

10.0 Hydrology, Hydrogeology and Geology

Introduction

- 10.1 This chapter provides a comparative assessment of the likely hydrological, hydrogeological and geological effects of the proposed development compared with those previously assessed for the consented development.
- 10.2 A hydrology, hydrogeology and geology assessment was undertaken for the Original 21 Turbine Design (Original Chapter 10). Additional baseline information relevant to this EIA topic was provided in the **FEI Addendum** submission (September 2015) when the wind farm layout was reduced to 19 turbines. This information took the form of **Original Appendix 1 - Revised Borrow Pit Assessment (Grontmij); Original Appendix 2 - Peat Depth Survey Report (Fluid Environmental Consulting); and Original Appendix 3 - Revised Peat Management Plan (PMP) (Fluid Environmental Consulting)**. The hydrology, hydrogeology and geology assessment was not updated in September 2015 as it was considered there were no significant changes to the potential effects from the reduced 19 turbine scheme, which was consented in December 2018. This chapter therefore evaluates the changes from the consented development (19 turbine scheme) to the proposed development (19 turbine scheme).
- 10.3 For consistency this chapter has used the same methodology as **Original Chapter 10** of the ES, for the prediction and evaluation of impacts.
- 10.4 The main changes to guidance/legislation/policy since the previous submission are:
- Good Practice During Wind Farm Construction (Scottish Renewables, SNH, SEPA & Forestry Commission Scotland, 4th Edition 2019);
 - Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey. Guidance on Developments on Peatland;
 - Scottish Executive (2017) Peat Landslide Hazard and Risk Assessments. Best Practice Guide for Proposed Electricity Generation Developments. Second Edition;
 - Scotland's National Peatland Plan Working for our future. Scottish Natural Heritage 2015; and
 - the replacement of a number of Pollution Prevention Guidance Notes (PPG) to Guidance for Pollution Prevention (GPPs) documents. These include:
 - GPP2: Above ground oil storage tanks (EA, SEPA & EHSNI, January 2018);
 - GPP5: Works and maintenance in or near water (EA, SEPA & EHSNI, January 2017);
 - GPP8: Safe storage and disposal of used oils (EA, SEPA & EHSNI, July 2017);
 - GPP13: Vehicle washing and cleaning (EA, SEPA & EHSNI, April 2017);
 - GPP21: Pollution incidence response planning (EA, SEPA & EHSNI, July 2017); and
 - GPP22: Dealing with spills (EA, SEPA & EHSNI, October 2017).

10.5 This chapter is supported by the following appendices and figures:

- **Variation Appendix 10.1 Peat Survey Report:** updated in 2019 to include additional survey data including figures of peat occurrence across the site and the infrastructure;
- **Variation Appendix 10.2 Outline Peat Management Plan:** updated in 2019 to include additional survey data and updated calculations of peat excavation and peat reuse including a figure presenting peat reuse on the site;
- **Variation Appendix 10.3 Watercourse Crossing Inventory:** Data sheets with associated photos of the two new watercourse crossings; and
- **Figure 10.1 Hydrological Features and Figure 10.2 Groundwater Terrestrial Dependent Ecosystems (GWDTE):** to present the proposed scheme infrastructure with respect to watercourse buffers, GWDTE and watercourse crossings.

Consented Development Effects

10.6 **Original Chapter 10**, prior to mitigation, identified likely significant effects during the construction period as follows:

- A major potential impact due to tree felling causing *'a temporary decline in downstream water quality due to turbid and nutrient rich runoff due to increase in soil erosion, spillages and leakages of oil, fuel and other potentially polluting substances and the removal of riparian vegetation.'*
- A major potential impact due to the construction of site infrastructure resulting in *'generation of turbid runoff which could cause a temporary decrease in water quality in down-gradient watercourses, water bodies and associated receptors.'*
- A moderate potential impact due to vehicular and plant movement onsite, storage and use of oils and chemicals, and maintenance of plant resulting in *'spillages or leakage of fuels, oils or other potentially polluting substances which could migrate to groundwater and/ or surface watercourses affecting water quality.'*
- A moderate potential impact due to concrete construction of foundations and other hardstanding resulting in *'spillages of concrete during turbine foundation construction which could migrate to groundwater and/ or surface watercourses affecting water quality.'*

10.7 Various mitigation measures for the construction period are presented in **Original Chapter 10** that enabled the resulting assessment to determine the residual impacts to be minor.

10.8 No likely significant effects were identified during the operation period.

10.9 Prior to mitigation, likely significant effects were identified during the decommissioning period as follows:

- A major potential impact due to the removal of site infrastructure resulting in *'a temporary decrease in water quality from the generation of turbid runoff migrating to down gradient surface watercourses and associated receptors.'*

- A moderate potential impact due to vehicular and plant movement onsite, storage and use of oils and chemicals, and maintenance of plant resulting in ‘a temporary decrease in water quality from spills or leakage of fuels, oils or other potentially polluting substances.’

10.10 After mitigation the residual impacts were assessed to be minor.

10.11 The conclusions reached in **Original Chapter 10** applied equally to the consented development as it involved relatively minor alterations to the proposed development that did not change the overall hydrological assessment. These alterations comprised of:

- a realignment of the track near Turbine 15 which added a watercourse crossing of a minor tributary as shown in **Variation Appendix 10.3 (Watercourse Crossing Two)**, increasing number of crossing to seven. There are no GWDTE in this area;
- relocation of the substation to the opposite (east) side of the track leading to Turbine 8, but no closer to a watercourse or GWDTE;
- removal of Turbines 1 and 2, neither of which were close to watercourses or GWDTE; and
- increase in the size of borrow pits and the addition of a fifth borrow pit, all of which have remained at least 100 m from watercourses and are not in the vicinity of any GWDTE.

Baseline

10.12 Additional peat depth data and watercourse data have been collected for the proposed development to comply with the latest guidance. All other baseline information remains the same.

10.13 The additional peat survey data is included in **Variation Appendix 10.1: Peat Survey Report May 2019** and presents figures using all the peat data collected across all surveys in the form of point data and an interpolated peat depth contour plot. This data is used to demonstrate avoidance of peat and for the calculation of peat excavation volumes.

10.14 The watercourse crossing data sheets are presented in **Variation Appendix 10.3: Watercourse Crossings**.

Proposed Development Effects

10.15 The assessment for the proposed development has further considered the sensitive hydrological, hydrogeological and geological receptors as in the **Original Chapter 10**, and in particular the need to avoid the construction of infrastructure:

- in or near watercourses and waterbodies;
- on or near GWDTE; and
- within areas of deep peat.

10.16 The changes to the consented layout, as described in **Variation Chapter 4: Project Description**, have resulted in the following:

- A reduction in the area of the overall infrastructure footprint, mainly as a result of a reduction in the area of crane hardstandings;

- minimisation of the number of watercourse crossings and avoidance of buffers around watercourses so that the only sections of new infrastructure that enter the buffer zones are the two locations where the access track to the southern turbines cross minor tributaries of the Water of Deugh, one of which is in a slightly different location (~50 m further downstream) than the consented crossing location;
- significant reduction in the peat volume required to be excavated that directly underlies the infrastructure footprint. However, overall the excavated volume is similar to the previous layout as the excavation calculations now include slope batters, excavations widths greater than track widths and excavations of drains; and
- a change in the proximity of the infrastructure to the 15 M6 mire GWDTE considered to be groundwater dependent.

10.17 These adjustments require an assessment of whether a change in the likely significant effect has occurred.

Footprint Reduction

10.18 The reduction of the overall footprint will reduce potential impacts on watercourses from sediment release. This was previously assessed as: A major potential impact due to the construction of site infrastructure resulting in 'generation of turbid runoff which could cause a temporary decrease in water quality in down-gradient watercourses, water bodies and associated receptors.' It is considered that the change is minor and no adjustment of the assessment is required, and no additional mitigation measures are required to address the layout changes.

Watercourse Crossings

10.19 The proposed development includes a single additional crossing as a result of the realignment of access track, as shown in **Variation Appendix 10.3 (Watercourse Crossing One)**. This new crossing is considered to be minor therefore no significant impacts on flooding or flow alteration are anticipated.

Peat Excavation and Reuse

10.20 The volume of peat that is required to be excavated and the assumptions associated with those calculations are presented in **Variation Appendix 10.2: Outline Peat Management Plan**. The peat reuse strategy is in accordance with previous discussions with SEPA for the consented scheme and allows a peat balance to be achieved so that all excavated peat is used to create new habitat or tie in with existing habitat. It should be recognised that the peat to be excavated at Pencloe is degraded due to the mature commercial forestry plantations and the program of felling and peat restoration along with the development of peat wetlands in the borrow pits provides potential for limited improvements to the condition of peat on the site.

10.21 Over the life time of the wind farm it is expected that there will be a potential for more peat to be reused on the site than the volume excavated. This is as a result of 7.13 ha of mainly forested poor quality peatland habitat being directly lost to tracks, turbines and other infrastructure generating a total amount of excavated peat of about 65,300 m³ and there is a capacity for the reuse of about 67,700 m³ of peat onsite. Peat reuse is undertaken on excavated slopes to place peat turves to tie in with existing peat habitat, to restore the southern construction compound at the end of the construction period, and to reprofile the five borrow pits to produce engineered wetland areas.

10.22 The potential effect of the project on the peat is considered to be minor as the peat at Pencloe is shallow, discontinuous and of poor quality due to the forestry land use, and the peat can all be reused on site to create better quality peat habitats.

GWDTE

10.23 A GWDTE assessment was undertaken and included as part of the Original ES (**Original Appendix 10.2 Groundwater Dependent Terrestrial Ecosystem**). The assessment determined that only M6 mire and M23a rush-pasture were found to be possible GWDTE. The assessment determined that 'M6 mire is a flush and spring habitat occurring largely as thin linear polygons covering an area of 5.8 ha, typically within very much larger areas of blanket mire (M19a) and acid grassland (U5b and U6) but also as mosaics with M15b wet heath, M23a marshy grassland and U4a acid grassland. It is only regarded as moderately groundwater dependent and then only in several locations. Generally, it is associated with artificial drainage of natural blanket bog and input from the watercourses but in several cases, it is likely to depend upon groundwater seepage, albeit of very limited flow paths.'

10.24 The Original ES assessment considered that 1.9% of M6 will be permanently lost due to construction of tracks that cross mosaics near Turbine 10, Turbine 15 and at the hill top near Saddle Hags. The proposed relocation of Turbine 15 for the proposed scheme has reduced the level of this impact.

10.25 The Original ES assessment determined that only one area of M23a rush pasture was potentially groundwater dependent and this was not considered to be at risk. The closest infrastructure, borrow pits 1 and 2, is no closer than during the previous assessment and therefore no update is considered necessary.

10.26 The Original ES assessment identified 13 areas of M6 mire within the site boundary, locations 3 to 15 on Original Figure 10.2. Of these seven were considered to be at risk from the development, locations 4, 5, 7, 8, 9, 12 and 14.

10.27 The adjusted layout results in a reassessment of the risk to the 13 M6 mire locations as:

- the access track is now located down gradient of the M6 mire at locations 4 and 5 so they are no longer considered at risk;
- the small flush at location 6 is now considered at risk;
- the M6 mire at locations 7, 8, 9, 12 remain at risk as there are only minor changes to the layout in this area;

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- the M6 mire at locations 10, 11, 13 and 15 remain not at risk, again due to only minor changes to the layout; and
 - the M6 mire at location 14 remains at risk although the infrastructure has been relocated further away from these habitats.

10.28 There is little change in the potential impact on the GWDTE that are considered groundwater dependent, M6 mire, with two locations removed from the at risk list and one location added.

10.29 The overall effect has therefore not changed significantly from the consented layout and the relevant mitigation measures as presented in the Original ES are required to be implemented.

Conclusions

10.30 The proposed layout has been assessed for any change in the potential effects on the identified sensitive receptors when compared to the effects considered in the consented layout assessment. The alterations to the layout generally improve the avoidance of peat, continue to minimise the number of watercourse crossings and their associated buffers and avoid groundwater dependent terrestrial ecosystems as far as possible.

10.31 The main likely potential impacts determined from the Original ES assessment relate to sediment release, fuel/oil/chemical spills or concrete release. The level of these potential impacts and the mitigation requirements have not changed with the proposed development