effect	Likelihood and Significance
Land, soils and geology	No likely significant impact	Effects would likely be imperceptible to slight	**No likely significant effect**
Site stability	No likely significant impact if existing mitigation measures are adhered to.	Effects would likely be imperceptible to slight	**No likely significant effect**

3.5.7.2 Overall Preference of Alternatives

The land, soils and geology aspect of the Derrybrien Project site has been assessed in Chapter 10 of this EIAR. The assessment of the continued operation of the site indicates that no significant impact and only slight impacts from continued operation are likely to occur and with positive benefits from the effect of the site drainage with site stability increasing with time.

With the implementation of the mitigation principles all alternatives would likely be feasible on the site. In terms of ranking, consideration has been given to increasing potential for impact on land, soils and geology and increasing potential for impact on site stability. With regards to the various alternatives assessed none of the 'Continued Operation', Do-Nothing (early cessation and decommissioning of the wind farm) and battery storage alternatives present likely significant impacts with regards to soils, geology and land, the critical impacts for consideration being site stability impacts. With regards to the restoration of the land use to forestry that too would not present likely significant impact. This is based on the current mitigation being implemented.

The alternative to use the site for a synchronous condenser would present an increased likelihood of site stability impacts however with the mitigation proven to be successful for the project this would be a viable project alternative.

The repowering option is a viable option for the wind farm however the siting of turbines and hardstands, and the roads and repository layout would require further assessment of the site to mitigate the site stability impact. The assessment of peat stability likelihood would be a key input into the new wind farm design. Furthermore, it would be most likely that significantly larger laydown, foundations and hardstand areas would be required, increasing the direct impact on the peat due to excavation and requiring the deposition of further volumes of peat within the site boundary. Nonetheless it is also possible to be a viable alternative with the implementation of the mitigation principles adopted after the peat slide event in 2003. Detailed assessment of the required loading, in particular due to crane loading on the floating roads, would be necessary.

Increasing scale of potential impacts on Land ,Soils and Geology can be listed as follows:

Continued Operation less than 'Do Nothing' (Early Cessation and Decommissioning) less than Alternative land-use less than BESS less than Synchronous condenser less than Solar or Repowering with BESS of a synchronous condenser less than Repowering.

3.5.8 Hydrology and Hydrogeology

In this section, the alternatives are assessed in terms of their potential impacts on hydrology and hydrogeology

3.5.8.1 Analysis of Alternatives

The 'Continued Operation and Do Nothing (Early Cessation and Decommission of the Project) as alternatives have been dealt with in Chapter 11 Section 11.3.4).

The Repowering alternative would require additional infrastructure construction which would likely require additional drainage works associated with additional turbine locations, access track widening, the storage for large amounts of peat excavated for deeper foundations, and potentially additional land take would all be factors to be considered. One of the important risks would be that of a peat slide.

A solar farm project would require significant additional land take with additional access tracks and associated drainage and groundworks although foundations would likely be piled all of which would have potential for impact on the hydrological and hydrogeological regime.

Battery Energy Storage would utilise the existing infrastructure on the site to a very large extent with minimum requirement for additional drainage or groundworks.

Development of synchronous condenser project on site would be much less impactful than the windfarm repowering and the solar farm alternatives. Its footprint would be smaller but additional drainage would be required at its foundation locations, Foundation generation would also generate additional spoil and the construction activity could impact both surface and groundwater.

The analysis of alternatives in terms of hydrogeology and hydrology from these developments is presented in Table 3-41to Table 3-45

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Table 3-41: Hydrology & Hydrogeology - Repowering of the wind farm site

Source	Potential Impacts	Potential Effects	Likelihood & Significance
Increase in site area	Additional felling	Increased suspended solids runoff, increase in runoff rates with a decreased time to peak following heavy rainfall	Probably enough area adjoining to east and west of site to avoid new felling areas. Impact on surface water quality **minor, temporary** and readily mitigatable. Readily mitigated.
Upgrading External Access Roads & Upgrade to Bridges	Rerouting of streams / rivers. Increased sediment run-off to streams, potential for cement spills	Interruption to natural hydrological regime causing changes in potential flood risk downstream.	**Likely. Minor negative, temporary**. Cement spill significant adverse. All readily mitigatable.
Installing New Internal Roads	Increased hardstanding area where greenfield previously. Increased mineral and peats silt run-off	Increased runoff rates during flood events from site compared to current wind farm.	**Likely. Minor, negative and temporary.** Readily mitigatable.
Installation of larger turbines and crane stands	Increased hardstanding area where greenfield previously. Requirement for large peat excavation and de-watering. Risk of increased peat solids washout directly or via new peat repositories. Peat slide due to larger weight bearing risks	Increased runoff rates during flood events from site compared to current wind farm. Peat slide – depending on size of the slide, erosion and deposition downstream changing river morphology.	**Likely except for peat slide, which would be unlikely. Minor to moderate, negative, temporary to short-term, except for peat slide, which would be significant to profound, adverse and short-term.** Readily mitigatable, except for peat slide
Additional Drainage	Gradual reduction in groundwater level. Increased peats silt run-off	Groundwater displaced from onsite to downstream offsite gradually over time. Rainwater landing on site may move more quickly offsite due to additional drainage channels.	**Likely. Minor negative, temporary. Readily mitigatable.**
Modification of substation	Requirement for sub-station area might require more peat excavation and deposition and cement pouring.	Contamination of waters leaving site into tributary of Owendallulleegh.	**Likely. Minor negative, temporary. Cement spill significant adverse.** All readily mitigatable.

Table 3-42: Hydrology & Hydrogeology - Solar Farm

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Increase in site area	Additional felling	Increased suspended solids runoff, increase in runoff rates with a decreased time to peak in following heavy rainfall	Probably enough area adjoining to east and west of site to avoid new felling areas. **Impact on surface water quality minor, temporary and readily mitigatable.** Readily mitigated.
Upgrading External Access Roads & Upgrade to Bridges	Rerouting of streams / rivers. Increased sediment run-off to streams, potential for cement spills	Interruption to natural hydrological regime causing changes in potential flood risk downstream.	**Likely. Minor negative, temporary. Cement spill significant adverse.** All readily mitigatable.
Installing New Internal Roads	Increased hardstanding area where greenfield previously. Increased mineral and peats silt run-off	Increased runoff rates during flood events from site compared to current wind farm.	**Likely. Minor, negative and temporary**. Readily mitigatable.
Piling for some array foundations	Peat slide due to larger weight bearing equipment for piling	Peat slide – depending on size of the slide, erosion and deposition downstream changing river morphology.	**Unlikely after extensive Geotech surveys beforehand. Occurrence could equate to significant to profound, adverse and short-term.**
Additional Drainage	Gradual reduction in groundwater level. Increased peats silt run-off	Groundwater displaced from onsite to downstream offsite gradually over time. Rainwater landing on site may move more quickly offsite due to additional drainage channels.	**Likely. Minor negative, temporary. Readily mitigatable.**
Additional trenching for cables	Increased peats silt run-off	Increased suspended solids runoff and contamination of water	**Likely. Minor negative, temporary. Readily mitigatable.**

Table 3-43: Hydrology & Hydrogeology - Battery Energy Storage

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
No increase in site area if existing crane hard stands are used on which to construct foundations.	Concrete leaching to drainage with impact on water quality	pH and sediment effect on aquatic ecology	**Likely, Minor, negative and temporary.** Readily mitigatable

General site works	Increased mineral and peats silt runoff	Increased nutrient run-off, increased solids runoff, contamination of watercourses	**Likely. Minor, negative and temporary**. Readily mitigatable.
Co-location of BESS with existing or new windfarm **Large excavated peat storage area(s) required**	Additional land take and construction areas required with additional drainage with increased potential for peat and mineral silt runoff	Increased nutrient run-off, increased solids runoff, contamination of watercourses	**Likely. Minor, negative and temporary.** Readily mitigatable

Table 3-44: Hydrology & Hydrogeology - Synchronous Condensers

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Limited increase in site area if co-location required	Additional felling	Increased suspended solids runoff, increase in runoff rates with a decreased time to peak in following heavy rainfall	Probably enough area adjoining to east and west of site to avoid new felling areas. **Impact on surface water quality minor, temporary and readily mitigatable**. Readily mitigated.
Possible requirement of concrete supporting plinths	Potential for cement spills	Contamination of waters leaving site into tributary of Owendalulleegh.	Cement spill **Very unlikely but would be significant adverse.** All readily mitigatable.
General site works	Increased mineral and peats silt run-off	Contamination of waters leaving site.	**Likely. Minor, negative and temporary.** Readily mitigatable.

Table 3-45: Hydrology & Hydrogeology – Alternative land use

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Re-profiling of site for replanting including brash winnowing	Disturbance of ground	Increased suspended solids runoff, increase in runoff rates with a decreased time to peak in following heavy rainfall Contamination of waters leaving site into tributary of Owendalulleegh.	**Likely. Minor, negative and temporary.** Readily mitigatable.
Installation of new drainage	Excavation and side casting of peat materials	Increased suspended solids runoff, increase in runoff rates with a decreased time to peak in following heavy rainfall	**Likely. Minor, negative and temporary.** Readily mitigatable.

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Tracking of heavy equipment across peat soil areas	Increased mineral and peats silt run-off	Increased suspended solids runoff, Contamination of waters leaving site.	**Likely. Minor, negative and temporary.** Readily mitigatable.

3.5.8.2 Overall Preference of Alternative

The Do Nothing (Early Cessation and Decommission of the Project as alternatives have been dealt with in Chapter 11, Section 11.3.4. This would be similar to continued operation of the project and subsequent decommissioning but would occur much earlier, circa 2020 to 2022. No significant impacts have been identified associated with decommissioning, but slight temporary impacts associated with soil disturbance and increased soils have been identified, which would be temporary in nature.

In many significant respects repowering would be the same as constructing a new wind farm but with some advantages as there would be no need to clear-fell large tracts of forestry, a large portion of the on-site road tracks could still be used, although depending on the final layout, some would have to be significantly upgraded to manage the heaviest machinery and loads. In addition, external public roads and probably bridges would have to be upgraded, particularly at sharp bends and narrow stretches to facilitate the transport to site of the larger turbine components. More drainage works, storage for large amounts of peat excavated for deeper foundations, and potentially additional land take would be required and would need to be considered. An important risk factor would be that of a peat slide but the fact that the site has been gradually drying out over the past 17 years and that there is a wealth of acquired knowledge about the site likely makes this a much lower risk project than if it were being undertaken on the baseline site, so that the potential impacts on surface and subsurface waters would therefore be much lower.

A solar farm development would come with at least the same but probably slightly more potential impacts on the local hydrological regime as it would require a greater additional land take, groundworks would be more distributed and more extensive across the footprint of the farm. It would also carry potential for a peat slide. Co-location with the existing farm or a re-powered farm could also require additional works to the Agannygal substation and the interconnector, extending further the footprint of potential hydrological impacts.

A BESS project would be the easiest to project manage in terms of pollution control measures. It would likely be least potentially problematic for the receiving hydrological environment in that existing hydrological regimes can be more easily retained, and similar to but probably marginally better than the synchronous condenser alternative.

A synchronous condenser project would require a certain amount of additional land take and associated works. Overall however, it would be potentially much less impactful than the windfarm repowering and the solar farm alternatives.

Of the two co-location options, that with the repowering alternative would be at least marginally better, as it wouldn't require additional land take and it would avail of a portion of the redundant, decommissioned infrastructure.

Alternative land use would result in a likely new drainage layout and ground preparation to facilitate replanting over a larger area. It would potentially represent a more significant level of impact in terms of drainage requirements and loss of suspended matter from the requiring mitigation.

In increasing scale of potential impacts from hydrogeology and hydrology, the alternatives can be listed as follows;

'Continued Operation' less than 'Do Nothing (Early Cessation and Decommission of the Project)' or 'Alternative land use' less than 'Continued Operation' & 'Battery Energy Storage' less than 'Battery Energy Storage' less than 'Synchronous Condenser' less than 'Re-Powering' less than 'Solar Farm' less than 'Re-Powering & Solar Farm'.

It is important to point out that even for those alternatives and variants with potentially higher hydrological impacts, with careful site management, mitigation planning and rigorous supervised implementation, downstream risks can be very significantly reduced to acceptable, mainly temporary, levels. The single caveat, however, given the early history of the site, is the possibility of a recurrence of a peat slide. While this is far less likely to re-occur now, it is undoubtedly the one effect that must be avoided.

3.5.9 Air & Climate

This section considers the likely impacts and effects on air quality and climate change which would likely arise resulting from the alternative projects.

3.5.9.1 Analysis of Alternatives

The 'Continued Operation' alternative would be the continued operation of the existing Project as described in Chapter 12, Section 12.4.8 with its final decommissioning in circa 2040.

The 'Do Nothing (early cessation and decommissioning of Project) option would see an immediate reduction in renewable generation onto the grid representing just over 1% of current installed capacity (circa 4,000 MW).

Alternative land use would see re-establishment of a mixture of commercial coniferous and broadleaved forest plantation on most of the site, excluding the infrastructure areas which would be left in situ following decommissioning of the project. Air quality impacts would be limited to ground preparation and replanting activities, thinning operations and ultimately final harvesting and replanting which would not occur for circa 35 – 40 years.

Repowering would require the decommissioning of the existing wind farm element of the project and construction of new larger wind turbine foundations and road widening. However, the site is remote from any occupied dwelling, just over 2km, and construction would occur within the wind farm site. Any air quality impacts from dust and vehicle emissions would be very localised and would quickly dissipate. There would be a carbon cost in repowering but the carbon repayment period would likely be less than two years as the larger turbines would increase renewable electricity output and the site infrastructure would be re-used where feasible. A repowered modern wind farm would be expected to increase output capacity by at least 50% over the existing and to operate to a higher capacity factor circa 33% producing a larger contribution of renewable electricity to the grid with larger displacement of both greenhouse gases and transboundary air pollutants.

A solar farm, of between 44 and 68MW capacity, developed on the site would also give rise to localised air quality impacts during construction but these would likely be less than repowering as foundations for the solar farm would be piled rather than excavated. Existing infrastructure would also be largely reused. The effects on air quality would likely be negligible given the distance to the nearest occupied dwelling. The operational capacity factor of a solar farm is circa 10% hence it would produce less renewable electricity than the current wind farm

or repowering option and would therefore displace less greenhouse gases and transboundary pollutants.

Battery energy storage systems operate both by storing excess renewable electricity, which cannot be input to the grid due to curtailment issues and subsequently discharging it when required and also by providing stabilising grid services. Synchronous condensers provide stabilising grid services. Both serve to extend and support the penetration of renewables into the grid but are not primary producers of renewable generation.

The analysis of alternatives in terms of effect of air and climate from these developments is presented in Table 3-46 to Table 3-51**.**

Table 3-46: Air & Climate – Do Nothing (Early cessation & decommissioning Alternative) [circa 2020-2021]

Source	Potential Impact	Potential Effect	Likelihood and Significance
Air Quality	Early cessation would mean immediate decommissioning and there would be no reduction in transboundary gas emissions through displacement effects of renewable generation	Early cessation of the project would see no continued benefit on air quality from the Project	**Likely immediate slight negative impact** on air quality overall
Climate change impacts	Early cessation would see an immediate reduction in renewable electricity generation nationally of the order of circa 1%.	No further contribution to reduction of greenhouse gas emissions would occur	**Likely immediate slight negative impact** on climate overall.

Table 3-47: Air & Climate - Repowering

Source	Potential Impacts	Potential Effects	Likelihood and Significance
Air Quality	Air quality impacts during construction of new wind turbine foundations, new hardstands and access track widening. Renewable electricity production would displace fossil fuel combustion and associated transboundary air pollutants Final decommissioning would also generate dust ad exhaust emissions	Impacts on air quality could arise which would be localised and remote from dwellings adjacent to the wind farm. Displacement of fossil fuel emissions would likely give rise to improved air quality as a result of reduction in transboundary air pollutants .	Mitigation measures such as dust management plans during these activities coupled with the distance to the nearest occupied dwellings (circa 2.1km) would mean that **no significant effects on air quality would be likely to occur.** Increased positive benefits from increased reduction in transboundary emissions likely to occur which would be **positive, moderate in scale and medium term.**
Climate Change	Repowering would lead to increased renewable generation from the development. There would be a lag period of circa 24 months during decommissioning of the existing wind farm and construction of the repowered wind farm when no renewable	Repowering would lead to greater displacement of fossil fuel generated greenhouse gas emissions through increased contribution to renewable electricity on the grid. This would also help achieve Irelands renewable energy targets and increase security of supply.	Decommissioning and construction activities could be undertaken but conservatively a 3 – 4 year period would occur when no renewable electricity generation would occur from the site. There would be a short term loss of renewable generation but when

Source	Potential Impacts	Potential Effects	Likelihood and Significance
	electricity would be produced but thereafter the repowered wind farm would be capable of generating higher levels of renewable electricity into the grid.		operational the effects of the wind farm on climate change would be positive and moderate over the medium term (circa 25 to 30 years).

Table 3-48: Air & Climate - Solar Farm

Source	Potential Impacts	Potential Effects	Likelihood and Significance
Air Quality	Dust and Vehicle exhaust emissions would arise during construction of the solar farm. Renewable electricity produced by solar would displace fossil fuel combustion related transboundary air pollutants. Dust and vehicle exhaust emissions would occur during	Air quality impacts from dust and hydrocarbon emissions could impact air quality and impact human health. Greenhouse gas emissions from thermal combustion electricity generation would be displaced by the solar farm operation but to a lesser extent than the project. The capacity factor of solar is less than that of the project (10% compared to 25%) and less renewable electricity will be produced with less displacement of greenhouse gas emissions compared to wind.	Given the separation distances to the nearest occupied dwellings and use of appropriate mitigation. **no significant** effect would likely occur on air quality The effect of greenhouse gas reduction would be **positive, of minor significance and of medium term.** There will be **no significant impact** on human health from initial decommissioning of the wind farm, construction of the solar farm or final decommissioning.
Climate	Renewable electricity produced by solar would displace greenhouse gas emissions produced by conventional thermal electricity generating stations.	Again, the capacity factor of solar is less than that of the project (10% compared to 25%) and less renewable electricity will be produced. Displacement of greenhouse gases by solar would be less than the existing Project and the Repowering option.	Greenhouse gasses and transboundary gases would be displaced by the solar farm operation but to a lesser extent than the project. The effect would be **positive, of minor significance and of medium term.**

Table 3-49: Air & Climate - Battery Energy Storage Systems

Source	Potential Impacts	Potential Effects	Likelihood and significance
Air Quality	Air quality impacts from dust and exhaust emissions would be very limited and localised as BESS units would be constructed on existing hard stand areas with little excavation required. Most of the wind farm infrastructure post minimal decommissioning would be left in place. Limited displacement of transboundary pollutants would occur from BESS operations Final decommissioning could also give rise to limited air quality impairment.	Construction would be confined to the existing hard stands only and some cable and minor substation work. Decommissioning effects with appropriate mitigation would be minimal. BESS units would increase the availability of renewable generation on the grid and hence would marginally increase displacement of transboundary gases. This would be significantly less than the 'Continued Operation' or Repowering alternatives	With good mitigation and given the separation distances **no significant impact** on air quality would likely occur. Final decommissioning would be similar in scale to the 'Continued Operation' alternative would be **short term and imperceptible.** Displacement of transboundary pollutants would be **slight, positive and medium term**.
Climate	Limited displacement of greenhouse gas emissions from conventional thermal generation plant would occur from BESS operations	BESS units would increase the availability of renewable generation on the grid and hence would marginally increase displacement of greenhouse gases. This would be significantly less than the 'Continued Operation' or Repowering alternatives	Displacement of greenhouse gas emissions would be **slight, positive and medium term**
Co-location of BESS with Wind and solar	Co-locating BESS units with wind would maintain renewable electricity generation from the site and also extend its usefulness on the national grid.	This would increase the effectiveness of the 'Continued Operation' or repowering alternative in displacing greenhouse gas emissions.	Co-location displacement of greenhouse gas emissions would be **medium, positive and medium term.**

Table 3-50: Air & Climate - Synchronous Condenser

Source	Potential Impact	Potential Effect	Likelihood and significance
Air Quality	Impacts on air quality from dust and hydrocarbons during construction and decommissioning would occur. Synchronous condensers do not generate renewable electricity but would extend the penetration of renewables onto the grid. They mainly provide grid services to support fault rectification.	Construction would be confined to the Synchronous Generator location within the site only with some cable and minor substation works. Very limited potential to reduce transboundary pollutants through displacing fossil fuel combustion electricity generation.	With good mitigation and given the separation distances **no impact on air quality would likely occur** during construction or decommissioning. By extending the penetration of renewables there would be a imperceptible**, intermittent positive effect** on transboundary pollutants.
Climate	Impacts on Greenhouse gas emissions and transboundary gases	Very limited potential to reduce greenhouse gas emissions through displacing fossil fuel combustion electricity generation	By extending the penetration of renewables there would be an imperceptible**, intermittent positive effect** on greenhouse gas reduction.
Co-location of an Synchronous Condenser with wind and solar.	Co-locating a synchronous condenser with the existing or a repowered wind farm would potentially see continued generation of renewable electricity with additional stabilising grid services been provided.	Very limited potential to reduce transboundary pollutants through displacing fossil fuel combustion electricity generation but would be less than with the BESS option.	Co-location would lead to **moderate, medium term positive effects** on reducing greenhouse gas emissions

Table 3-51: Air & Climate - Alternative Land-use

Source	Potential Impact	Potential Effect	Likelihood and Significance
Air Quality	Dust and vehicle exhaust emissions during ground preparation for replanting. Dust and vehicle exhaust emissions during thinning and final harvesting	Air quality impacts would be limited to specific periods in time (replanting in year zero, thinning circa year 20 and harvesting circa year 2040. Given the remoteness of the site from the nearest dwellings air quality effects would be unlikely to occur.	Air quality impacts from replanting , thinning and harvesting would be negligible would be very short term, **negative and negligible**. The loss of displacement of transboundary air pollutants would be

Source	Potential Impact	Potential Effect	Likelihood and Significance
	The project would not contribute to a reduction in transboundary air pollutants	There would be no reduction in transboundary air pollutants from the change in land use as no thermal electricity generation would be displaced.	immediate would be **negative, slight and long term.**
Climate Change	No renewable electricity generation and no displacement of greenhouse gas generating thermal generation plant. Carbon sequestration by actively growing forest plantation would occur.	Loss of reduction in level of greenhouse gas emissions from electricity production and loss of reducing positive impact on limiting climate change. Replanting of circa 222ha of forest plantation would give rise to an initial likely loss of carbon from ground preparation activities but within a period of two to four years carbon sequestration from the growing plantation would likely commence.	The loss of displacement of greenhouse gas emissions would be **immediate, negative, medium and long term**. This would be offset by the carbon sequestration from the actively growing plantation which would be positive, medium in effect on climate change reduction and would occur over the lifecycle of the forest plantation , that is out to 40 years.

3.5.9.2 Overall Preference of Alternative

In terms of air quality it is unlikely that any significant effects would occur from either construction or decommissioning of any of the alternatives as good mitigation would be implemented to minimise local impacts. There is some variation in reducing emissions of transboundary air pollutants through displacement of fossil fuel electricity generation and this would be higher where renewable electricity generation increases (repowering) or continues ('Continued Operation' and Solar) on the site. The likely effectiveness in reducing Greenhouse gas emissions through displacement of fossil fuel electricity generation would also be linked to the renewable generation output from the site which would increase with repowering, be the same with the 'Continued Operation' project and be less with Solar. Co-locating battery energy storage systems or a synchronous condenser with renewable generation from the site would marginally increase the effectiveness of overall in combatting climate change.

In increasing scale of potential impacts from hydrogeology and hydrology, the alternatives can be listed as follows;

'Repowering with BESS' less than 'Repowering' less than 'Continued Operation with BESS' less than 'Continued Operation' less than 'Solar with BESS' less than 'Solar' less than 'BESS less than 'Alternative Land use' less than 'Synchronous Condenser less than 'Do Nothing (Early cessation and Decommissioning)'.

3.5.10 Material Assets

This section considers the likely impacts and effects on material assets which would likely arise resulting from the alternative projects.

3.5.10.1 Analysis of Alternatives

The 'Continued Operation' scenario, whereby the wind farm would continue to operate until end of life circa. 2040, is considered, in terms of potential environmental impacts on material assets, by Chapter 13, Section 13.3.3 of the rEIAR.

The analysis of alternatives in terms of effect on material assets from these developments is presented in Table 3-52 to Table 3-56.

Table 3-52: Material Assets - Repowering of the Wind Farm Site

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Decommissioning followed by repowering project construction	Increase in duration of site activities due to decommissioning works being followed by construction works.	Effects relating to the use of water resources and telecommunications services, will continue over a longer duration than 'Continued Operation'	Duration of effects has a high likelihood of lasting longer. However, effects are **generally imperceptible** and would continue to be so when compared to 'Continued Operation'
Increase in site area	Land use change impacts in the project site may relate to a larger area should additional parts of the site be felled / cleared to accommodate repowering.	Neutral effects, per those experienced during construction of existing wind farm and the 'Continued Operation' scenario.	Potentially sufficient area adjoining the east and west of the site to avoid new felling areas thereby avoiding some of these potential effects. Effects considered **neutral in nature.**
Increase in site staffing levels	Combination of decommissioning and repowering staff resulting in increased level of staffing on site.	Increased effects on water usage, diesel use (in construction) and use of telecommunications systems due to increased staffing than 'Continued Operation'	Increased staffing is highly likely however, significance of effects when compared to 'Continued Operation' does not alter significantly.
Operation of the repowered wind farm	Ongoing impacts on material assets usage as a result of operations and maintenance activities.	Effects relating to the use of water resources and telecommunications services, will continue over a longer duration than 'Continued Operation'	Duration of effects has a high likelihood of lasting longer. However, effects are generally imperceptible and would continue to be so when compared to 'Continued Operation'.

Table 3-53: Material Assets - Solar Farm

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Decommissioning followed by solar farm construction	Increase in duration of site activities due to decommissioning works being followed by construction works.	Effects relating to the use of water resources and telecommunications services, will continue over a longer duration than 'Continued Operation'.	Duration of effects has a high likelihood of lasting longer. However, effects are generally **imperceptible** and would continue to be so when compared to 'Continued Operation'
Increase in site area	Land use change impacts in relation to the additional land take required for the development of a solar farm.	Neutral effects, per those experienced during construction of existing wind farm and the 'Continued Operation' scenario.	Potentially sufficient area adjoining the east and west of the site to avoid new felling areas thereby avoiding some of these potential effects.

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
			Effects considered neutral in nature.
Increase in site staffing levels	Combination of decommissioning and repowering staff resulting in increased level of staffing on site.	Increased effects on water usage, diesel use (in construction) and use of telecommunications systems due to increased staffing than 'Continued Operation'	Increased staffing is highly likely however, significance of effects when compared to 'Continued Operation' does not alter significantly.
Operation of the solar farm	Ongoing impacts on material assets usage as a result of operations and maintenance activities.	Effects relating to the use of water resources and telecommunications services, will continue over a longer duration than 'Continued Operation'. Water usage in particular for cleaning during the operation of the solar farm is expected to have a great effect on water resources.	Ongoing staffing will be necessary however staff levels for operational solar farms are extremely low and effects are generally **imperceptible**, perhaps slight in the case of water use, but generally expected to be not significant.

Table 3-54: Material Assets - Battery Energy Storage System

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Decommissioning followed by battery storage project construction / installation	Increase in duration of site activities due to decommissioning works being followed by construction works.	Effects relating to the use of water resources and telecommunications services, will continue over a longer duration than 'Continued Operation'.	Duration of effects has a high likelihood of lasting longer. However, effects are generally **imperceptible** and would continue to be so when compared to 'Continued Operation'. Conversion of the site to battery storage would require only minor works and not of significant duration.
Increase in site staffing levels	Combination of decommissioning and battery construction staff resulting in increased level of staffing on site.	Increased effects on water usage, diesel use (in construction) and use of telecommunications systems due to increased staffing than 'Continued Operation'	Increased staffing is highly likely however, only at very low levels so significance of effects would not be expected to alter when compared to 'Continued Operation'.
Operation of the battery site	Ongoing impacts on material assets usage as a result of operations and maintenance activities.	Effects relating to the use of water resources and telecommunications	Staffing at battery sites is generally intermittent and consists of very low

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
		services, will continue over a longer duration than 'Continued Operation'.	levels. It would not be expected to give rise to perceptible effects.

Table 3-55: Material Assets - Synchronous Condensers

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Decommissioning followed by synchronous condenser project construction / installation	Increase in duration of site activities due to decommissioning works being followed by construction works.	Effects relating to the use of water resources and telecommunications services, will continue over a longer duration than 'Continued Operation'.	Duration of effects has a high likelihood of lasting longer. However, effects are **generally imperceptible** and would continue to be so when compared to Do-Nothing. Conversion of the site to synchronous condenser site would not require significant works nor would it be of significant duration.
Increase in site staffing levels	Combination of decommissioning and synchronous condenser construction staff resulting in increased level of staffing on site.	Increased effects on water usage, diesel use (in construction) and use of telecommunications systems due to increased staffing than 'Continued Operation'	Increased staffing is highly likely however, only at very low levels so significance of effects would not be expected to alter when compared to 'Continued Operation'
Additional land take	Land use change impacts in the project site may relate to a larger area should additional parts of the site be felled / cleared to accommodate synchronous condenser.	Neutral effects, per those experienced during construction of existing wind farm and the 'Continued Operation' scenario.	Potentially sufficient area adjoining the east and west of the site to avoid new felling areas thereby avoiding some of these potential effects. Effects considered **neutral** in nature.
Operation of the synchronous condenser	Ongoing impacts on material assets usage as a result of operations and maintenance activities.	Effects relating to the use of water resources and telecommunications services, will continue over a longer duration than 'Continued Operation'.	Staffing at a synchronous condenser site is generally intermittent and consists of very low levels. It would not be expected to give rise to perceptible effects.

Table 3-56: Material Assets - Alternative Land Use

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Decommissioning followed by forest plantation establishment	Increase in duration of site activities due to decommissioning works being followed by forest establishment works.	Effects relating to the use of water resources will continue over a longer duration than 'Continued Operation'. Positive effects relating to energy generation from renewable resources would stop at decommissioning of the wind farm under 'Continued Operation'.	Duration of effects has a **high likelihood of lasting longer. However, effects are expected to be generally imperceptible** and would continue to be so when compared to 'Continued Operation'
Increase in site staffing levels	Combination of decommissioning and forest plantation staff resulting in increased level of staffing on site.	Increased effects on water usage and use of telecommunications systems due to increased staffing than 'Continued Operation'.	Increased staffing is highly likely however, significance of effects would not be expected to alter when compared to 'Continued Operation'.
Land use change	Land use change impacts relating to the change from industrial wind farm to industrial forestry.	Neutral effects, per those experienced during construction of existing wind farm and the 'Continued Operation' scenario.	Land use change effects considered **neutral** in nature per original wind farm construction.
Change from wind farm to commercial forest	Impacts on energy generation from renewable sources relating to the change from industrial wind farm to industrial forestry.	Negative effects per the 'Continued Operation' scenario.	**Significant negative effects** as a result of the end of renewable energy generation at the site. Effects same as 'Continued Operation' scenario.

3.5.10.2 Overall Preference of Alternative

The Do Nothing (Early cessation and decommissioning of the Project) option would largely result in the same effects as the 'Continued Operation' option; however, these effects would occur on a different timescale. Under the early cessation and decommissioning alternative scenario the potential effects as described for decommissioning in Section 13.3.3 of the rEIAR would remain the same. However, the duration of ongoing operational impacts is adjusted, with activities ongoing till approximately 2021 only. Therefore, ongoing operational impacts would be amended as follows, with others remaining the same as that presented above:

- Short-term, imperceptible, negative effects as a result of operational impacts as a result of ongoing maintenance and operations activities.
- Short-term, significant, positive effects in relation to energy supply are experienced as a result of the Project's operation.

This alternative option does not introduce any new impacts in relation to material assets.

Alternative Land Use by redevelopment of the site as a commercial forest plantation would require the removal of many of the materials currently on site, per the decommissioning strategy, and then also require works at the site for ground preparation, fertilisation and planting. This alternative option would have potential impacts on material assets as follows:

- Continuing use of material assets e.g. water resources.
- Impacts on land use due to the changed land use at the site.
- Impacts on energy infrastructure.

Repowering of the wind farm, when considered in relation to material assets, is largely the same as the decommissioning of the existing wind farm and then undertaking construction of a new wind farm. The most significant impacts on material assets during construction, as described by Chapter 13 of this rEIAR, are associated with the change in land use. Repowering of the site would result in the removal of materials per the 'Continued Operation' decommissioning strategy, and then also require the construction of the new wind farm with potential impacts on material assets as follows,

- Continuing use of material assets e.g. water resources, telecommunications.
- Continuing generation of energy from renewable resources.

There are however advantages associated with this option over the original construction impacts; notably that there wouldn't be a need for as widespread a land use change in order to accommodate the repowering project and it would facilitate a continuing positive impact in relation to energy generation from renewable sources.

Redevelopment of the site as a solar farm would result in the removal of many of the materials currently on site, per the decommissioning strategy, and then require works to construct a solar farm, with potential impacts on material assets as follows:

- Continuing use of material assets e.g. water resources, telecommunications.
- Continuing generation of energy from renewable resources.

There are again advantages associated with this option over the original construction impacts; notably that there wouldn't be a need for as widespread land use change in order to

accommodate the repowering project and it would facilitate a continuing positive impact in relation to energy generation from renewable sources.

Redevelopment of the site for battery energy storage would result in the removal of many of the materials currently on site, per the decommissioning strategy, and then require works to construct / install battery storage, with potential impacts on material assets as follows:

- Continuing use of material assets e.g. water resources, telecommunications.
- Continuing positive impact on energy infrastructure through the opportunity to store energy generated from renewable resources.

Redevelopment of the site with a synchronous condenser would result in the removal of many of the materials currently on site, per the decommissioning strategy, and then also require works to construct / install a synchronous condenser, with potential impacts on material assets as follows:

- Continuing use of material assets e.g. water resources, telecommunications.
- Continuing positive impact on energy infrastructure through the opportunity to store energy generated from renewable resources.

In increasing scale of potential impacts on material assets the alternatives can be listed as follows:

Continued Operation less than Battery Energy Storage less than Synchronous Condenser less than Repowering less than Solar Farm less than Alternative Land Use less than Do Nothing (Early Cessation and Decommissioning of the Project).

3.5.11 Traffic and Transport

This section considers the likely impacts and effects on traffic and transport which would likely arise resulting from the alternative projects.

3.5.11.1 Analysis of Alternatives

The ‘Continued Operation’ scenario, whereby the wind farm will continue to operate until end of life circa. 2040, is considered, in terms of potential environmental impacts on roads, traffic and transport, by Chapter 14, Section 14.3.2 of the rEIAR.

The analysis of alternatives in terms of effect on traffic and transport from these developments is presented in Table 3-57 to Table 3-61.

Table 3-57: Traffic & Transport - Alternative Land Use

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Decommissioning followed by forest plantation establishment	Increase in duration of site activities due to decommissioning works being followed by forest establishment works.	Negative effects on local road users through increased use of roads, over a longer period than 'Continued Operation'.	Duration of negative effects has a high likelihood of lasting longer. However, significance of effects when compared 'Continued Operation'unlikely to alter significantly. Effects can be reduced through use of appropriate traffic management measures.
Increase in site staffing levels	Combination of decommissioning and forest establishment resulting in increased level of staffing on site.	Negative effects on local road users due to increased traffic movements than 'Continued Operation'	Increased staffing is highly likely however, significance of effects when compared to 'Continued Operation' does not alter significantly.
Importation of materials for ground preparation and fertilisation	Increased traffic movements on the public road network.	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'	Increased traffic movements for materials are highly likely however volumes are expected to be low and effects are not likely to be significant or require mitigation.
Maintenance of the forest	Ongoing traffic impacts on surrounding road users as a result of maintenance activities.	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'	Increased traffic movements for likely however volumes are expected to be low and imperceptible in effect.
Felling activities of the commercial forest	Increased traffic movements on the public road network.	Negative effects as a result of Felling activities.	Increased traffic movements for felling will be experienced and could give rise to significant effects. However, effects could be reduced through use of appropriate traffic management measures.

Table 3-58: Traffic & Transport - Repowering of the Wind Farm Site

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Decommissioning followed by repowering project construction	Increase in duration of site activities due to decommissioning works being followed by construction works.	Negative effects on local road users through increased use of roads, over a longer period than 'Continued Operation'.	Duration of negative effects has a high likelihood of lasting longer. However, significance of effects when compared 'Continued Operation' unlikely to alter significantly. Effects can be reduced through use of appropriate traffic management measures.
Increase in site area	Removal of materials from the additional site areas (e.g. felled trees) and importation of materials to additional site areas (e.g. fill materials).	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'.	Potentially sufficient area adjoining the east and west of the site to avoid new felling areas thereby avoiding some of these potential effects. Effects can be reduced through use of appropriate traffic management measures.
Increase in site staffing levels	Combination of decommissioning and repowering staff resulting in increased level of staffing on site.	Negative effects on local road users due to increased traffic movements than 'Continued Operation'	Increased staffing is highly likely however, significance of effects when compared to 'Continued Operation' does not alter significantly.
Importation of materials for additional / upgraded roads, civil works, turbines, grid connection etc.	Increased traffic movements on the public road network.	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'.	Increased traffic movements for materials are highly likely with significant impacts on local road users. Effects can be reduced through use of appropriate traffic management measures.
Importation of larger turbines to the site	Upgrading of public roads & bridges on haul routes.	Negative effects on local roads users through disruptions caused during public road works.	Likely impacts although likely only moderate short-term effects which could also be reduced through use of appropriate traffic management measures.

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Operation of the repowered wind farm	Ongoing traffic impacts on surrounding road users as a result of operations and maintenance activities.	Negative effects on local road users through increased traffic movements on roads than Do-Nothing.	Ongoing staffing will be necessary however, effects are not significant and can be managed through use of appropriate traffic management measures.
Decommissioning of the repowered wind farm	Increased traffic movements on the public road network.	Negative effects as a result of decommissioning activities. Some positive effects as a result of public road / bridge upgrades undertaken during construction phase of repowering.	Increased traffic movements for materials will be necessary in decommissioning with significant impacts on local road users. Effects can be reduced through use of appropriate traffic management measures.

Table 3-59: Traffic & Transport - Solar Farm

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Decommissioning followed by solar farm construction	Increase in duration of site activities due to decommissioning works being followed by construction works.	Negative effects on local road users through increased use of roads, over a longer period than 'Continued Operation'.	Duration of negative effects has a high likelihood of lasting longer. However, significance of effects when compared 'Continued Operation' unlikely to alter significantly. Effects can be reduced through use of appropriate traffic management measures.
Increase in site area	Removal of materials from the additional site areas (e.g. felled trees) and importation of materials to additional site areas (e.g. fill materials).	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'	Potentially sufficient area adjoining the east and west of the site to avoid new felling areas thereby avoiding some of these potential effects. Effects can be reduced through use of appropriate traffic management measures.

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Increase in site staffing levels	Combination of decommissioning and solar farm construction staff resulting in increased level of staffing on site.	Negative effects on local road users due to increased traffic movements than 'Continued Operation'	Increased staffing is highly likely however, significance of effects when compared to 'Continued Operation' does not alter significantly.
Importation of materials for additional roads, civil works, arrays, grid connection etc.	Increased traffic movements on the public road network.	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'.	Increased traffic movements for materials are highly likely with significant impacts on local road users. Effects can be reduced through use of appropriate traffic management measures.
Operation of the solar farm	Ongoing traffic impacts on surrounding road users as a result of operations and maintenance activities.	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'.	Ongoing staffing will be necessary however, staff levels for operational solar farms are extremely low and effects are not likely to be significant or require mitigation.
Decommissioning of the solar farm	Increased traffic movements on the public road network.	Negative effects as a result of decommissioning activities.	Increased traffic movements for materials will be necessary in decommissioning however volumes for removal would be expected to be low and not significant and unlikely to require mitigation.

Table 3-60: Traffic & Transport - Battery Energy Storage

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Decommissioning followed by battery storage construction / installation	Increase in duration of site activities due to decommissioning works being followed by construction / installation works.	Negative effects on local road users through increased use of roads, over a longer period than 'Continued Operation'.	Duration of negative effects has a high likelihood of lasting longer. However, significance of effects when compared 'Continued Operation' unlikely to alter significantly. Conversion of the site to battery storage would require only minor works and not of significant duration.

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
			Effects can be reduced through use of appropriate traffic management measures.
Increase in site staffing levels	Combination of decommissioning and battery construction staff resulting in increased level of staffing on site.	Negative effects on local road users due to increased traffic movements than 'Continued Operation'	Increased staffing is highly likely however, only at very low levels so significance of effects would not be expected to alter when compared to 'Continued Operation'.
Importation of materials / units.	Increased traffic movements on the public road network.	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'.	Increased traffic movements for materials are highly likely however imports are not expected to result in significant impacts on local road users. Effects can be reduced through use of appropriate traffic management measures.
Operation of the battery site	Ongoing traffic impacts on surrounding road users as a result of operations and maintenance activities.	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'.	Staffing at battery sites is generally intermittent and consists of very low levels. It would not be expected to give rise to perceptible effects.
Decommissioning of the battery site	Increased traffic movements on the public road network.	Negative effects as a result of decommissioning activities.	Increased traffic movements for materials will be necessary in decommissioning however volumes for removal would be expected to be low and not significant and unlikely to require mitigation.

Table 3-61: Traffic & Transport - Synchronous Condensers

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
Decommissioning followed by synchronous condenser construction / installation	Increase in duration of site activities due to decommissioning works being followed by construction / installation works.	Negative effects on local road users through increased use of roads, over a longer period than 'Continued Operation'.	Duration of negative effects has a high likelihood of lasting longer. However, significance of effects when compared 'Continued Operation' unlikely to alter significantly. Conversion of the site to synchronous condenser site would not

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
			require significant works nor would it be of significant duration. Effects can be reduced through use of appropriate traffic management measures.
Increase in site staffing levels	Combination of decommissioning and synchronous condenser staff resulting in increased level of staffing on site.	Negative effects on local road users due to increased traffic movements than 'Continued Operation'	Increased staffing is highly likely however, only at very low levels so significance of effects would not be expected to alter when compared to 'Continued Operation'
Additional land take	Increased traffic movements on the public road network for removal of cleared materials / fill import (if required).	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'.	Increased traffic movements for material removal (e.g. felled trees) is likely however it is not expected to result in significant impacts on local road users. Effects can be reduced through use of appropriate traffic management measures.
Importation of materials / units.	Increased traffic movements on the public road network.	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'	Increased traffic movements for materials are highly likely however imports are not expected to result in significant impacts on local road users. Effects can be reduced through use of appropriate traffic management measures.
Operation of the synchronous condenser site	Ongoing traffic impacts on surrounding road users as a result of operations and maintenance activities.	Negative effects on local road users through increased traffic movements on roads than 'Continued Operation'.	Staffing at a synchronous condenser site is generally intermittent and consists of very low levels. It would not be expected to give rise to perceptible effects.
Decommissioning of the synchronous condenser site	Increased traffic movements on the public road network.	Negative effects as a result of decommissioning activities.	Increased traffic movements for materials will be necessary in decommissioning however volumes for removal would be expected to be low

Activity	Potential Impacts	Potential Effects	Likelihood & Significance
			and not significant and unlikely to require mitigation.

3.5.11.2 Overall Preference of Alternative

Early cessation and decommissioning of the Project would largely result in the same effects as the 'Continued Operation' option; however, these effects would occur on a different timescale. As noted within Chapter 14, Section 14.3.2 of this rEIAR the ongoing operational and ultimate decommissioning effects can be summarised as follows:

- Short-term, negative, slight effects as a result of operational material movements to / from the site (including felled trees) as a result of ongoing maintenance and operations activities.

- Temporary, negative and moderate effects on local road users as a result of decommissioning activities.

- Beyond the local network, effects which are likely to occur on the national network are expected to be temporary, imperceptible, negative as a result of decommissioning activities.

- During both operations and decommissioning slight, long-term, positive effects will be experienced by road users as a result of the infrastructure improvements made to roads and bridges during the construction phase.

Under the early cessation and decommissioning alternative scenario the above potential effects, in relation to roads, traffic and transport, remain. However, the duration of ongoing operational impacts is adjusted, with activities ongoing till approximately 2021 only. Therefore, ongoing operational impacts would be amended as follows, with others remaining the same as that presented above:

- Temporary, negative, slight effects as a result of operational material movements to / from the site (including felled trees) as a result of ongoing maintenance and operations activities.

This alternative option does not introduce any new impacts in relation to roads, traffic and transport.

Repowering of the wind farm, when considered in relation to roads, traffic and transport, would be largely the same as the decommissioning of the existing wind farm and then undertaking construction of a new wind farm.

The most significant impacts on roads, traffic and transport, as described by Chapter 14 of this rEIAR, are those associated with the movement of materials to and from the site. Repowering of the site would result in the removal of many of the materials currently on site, per the decommissioning strategy, and then also require the import of additional materials to site and works to the road network as follows:

- Materials for widening and strengthening of on-site roads, general civil works.

- Materials for turbine foundations and hardstands where existing infrastructure is not suitable for reuse.

- Materials for grid connection works, where upgrades are required.

- Importation of new turbines components.

- Potential for additional public road works to facilitate delivery of abnormal loads to the site.

There are however advantages associated with this option over the original construction impacts; notably that there wouldn't be a need for as widespread tree felling and removal from site as there was during the initial wind farm's construction and that many of the site roads would likely be retained, albeit they might have to be strengthened and widened.

Redevelopment of the site as a solar farm would result in the removal of many of the materials currently on site, per the decommissioning strategy, and then also require the import of additional materials to site and works to the internal site road network as follows:

- Materials for adjusting existing access roads, constructing new solar array access roads, general civil works.
- Materials for solar array construction; mainly comprising footings for array panels.
- Materials for grid connection works, where upgrades / alterations are required.
- Importation of solar array components.

Redevelopment of the site for battery energy storage would result in the removal of many of the materials currently on site, per the decommissioning strategy, and then also require the import of additional materials to site and works as follows:

- Materials for concrete plinth construction, general civil works.
- Battery container imports.

Redevelopment of the site with a synchronous condenser would result in the removal of many of the materials currently on site, per the decommissioning strategy, and then also require the import of additional materials to site and works as follows:

- Materials for concrete plinth construction, general civil works including building construction.
- Synchronous condenser component imports.

Redevelopment of the site as a commercial forest plantation would require the removal of many of the materials currently on site, per the decommissioning strategy, and then also require the import of additional materials to site for ground preparation, fertilisation and planting.

- Materials for ground preparation and fertilisation.
- Importation of planting materials.

In increasing scale of potential impacts on the roads, traffic and transport environment, the alternatives can be listed as follows:

'Continued Operation' less than 'Do-Nothing (Early Cessation and Decommissioning of the Project)' less than 'Battery Energy Storage' less than 'Synchronous Condenser' less than 'Solar Farm' less than 'Alternative Land Use' less than 'Repowering'.

3.5.12 Cultural Heritage

This section considers the likely impacts and effects on Cultural Heritage which would likely arise resulting from the alternative projects.

3.5.12.1 Analysis of Alternatives

The cultural heritage baseline information described in Chapter 15, Section 15.2.7 did not identify any extant archaeological sites or architectural heritage structures located within the wind farm site and nothing of archaeological significance was identified in any area of the site during construction. There are no recorded archaeological sites within 400m of the wind farm boundary and there are no National Monuments or archaeological sites subject to Preservation Orders located within the 3km study area. There are also no monuments with potential visual alignment attributes, such as megalithic tombs or stone circles, located within the 3km study area. No structures of architectural heritage significance were identified within the wind farm site and none of the structures located within 2km of its boundary are listed as Protected Structures or are included in the NIAH. No potential architectural heritage structures (whether designated or not) were identified during the pre-development assessments of the wind farm. No potential negative impacts on architectural heritage, folklore or traditions were predicted during the pre-development cultural heritage assessment of the wind farm.

The 'Continued Operation' alternative is described, and the continued operation to circa 2040, is assessed in Section 15.3.3.2 and based on the existing baseline the future operation of the wind farm is predicted to result in no likely effects on the archaeological, architectural heritage and cultural heritage resources.

There is no potential for cultural heritage impacts and effects on the existing baseline to occur from any of the alternatives proposed. However, there is always potential for impacts to occur to undiscovered cultural heritage on the site based on the construction excavation or piling requirements of the various alternatives. The degree of potential impact would be directly related to the degree of ground disturbance form the various alternatives. The 'Continued Operation' alternative would rank lowest in terms of potential impact as it is already constructed. Alternative land use on the site would also rank low but there would be some potential for ground disturbance and BESS would reuse the existing hardstand areas with minor ancillary construction works. Repowering, solar and a synchronous condenser would require new foundation areas with potential to impact on undiscovered cultural heritage and therefore would have the highest potential for impact on undiscovered archaeology.

Co-location of alternatives would be additive in their potential effects.

3.5.12.2 Overall Preference of Alternative

Based on the above, a notional ranking of alternatives from the cultural heritage on increasing scale of potential impacts can be listed as follows:

'Continued Operation' less than 'Do Nothing (Early Cessation and Decommissioning)' less than 'Alternate Land use' or 'BESS' less than 'Synchronous Condenser' less than 'Repowering' less than 'Solar' less than 'Repowering with BESS or with a Synchronous Condenser' less than 'Solar with BESS or Synchronous Condenser'

3.6 Conclusion and Overall Alternative Preference

This section provides an overall assessment in tabular form with the preferred alternative indicated based on the likely impacts on each factor and on the ability of the alternative to

meet the project objectives. The ranking of assessments in terms of their likely impacts on the key factors of the rEIAR is presented in Table 3-62.

Ranking has been indicated on a numerical scale (1-10) with the lowest likely impact rated 1 and the highest rated 10.

The assessment of alternatives has clearly indicated the 'Continued Operation' Option as the most preferable alternative overall with the exception of the factors related to shadow flicker, air and climate. In reality shadow flicker (Chapter 6) has been assessed as imperceptible for the 'Continued Operation' Alternative in the rEIAR but this factor is ranked higher as it is compared to alternatives where no shadow flicker would be possible. With respect to air and climate the assessment in Chapter 12 of the rEIAR did not identify any significant negative impacts but did identify the positive effects on air quality and climate related to the displacement of fossil fuel electricity generation with associated transboundary pollutant and greenhouse gas emissions. The displacement impact and hence effect on climate and air quality is directly related to the level of renewable generation produced by each alternative with repowering and co-location with repowering likely to generate higher levels than the 'Continued Operation' alternative and thereby scoring higher. Land use change in terms of replanting forests would also contribute positively to climate impacts but would not meet the project objectives of producing renewable electricity.

In conclusion, the 'Continued Operation' alternative, that is the continued operation of the Project to circa 2040, based on the current high level analysis is the preferred option for this site.

Table 3-62: Summary of Alternatives considered and ranking by factor

	Alternatives Considered							Co-location alternatives considered		
Key rEIAR Factor	**'Continued Operation'**	**Do Nothing (Early Cessation & Decommissioning)**	**Alternative Land Use**	**Repowering**	**Solar**	**BESS**	**Synchronous Condenser (SC)**	**'Continued Operation' with BESS or SC**	**Repowering with Bess or SC**	**Solar with BESS or SC**
Population & Human Health	1	10	9	4	6	7	8	2	3	5
Noise	1	2	3	8	6	5	7	4	10	9
Shadow Flicker	3	1	1	4	2	2	2	3	3	3
Biodiversity (Terrestrial)	1	2	7	5	6	3	4	3	7	6
Aquatic Ecology	1	2	6	7	8	4	5	3	9	10
Landscape & Visual	1	2	3	7	6	5	4	4	7	6
Land, Soils and Geology	1	2	3	6	7	4	5	4	7	7
Hydrology and Hydrogeology	1	2	2	6	7	4	5	3	8	8
Air & Climate	4	10	9	2	6	7	8	3	1	5
Material Assets	1	7	6	4	5	2	3	2	4	5
Traffic & Transport	1	2	6	7	5	3	4	3	7	5
Cultural Heritage	1	2	3	5	6	3	4	4	7	8

3.7 References

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