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# INTRODUCTION

11.1 This Chapter assesses the impacts of the proposed development on hydrology, hydrogeology and geology (including soils). It includes assessment of all surface water including streams, rivers and lochs; groundwater within a 1km buffer of the Site; and the superficial and bedrock geology within the Site. The assessment of impacts has been made on the basis of the proposed turbine and infrastructure layout as fully described in Chapter 3: Description of the Development.

11.2 The Chapter outlines the embedded good practice methods which have been incorporated into the Site design and would be used during the construction and operation of the proposed development to prevent or reduce identified effects and risks.

11.3 Further mitigation methods to address any potential effects are proposed, where appropriate, and residual effects assessed.

11.4 The assessment uses information and findings presented in Chapter 9: Ecology and Biodiversity (including fisheries), and Technical Appendix 2.1: Forestry, to inform the assessment of potential effects on water quality and on possible areas of Groundwater Dependent Terrestrial Ecosystems (GWDTEs) presented in this Chapter.

11.5 This Chapter should be read in conjunction with Chapter 2: Site Description and Design Evolution and Chapter 5: Environmental Impact Assessment. Planning policies of relevance to this assessment are outlined in Chapter 4: Renewable Energy and Planning Policy.

# LEGISLATION, PLANNING POLICY AND GUIDANCE

11.6 This assessment has been undertaken with regard to environmental legislation, planning policy and general guidance, including the following.

## Legislation

11.7 This assessment has been completed in compliance with the following legislation:

- The Water Environment (Controlled Activities) (Scotland) Regulations, 2011 (as amended) (Controlled Activities Regulations (CAR));
- EU Water Framework Directive (2000/60/EC);
- EU Drinking Water Directive (98/83/EC);
- The Environment Act 1995;
- Environmental Protection Act 1990;
- The Water Supply (Water Quality) (Scotland) Regulations, 2001;
- The Flood Risk Management (Scotland) Act 2009;
- Water Environment and Water Services (Scotland) Act 2003 (WEWS Act); and
- Private Water Supplies (Scotland) Regulations 2006.

## Planning Policy

11.8 In addition to Scottish Planning Policy (SPP) published by The Scottish Government (Ref. 11.1), the Aberdeenshire Council (AC) Local Development Plan (LDP) (Ref. 11.2) provides planning guidance on the type and location of development that can take place in the region. The LDP presents development policies of which the following are relevant to this assessment:

- Policy C4: Flooding;
- Policy P4: Hazardous and potentially polluting developments and contaminated land;
- Policy PR1: Protecting important resources; and
- Policy R3: Minerals and hill tracks.

## Guidance

11.9 The following guidance is also applicable to the assessment.

### *Planning Advice Notes*

11.10 Planning Advice Notes (PANs), published by the Scottish Government, include:

- PAN 50 Controlling the Environmental Effects of Surface Mineral Workings;
- PAN 61 Planning and Sustainable Urban Drainage Systems (SUDS); and
- PAN 69 Planning and Building Standards Advice on Flooding.

### *Scottish Environment Protection Agency (SEPA) Pollution Prevention Guidance Notes (PPG) and Guidance for Pollution Prevention (GPP)*

11.11 Pollution Prevention Guidance Notes (PPG) and Guidance for Pollution Prevention (GPP), published by the Scottish Environment Protection Agency (SEPA), include:

- PPG01 General Guide to the Prevention of Pollution;
- GPP02 Above Ground Oil Storage;
- PPG03 Use and Design of Oil Separators in Surface Water Drainage Systems;
- GPP05 Works and Maintenance in or near Water;
- PPG06 Working at Construction and Demolition Sites;
- PPG07 Safe Storage - The Safe Operation of Refuelling Facilities;
- GPP08 Safe Storage and Disposal of Used Oils;
- GPP13 Vehicle Washing and Cleaning;
- GPP21 Pollution Incident Response Planning; and
- GGP22 Dealing with Spills.

### *Construction Industry Research and Information Association (CIRIA) Publications*

11.12 Construction Industry Research and Information Association (CIRIA) publications include:

- C532 Control of Water Pollution from Construction Sites (2001);
- C648 Control of Water Pollution from Linear Construction Projects – Technical Guidance (2006);
- C741 Environmental Good Practice on Site (2015); and
- C753 The SUDS Manual (2015).

### *SEPA Publications*

11.13 Other SEPA publications include:

- Engineering in the Water Environment: Good Practice Guide – River Crossings (2010);
- Engineering in the Water Environment: Good Practice Guide – Sediment Management (2010);
- Groundwater Protection Policy for Scotland, Version 3 (2009);
- Land Use Planning System SEPA Guidance Note 4, Version 6 (May 2014);
- Land Use Planning System SEPA Guidance Note 7, Version 3 (December 2010);
- Land Use Planning System SEPA Guidance Note 31, Version 1 (October 2014);
- Position Statement – Culverting of Watercourses (2006); and
- Regulatory Position Statement – Developments on Peat (2010).

### *Other Guidance*

11.14 Other guidance documents include:

- Department of Environment, Food and Rural Affairs (DEFRA) Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2011);
- DEFRA Good Practice Guide for Handling Soils (Ministry of Agriculture, Fisheries and Food (MAFF) 2000);
- Scottish Natural Heritage (SNH), 2nd Edition June 2013 - Constructed Tracks in Scottish Uplands;
- Good Practice during Windfarm Construction, Version 3, a joint publication by Scottish Renewables, SNH, SEPA, Forestry Commission Scotland (FCS) and Historic Environment Scotland (HES) (2015); and
- Scottish Renewables and SEPA - Developments on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste (2012).

# SCOPE AND CONSULTATION

11.15 The scope of the study has been determined through a combination of professional judgement, reference to relevant guidance documents and consultation with stakeholders.

## Consultation

11.16 Consultation for the proposed development was undertaken with statutory and non-statutory bodies during 2017 and 2018 as set out in Chapter 6: Scoping and Consultation. The outcome of the relevant consultations with regards to the water environment and geology (including peat) is summarised in Table 11-1. With respect to hydrology, hydrogeology and geology, consultees did not add further comment and referred to or reiterated advice given in the original (2017) scoping process.

**Table 11-1**
**Key Issues Raised During Scoping**

| Consultee | Summary of Key Issues | Where Addressed in Chapter |
|---|---|---|
| Marine Scotland | • Impact on downstream salmonid populations;<br>• Request for Water Quality Monitoring Plan;<br>• Felling and cumulative impacts on downstream water quality and fish populations; and<br>• Recommendation for restoration and decommissioning plan to include fisheries related issues. | See Chapter 9: Ecology and Assessment of Effects |
| Scottish Water | • Drinking Water Protected Areas; and<br>• Scottish Water assets within the Site including two raw water mains in potential conflict with the Site access route and a 6" asbestos cement main and 9" cast iron main. | See Baseline Conditions and Assessment of Effects |
| Aberdeenshire Council | • A LNCS at Craigs of Succoth which covers a slightly larger area that that covered by the Site of Special Scientific Interest (SSSI) immediately adjacent to the proposed development. | See Baseline Conditions |
| SEPA | • Peat and GWDTE assessment;<br>• Requirement for a Schedule of Water crossings; Peat slide Risk Assessment and Management Plan; and Borrow Pit Appraisal;<br>• The River Deveron is categorised as a Drinking Water Protected River and the Site boundary borders a Drinking Water Protected Catchment. These designations must be considered when designing a surface water drainage system for the construction phases of the Site and full life of the proposal; and<br>• Provided Regulatory Advice and Guidance which should be adhered to. | See Technical Appendix 11.1, Baseline Conditions and Assessment of Effects |

| Consultee | Summary of Key Issues | Where Addressed in Chapter |
|---|---|---|
| Scottish Natural Heritage | • Careful design of the wind farm, and referred to published guidance;<br>• Effect on Craigs of Succoth SSSI; and<br>• Peat survey to be undertaken at appropriate intervals and to follow Scottish Government Guidance. | See Chapter 3, Description of the Development, Technical Appendix 11.1 and Assessment of Effects |
| Deveron District Salmon Fishery Board (DDSFB) | • Effects on Atlantic salmon (*Salmo salar* L.), trout (*Salmo trutta* L.) and the European eel (*Anguilla anguilla* L.) within the River Deveron and River Bogie;<br>• Effects on water quality;<br>• Requirement for adequate baseline survey data;<br>• Requirement for appropriate mitigation measures to minimise effects on fisheries and water quality; and<br>• Development of a formal Fisheries Plan in consultation with the DDSFB. | See Chapter 9, Ecology and Assessment of Effects |
| Meetings with DDSFB (09/08/17 and 30/04/19) | • Meetings were held to discuss consultation response above, development plans, fisheries data and fisheries and water quality monitoring plan. | N/A |
| Fisheries Management Scotland (FMS) | • The proposed development falls within the district of the Deveron District Salmon Fishery Board, and the catchments relating to the Deveron, Bogie & Isla Rivers Charitable Trust. These should be consulted.<br>• Reference to guidance produced by FMS in conjunction with Marine Scotland Science, providing advice for DSFBs and Trusts in dealing with planning applications. | See above and Chapter 9: Ecology and Biodiversity, |

## Effects Assessed in Full

11.17 The following potential effects have been assessed in full:

- pollution risk, including potential effects on surface water and groundwater quality and public and private water supplies during forest felling, and construction and operation of the proposed development;
- erosion and sedimentation which could give rise to potential effects on surface water and groundwater quality, and public and private water supplies during forest felling, construction and operation of the proposed development;
- fluvial flood risk resulting from changes to runoff volumes and rates and modifications to natural and man-made drainage patterns during operation of the proposed development;
- potential effects upon the linkage between groundwater and surface water during construction and operation of the proposed development;
- potential effects on areas of peat during construction and operation;
- potential effects on areas of possible GWDTE during construction and operation; and
- potential cumulative effects during construction and operation.

## Effects Scoped Out

11.18 On the basis of the desk based and survey work undertaken, policy, guidance and standards, the professional judgement of the Environmental Impact Assessment (EIA) team, feedback from consultees and experience from other relevant projects, the following topic areas have been scoped out of the assessment:

- increased flood risk caused by blockages to flow in watercourses during operation and maintenance of the proposed development as these crossings would be subject to maintenance requirements under the Controlled Activities Regulations (CAR). Flood risk onsite during these phases is also considered negligible and the proposed development design ensures no critical infrastructure is located near watercourses;
- changes to public/private water supply yield as a consequence of changes to runoff rates and volumes during maintenance of the proposed development as no significant alterations to runoff rates/infiltration or drawdown of the water table are anticipated during or as a consequence of maintenance; and
- potential cumulative effects in relation to public/private water supply yields during the operational phase as water requirements are low during operation and any change would not be discernible at the catchment level.

11.19 Areas covered by the proposed Habitat Management Plan (HMP) have also been scoped out of the assessment as the proposals relate to land management approaches and practices that are common best practice (see Chapter 9: Ecology and Biodiversity). The assessment in this Chapter considers the proposed wind farm and its enabling infrastructure only.

# APPROACH AND METHODS

## Assessment Structure

11.20 The assessments of both the construction and operational phases of the proposed development have been structured around the consideration of the following potential effects on receptors:

- pollution risk: potential effects on surface water and groundwater quality; public and private water supplies;
- erosion and sedimentation: potential effects on surface water and groundwater quality; public and private water supplies;
- fluvial flood risk: potential effects on flood risk both to the proposed development and offsite effects during the operational phase only (excluding blockages to flow in watercourses);
- infrastructure and man-made drainage: potential effects on surface and sub-surface drainage patterns (which could directly feed GWDTEs across the Site); and
- cumulative effects: potential effects of the proposed development in combination with those from other developments within the hydrological study area.

11.21 The contamination of surface water and groundwater caused by leakage and spills of chemicals from forest felling, vehicle use and construction and operational activities has the potential to lead to a pollution event. Deterioration of the quality of either surface water or groundwater could cause

a potential effect on the status of the receiving water bodies and any public or private water supplies. The effects have been assessed, using professional judgement, in terms of the frequency and duration of activities that have the potential to cause pollution, together with the nature of the potential pathways linking the source of pollution to a receptor(s). The length of the pathway is a key factor in determining the risk of contamination, with particular attention given to the potential occurrence of direct pollution to water bodies.

11.22 The potential for erosion and sedimentation mainly occurs during the construction phase of the proposed development. Potential causes include the transfer of sediment during rainfall events from areas of forest felling, exposed ground or stockpiled materials, which subsequently enter the watercourses. This can cause blockages in watercourses as well as a deterioration of water quality. The effects have been assessed in the same way as for contamination events. The potential for an activity to cause erosion or sedimentation is based on a combination of the type of land cover, the nature of the activity, experience from other relevant projects, professional judgement and relevant guidance.

11.23 Increases in the potential flood risk to a receptor would be localised, resulting from increased runoff from areas of hardstanding, compacted ground or due to the under-sizing of water crossings. The effects have been assessed using the good practice techniques and professional judgement.

11.24 Water abstraction could potentially be required during the construction phase of the proposed development. This could affect the quantitative status of waterbodies (either surface water or groundwater). The effect has been assessed primarily on the proposed quantities of water required for abstraction, as well as the duration of abstraction and management of abstracted water.

11.25 Identification of potential GWDTEs provide a visual means of assessing the nature of the underlying groundwater in the absence of extensive field investigation. Consequently, they are a valuable tool in assessing potential changes in groundwater flow. However, while GWDTEs play a role in the interpretation of groundwater movement, the ecosystems themselves are subject to protection due to their ecological value. Given their various roles, effects on GWDTEs are considered in both this Chapter and the Ecology and Biodiversity Chapter (see Chapter 9: Ecology and Biodiversity). This Chapter assesses the potential effect of the proposed development upon the quality and quantity of groundwater supporting the GWDTE, due to potential effects on sub-surface drainage patterns.

## Study Area

11.26 The study area includes the entire proposed Site infrastructure as described in Chapter 3: Description of the Development, and as shown on Figure 3.1. In addition, details of local water use and quality within a buffer of at least 5km from the proposed infrastructure have been considered. The study area encompasses the Site as well as bodies of water and their catchments which could potentially be affected by the construction and operation of the proposed development.

11.27 The study area for potential cumulative effects uses the catchments within the study area, with a maximum downstream distance of 5km from the proposed infrastructure. Beyond this 5km distance, any effect is considered to be so diminished as to be undetectable and therefore not significant.

## Information and Data Sources

11.28 An initial desk study has been undertaken to determine and confirm the baseline characteristics by reviewing available information on hydrology, hydrogeology and geology. The following sources of information have been consulted in order to characterise baseline conditions of the area within and surrounding the Site (Table 11-2):

**Table 11-2**
**Source of Data and Information**

| Topic | Source of Data and Information |
|---|---|
| Topography; and Elevation, Relief and Climate | Ordnance Survey (OS) mapping: 1:25 000 raster.<br>OS OpenData Terrain 50 Dataset.<br>Flood Estimation Handbook (FEH) web service. |
| Geology: Bedrock and Superficial | Online British Geological Survey (BGS) drift and solid geology mapping.<br>Online Soil Survey for Scotland mapping.<br>British Geological Survey (BGS) DigMapGB-50 Vector Mapping:<br>• Bedrock (1:50,000)<br>• Superficial (1:50,000)<br>• Features (1:50,000)<br>James Hutton Institute:<br>• The Soil map of Scotland (partial cover) (1:25,000) |
| Surface Water; Flooding; Groundwater; Water Quality; Abstractions and Discharges; Private Water Supplies; and Statutory Designated Sites | Aberdeenshire Council.<br>Moray Council.<br>SEPA, including SEPA Interactive Maps:<br>• Water Environment HUB<br>• Flood Maps<br>Association of Salmon Fishery Boards (ASFB).<br>River Deveron District Salmon Fishery Board.<br>Deveron, Bogie and Isla Rivers Charitable Trust.<br>SEPA Website (www.sepa.org.uk) for details of flood risk.<br>The Scotland's Environment Website (www.environment.scotland.gov.uk) for details of the current status of surface water.<br>Centre for Ecology and Hydrology and BGS Wallingford Hydrometric Register and Statistics 1996-2000, 2008.<br>SEPA Groundwater Vulnerability Map of Scotland, 2003.<br>British Geological Survey (BGS) Hydrogeology of Scotland, 1988.<br>BGS Hydrogeological Map of Scotland, 1998.<br>SEPA Aquifer Map of Scotland, 2004.<br>The Scotland's Environment Website (www.environment.scotland.gov.uk) for details of the current status of groundwater quality. |

| Topic | Source of Data and Information |
|---|---|
| | Further correspondence (beyond the initial consultation) with SEPA (dated 18 April 2017) regarding the hydrology, hydrogeology and flood risk of the area surrounding the Site.<br><br>Further correspondence (beyond the initial consultation) with AC and Moray Council (MC) (both 18th April 2017) regarding private water abstractions and flooding.<br><br>Natural Power Clashindarroch Wind Farm Private Water Supply Risk Assessment Planning Conditions 19 & 57 (23/04/2012).<br><br>Scottish Natural Heritage Sitelink Online Information Service:<br>• BGS UK Hydrogeology Viewer.<br><br>BGS Groundwater *Vulnerability Mapping of Scotland (1:625,000).* |

## Field Survey

11.29 The project hydrologists, hydrogeologists, geologists and ecologists have worked closely on this assessment to ensure that appropriate information is gathered to allow a comprehensive impact assessment to be completed.

11.30 Detailed Site visits and walkover surveys have been undertaken by the authors of this assessment on the following dates:

- 3 May 2017 to identify presence of GWDTEs and assess ground conditions;
- 8 - 11 May 2017 to conduct a peat/soil depth probing exercise;
- 25 - 26 July 2017 to assess potential watercourse crossings, areas of historic flooding, surface water sampling and private water supply survey;
- October 2018 further peat probing and borrow pit assessment; and
- 30 April 2019, further survey of proposed watercourse crossings.

11.31 The field work has been undertaken in order to:

- verify the information collected during the desk and baseline study;
- allow appreciation of the Site, determine gradients, access routes, ground conditions, etc., and to assess the relative location of all the components of the proposed development;
- undertake a visual assessment of the main surface waters and identify and verify private water supplies;
- identify drainage patterns, areas vulnerable to erosion or sediment deposition, and any pollution risks;
- collect surface water samples for baseline quality monitoring purposes;
- assess areas of potential GWDTE; and
- visit any potential watercourse crossings and prepare a schedule of potential watercourse crossings.

11.32 The desk study and field surveys have been used to identify potential development constraints and have been used as part of the Site iterative design process.

11.33 The data obtained as part of the desk study and collected as part of the field work has been processed and interpreted to complete the impact assessment and recommend mitigation measures where appropriate.

## Assessment Methods

### *Assessing Significance*

11.34 The significance of potential effects from the proposed development has been assessed by considering two factors: the sensitivity of the receiving environment and the potential magnitude of impact, should that effect occur.

11.35 The assessment methodology has also been informed by experience of carrying out such assessments for a range of wind farm and other developments, knowledge of the water environment characteristics in Scotland and cognisance of good practice.

11.36 This approach provides a mechanism for identifying the areas where mitigation measures are required and for identifying mitigation measures appropriate to the significance of potential effects presented by the proposed development.

11.37 Criteria for determining the significance of effect are provided in Table 11-3, Table 11-4 and Table 11-5.

#### Sensitivity of Receptor

11.38 The sensitivity of the receiving environment (i.e. the baseline quality of the receiving environment) is defined as its ability to absorb an effect without a detectable change. It can be considered through a combination of professional judgement and a set of pre-defined criteria which are set out in Table 11-3. Receptors in the receiving environment only need to meet one of the defined criteria to be categorised at that associated level of sensitivity.

**Table 11-3**
**Criteria for Assessing Sensitivity of Receptor**

| Sensitivity | Definition |
|---|---|
| **High** | • SEPA Water Framework Directive Water Body Classification: High-Good or is close to the boundary of a classification Moderate to Good or Good to High;<br>• receptor is of high ecological importance or national or international value (e.g. Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), habitat for protected species) which may be dependent upon the hydrology of the Development Area;<br>• receptor is at high risk from flooding above 0.5% Annual Exceedance Probability (AEP) and/or water body acts as an active floodplain or flood defence;<br>• receptor is used for public and/or private water supply (including Drinking Water Protected Areas (DWPA);<br>• groundwater vulnerability is classified as high; and<br>• if a GWDTE is present and identified as being of high sensitivity. |
| **Moderate** | • SEPA Water Framework Directive Water Body Classification Moderate or is close to the boundary of a classification Low to Moderate;<br>• receptor is at moderate risk from flooding (0.1% AEP to 0.5% AEP) but does not act as an active floodplain or flood defence; and<br>• moderate classification of groundwater aquifer vulnerability. |
| **Low** | • SEPA Water Framework Directive Water Body Classification Poor or Bad;<br>• receptor is at low risk from flooding (less than 0.1% AEP); and<br>• receptor not used for water supplies (public or private). |
| **Not Sensitive** | • Receptor would not be affected by the proposed development, e.g. lies within a different and unconnected hydrological/hydrogeological catchments. |

## Magnitude of Impact

11.39 The potential magnitude of an impact would depend upon whether the potential effect would cause a fundamental, material or detectable change. In addition, the timing, scale, size and duration of the potential effect resulting from the proposed development are also determining factors. The criteria that have been used to assess the magnitude of impact are defined in Table 11-4.

**Table 11-4**
**Criteria for Assessing Magnitude of Impact**

| Magnitude | Criteria | Definition |
|---|---|---|
| **Major** | Results in loss of attribute | Fundamental (long term or permanent) changes to the baseline hydrology, hydrogeology and geology such as:<br>• wholesale changes to watercourse channel, route, hydrology or hydrodynamics;<br>• changes to the Site resulting in an increase in runoff with flood potential and also significant changes to erosion and sedimentation patterns;<br>• major changes to the water chemistry; and<br>• major changes to groundwater levels, flow regime and risk of groundwater flooding. |
| **Medium** | Results in impact on integrity of attribute or loss of part of attribute | Material but non-fundamental and short to medium term changes to baseline hydrology, hydrogeology and water quality, such as:<br>• some fundamental changes to watercourses, hydrology or hydrodynamics. Changes to site resulting in an increase in runoff within system capacity;<br>• moderate changes to erosion and sedimentation patterns;<br>• moderate changes to the water chemistry of surface runoff and groundwater; and<br>• moderate changes to groundwater levels, flow regime and risk of groundwater flooding. |
| **Low** | Results in minor impact on attribute | Detectable but non-material and transitory changes to the baseline hydrology, hydrogeology and water quality, such as:<br>• minor or slight changes to the watercourse, hydrology or hydrodynamics.<br>• changes to site resulting in slight increase in runoff well within the drainage system capacity;<br>• minor changes to erosion and sedimentation patterns;<br>• minor changes to the water chemistry of surface runoff and groundwater; and<br>• minor changes to groundwater levels, flow regime and risk of groundwater flooding. |
| **Negligible** | Results in an impact on attribute but of insufficient magnitude to affect the use/integrity | No perceptible changes to the baseline hydrology, hydrogeology and water quality such as:<br>• no alteration or very minor changes with no impact to watercourses, hydrology, hydrodynamics, erosion and sedimentation patterns;<br>• no pollution or change in water chemistry to either groundwater or surface water; and<br>• no alteration to groundwater recharge or flow mechanisms. |

## Potential Effects

11.40 The sensitivity of the receptor together with the magnitude of impact determines the significance of the effect, which can be categorised into a level of significance as identified in Table 11-5. This also takes into account good practice measures implemented and embedded as part of the design and construction of the proposed development and use of professional judgement where appropriate. Good practice measures (i.e. embedded mitigation) are discussed later in the Chapter.

11.41 The significance of a potential effect provides a guide to assist in decision making. However, it

should not be considered as a substitute for professional judgment and interpretation. In some cases, the potential sensitivity of the receiving environment or the magnitude of potential impact cannot be quantified with certainty and therefore professional judgement remains the most robust method for identifying the predicted significance of a potential effect.

11.42 The characteristics of the impacts are described as: direct/indirect, temporary (revisable) or permanent (irreversible), together with timescales (short, medium and long term).

**Table 11-5**
**Significance of Effect**

| Magnitude of Impact | Sensitivity of Receptor | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Not Sensitive |
| Major | **Major** | **Major** | **Moderate** | Negligible |
| Medium | **Moderate** | **Moderate** | Minor | Negligible |
| Low | **Moderate** | Minor | Minor | Negligible |
| Negligible | Negligible | Negligible | Negligible | Negligible |

### *Mitigation*

11.43 Any potential effects of the proposed development on the water environment or geology identified by the assessment have been addressed and mitigated by the design and the application of good practice guidance to be implemented as standard during construction and operation to prevent, reduce or offset effects where possible. As such, a number of measures would form an integral part of the construction process and these have been taken into account prior to assessing the likely effects of the proposed development (embedded mitigation). Where appropriate, further more tailored mitigation measures have been identified prior to determining the likely significance of residual effects.

11.44 Good practice measures would be applied in relation to forest felling, pollution risk, sediment management, peat management (if required) and management of surface runoff rates and volumes. This would form part of the Construction and Environmental Management Plan (CEMP) to be implemented for the proposed development and would be prepared prior to construction, a draft of which is provided in Technical Appendix 2.1: Draft Construction and Environmental Management Plan.

11.45 The final CEMP would include details and responsibilities for environmental management onsite for environmental aspects and would outline the necessary surface water management, oil and chemical delivery and storage requirements, waste management, traffic and transport management and would specify monitoring requirements for waste water, water supply including an Environmental Incident Response Plan (EIRP) and all appropriate method statements and risk assessments for the construction of the proposed development.

### *Residual Effects*

11.46 A statement of residual effects, following consideration of any further specific mitigation measures where identified, is then given.

### *Statement of Significance*

11.47 The assessment provides a Statement of Significance associated with the proposed development. Effects of major and moderate significance are considered to be **Significant** in terms of the EIA Regulations.

## Cumulative Effects Assessment

11.48 The assessment also considers potential cumulative effects associated with other wind farm developments within the same surface water catchments.

11.49 A cumulative effect is considered to be the effect on a hydrological, hydrogeological or geological receptor arising from the proposed development in combination with other proposed developments which are likely to affect surface water, groundwater or geology.

11.50 Proposed developments (consented and in planning) within the same catchment as the Site and within a distance of 5km from the proposed development have been considered.

11.51 Cumulative effects are considered using the same methodology as for the effects of the proposed development in isolation.

## Assumptions, Limitations and Confidence

11.52 This assessment has been largely completed using the most recent data and resources published, however any gaps in the data have been supplemented with data provided within the 2009 Clashindarroch Wind Farm Environmental Statement (ES), supporting reports for discharging planning conditions and ongoing water monitoring data. All data has been reviewed critically and best judgement has guided the information and interpretation made in this Chapter.

# BASELINE CONDITIONS

11.53 The Site location and hydrological setting (regional and local) are presented within Figures 11.1 and 11.2 respectively.

## Climate and Topography

11.54 The standard-period average annual rainfall (SAAR) for the surface water catchments at Site is 1417mm based on data obtained from the Flood Estimation Handbook (FEH) Web Service (Ref. 11.3).

11.55 The Site is located in an area of upland forestry, immediately north east of the Clashindarroch Wind Farm (completed in 2014), and approximately 6km to the south west of Huntly in Aberdeenshire. The Site is accessed from the A920 at Wellheads/Craighead, 3km to the west of Huntly, from the Clashindarroch Wind Farm access track.

11.56 The Site straddles several hills including Auchindinnie Hill (330m Above Ordnance Datum (AOD)), Raven Hill (421m AOD), Craigend Hill (492m AOD), Grumack Hill (517m AOD), Muckle Black Hill (522m AOD) and Red Hill (526m AOD). The Site lies within the catchment of several watercourses, including the Kirkney Water, Ness Bogie and Glen Burn. There are existing forestry tracks that serve much of the Site, accessed using the Clashindarroch Wind Farm access track.

## Statutory Designated Sites of Hydrological Interest

11.57 Review of the SNH online SiteLink service (Ref. 11.4) confirms that there are no statutory designated sites present within the application boundary. However, within 5km of the proposed development exist four statutory designated sites as follows (see Figure 11.1):

- Craigs of Succoth (flora);
- Bin Quarry (geological);
- Mortlach Moss (flora); and
- Hill of Towanreef (flora and geological).

11.58 Adjacent to the western Site boundary lies the Craigs of Succoth Site of Special Scientific Interest (SSSI), designated as such for qualifying features regarding upland habitats of calaminarian grassland and serpentine heath, and subalpine flushes. SNH describe the SSSI serpentine outcrop as:

*"having a semi-toxic quality with high levels of one or more heavy metals. Soils and groundwater derived from these rocks contain relatively high concentrations of certain minerals and give rise to a rich and unusual flora."*

11.59 No development is proposed within 500m of the Craigs of Succoth SSSI.

11.60 Bin Quarry SSSI is located to the north west of Huntly. The site has been designated for qualifying features regarding earth sciences of Caledonian Igneous and Mineralogy of Scotland. Its qualifying interests are geological and it lies remote from and unconnected to any area of the proposed development.

11.61 Mortlach Moss SSSI and Special Conservation Area (SAC) is located 5km north of Huntly, on the margins of Bin Forest. The site has been recognised with qualifying features relating to wetlands of basin fen and base-rich fens. The site lies to the north of the River Deveron and is thus hydraulically remote from the proposed development.

11.62 The Hill of Towanreef SSSI and SAC covers much of the hills of The Buck (721m AOD), White Hill (450m AOD), White Hill of Bogs (411m AOD) and Turf Hill (439m AOD). Qualifying features of the Hill of Towanreef site are: alpine and subalpine heaths, blanket bog, calaminarian grassland and serpentine heath, Caledonian Igneous, dry heaths, grasslands on soils rich in heavy metals, Juniper on heaths or calcareous grasslands, Marsh saxifrage (*Saxifraga hirculus*), upland assemblage and vascular plant assemblage. The Hill of Towanreef lies in the headwaters of Allt Deveron and Water of Bogie, upstream of the Site, e.g. it is hydraulically remote from the Site.

## Soils and Geology

11.63 A detailed review of the soils, superficial and solid geology at the Site is given the following supporting Technical Appendices:

- Technical Appendix 11.1: Peat Assessment; and
- Technical Appendix 11.2: Borrow Pit Assessment.

11.64 Summary details are given below.

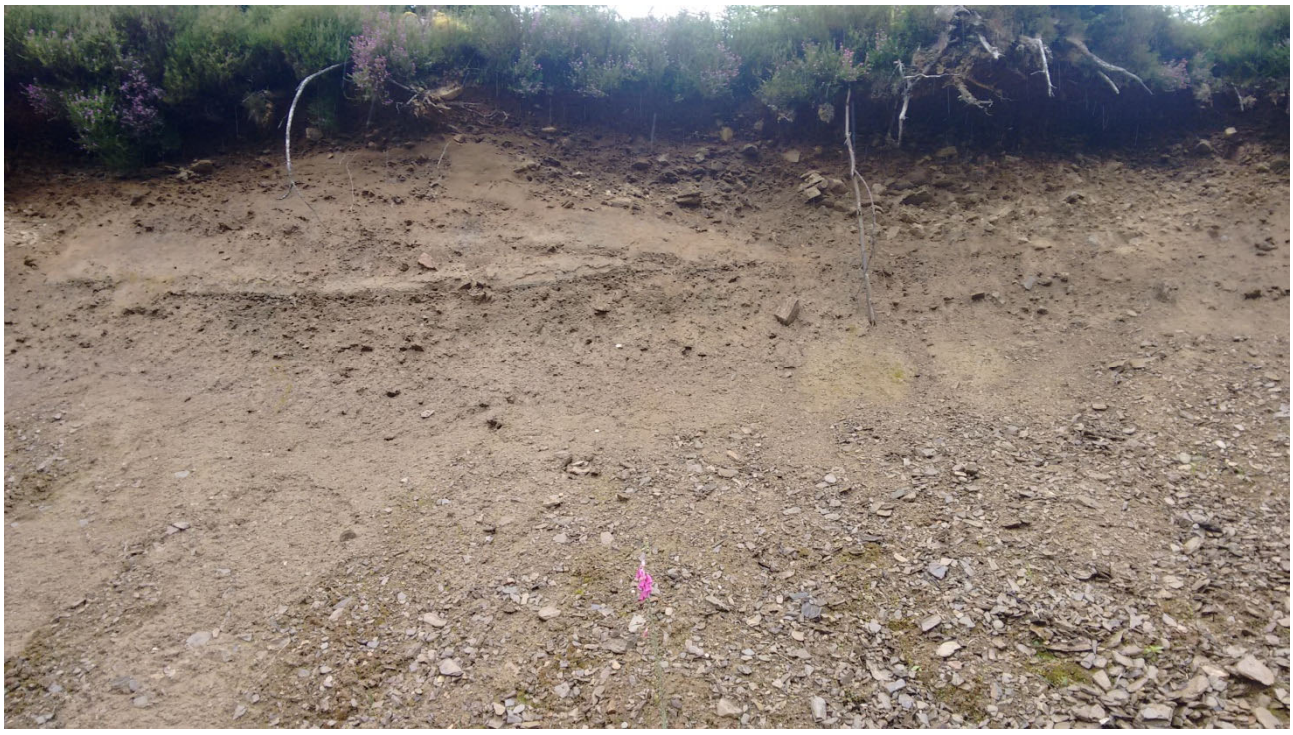
### *Soils*

11.65 An extract of the 1:25,000 Soil Survey of Scotland mapping is presented as Figure 11.3.

11.66 The principal soil type underlying the Site is a mineral podzol (humus-iron podzols) with minor units of peat, peaty gleys, peaty gleyed podzols, brown soils and mineral gleys (noncalcareous gleys). Mineral podzols are ubiquitous within the Site, described by the Hutton institute as freely drained and derived from slates, phyllites and other weakly metamorphosed argillaceous rocks.

### *Superficial Deposits*

11.67 An extract of the regional superficial geological mapping is presented as Figure 11.4. BGS superficial geology mapping indicates that superficial geology is largely absent within the application site with bedrock at or near the surface. Glacial till, where present, is generally within the valleys between the summits of hills (Photograph 11-1).



**Photograph 11-1**
**Glacial Till Exposed along the Valley of Lag Burn NGR NJ 45239 32818 (26/07/2017)**

11.68 Alluvium, consisting of clay, silt and gravel is shown to bound larger watercourses such as the Ealaiche Burn in the south and the River Deveron to the north.

11.69 With reference to Technical Appendix 11.1, which reports the results of a programme of peat depth probing undertaken at the Site, it has been confirmed that no peat has been proven beneath or near any of the proposed wind farm infrastructure.

### *Bedrock and Solid Geological Features*

11.70 An extract of the regional bedrock geological mapping is presented in Figure 11.5. The BGS record that the bedrock geology comprises chiefly of metasedimentary rocks with several igneous units.

11.71 A number of geological faults are indicated to the north of the Site; these predominantly trend in an east, north east to west, south west direction or a south east to north west direction. No faults are shown below the proposed wind farm infrastructure.

## Hydrogeology

11.72 Extracts of the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) groundwater vulnerability map and the Hydrogeological Map for Scotland are presented as Figure 11.6 and Figure 11.7, respectively.

11.73 Figure 11.6 confirms that the superficial deposits are recorded as absent over much of the Site and where present are characterised as having intergranular flow and low productivity (e.g. the low bulk permeability of the glacial till). In the larger valleys, such as the Deveron, the alluvium is recorded to have a high intergranular productivity. The glacial till will store and allow little groundwater movement, whereas the alluvium will contain more water which is likely to be locally in hydraulic continuity with surface water and be perched above the glacial till.

11.74 Figure 11.6 also shows that the bedrock beneath the Site is likely to contain little groundwater (e.g. it has a low productivity). Groundwater flow would only occur where secondary permeability has been established (e.g. in fractures or in the upper weathered surface of the bedrock).

11.75 Groundwater in the bedrock at Site is considered vulnerable to pollution given the absence or thin cover of superficial deposits.

11.76 The BGS hydrogeological map (Figure 11.7) illustrates that the Site is underlain by rocks with limited or without significant groundwater.

11.77 Groundwater recharge at the Site is limited by the following factors:

- where forest is present, a large proportion of the incident rainfall will be intercepted by the canopy and additional moisture losses will occur as a result of evapotranspiration;
- steeper topographic gradients will result in the formation of surface water runoff; and
- the glacial till deposits inhibit infiltration owing generally to the fact that the till has a low bulk permeability.

11.78 The BGS state that groundwater flow in upland areas, typical of much of the Site, tends to follow surface flow paths, e.g. from high ground to adjacent valleys.

11.79 Under its responsibilities of the Water Framework Directive (WFD), SEPA have classified groundwater bodies that underlay the Site as presented in Table 11-6 (Ref. 11.5).

**Table 11-6**
**SEPA Groundwater Body Classification (2015)**

| Water Body Name | Area (km²) | Overall Status | Water Balance | Chemical Status |
|---|---|---|---|---|
| Gartly | 156.8 | Good | Good | Good |
| Keith | 331.0 | Good | Good | Good |

11.80 SEPA has confirmed there are no groundwater level or water quality monitoring sites within a 5km radius of the Site.

### *Groundwater Dependent Terrestrial Habitats*

11.81 SEPA's wind farm planning guidance states a National Vegetation Classification (NVC) survey should be undertaken to identify wetland areas that might be dependent on groundwater. If potential GWDTEs are identified within (a) 100m of proposed excavations less than 1m deep (e.g. roads, tracks and trenches), or (b) within 250m of excavations deeper than 1m (e.g. excavated tracks, borrow pits and foundations), then it is necessary to assess how the potential GWDTEs could be affected by the proposed development.

11.82 SEPA's wind farm planning guidance has been used to inform the Site design in relation to GWDTE.

11.83 A summary of the habitat survey completed at the Site is provided in Chapter 9: Ecology and Biodiversity, along with a detailed National Vegetation Classification (NVC) habitat plan. This plan has been used to assess for the potential presence of moderately and highly GWDTE in accordance with SEPA guidance, see also Figure 11.8. Review of this Figure shows:

- as a consequence of the existing commercial forestry, little habitat which might be supported by groundwater has been recorded;
- no areas of potentially high GWDTE have been recorded; and
- small and isolated areas of potential moderate GWDTE have been recorded and are typically associated with areas that have not been subject to forest planning, e.g. adjacent to watercourses and some of the forestry tracks.

11.84 Following the site visits and review of baseline conditions it is considered that the areas of potential moderate GWDTE are not sustained by groundwater for the following reasons:

- little groundwater is present at the Site;
- the areas of potential GWDTE are found at lower elevations, where slopes are shallower and surface water runoff might be expected to be shed; and
- glacial till has been proven to underlie the soils at the Site and will hinder the infiltration of incident rainfall-runoff allowing surface water to pond and saturate soils.

11.85 It is therefore concluded that the areas identified onsite as being potentially moderately groundwater dependent are likely to be sustained by incident rainfall and local surface water runoff

rather than by groundwater. Accordingly, the 100m and 250m buffers proposed in SEPA's GWDTEs guidance need not apply.

## Local Hydrology

11.86 The proposed development lies entirely within the River Deveron river basin defined by the FEH web service with a total catchment area of 1,232.43km$^2$ (Figure 11-1). Six surface water sub-catchments serve the Site that drain to either the River Deveron or the River Bogie, which has a confluence with the River Deveron downstream of Huntly (Figure 11-2).

11.87 All of the proposed development lies within catchments that drain to the River Bogie.

11.88 The six surface water sub-catchments are described as follows (see Figure 11-2 for locations), from west to east:

- Ealaiche Burn: This catchment drains the western part of the Site separated by the watershed of Raven Hill, Hill of Finglenny and Meikle Watchman. This watercourse forms from the confluence of its headwater tributaries: Blind Stripe, Bogrotten Burn, Craig Water and Stripe of Baditimmer that all drain the Site. Downstream of the Site, Ealaiche Burn discharges to Kirkney Water that flows north east to its confluence with the Water of Bogie. This catchment is heavily forested with commercial forestry of mixed ages (Photograph 11.2). Within this catchment the proposed infrastructure would include:
    - turbines: 2, 5, 12 and 13;
    - access tracks to the turbines;
    - permanent met mast;
    - two potential new watercourse crossings; and
    - existing and proposed access track.

**Photograph 11.2**
**Ealaiche Burn Catchment Looking North West from NGR NJ 43387 31601 (26/07/2017)**

- Lag Burn: The Lag Burn drains the central section of the Site and includes its headwater tributaries: Allt Earse, Badilauchter Burn, Blind Burn, Burn of Bedlaithen, Burn of Raibet, Deer's Grain, Dry Burn, East Burn of Pots, Garral Burn, Hareetnach Burn, Oxter Burn and West Burn of Pots. Some headwater tributaries within the Lag Burn catchment have been clear felled (Photograph 11-3). SEPA have recorded the main Lag Burn stream (including the headwater tributary Badilauchter Burn) as an "Opportunity Areas for Sediment Management" (Ref. 11.6) where the watercourse is recorded to be moderate - highly erosive between the Clashindarroch Wind Farm access track and its confluence with Priest's Water. Downstream of the confluence Ness Bogie is recorded by SEPA to include areas of sediment transport and high deposition prior to its confluence with the River Bogie. Within this catchment the proposed infrastructure would include:
    - turbines: 1, 9, 6, 7, 8, 4, 3, 11, 10 and 14;
    - access tracks to turbines;
    - laydown area;
    - existing access track; and
    - existing watercourse crossings: 11, 12 and 13.

**Photograph 11.3**
**Lag Burn Catchment Looking South West to Badilauchter Burn from NGR NJ 43171 33082 (26/07/2017)**

- Priest's Water: This catchment (Photograph 11.4) includes the headwater tributaries of Black Burn, Burn of Corrylair, Burn of Tilathrowie, Chapel Burn, Dry Burn, Green Slouch, Killin Burn, Long Slouch and The Grains. This catchment also drains the central area of the Site, between the watershed of Mukle Long Hill - Chapel Hill - Hill of Drumbulg - Bar Hill to the north and Mukle Black Hill – Carlin Hill – Auchindinnie Hill – Hill of Drumfergue – The Drum to the south. At the confluence of Lag Burn and Priest's Water, the watercourse is recognised as Ness Bogie that in turn discharges to the Water of Bogie further downstream. Within this catchment the proposed infrastructure would include:

- borrow pit search area: 1, 2 and 3;
- substation;
- existing access track;
- existing borrow pit;
- existing substation; and
- existing watercourse crossings: 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10.

**Photograph 11.4**
**Priest's Water Catchment Looking North West to Killin Burn from NGR NJ 45226 34327 (26/07/2017)**

- Sheild Burn: This sub-catchment serves a small area in the west of the Site separated by the watershed Hill of Bogairdy – Muckle Long Hill – Chapel Hill and includes the headwater tributary Birken Burn. No infrastructure is proposed within this catchment.

- Glen Burn: This catchment covers the north of the Site, serving much of the Clashindarroch Wind Farm access track from the A920. The Glen Burn catchment includes its tributaries Back Burn, Burn of Craigentrindy, Collonach Burn, Costly Burn, Croftmillan Burn and Gordon's Burn. Many of the watercourses within this catchment are angular and straightened suggesting significant modification by engineering. Several reservoirs, ponds, springs and wells have also been identified within this catchment. Much of the northern end of this catchment covers agricultural land with only the headwater reaches in the south located within commercial forestry (Photograph 11.5). Within this catchment, the proposed infrastructure would include the temporary construction compound only.

**Photograph 11.5**
**Glen Burn Catchment Looking South East Towards Collonach Burn from NGR NJ 49117 38962 (26/07/2017)**

- Craighead: this catchment serves the existing Site entrance at the junction with the A920. Although there is no watercourse in this catchment, surface water runoff would drain north westwards towards the River Deveron before entering road drainage alongside the A920. Within this catchment no infrastructure is proposed. See Photograph 11.6.

**Photograph 11.6**
**Craighead Catchment from Site Access Point off A920 (26/07/2017)**

11.89 Table 11-7 shows catchment descriptors from the FEH database for the five surface water catchments that contain watercourses (i.e. excluding Craighead), and which can be used to describe the catchments anticipated response to precipitation. Descriptors are not given for the Craighead catchment as without a defined watercourse the catchment is incorporated within the larger River Deveron catchment.

**Table 11-7**
**Catchment Descriptors for Principal Watercourses**

| Catchment | Downstream Point NGR | Area ($km^2$) | SAAR (mm) | ALTBAR (mASL) | DPSBAR (m/km) | LDP (km) |
|---|---|---|---|---|---|---|
| **Ealaiche Burn** | NJ 45350 30300 | 8.07 | 1,067 | 410 | 140.8 | 5.72 |
| **Lag Burn** | NJ 49100 34350 | 9.84 | 1,032 | 355 | 176.5 | 8.54 |
| **Priest's Water** | NJ 49100 34450 | 9.59 | 1,009 | 329 | 143.0 | 7.00 |
| **Shield Burn** | NJ 50200 35200 | 3.24 | 953 | 265 | 124.3 | 3.81 |
| **Glen Burn** | NJ 48250 40400 | 12.12 | 963 | 291 | 112.5 | 7.02 |

**Notes:** Grid reference of downstream maximum extent of catchment as denoted by ether the application boundary or confluence with another watercourse; SAAR – surface average annual rainfall between 1961 and 1990; ALTBAR – mean catchment altitude (metres above sea level); DPSBAR – index of catchment steepness; and LDP – longest drainage path.

### *Flood Risk*

11.90 SEPA have developed national flood maps (Ref. 11.7) that present modelled flood extents for river, coastal, surface water and groundwater flooding. The river, coastal, surface water and groundwater maps were developed using a consistent methodology to produce outputs for the whole of Scotland, supplemented with more detailed, local assessments where available and suitable for use. Flood extents are presented in three likelihoods:

- High likelihood: A flood event is likely to occur in the defined area on average more than once in every ten years (1:10). Or a 10% chance of happening in any one year;
- Medium likelihood: A flood event is likely to occur in the defined area on average more than once in every two hundred years (1:200). Or a 0.5% chance of happening in any one year; and
- Low likelihood: A flood event is likely to occur in the defined area on average more than once in every thousand years (1:1000). Or a 0.1% chance of happening in any one year.

11.91 The flood risk from each of these potential sources is discussed below. Consultation with AC and SEPA has been conducted and used to inform this assessment.

### *Flooding from the Sea or Tidal Flooding*

11.92 The SEPA coastal flood maps confirm that the Site is distant from all coastal flooding extents. The lowest elevations within the proposed development are approximately 168m AOD.

### *Flooding from Rivers or Fluvial Flooding*

11.93 The SEPA river flood map was developed using a nationally consistent approach to produce flood hazard information, such as depth of water and speed of flow arising from river flooding. It is based on a two-dimensional flood modelling method applied across Scotland to all catchments greater than 3km$^2$.

11.94 The river flood map includes hydraulic structures and defences such as bridges, culverts and flood storage areas where appropriate information was available. Review of the SEPA river flood map confirms that none of the proposed wind farm infrastructure lies within an area identified by SEPA as at flood risk.

11.95 The flood extents mapped by SEPA are shown to be confined by the channels of each watercourse, confirming site observations where watercourse channels are incised within the soils and superficial geology. At lower elevations and beyond the Site boundary, e.g. the Kirkney Water, River Bogie and the River Deveron, flood extents are noted to be larger.

11.96 It is noted downstream of the confluence of Glen Burn and the River Deveron that a flood defence scheme has been constructed serving the town of Huntly.

### *Flooding from Surface Water*

11.97 SEPA has modelled many small surface water flood extents within the Site, largely coinciding with existing forestry tracks, it is noted however that all the flood extents are minor and disparate, never forming large linked areas.

11.98 SEPA has confirmed that they do not have any record of existing or proposed flood defence measures in the study area.

### *Flooding from Groundwater*

11.99 The SEPA groundwater flood map illustrates that the Site is remote from any predicted groundwater flooding and concurs with the desk based assessment which has shown that there is little potential for significant groundwater at the Site.

### *Historical Flooding Records*

11.100 Within the study area SEPA has supplied photographic records regarding the most recent records of flooding of the River Bogie (07/01/2016). The River Bogie is shown to flow out of bank and flood water has been witnessed to extend to the A97 public road in the vicinity of Gartly Community Hall, and adjacent fields have been witnessed to have large areas beneath both standing and flowing water (Photograph 11.7).

**Photograph 11.7**
**Flooding at Bogie Cottage (07/01/2016)**

### *Surface Water Quality*

11.101 SEPA has classified watercourses as part of their responsibilities under the WFD. Classifications of the principal watercourses at the Site are shown in Table 11-8.

**Table 11-8**
**SEPA Surface Water Quality Classification (2015)**

| Watercourse | Overall Status | Overall Ecology | Fish Barrier | Morphology | Overall Hydrology |
|---|---|---|---|---|---|
| Glen Burn | Good | Good | High | Good | High |
| River Deveron (Black Water to Huntly) | Good | Good | Good | Good | High |
| Kirkney Water | Good | Good | High | Good | High |
| Priest's Water/Lag Burn | Moderate | Moderate | Moderate | Good | High |
| River Bogie (Culdrain to Huntly) | Poor | Poor | High | Good | High |
| River Deveron (Huntly to Turriff) | Moderate | Moderate | Moderate | Good | Good |

11.102 SEPA has identified pressures of access for fish migration from watercourse crossings presenting a barrier within the Priest's Water/Lag Burn catchment and the River Bogie (Culdrain to Huntly). Review of aerial photography suggests the presence of several weirs on the River Bogie.

11.103 To further characterise surface water quality for watercourses serving the Site, water monitoring was undertaken during field investigations (26/07/2017). Four points were visited in order to assess water quality upstream and downstream of the Site. Details are presented in Table 11-9 with monitoring locations presented within Figure 11.2.

**Table 11-9**
**SLR Surface Water Quality Monitoring Points**

| Monitoring Location | NGR | Watercourse | Surface Water Catchment | Location |
|---|---|---|---|---|
| **SWD** | NJ 43859 31368 | Ealaiche Burn | Ealaiche Burn | Downgradient of confluence of Bogrotten Burn and Craig Water. |

**Photograph 11-8**
**Sample Point SWD**

**Photograph 11-9**
**Sample Point SWD Upstream**

**Photograph 11-10**
**Sample Point SWD Downstream**

| Monitoring Location | NGR | Watercourse | Surface Water Catchment | Location |
|---|---|---|---|---|
| **SWE.1** | NJ 45396 32811 | Lag Burn | Lag Burn | Downstream of confluence of Lag Burn and Hareetnach Burn. |

**Photograph 11-11**
**Sample Point SWE.1**

**Photograph 11-12**
**Sample Point SWE.1 Upstream**

**Photograph 11-13**
**Sample Point SWE.1 Downstream**

| Monitoring Location | NGR | Watercourse | Surface Water Catchment | Location |
|---|---|---|---|---|
| **SWF.1** | NJ 46283 35209 | Burn of Tillathrowie | Priest's Water | Downstream of confluence of Burn of Tillathrowie and Burn of Corshalloch. |

**Photograph 11-14**
**Sample Point SWF.1**

**Photograph 11-15**
**Sample Point SWF.1 Upstream**

**Photograph 11-16**
**Sample Point SWF.1 Downstream**

| Monitoring Location | NGR | Watercourse | Surface Water Catchment | Location |
|---|---|---|---|---|
| **SWG** | NJ 48208 40326 | Croftmillan Burn | Glen Burn | Downstream of Wellheads Farm and upstream of confluence of Glen Burn. |

**Photograph 11-17**
**Sample Point SWG**

**Photograph 11-18**
**Sample Point SWG Upstream**

**Photograph 11-19**
**Sample Point SWG Downstream**

11.104 The results for the surface water quality monitoring are presented in Table 11-10 and were compared to the Environmental Quality Standards (EQS). Review of the data collected shows that:

- there are no exceedances of EQS for the parameters analysed for any of the samples collected on 26/07/2017;

- sample location SWG (Glen Burn) presents higher concentrations of the following parameters, which may be a response to the very different land use upgradient of SWG compared to the other monitoring locations (i.e. farming compared to commercial forestry):
  - bicarbonate alkalinity;
  - sulphate;
  - calcium;
  - magnesium;
  - manganese; and
  - potassium.

**Table 11-10**
**SLR Surface Water Quality Results (26 July 2017)**

| | | pH | Alkalinity, Bicarbonate as CaCO3 | Alkalinity, Carbonate as CaCO3 | Total Suspended solids | True Colour | Dissolved Oxygen | BOD, unfiltered | Sulphate | Chloride | Calcium (dissolved) | Calcium (total) | Iron (total) | Magnesium (dissolved) | Magnesium (total) | Manganese (total) | Potassium (dissolved) | Potassium (total) | Sodium (dissolved) | Sodium (total) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH Units | mg/l | mg/l | mg/l | mg/l Pt/Co | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l |
| EQS | AA | | | | | | | | | 250 | | | 1 | | | 0.123 | | | | |
| | MAC | 6-9 | | | 25 | | <7 | | | | | | | | | | | | | |
| SWD | | 7.37 | 55 | <2 | <2 | 55.1 | 9.15 | <1 | <2.0 | 9.9 | 4.91 | 5.99 | 0.3110 | 1.49 | 1.83 | 0.00986 | <1.00 | <2.00 | 6.59 | 8.32 |
| SWE.1 | | 7.51 | 60 | <2 | <2 | 11.6 | 8.97 | <1 | 2.1 | 9.6 | 5.71 | 5.68 | 0.0403 | 1.67 | 1.69 | 0.00174 | 1.41 | <2.00 | 8.27 | 8.47 |
| SWF.1 | | 7.63 | 50 | <2 | <2 | 12.7 | 9.54 | <1 | 3.7 | 11.2 | 9.34 | 10.20 | 0.1530 | 2.85 | 3.21 | 0.01540 | 1.15 | <2.00 | 7.50 | 8.55 |
| SWG | | 7.60 | 85 | <2 | <2 | 28.4 | 8.71 | <1 | 8.1 | 14.6 | 19.08 | 21.20 | 0.2730 | 4.90 | 5.40 | 0.06150 | 4.91 | 5.48 | 8.14 | 9.05 |

**Note:** AA: Annual Average.
MAC: Maximum Allowable Concentration (Minimum for Dissolved Oxygen)

### *Fisheries*

11.105 Fisheries are discussed in more detail within Chapter 9: Ecology and Biodiversity but are summarised below.

11.106 The River Deveron catchment is managed by the River Deveron District Salmon Fisheries Board (RDDSFB) and the Deveron, Bogie & Isla Rivers Charitable Trust (DBICT). The River Deveron is recognised as a prolific salmon, sea trout and brown trout fishery and holds the record for the heaviest fly caught salmon in the United Kingdom. Fishing beats on the River Deveron are all located downstream of the Site.

11.107 The RDDSFB and DBICT have implemented within the River Deveron river basin the Deveron District Biosecurity Project 2015-16 – Invasive Species Control, supported by SNH (Ref. 11.8). The Biosecurity Project aims to tackle invasive species including:

- Giant hogweed (Heracleum mantegazzianum);
- American mink (*Neovison vison*); and
- Japanese knotweed (*Fallopia japonica*).

11.108 Other potential threats to the River Deveron river basin identified by the Deveron District Biosecurity Project include signal crayfish (*Pacifastacus leniusculus*), zebra mussels (*Dreissena polymorpha*) and the freshwater fish parasite (*Gyrodactylus salaris)*.

### *Private Water Supplies (PWS)*

11.109 Private water supplies are regulated by the Private Water Supplies (Scotland) Regulations 2006. The Regulatory objective is to ensure the provision of clean and wholesome drinking water and the delivery of significant health benefits to those using such supplies.

11.110 As part of this assessment, data requests were made to AC and MC regarding details of private PWS within 5km of the proposed Site, supplemented with information provided in Natural Power's Clashindarroch Wind Farm Private Water Supply Risk Assessment Planning Conditions 19 & 57 (23/04/2012).

11.111 AC confirmed that there are 211 properties served by PWS while MC provided details of a further six properties within a 5km radius of the Site.

11.112 Properties that were identified within the surface water catchments that drain the Site were issued with a PWS questionnaire regarding their water supply. Of the 73 properties contacted, 24 responded.

11.113 To guide the PWS assessment a screening process has been applied using the following criteria:

- owing to the low permeability of the underlying superficial and bedrock aquifers and the shallow nature of groundwater flow within these aquifers, the hydrogeological "catchment areas" to any groundwater or spring PWS are likely to be similar to their surface water catchment areas. Only PWS sources within the six catchments presented in Figure 11.2, and discussed above, are therefore considered to be in immediate hydraulic connection to the Site; and

- to consider the impact of dilution of surface waters and diffusion of groundwater a 1km buffer has been applied to the site boundary and only PWS within this buffer are considered further.

11.114 Properties were visited by an SLR Hydrologist and Vattenfall representative on 25/07/2017 to gather further detailed information for properties identified by either MC or AC to be served by a PWS within the surface water catchments. Details of properties assessed are provided in Table 11-11 and illustrated on Figure 11.2.

**Table 11-11**
**Summary of Private Water Supplies Within 5km Hydraulically Connected to the Site**

| ID (Figure 11.2) | Property/Properties Supplied | Questionnaire Response / Property Visited | Source Type (NGR) | Potential Upgradient Infrastructure | Surface Water Catchment |
|---|---|---|---|---|---|
| **A.1** | Wellhead Cottage 1 | × | Unknown | Existing Access Track | Glen Burn |
| **A.2** | Wellhead Cottage 2 | × | Unknown | | |
| **B.1** | Evron Cottage* | × | Spring NJ 48625 39741 | None, However Pipeline Crosses Existing Access Track | |
| **B.2** | Colinvale Lodge* | × | | | |
| **C.1** | Wellheads | ✓ | Spring NJ 49395 39056 | Existing Access Track | |
| **C.2** | Bowman-hillock* | × | | | |
| **D.1** | Tigh Fada | ✓ | Borehole NJ 47928 39392 | None | |
| **E.1** | Lower Gordonsburn | ✓ | Spring NJ 47467 37539 | Existing Borrow Pit and Access Track | |
| **F.1** | Upper Gordonsburn* | × | Borehole NJ 46480 37588 | None | |
| **G.1** | Balliesward | ✓ | Spring NJ 46894 37218 | None | |
| **H.1** | Bogairdy House | ✓ | Three Springs NJ 48130 36362 | None | Shield Burn |
| **H.2** | Bogairdy Mill* | × | | | |
| **H.3** | Bogairdy Heights* | × | | | |
| **H.4** | Upper Drumbulg* | × | | | |
| **H.5** | Lower Drumbulg | ✓ | As Property IDs 9-13 + Borehole NJ 48678 35082 | | |
| **I.1** | Whitestone of Tillathrowie | ✓ | Spring / Well NJ 47928 35975 | None | |
| **I.2** | The Schoolhouse | ✓ | | | |
| **J.1** | Smithy Cottage | × | Unknown | Unknown | |
| **K.1** | Loanhead | × | Unknown | Unknown | |

| ID (Figure 11.2) | Property/Properties Supplied | Questionnaire Response / Property Visited | Source Type (NGR) | Potential Upgradient Infrastructure | Surface Water Catchment |
|---|---|---|---|---|---|
| **L.1** | Upper Tillathrowie* | × | Spring NJ 46909 35219 | Existing Access Track | Priest's Water |
| **L.2** | Tillathrowie 1* | × | | | |
| **L.3** | Tillathrowie 2* | × | | | |
| **L.4** | Tillathrowie 3* | × | | | |
| **L.5** | Tillathrowie 4* | × | | | |
| **L.6** | Tillathrowie 5* | × | | | |
| **L.7** | Tillathrowie 7 | ✓ | | | |
| **L.8** | Tillathrowie 9* | × | | | |
| **L.9** | Druim-An-Ault* | × | | | |
| **L.10** | Easter Tillathrowie* | × | | | |
| **M.1** | Wester Tillathrowie | × | Unknown | WX 1-9, Substation | |
| **N.1** | Corrylair | × | Unknown | Borrow Pit and Borrow Pit Search Area 1, 2 and 3 | |

* For properties that did not respond to the questionnaire and who were unavailable during the site visit, information has been taken from the Natural Power Clashindarroch Wind Farm Private Water Supply Risk Assessment Planning Conditions 19 & 57 (23/04/2012).

11.115 Table 11.11 confirms that no proposed wind turbines are located upstream or close to any PWS. Further, with the exception of the PWS Wester Tillathrowie (M.1) and Corrylair (N.1), no infrastructure is proposed upstream of any PWS.

11.116 Six PWS sources have been confirmed or could potentially be in hydraulic connection to the existing access track, as follows:

- Colinvale Lodge and Evron Cottage;
- Lower Gordonsburn; and
- Upper Tillathrowie, Tillathrowie 1, Tillathrowie 2, Tillathrowie 3, Tillathrowie 4, Tillathrowie 5, Tillathrowie 7, Tillathrowie 9, Druim-An-Ault and Easter Tillathrowie*
- Wellheads and Bowman-hillock;
- Wellhead Cottage 1; and
- Wellhead Cottage 2.

11.117 Review of Figure 11.2 and Table 11-11 confirms that all of the confirmed PWS sources are more than 500m from the proposed development infrastructure and therefore more than the 100m and 250m separation buffers specified in SEPA guidance (SEPA, 2017 (Ref. 11.9)).

### *Licensed Abstractions / Discharges*

11.118 SEPA holds records for many Controlled Activity Regulations (CAR) authorisations within the study area. The majority are for private home septic tank effluent discharges, none of which are located within the Site boundary. Licences for water abstraction and impoundment that are hydraulically connected to the Site and within 2km are summarised in Table 11-12 and shown on Figure 11.2.

**Table 11-12**
**Abstraction/Impoundment CAR Licences Hydraulically Connected to Site within 2km**

| Drawing Ref. No. | CAR Licence No. | Name | Activity | NGR | Distance to Site (km) |
|---|---|---|---|---|---|
| 1 | CAR/R/1116526 | Abstraction at Clashindarroch Wind Farm, Huntly | Water abstraction | NJ 48530 37600 | 0.000 At Proposed Site Compound |
| 2 | CAR/S/1018715 | Craighead Water Treatment Works (WTW) | Water abstraction | NJ 49750 40460 | 0.425 East |
| 3 | RES/R/1127807 | Craighead Reservoir | Impoundment | NJ 49562 40324 | 0.370 East |
| 4 | CAR/R/1011318 | Artloch Fishery, Longhill, Huntly | Impoundment / Fishing | NJ 47790 40325 | 0.760 West |
| 5 | CAR/R/1116472 | Temporary Compound 2, Abstraction at Clashindarroch Wind Farm | Water abstraction | NJ 42000 31120 | 1.200 West |

11.119 Scottish Water operates the Craighead Reservoir immediately south of the A920 near the existing Site entrance. This reservoir supplies drinking water to the Craighead Water Treatment Works (WTW) located nearby at NGR NJ 49776 40462. Both are located downstream of the Site.

11.120 The impoundment at Artloch (Drawing reference (ref). 4) is located upstream of the Site. The applicant holds two groundwater well abstractions (ref. 1 and 5) which were developed when the Clashindarroch Wind Farm was constructed. It is understood that only ref. 5 is currently used and is a 70m deep borehole which is used to provide water for use at the Site control room.

11.121 The River Deveron catchment to the west and north of the Site has been designated as a Drinking Water Protection Zone (DWPZ) and asset plans provided by Scottish Water have highlighted the presence of infrastructure conveying raw water from within the Glen Burn catchment and the River Deveron to Craighead Reservoir and the Craighead WTW. The infrastructure is illustrated on Figure 11.2, and is understood to comprise:

- River Deveron abstraction at NGR NJ 48729 40665;
- Glen Burn abstractions:
- Several minor springs in the vicinity of NGR NJ 49204 40000;
- Croftmillan Burn abstraction at NGR NJ 49083 39196;
- Croftmillan Burn abstraction at NGR NJ 48804 39296;

- Croftmillan Burn abstraction at NGR NJ 49207 38680; and
- Croftmillan Burn abstraction at NGR NJ 49589 37788.

11.122 The proposed temporary construction compound is located at the top of the Glen Burn catchment. The Clashindarroch Wind Farm access track also lies within this catchment. Both are potentially upstream and in hydraulic continuity with these Scottish Water sources. It is noted, that the proposed temporary construction compound is at the same location as the temporary construction compound that as used for the Clashindarroch Wind Farm.

## Receptor Sensitivity

11.123 Table 11.13 outlines the receptors identified as part of the baseline study, and their sensitivity based upon the criteria contained in Table 11-3. These receptors form the basis of the assessment, and as per the methodology, are used in conjunction with an estimate of the magnitude of an impact to determine the significance of any potential effect.

**Table 11-13**
**Sensitivity of Receptors**

| Receptors | Sensitivity | Reason for Sensitivity | Effects Assessed for Construction and Operation |
|---|---|---|---|
| Water Dependent Statutory Designated Sites | High | All designated sites are outside of direct hydraulic connectivity to the Site. | None |
| Soils and Geology | High | No significant peat depths or geological designated sites would be disturbed by the proposed development. | None |
| Hydrogeology | High | Groundwater beneath the Site is of Good water quality. | Pollution, drainage and groundwater-surface water interactions. |
| Hydrology | High | Surface water catchments draining the Site have been classified with Moderate-Good water quality. | Pollution, erosion and sedimentation, drainage and groundwater-surface water interactions. |
| Flooding | Moderate | Four of the surface water catchments draining the Site contribute runoff to the River Bogie and River Deveron, both of which have flooded recently. | Changes in runoff rate and volume due to changes in vegetation cover. |
| Fisheries | High | Surface water catchments serving the Site all discharge to the River Deveron, recognised as a Salmonid watercourse. | Pollution, erosion, sedimentation. |
| GWDTE | High | No GWDTE have been identified. | None. |
| Private Water Supplies | High | Private water supplies located close to proposed wind farm infrastructure. | Pollution, erosion, sedimentation and |

| Receptors | Sensitivity | Reason for Sensitivity | Effects Assessed for Construction and Operation |
|---|---|---|---|
| Licenced Abstractions / Discharges | High | Existing track within the Glen Burn catchment crosses Scottish Water drinking water infrastructure and is in a DWPA | changes in yield. |

# FUTURE BASELINE

11.124 Climate change studies predict a decrease in summer precipitation and an increase in winter precipitation alongside slightly higher average temperatures. This suggests that there may be greater pressures on water supplies and water levels in summer months in the future. In addition, summer storms are predicted to be of greater intensity. Therefore, peak fluvial flows associated with extreme storm events may also increase in volume and velocity.

# ASSESSMENT OF EFFECTS

11.125 The assessment of effects is based on information presented in Chapter 3: Description of the Development and is structured as follows:

- construction effects of the proposed development;
- operational effects of the proposed development; and
- cumulative effects of the proposed development, and other proposed wind farms in the study area.

## Embedded Mitigation and Good Practice Measures

### *Embedded Mitigation*

11.126 The proposed development has undergone design iterations and evolution in response to the hydrological and hydrogeological constraints identified as part of the baseline studies and field studies so as to avoid and/or minimise potential effects on receptors where possible. This has included watercourse locations, areas of potential flooding and GWDTEs.

#### Buffer to Watercourses

11.127 In accordance with wind farm construction best practice guidelines, a 50m buffer was applied between watercourses and any proposed construction activities or infrastructure within the Site (see Figure 11.2).

11.128 The layout of the proposed access track was designed to minimise the requirement for any additional watercourse crossings. The existing access track watercourse crossings would be used and upgraded where required.

### *Good Practice Measures*

11.129 Certain Good Practice Measures would be adhered to during the construction and operation of the proposed development. Good practice measures would be applied in relation to pollution risk, and management of surface runoff rates and volumes. This would form part of the final CEMP (see Technical Appendix 3.1: Draft Construction and Environmental Management Plan) to be implemented for the proposed development.

11.130 Key good practice measures are stated below and the assessment incorporates these measures as part of the proposed development. Any further specific mitigation which might be required to reduce the significance of a potential effect has been identified in the assessment of likely effects during the construction and operation phases.

#### General Measures

11.131 As a principle, preventing the release of any pollution/sediment is preferable to dealing with the consequences of any release. There are several general measures which cover all effects assessed within this chapter, details are given below.

11.132 Prior to construction, section specific drainage plans would be produced. These would take into account any existing local drainage which may not be mapped and incorporate any section specific mitigation measures identified during the assessment.

11.133 Measures would be included in the final CEMP for dealing with pollution/sedimentation/flood risk incidents and would be developed prior to construction. This would be adhered to should any incident occur, reducing the effect as far as practicable.

11.134 The final CEMP would contain details on the location of spill kits, would identify hotspots where pollution might be more likely to originate from, provide details to site personnel on how to identify the source of any spill and state procedures to be adopted in the case of a spill event. As identified in the draft CEMP, a specialist spill response contractor would be identified to deal with any major environment incidents.

11.135 A wet weather protocol would be developed. This would detail the procedures to be adopted by all staff during periods of heavy rainfall. Tool box talks would be given to engineering/construction/ supervising personnel.

11.136 Roles would be assigned to different engineering/construction/supervising personnel and the inspection and maintenance regimes of sediment and runoff control measures would be adopted during these periods. In extreme cases, the above protocol would dictate that work onsite might have to be temporarily suspended until weather/ground conditions allow.

#### Water Quality Monitoring

11.137 Water quality monitoring during the construction phase would be undertaken for the surface water catchments that drain the Site, to ensure that none of the tributaries of the main channels are carrying pollutants or suspended solids. Monitoring would be carried out at a specified frequency (depending upon the construction phase) on these catchments.

11.138 This monitoring would continue throughout the construction phase and immediately post

construction. Monitoring would be used to allow a rapid response to any pollution incident as well as to assess the impact of good practice or remedial measures. Monitoring frequency would increase during the construction phase if remedial measures to improve water quality were required to be implemented. The water quality monitoring plan would be developed during detailed design and AC, SEPA and the DDSFB would be consulted on the plan and the agreed plan would be contained within the final CEMP.

11.139 The performance of the good practice measures would be kept under constant review by the water monitoring schedule, based on a comparison of data taken during construction phase with a baseline data set, sampled prior to the construction period.

### Pollution Risk

11.140 Good practice measures in relation to pollution prevention would include the following:

- refuelling would take place at least 50m from watercourses and where possible it would not occur when there is risk that oil from a spill could directly enter the water environment. For example, refuelling during periods of heavy rainfall or when standing water is present would be avoided;
- foul water generated onsite would be managed in accordance with best practice and would be drained to a sealed tank and routinely removed from Site;
- drip trays would be placed under vehicles when parked, if the vehicles could potentially leak fuel/oils;
- areas would be designated for washout of vehicles which would be a minimum distance of 50m from watercourses;
- washout water would also be stored in the washout area before being treated and disposed of;
- if any water was found to be contaminated with silt or chemicals, runoff would not be allowed to enter a watercourse directly or indirectly without treatment;
- water would be prevented as far as possible, from entering excavations;
- procedures would be adhered to for the storage of fuels and other potentially contaminative materials in line with the Water Environment (Oil Storage) (Scotland) Regulations 2006, to minimise the potential for accidental spillage (e.g. stored in 110% bunded storage facilities); and
- a plan for dealing with spillage incidents would be designed prior to construction, and this would be adhered to should any incident occur, reducing the effect as far as practicable. This would be included in the final CEMP.

11.141 Site investigation (e.g. trial pitting and/or boreholes) would be undertaken prior to any construction works where excavation would be required to establish the wind farm and it would inform detailed design and construction methods to ensure pollution risk is considered prior to construction. These methods would be specified in the final CEMP.

### Erosion and Sedimentation

11.142 Good practice measures for the management of erosion and sedimentation would include the following:

- all stockpiled materials would be located more than 50m from watercourses;
- water would be prevented as far as possible, from entering excavations through the use of appropriate cut-off drainage;
- where the above is not possible, water that enters excavations would pass through a number of settlement lagoons and silt/sediment traps to remove silt prior to discharge into the surrounding drainage system. Detailed assessment of ground conditions would be required to identify locations where settlement lagoons would be feasible;
- clean and dirty water onsite would be separated and dirty water would be filtered before entering the stream network;
- if materials were to be stockpiled on a slope, silt fences would be located at the toe of the slope to reduce sediment transport;
- the amount of ground exposed, and time period during which it is exposed, would be kept to a minimum and appropriate drainage would be in place to prevent surface water entering deep excavations;
- where required stockpiled material would either be seeded or appropriately covered, minimising the area of exposed bare ground;
- a design of drainage systems and associated measures to minimise sedimentation into natural watercourses would be developed. This could include silt traps, check dams and/or diffuse drainage;
- silt/sediment traps, single size aggregate, geotextiles or straw bales would be used to filter any coarse material and prevent increased levels of sediment. Further to this, activities involving the movement or use of fine sediment would avoid periods of heavy rainfall where possible; and
- construction personnel and the Principal Contractor would carry out regular visual inspections of watercourses to check for suspended solids.

### Fluvial Flood Risk

11.143 Sustainable Drainage Systems (SuDS) would be incorporated as part of the proposed development.

11.144 SuDS techniques aim to mimic pre-development runoff conditions and balance or throttle flows to the rate of runoff that might have been experienced at the Site prior to development. Good practice in relation to the management of surface water runoff rates and volumes and potential for localised fluvial flood risk would include the following:

- drainage systems would be designed to ensure that any sediment, pollutants or foreign materials which could cause blockages are removed before water is discharged into a watercourse;
- onsite drainage would be subject to routine checks to ensure that there is no build-up of sediment or foreign materials which could reduce the efficiency of the original drainage

design causing localised flooding;

- appropriate drainage would attenuate runoff rates and reduce runoff volumes to ensure minimal effect upon flood risk;
- where necessary, check dams would be used within cable trenches in order to prevent trenches developing into preferential flow pathways and trenches would be backfilled with retained excavated material; and
- as per good practice for pollution and sediment management, prior to construction, section specific drainage plans would be developed and construction personnel would be made familiar with the implementation of these.

11.145 Further information on ground conditions and drainage designs would be provided in the final CEMP.

### Water Abstractions

11.146 Abstraction of water for construction activities is proposed from the existing abstraction borehole within the Site boundary, licence number CAR/R/1116526.

11.147 Good practice that would be followed in addition to the CAR Licence regulations includes:

- water use would be planned so as to minimise abstraction volumes;
- water would be re-used where possible; and
- abstraction volumes would be recorded.

### Water Course Crossings

11.148 Two additional water crossings are required for the proposed development as detailed within Chapter 3: Description of the Development. The locations of existing watercourse crossings that would be used on the existing access track are shown on Figure 11.1. Crossings that would require upgrade are also shown on Figure 11.1.

11.149 A schedule of all watercourse crossings is shown as Technical Appendix 11.3.

11.150 Design details for the two proposed watercourse crossings and the upgraded crossings would be agreed with SEPA as part of the detailed site design. All engineering works would be undertaken in accordance with a Controlled Activity Regulations (CAR) Licence.

### Forest Felling

11.151 Forest managers can control the impact of forest harvesting on soil and water acidification by phasing felling. Other management practices can also ameliorate the effects, such as restricting whole-tree harvesting and the removal of forest residues in acid-sensitive areas. The Forestry Commission (Ref. 11.10) report that "*research shows that the effects of harvesting on surface water acidity are difficult to discern when 20% or less of a catchment is felled within any three-year period. Consequently, where the rate of felling exceeds this figure it may be necessary to carry out a site impact assessment to determine if the watercourse is at risk: this includes felling for habitat restoration or wind farm developments*".

11.152 The forestry management plan would include contingencies for possible events such as severe weather. The plan would describe how the Site would be set out and worked to reduce the risk of adverse effects. This would cover the selection of cultivation techniques to minimise disturbance, such as mounding or scarification, and the appropriate matching of harvesting machinery to ground conditions. The timing of operations to avoid adverse weather and ground conditions, and the strict enforcement of protective riparian buffer areas would also be covered in the plan.

11.153 Detailed consideration of the required felling and of forest management are given in Technical Appendix 3.2: Forestry. It is confirmed that where possible, due to the crop growth rates, age and current crop height the infrastructure within woodland areas could be largely keyholed into the existing crops. Where keyholing is not viable, the crop will be clear felled back to an existing wind firm edge. Acidification of rainfall runoff as a consequence of tree felling would, therefore, not occur.

## Construction Effects

11.154 Construction activities, as set out in Chapter 3: Description of the Development, have the potential to affect hydrological receptors and these are assessed below.

11.155 The assessment assumes that good practice (see Good Practice Measures, above) would be applied throughout construction and the levels of predicted magnitude are based on this assumption.

### *Potential Effects*

#### Pollution Risk

11.156 During the construction phase, there is the potential for a pollution event to affect surface water bodies impacting on their water quality. This would have a negative effect on the receptor and degradation of the water quality could impact on any aquatic life and private and public water supplies that were abstracting from the watercourse.

11.157 Pollution could occur from excavated and stockpiled materials during Site preparation. Contamination of surface water runoff from machinery, leakage and spills of chemicals from vehicle use, and the construction of infrastructure also have the potential to affect surface water bodies. Potential pollutants include sediment, oil, fuels and cement.

11.158 The risk of a pollution incident occurring would be managed using good practice measures as detailed above. Many of these practices are concerned with undertaking construction activities away from watercourses and identifying safe areas for stockpiling or storage of potential pollutants that could otherwise lead to the pollution of watercourses.

11.159 The baseline assessment has shown that the proposed development lies within the River Deveron catchment, and that it and its tributaries are recognised as important salmonid rivers and as such are recognised as High sensitivity receptors.

11.160 The magnitude of a pollution event within the surface water sub-catchments is considered to be Negligible following adherence to good practice measures. The potential effect of a Negligible magnitude event on watercourses of High sensitivity would be of Negligible significance and **Not Significant** in terms of the EIA Regulations. No further mitigation measures would therefore be required.

11.161 The groundwater bodies extending beyond the study area are very large when compared to the area of proposed development. Any effects from pollution would be judged not to be detectable beyond the study area. Potential pollution events occurring during the construction of the turbines or any hardstanding would be likely to be of Negligible magnitude as they would be controlled by good practice measures and would be subject to some attenuation in the soils before reaching groundwater. Should pollutants reach the groundwater the scale of the effect would be low in relation to the overall groundwater body. The effect to groundwater, which has been assigned a High sensitivity, is therefore assessed as being of Negligible significance, and would be **Not Significant**. No further mitigation measures would be required.

### Erosion and Sedimentation

11.162 Site traffic during the construction phase has the potential to cause erosion and increase in sedimentation loading during earthworks which could be washed by rainfall or inappropriate site practices, into surface water features. This has the potential to reduce the surface water quality, increase turbidity levels, reduce light and oxygen levels and affect the ecology of watercourses including fish populations. After consideration of good practice measures, the magnitude of the likely impact to the receptors has been assessed as Negligible. The effects on the High sensitivity receptors described above, without mitigation has also assessed as Negligible and **Not Significant**. No further mitigation measures would then be required.

11.163 Excavations, construction of hardstanding and diversion of drainage channels are key sources of sediment generation. Adherence to good practice measures would ensure that any material generated is not transported into nearby watercourses.

11.164 Location specific good practice measures would be specified in the final CEMP and would be identified onsite by the Site ECoW to control the amount of fine sediment that could potentially enter a watercourse if not managed appropriately. These measures would potentially include cut-off drainage, sediment traps and sumps.

### Fluvial Flood Risk

11.165 Construction of hardstanding including the substation, temporary construction compound and turbine bases would create impermeable surface areas. This would lead to a relatively small increase in the total impermeable surface area of the Site, causing negligible increases in runoff rates and volumes within four of the surface water sub-catchments.

11.166 Adherence with good practice measures including appropriate drainage design and compliance with the final CEMP would limit any potential effects to being local and of short duration and consequently of Negligible magnitude.

11.167 The magnitude of the increase in impermeable area within the catchments would not be sufficient to have a measurable effect on groundwater levels, as the extent of the impermeable area would be insignificant compared to the extent of the underlying geology and groundwater.

11.168 It is proposed that any rainwater and limited groundwater ingress which would collect in the turbine excavations during construction would be stored and attenuated prior to controlled discharge to ground adjacent to the excavation.

11.169 Attenuation of runoff generated within the proposed turbine excavations would allow settlement

of suspended solids within the runoff prior to discharge in accordance with the Site control component of the SuDS management train.

11.170 The potential effect on flood risk, which is considered to be a receptor of Moderate sensitivity, is therefore assessed as being of Negligible significance and **Not Significant** in relation the EIA Regulations. No further mitigation would therefore be required.

### Infrastructure and Man-made Drainage

#### Water Table

11.171 During the construction period, man-made drainage would be required to ensure that construction areas are workable and not saturated. In particular, drainage would be required around the turbine working areas, the construction compound and substation to manage surface flows (some of this would only be temporary). Excavation of turbine foundations could require temporary de-watering for the period of the foundation build. These drainage activities could lead to temporary changes, in the water table surrounding these construction activities (i.e. where de-watering is required below the level of the natural water-table).

11.172 As areas of potential GWDTE are sustained by surface water rather than groundwater, surface water drainage paths to these habitats would be maintained and not affected during the construction phase.

11.173 The potential effect of the proposed development on groundwater and areas of potential GWDTE would be considered unlikely to change during the operation of the proposed development and therefore has not been considered under operational effects as discussed later in this Chapter.

11.174 Excavations associated with construction works (e.g. cut tracks, turbine bases foundations, cable trenches etc.) can result in local lowering of the water table. This is important in areas of upgradient of peat and PWS sources that are derived from groundwater sources (springs and boreholes). The fieldwork and baseline studies have confirmed that there are only isolated peat deposits identified within the study area, none of which are close to any of the proposed infrastructure (see Technical Appendix 11.1: Peat Assessment).

11.175 Dewatering associated with construction of turbine foundations is usually temporary and additional dewatering following construction would not be required. Cable laying, without appropriate mitigation measures, can also lower high groundwater levels and provide a preferential drainage route for groundwater movement that can lead to local and permanent drying of soils/superficial deposits and/or water supplies.

11.176 The design of the proposed development has avoided areas of ecological or habitat interest wherever possible. Furthermore, the underlying bedrock has little groundwater and therefore limited or little dewatering is likely to be required. There remains potential, however, for localised dewatering of soils near cable trenches and turbine bases, without the incorporation of mitigation measures.

#### PWS

11.177 Private water supplies potentially sourced from groundwater have been identified at Corrylair and Wester Tillathrowie and these could potentially be in hydraulic continuity with the proposed

development.

11.178 Development of the borrow pit search areas 1, 2 and 3 could affect the quantity and quality of water that drains to Corrylair whilst the development of the substation would lie upgradient of Wester Tillathrowie. However, with the proposed safeguards the magnitude of potential effect on the private water supplies is assessed as Low. Given that these are High sensitivity receptors the potential effect is assessed to be of Minor significance and **Not Significant** in terms of the EIA Regulations. Further mitigation would therefore not be required.

Groundwater and GWDTE

11.179 The sensitivity of the groundwater receptor (and habitat that might be dependent on groundwater) has been assessed as High. However, as discussed above and as a consequence of the Site geology, the extent of any dewatering would be very small. Without mitigation the magnitude of impact is assessed as Negligible and therefore the potential significance of effect of changing groundwater levels and flow due to dewatering is considered to be of Negligible significance and **Not Significant**. and therefore would require no further mitigation.

Water Abstraction

11.180 During the construction of the proposed development, water could potentially be abstracted for uses such as dust suppression, vehicle washing, concrete batching and welfare facilities. The volume of water and mitigation required would be regulated through the existing CAR abstraction licence and therefore the magnitude of effect on groundwater-surface water interactions is considered Negligible. The significance of effect would therefore be Negligible and **Not Significant**.

### *Residual Effects*

11.181 No significant residual effects on surface water, groundwater and geology receptors are predicted during the construction period of the proposed development.

## Operational Effects

11.182 During the operational phase of the proposed development, routine maintenance of infrastructure would be required. This could include work such as maintaining wind farm tracks, maintaining drainage paths and turbine maintenance.

11.183 Should any maintenance be required onsite during the operational life of the proposed development which would involve construction type activities; mitigation measures would be adhered to along with the measures described in the final CEMP, in order to avoid potential effects.

### *Potential Effects*

#### Pollution Risk

11.184 The possibility of a pollution event occurring during the operation phase is considered very unlikely. There would be a limited number of vehicles required onsite for routine maintenance in addition to the Applicant's operational presence. Storage of fuels/oils onsite would be limited to the hydraulic oil required in turbine gearboxes and this would be bunded (satisfying storage guidance) to prevent fluid escaping.

11.185 Based upon this, the potential risk associated with a pollution event (i.e. frequency, duration and likelihood) is considered to be low. It is therefore anticipated that the magnitude of a pollution event during the operational phase of the proposed development would be Negligible, as no detectable change would be likely to occur. Therefore, the significance of a pollution event during the operational phase of the development is predicted to be Negligible for all receptors. No mitigation would therefore be required.

### Erosion and Sedimentation

11.186 During the operation of the proposed development, it is not anticipated that there would be any significant excavation or stockpiled material beyond the clearing of SuDS features to maintain their efficiency, reducing the potential for erosion and sedimentation effects.

11.187 Immediately post-construction, newly excavated drains and track dressings could be prone to erosion as at that stage any vegetation would not have matured. Appropriate design of the drainage system, incorporating sediment traps, would reduce the potential for the increased delivery of sediment to natural watercourses. Potential effects from sedimentation or erosion during the operational phase are considered likely to come from linear features on steeper slopes, where velocities in drainage channels would be higher. Immediately post-construction, flow attenuation measures would remain and be maintained to slow runoff velocities and prevent erosion until the vegetation has become established.

11.188 The likelihood, magnitude and duration of a potential erosion and sedimentation event occurring within the surface water catchments would be Negligible assuming adherence to good practice measures. Therefore, the potential effect on these High sensitivity receptors would be of Negligible significance and **Not Significant**. No specific mitigation beyond good practice would therefore be required.

11.189 Should any non-routine maintenance be required at the sections of track crossing wet areas (defined visually onsite by a contractor or operational personnel) there would be potential for erosion and sedimentation effects to occur due to the existence of disturbed material. Should this type of activity be required, then the good practice measures as detailed for the construction phase would be required on a case by case basis. Extensive work at water crossings/adjacent to the water environment might require approval from SEPA under the CAR (depending upon the nature of the activity).

### Fluvial Flood Risk

11.190 The risk of an effect on fluvial flood risk could arise as a result of a potential restriction of flow at the existing watercourse crossings following a period of intense rainfall. In accordance with good practice, routine inspection of the culverts at the Site would be undertaken, reducing the likelihood of a blockage occurring. In the unlikely event of a blockage, any flooding would be localised. The magnitude of impact is assessed as Negligible, and thus the significance of effect has also been assessed as Negligible and **Not Significant**. No further mitigation would be required.

### Infrastructure and Man-made Drainage

11.191 Operation of the proposed development would require limited activities compared to the construction phase.

11.192 The magnitude of any potential effect on groundwater and sub-surface flows as a result of permanent hardstanding and associated drainage would be Negligible in relation to the overall groundwater body. The significance of effect is therefore considered to be Negligible and **Not Significant**. No further mitigation would be required.

### *Mitigation*

11.193 As there are no predicted significant effects under the terms of the EIA Regulations, other than the good practice measures (see Good Practice Measures) that would be implemented as standard, no specific mitigation, during operation, is required.

### *Residual Effects*

11.194 No significant residual effects on geology, surface water or groundwater receptors are predicted during the operational period of the proposed development.

## FURTHER SURVEY REQUIREMENTS AND MONITORING

11.195 This Chapter has demonstrated that the effects of the proposed development that have been assessed are not likely to have significant effects on the study area's soils, geology or hydrological receptors. The lack of significant effects relates primarily to the proposed 'Good Practice Measures', proposed water quality monitoring and the iterative design process which effectively act as 'embedded' mitigation.

11.196 No other further surveys or monitoring is considered necessary to complete this assessment.

11.197 It has been recognised in this assessment that a programme of water monitoring would be required prior to any construction activity and during construction of the proposed development. The monitoring programme would be agreed with SEPA, AC and DDSFB, and it is expected to include monitoring PWS sources and watercourses identified at potentially at risk without incorporation of best practice construction and mitigation techniques.

11.198 In addition, an outline Fisheries Management Plan (FMP) has been agreed in consultation with fisheries biologists form the Deveron, Bogie and Isla Rivers Charitable Trust (see Appendix 9.6) which includes provision for water quality monitoring.

## SUMMARY OF PREDICTED EFFECTS

11.199 A summary of effects and proposed mitigation measures required to reduce the potential effects to acceptable levels are identified in Table 11-14.

**Table 11-14**
**Summary of Residual Effect after Mitigation**

| Potential Effect | | Significance of Effect before Mitigation | Proposed Mitigation / Enhancements | Significance of Residual Effect |
|---|---|---|---|---|
| Construction | Pollution, Erosion and Sedimentation | Negligible - Low | None required above good practice techniques and water quality monitoring.<br><br>Monitoring of the Corrylair and Wester Tillathrowie PWS and key watercourses with fisheries interests. | Negligible |
| Operation | | No additional mitigation measures required. | | |
| Cumulative | | There are no predicted cumulative effects of the development within the hydrological study area. | | |

# CUMULATIVE EFFECTS ASSESSMENT

11.200 This section considers the potential cumulative geological and hydrological effect of the proposed development taking into consideration other wind farm developments within the same hydrological catchments. Any developments which are outwith the study area have not been considered.

11.201 The proposed development would lie adjacent to the operational Clashindarroch Wind Farm (18 turbines) and a single operational turbine at Balliesward (Figure 7.7a), also within the sub-catchments of the River Deveron's headwaters.

11.202 SuDS measures have been proposed at the Site and have also been incorporated in the design of the Clashindarroch Wind Farm. These measures, and the best practice measures incorporated in the design of the Clashindarroch Wind Farm would prevent any cumulative effects from occurring.

11.203 Similarly, there would be no cumulative effects on geology or soils.

11.204 The single turbine at Balliesward is of a scale, when compared to the extent of the local geology and the size of the ground and surface water catchments, that would not produce any potential cumulative effects.

# STATEMENT OF SIGNIFICANCE

11.205 This Chapter has assessed the likely significance of effects from the proposed development on hydrology, hydrogeology and geology (including soils).

11.206 As a consequence of the Site design, the proposed development has been assessed as having no significant effects following adoption of good practice measures and site-specific mitigation measures.

# REFERENCES


Ref 11.1: Scottish Government (2014). Scottish Planning Policy. The Scottish Government.

Ref 11.2: Aberdeenshire Council (2017) Local Development Plan. https://www.aberdeenshire.gov.uk/planning/plans-and-policies/aberdeenshire-local-development-plan-2017/ [accessed 28/11/2019]

Ref. 11.3: FEH Web Service, available online at https://fehweb.ceh.ac.uk/ [accessed 20/11/2019]

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