CHAPTER A9: HYDROLOGY, HYDROGEOLOGY AND GEOLOGY

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Figure 9.1: Local Hydrology

List of Appendices from EIA Report (January 2019) for Reference

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A.9. HYDROLOGY, HYDROGEOLOGY AND GEOLOGY

A.9.1 Executive Summary

A.9.1.1 The Site and the local geology, hydrology and hydrology (the water environment) has been subject to much previous investigation and assessment and therefore is very well understood and characterised. Potential development constraints, such as areas of deep peat, areas of potential peat instability, GWDTE and watercourses were identified as part of the evolving development proposals and were avoided.

A.9.1.2 It has been shown that subject to the adherence to industry standard best practice and mitigation the Proposed Varied Development (Addendum) would not have any significant effects on peat, geology, hydrology or hydrogeology, including GWDTE and private and licensed water supplies.

A.9.2 Introduction

A.9.2.1 The potential effects associated with the construction, operation and decommissioning of the Consented Development on hydrology, hydrogeology and geology were assessed within the 2015 ES and 2016 FEI Report. These effects were reassessed in relation to the Proposed Varied Development as part of the Section 36C Application, as reported within the EIA Report (January 2019).

A.9.2.2 These previous assessments considered potential effects on hydrogeology (groundwater), hydrology (surface water), Groundwater Dependent Terrestrial Ecosystems (GWDTEs), Private Water Supplies (PWS) and peat.

A.9.2.3 SEPA's consultation response to the Proposed Varied Development EIAR (2019) was received by letter dated 11th March 2019. Subsequent to this SSE has corresponded with the Case Officer at SEPA, with regard to CAR licensing requirements to be addressed within a Pollution Prevention Plan (PPP) / Construction Environmental Management Plan (CEMP) and Water Quality Monitoring Plan (WQMP). SSE has submitted draft versions of these documents to SEPA (email SSE to David Wilby 7th May 2019) and SEPA have confirmed that the outline information provided would be sufficient to grant a Construction Site License (CSL) (email David Wilby to SSE 9th May 2019). These documents will be updated and submitted at a later date to support the CSL application and to satisfy planning conditions.

A.9.2.4 This Chapter refers to the previous assessments and with reference to the Proposed Varied Development (Addendum) identifies whether there are any likely significant effects that differ from the previous assessment findings, namely those documented within the EIA Report (January 2019) for the Proposed Varied Development.

A.9.2.5 In the sections that follow, if the Proposed Varied Development (Addendum) does not alter the content or findings of Chapter 9 of the EIA Report (January 2019) for the Proposed Varied Development this is stated, and where additional information is required, to reflect the changes to the proposed development, this is provided.

A.9.2.6 This Chapter is also accompanied by Appendix A9.1: Borrow Pit Report, which provides updated information on the borrow pit areas, extraction volumes and anticipated restoration.

A.9.2.7 The 2015 ES was supported by a Peat Landslide Hazard Risk Assessment (Appendix 9.1 of the 2015 ES), a Groundwater Dependent Terrestrial Ecosystems Risk Assessment (Appendix 9.2 of the 2015 ES) and a Peat Management Plan (Appendix 9.3 of the 2015 ES). Prior to completing this assessment, a site walkover survey was completed (30 May 2019) and ground conditions reviewed, including signs of recent peat instability, for any change since the 2015 assessment was completed. No significant change was recorded, and it is confirmed these documents

remain valid and findings unchanged and therefore they have not been updated for this Addendum.

A.9.2.8 The previous assessments were prepared by SLR Consulting and ASH. This Chapter has also been prepared by SLR Consulting and ASH.

A.9.3 Consented Development

Summary of Effects

A.9.3.1 Unchanged, please refer to Section 9.2 of the EIA Report (January 2019).

A.9.3.2 The 2015 ES and 2016 FEI Report considered potential effects on sensitive receptors including geology and soils, groundwater dependent terrestrial ecosystems, groundwater quality, surface water flows, flood risk and surface water quality. With the adoption of proposed mitigation measures (as retained within Appendix 4.2: Schedule of Mitigation of the EIA Report (January 2019) for the Proposed Varied Development Application), the assessment concluded that the Consented Development would not give rise to any significant effects to hydrological, hydrogeological or geological receptors. It has been shown in this Chapter that this remains the case.

Consultation Responses

A.9.3.3 Unchanged, please refer to Section 9.2 of the EIA Report (January 2019).

Relevant Mitigation Measures and Conditions of Consent

A.9.3.4 Unchanged, please refer to Section 9.2 of the EIA Report (January 2019).

A.9.4 Scope of Assessment

A.9.4.1 Unchanged, please refer to Section 9.3 of the EIA Report (January 2019).

A.9.5 Legislation, Policy & Guidance

A.9.5.1 Unchanged, please refer to Section 9.4 of the EIA Report (January 2019).

A.9.6 Methodology

A.9.6.1 Unchanged, please refer to Section 9.5 of the EIA Report (January 2019).

A.9.7 Baseline

A.9.7.1 Unchanged, please refer to Section 9.6 of the EIA Report (January 2019).

Geology and Soils

Soils

A.9.7.2 Unchanged, please refer to Paragraph 9.6.2 of the EIA Report (January 2019).

A.9.7.3 The elements of the Proposed Varied Development (Addendum) are located on the same soils as reported in 2015, 2016 and 2019.

Superficial Geology

A.9.7.4 Unchanged, please refer to Paragraphs 9.6.3 and 9.6.4 of the EIA Report (January 2019).

A.9.7.5 Reference to British Geological Survey (BGS) 1:50,000 superficial geology map (Figure 9.2: Drift Geology of 2015 ES) demonstrates that the proposed changes introduced by the Proposed

Varied Development (Addendum), namely the relocation of T4 to T4b, the proposed access track south of T12, revised batching plant location and the proposed revised borrow pit search area (3) are underlain by Glacial Till or bedrock at or near the ground surface.

A.9.7.6 A comprehensive programme of peat depth probing has previously been completed at Site which included a Phase I and Phase II peat survey (see Appendix 9.1 of the 2015 ES). The peat depth survey confirms that the peat depth at the proposed revised location for T4b is shallow (<1m) as is the depth of peat beneath the proposed access track south of T12 and at the proposed batching plant.

A.9.7.7 To support this application peat depth probing has also been completed at the proposed borrow pit search area on 30th May 2019. No peat depths greater than 0.5m were recorded within or adjacent to the search area (see Appendix A9.1: Borrow Pit Report). No additional peat probing was required for the proposed access track south of T12 as this had been completed previously (see Appendix 9.1: Peat Landslide Risk Assessment of the 2015 ES) nor was any peat probing completed for the proposed access track to the borrow pit search area as there is an existing track which is suitable for the intended use without upgrade.

A.9.7.8 It is confirmed that no development is proposed in areas assessed of medium or high ground instability (see Appendix 9.1 of the 2015 ES).

Solid Geology

A.9.7.9 No change. The solid geology site beneath all of the proposed infrastructure, including the proposed borrow pit search area, comprises psammite and micaceous psammite of the Kildonan Psammite Formation.

A.9.7.10 Appendix A9.1: Borrow Pit Assessment is referred to for further details of the site geology and potential material quantities at the proposed borrow pit locations. It has been confirmed using volumetric modelling that the proposed borrow pits contain sufficient stone to facilitate construction of the proposed site infrastructure.

Hydrogeology

Aquifer Characteristics and Groundwater Vulnerability

A.9.7.11 Unchanged, please refer to Paragraph 9.6.7 and 9.6.8 of the EIA Report (January 2019).

Groundwater Levels and Flows

A.9.7.12 Unchanged, please refer to Paragraph 9.6.9 to 9.6.13 of the EIA Report (January 2019).

Groundwater Quality

A.9.7.13 Unchanged, please refer to Paragraph 9.6.14 to 9.6.16 of the EIA Report (January 2019).

Hydrology and Flood Risk

Local Hydrology

A.9.7.14 Unchanged, please refer to Paragraph 9.6.17 to 9.6.24 of the EIA Report (January 2019).

A.9.7.15 The site and surrounding area can be split into two catchment areas based on the surface topography and drainage patterns. These are the Allt a' Mhuilinn catchment, draining the west of the site and the Allt Smeorail catchment, draining the east of the site. Both catchments are tributaries of the River Brora.

A.9.7.16 Each catchment area is shown in Figure A9.1: Local Hydrology.

A.9.7.17 With reference to the Proposed Varied Development (Addendum):

- T4b remains within the catchment of the Allt Smeorail.
- The proposed track between the LiDAR and T12 is also located within the catchment of the Allt Smeorail.

A.9.7.18 It is proposed to move the batching plant; the new location is within the catchment of the Allt a' Mhuilinn, and not the catchment of the Allt Smeorail as proposed in earlier assessments.

A.9.7.19 The new borrow pit search area is located within the catchment of the Allt a' Mhuilinn. There is also an existing access track to the borrow pit search area which is located entirely within the surface water catchment of the Allt a' Mhuilinn.

A.9.7.20 The existing ford crossing of the Allt a' Mhuilinn is not suitable for access to and from the proposed borrow pit. A temporary bailey bridge style crossing will be installed to allow access to the borrow pit search area and to allow stone to be removed to form the required site access tracks. Photographs A9.1 and A9.2 show the Allt a' Mhuilinn and the existing access track crossing of the watercourse.

Photograph A9.1: Existing Crossing of the Allt a' Mhuilinn

Photograph A9.2: Existing Crossing of the Allt a' Mhuilinn (Looking Downstream)

A.9.7.21 With the exception of this crossing, none of the Proposed Varied Development (Addendum) is located within 50m of a watercourse.

A.9.7.22 The design and construction details of the proposed temporary crossing of the Allt a' Mhuilinn would be agreed with SEPA prior to construction and necessary authorisation, in accordance with the Controlled Activity Regulations, would be obtained.

Discharge Consents

A.9.7.23 Unchanged, please refer to Paragraph 9.6.25 to 9.6.27 of the EIA Report (January 2019).

Flood Risk

A.9.7.24 Unchanged, please refer to Paragraph 9.6.28 of the EIA Report (January 2019).

Water Resources

A.9.7.25 No licensed water abstractions are at risk from the Proposed Varied Development (Addendum). There is one private water supply located within the surface water catchments served by the development; a surface water abstraction at Moulin Cottage which uses surface water from the Allt a' Mhuilinn.

A.9.7.26 As noted in Paragraph 9.6.31 – 9.6.32 and Table 9.3 of the EIA Report (January 2019)) a new supply to this property was installed by the Applicant during construction of the existing neighbouring Gordonbush Wind Farm[1] to prevent any impacts associated with the adjacent access track. The proposed borrow pit search area (3), access track to the borrow pit search area and proposed batching plant are located in the surface water catchment that serves the Moulin Cottage (see P6, Figure A9.1: Local Hydrology).

Designated Sites

A.9.7.27 Unchanged, please refer to Paragraph 9.6.33 of the EIA Report (January 2019).

Groundwater Dependent Terrestrial Ecosystems

A.9.7.28 A detailed assessment of GWDTE at the site is provided in Appendix 9.2 of the 2015 ES. In summary, the majority of the potential GWDTE habitat at the site is sustained by surface rainfall-runoff rather than groundwater and as such the standoff buffers recommended in SEPA guidance to GWDTE do not apply. The exceptions to this are the areas of highly GWDTE located along watercourse corridors, and an area of highly GWDTE located in the west of the site, both of which may be sustained at least in part by groundwater flow. SEPA agreed with the GWDTE assessment contained within the 2015 ES, and to the mitigation measures proposed to safeguard habitats.

A.9.7.29 With regard to the Proposed Varied Development (Addendum) it is confirmed that:

- proposed turbine T4b is not located on habitat identified as potentially high or moderate GWDTE, subject to best practice construction techniques and maintenance of existing surface water flow paths construction of turbine T4b would not impair GWDTE;
- similarly, the proposed track south of T12 is not located on habitat identified as sustained by groundwater and subject to best practice construction techniques and maintenance of existing surface water flow paths no effect on GWDTE would occur;
- as the proposed batching plant is located on higher ground, adjacent to the existing access track, it is unlikely that the habitat at this location is sustained by groundwater,

[1] The supply comprises a lagoon formed by a weir. An alkathene pipe with filter has been fitted to connect the supply to a new 2,700 litre storage tank, which in turn connects via a new pipe to the property. A new paper and UV filter has been fitted within the property.

and again, subject to best practice construction techniques and maintenance of existing surface water flow paths no effect on GWDTE is anticipated;

- the proposed borrow pit search area is located in an area that has previously been used for commercial forestry (and has recently been felled) and was also used as a borrow pit during construction of the existing wind farm thus is not considered to support GWDTE; and
- the access track to the borrow pit search area is existing and does not require upgrade, therefore no impact on GWDTE would occur.

A.9.8 Potential Effects

A.9.8.1 Unchanged, please refer to Section 9.7 of the EIA Report (January 2019).

A.9.9 Mitigation Measures

A.9.9.1 Unchanged, please refer to Section 9.8 of the EIA Report (January 2019).

A.9.9.2 Mitigation measures were put forward in the 2015 ES, all of which are retained for the Proposed Varied Development (Addendum). These are summarised in Appendix 4.2: Schedule of Mitigation of the EIA Report (January 2019) and are secured through the Conditions of Consent, most notably the CEMP.

A.9.9.3 Of relevance to this application, mitigation measures have already been proposed to safeguard the water quality and flows in the Allt a' Mhuilinn and to the private water supply at Moulin Cottage, and include measures to manage peat stability, pollution risk, maintain surface and groundwater flows and minimise erosion and sedimentation.

Additional Mitigation Measures Relevant to Proposed Varied Development (Addendum)

A.9.9.4 There are no other additional mitigation measures proposed as a result of the Proposed Varied Development (Addendum). All mitigation will be contained within a PPP, CEMP and WQMP which will be submitted to satisfy CAR Construction Site License conditions as well as planning consent conditions specific to the Proposed Varied Development (Addendum) prior to commencement of construction.

A.9.10 Residual Effects

Geology and Soils

Loss of Rock and Soils

A.9.10.1 The geological deposits at the site do not have any particular geological rarity value and do not display any significant features which cannot be observed elsewhere. Therefore, their sensitivity is considered to be low. The magnitude of change is considered to be negligible, as the volume of rock that will be excavated as part of the Proposed Varied Development (Addendum) is very small when compared to the overall area of the underlying bedrock deposits. Therefore, the residual effect associated with loss of rock is assessed as **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

A.9.10.2 The peat deposits are considered to be of high sensitivity. However, the design of the wind farm has been progressed to minimise the number of wind turbines and associated infrastructure within areas of deep peat, and a 'floating track' design, which does not involve any excavation, will be utilised in areas where the peat depth is greater than 1m, where practicable. Furthermore, a PMP will be implemented through Condition 23 of the Conditions

of Consent to ensure maximum re-use, reinstatement and restoration of excavated peat. As detailed in Appendix A9.1: Borrow Pit Assessment, the proposed borrow pits would yield sufficient stone for the proposed development. Therefore, the overall magnitude of change is considered to be minor and the residual effect associated with loss of peat is assessed to be **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

A.9.10.3 Following the implementation of mitigation measures to enable re-use of soils on-site, the magnitude of change is considered to be negligible. The sensitivity of soils is considered to be low, therefore the residual effect associated with loss of soils is assessed as **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

Ground Stability

A.9.10.4 The Peat Slide Risk Assessment (see Appendix 9.1 of the 2015 ES) has shown that the majority of the site is located in an area assessed at negligible or low risk of ground instability. No development is proposed in areas assessed of medium or high ground instability. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

A.9.10.5 Subject to the best practice construction techniques and mitigation which would include intrusive site investigation to inform the detailed site design, the magnitude of change is considered to be negligible. The sensitivity of soils is considered to be low, therefore the residual effect associated with ground instability is assessed as **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

Groundwater Levels and Flows

Groundwater Recharge

A.9.10.6 The construction of the wind turbines, access tracks and infrastructure for the Proposed Varied Development (Addendum) have the potential to reduce the amount of recharge to the shallow groundwater system within the permeable horizons of the Glacial Till, thereby locally affecting shallow groundwater levels and flow regime. The magnitude of change is considered to be negligible, because the combined footprint of impermeable development is very small when compared to the overall area of the Glacial Till deposits. In addition, the proposed new tracks would be constructed from inert site won aggregate, which would encourage infiltration of rainfall and maintain recharge. The sensitivity of the shallow groundwater system receptor is considered to be low due to its local importance and scale. Therefore, the residual significance of effect is assessed as **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

A.9.10.7 The bedrock beneath the site is impermeable, generally without groundwater except in the near surface weathered zone and secondary fractures. Under baseline conditions, groundwater recharge from the surface will be further restricted by the presence of low permeability Glacial Till and peat deposits above. Therefore, the magnitude of change of recharge to the bedrock aquifer without mitigation is also considered to be negligible. The sensitivity of the bedrock aquifer receptor is considered to be low, given its low permeability and lack of groundwater to support local supplies. The residual significance of effect is therefore assessed as **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

Groundwater Flow

A.9.10.8 Drainage activities during construction of the Proposed Varied Development (Addendum) (e.g. dewatering of wind turbine foundation excavations and borrow pits) may lead to temporary changes in the surrounding water table. Construction of access tracks and other areas of hardstanding, although only excavated to shallow depths, may also impact on local shallow groundwater flows.

A.9.10.9 Wind turbine foundation excavations may require temporary dewatering during construction, leading to a localised lowering of the water table. Any groundwater entry into shallow excavations is expected to be readily controlled by temporary pumping over a very short timescale and resulting in temporary and very localised minor magnitude effect on groundwater levels and flow regime immediately adjacent to the foundation excavations. The sensitivity of shallow groundwater levels and flow regime to temporary dewatering is considered to be low, given their local importance and scale. The residual effect of dewatering is therefore assessed as **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

A.9.10.10 Foundations placed below the shallow or superficial groundwater table may locally alter shallow groundwater flow pathways in the vicinity of the foundation, due to the impermeable nature of concrete foundations. The magnitude of change is assessed as negligible, reflecting the small localised footprint of each of the proposed foundations compared to the extent of the underlying deposits. Groundwater in these deposits, where present, will readily flow around the turbine foundations. Therefore, the residual effect is assessed as **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

A.9.10.11 The potential moderate GWDTE at site has been shown to be sustained by rainfall rather than by groundwater and thus SEPA GWDTE guidance does not apply. As construction of some of the proposed infrastructure is required through the buffers associated with confirmed GWDTE, there is potential to disrupt water contributions to these habitats. With adoption of best practice construction techniques to maintain existing surface water flow paths, the magnitude of change associated with the Proposed Varied Development (Addendum) is considered to be negligible. The residual effect on GWDTE is therefore assessed to be **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

Groundwater Quality

A.9.10.12 The sensitivity of the groundwater receptors in terms of groundwater quality is assessed as medium. The magnitude of change to groundwater quality due to spillage of fuels, lubricants and other potentially contaminative liquids during the construction phase is considered to be negligible, given the following:

- the pollution control and environmental measures included within the CEMP;
- the relatively small areas of the site where spillage of fuels, lubricants and other potentially contaminative liquids could potentially occur; and
- the relatively small number of vehicles that will be using the site.

A.9.10.13 Given the above, the significance of effect to groundwater quality is assessed as **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

Surface Water Flows and Flood Risk

A.9.10.14 The Proposed Varied Development (Addendum) has the potential to alter the hydrological regime of the site due to construction of impermeable surfaces such as the wind turbine bases, construction of site drainage and abstraction of water to provide a water supply. However, following the implementation of mitigation measures outlined above, the magnitude of change is considered to be negligible.

A.9.10.15 The sensitivity of the surface water receptors to flow regime change is assessed as high. The residual significance of effect is therefore assessed as **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

Surface Water Quality

A.9.10.16 The sensitivity of the surface water receptors in terms of water quality is assessed as very high. The magnitude of change to surface water quality due to spillage of fuels, lubricants and other potentially contaminative liquids such as suspended solids is considered to be negligible, given the following:

- the pollution control and environmental measures included within the CEMP;
- the relatively small areas of the site where spillage of fuels, lubricants and other potentially contaminative liquids could potentially occur;
- the relatively small number of vehicles that will be using the site; and
- the distances between the proposed infrastructure and the surface water drainage network at the site.

A.9.10.17 The residual effect associated with surface water quality is therefore assessed as **not significant**. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

A.9.11 Cumulative Effects

A.9.11.1 No change in cumulative effect from those already reported upon is predicted. There would be no significant cumulative effects. This is consistent with the Consented Development and the Proposed Varied Development, as reported within the EIA Report (January 2019).

A.9.12 Comparison of Effects

A.9.12.1 Table A9.1 summarises the effects that were assessed for the Consented Development, the Proposed Varied Development and compares these with the effects of the Proposed Varied Development (Addendum).

Table A9.1: Comparison of Effects

Potential Receptors of Effect	Consented Development	Proposed Varied Development	Proposed Varied Development (Addendum)	Change
Geology and soils	Not Significant	Not Significant	Not Significant	No Change
Groundwater levels and flows and GWDTE	Not Significant	Not Significant	Not Significant	No Change
Groundwater quality	Not Significant	Not Significant	Not Significant	No Change
Surface water flows and flood risk	Not Significant	Not Significant	Not Significant	No Change
Surface water quality	Not Significant	Not Significant	Not Significant	No Change

A.9.13 Conclusions

A.9.13.1 Unchanged, please refer to Section 9.12 of the EIA Report (January 2019).

A.9.13.2 The assessment has confirmed, subject to best practice measures including mitigation, that the Proposed Varied Development (Addendum) would not have any significant effects on hydrology, hydrogeology and geology. Overall, the effects of the Proposed Varied Development (Addendum) will be the same or similar to those of the Consented Development and Proposed Varied Development.

A.9.14 References

Unchanged, please refer to Section 9.12 of the EIA Report (January 2019).