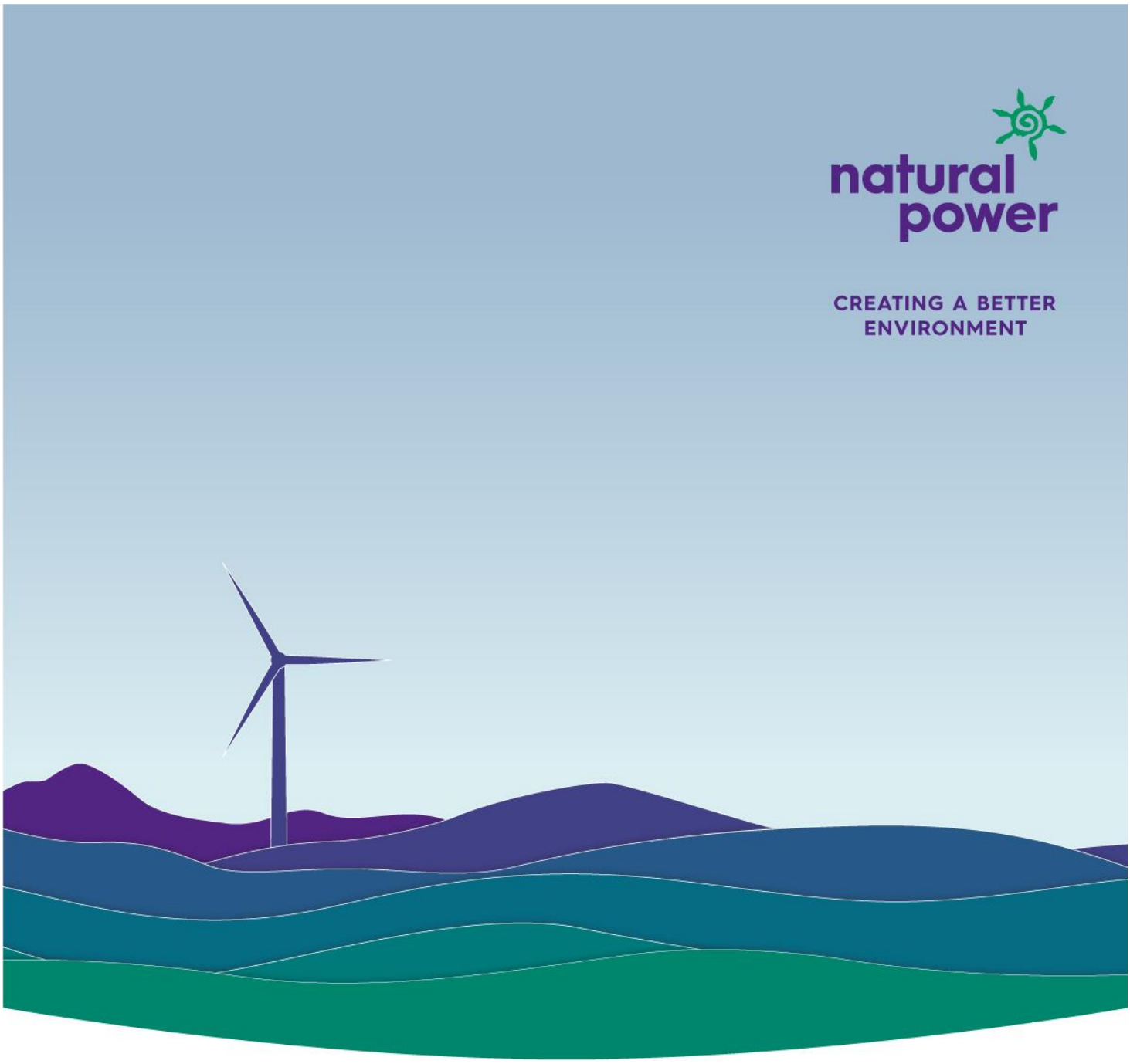
Creag Riabhach Wind Farm Extension

Technical Appendix 9.3: CRWF Water Quality Management Plan



Creag Riabhach Wind Farm CEMP

Appendix D: Water Quality Monitoring Plan
Condition 13(d)

August 2018

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ERG EVOLVING ENERGIES

ERG

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Contents

1. Introduction

This document details the requirements for water quality monitoring at Creag Riabhach Wind Farm and forms part of the Construction Environmental Management Plan (CEMP, Document Reference: 1200319). Creag Riabhach Wind Farm (herein referred to as "the Development") is situated near to Altnaharra, Sutherland and was consented by Scottish Ministers in October 2016. The Development comprises of the construction of up to twenty-two wind turbines and associated infrastructure.

Construction works have the potential to cause pollution to the water environment. All construction works on site, and specifically construction works to be undertaken within and in the vicinity of any watercourses, will be completed in compliance with current legislation and best practice as detailed in the CEMP and published guidance documents.

The purpose of this Water Quality Monitoring Plan will provide a continual review of water quality prior to, during and post completion of construction works and will serve to identify construction impacts (pollution) and corrective actions if required.

This Water Quality Monitoring Plan extends to all watercourses within the catchment of the construction areas.

1.1. Planning Requirements

A number of planning conditions associated with the Development require detailed attention and subsequent design of environmental protection through appropriate and detailed design considerations as well as the adoption of site-specific monitoring and contingency plans.

As detailed in Planning Condition 13 of the Decision Notice for the Section 36 Consent, there is a requirement to formulate a Water Quality Management Plan providing details on monitoring regimes. Other information pertinent to the management of water quality can be found in the Drainage Management Plan (Document Reference: TBC). Aquatic Ecology is discussed within the Construction and Operational Fish Management Plan (Document Reference: CC0511/CMS1/V3) and is presented as an Appendix to this report.

As part of the ERG's (the Client) continuing commitment to protect all aspects of the natural environment during the construction and operation of the Development, the following methodology for the site-specific water quality monitoring plan has been proposed.

This methodology, as detailed, will include the hierarchy of monitoring requirements needed to assess and monitor the water quality from watercourses which are potentially susceptible to impacts from infrastructure and construction areas within the site. This monitoring plan is designed to outline the means of assessing the effectiveness of wind farm construction and the implementation of associated mitigation measures.

2. Responsibilities

2.1. Balance of Plant Contractor

The Balance of Plant (BoP) Contractor is responsible for pollution prevention for the duration of the construction works and until such time as permanent measures, such as permanent drainage and silt mitigation controls, are deemed to be adequate and appropriately constructed.

As part of the site induction process the BoP encourages all personnel and visitors to report, any visual indications of changes in water quality (i.e. discolouration or other evidence of contamination) in any watercourses on site. Any evidence must be reported to the Ecological Clerk of Works (ECoW) and BoP Contractor.

2.2. Ecological Clerk of Works

The ECoW undertakes visual monitoring on site and liaises with the nominated water quality monitoring consultant and the BoP Contractor.

2.3. Water Quality Monitoring Works

The overall implementation and management of the water quality monitoring programme will lie with the nominated water quality monitoring consultant, employed by the Client. This responsibility extends to overall coordination of both field and laboratory aspects of the monitoring programme, liaison with the ECoW or other nominated site personnel and the BoP Contractor.

The nominated water quality monitoring consultant shall provide regular reporting of the field and laboratory analysis as detailed in Section 3.

3. Monitoring Requirements

The proposed monitoring methodology has been derived based on the following:

- Consideration of the potential natural and anthropogenic influences on the hydrological environment;
- Identification of on-site and downstream sensitive receptors;
- Once all possible effects have been identified, consider water management, construction management and monitoring practices that need to be taken into account; and
- If the sustainable water management measures fail or have not been implemented appropriately or the results of water quality monitoring record prolonged increases in concentrations that do not correlate with climatic conditions, consideration of the emergency procedures that should be implemented to reduce the effects on the hydrological environment.

Water quality monitoring at Creag Riabhach Wind Farm will include:

- Visual inspections;
- In-situ sampling using a handheld monitoring meter; and
- Extractive sample collection for laboratory analysis.

Table 3.1 provides a summary of the monitoring commitments to ensure compliance.

Table 3.1: Water Quality Monitorng Requirements

Item	Monitoring Method	Monitoring Locations	Monitoring Frequency	Monitoring Phases	Parameter
1	Visual	Site wide and receiving watercourses	Weekly Monthly	Construction (as part of ECoW role) Pre-Construction (minimum 6 months) Construction (as part of WQMP)	Discolouration Cloudiness Olfactory (hydrocarbon spillage)
2	In-Situ (data collected using handheld monitors)	7	Monthly Bi-Monthly	Pre-Construction (minimum 6 months) Construction Post Construction (up to 1 year)	pH Electrical Conductivity Dissolved Oxygen Turbidity Temperature
3	Water Sample Collection (samples collected and sent to a UKAS laboratory for analysis)	7	Monthly Bi-Monthly	Pre-Construction (minimum 6 months) Construction Post Construction (up to 1 year)	Ammoniacal Nitrogen Biological Oxygen Demand Chloride Dissolved Aluminium Dissolved Organic Carbon Nitrate Soluble Reactive Phosphate Sulphate Total Alkalinity Total Organic Carbon Total Oxidised Nitrogen Total Suspended Solids Total Petroleum Hydrocarbons

3.1. Water Quality Monitoring Locations

The seven sampling locations have been considered to be representative of the surface water quality within the main catchments of the development are located downstream of construction works or in the case of the control location situated upstream of construction related works. The monitoring locations will be clearly identified to ensure that the same locations are used throughout all phases of the development, ensuring a consistent approach and allowing for comparison of results over time and identification of any trends.

Grid references for the proposed monitoring locations are provided in Table 3.2 below, and illustrated in Figure 1, Appendix A. These locations were selected following a detailed desk study followed by a site visit which took place in June 2019.

Table 3.2: Water Quality Monitoring Sampling Points

ID	Easting	Northing	Comment	Photo	Watercourse	Proposed level of monitoring	Rationale for Inclusion
WQ1	253720	929107	Moorland, deep vee / gorge valley form		Unnamed tributary of the River Vagastie	Visual, in-situ and extractive	To monitor water quality draining from construction activity in the far northeast of the Development.
WQ2	253464	928547	Moorland & natural woodland. Incised, narrow channel. Channel was noted to be heavily vegetated and demonstrating low flows during survey.		Unnamed tributary of the River Vagastie	Visual, in-situ and extractive	To monitor water quality draining from construction activity in the north and east of the Development.
WQ3 (control)	252175	929825	Moorland, meandering narrow channel with shallow flow gradient		Allt Bealach an Fhuarain	Visual, in-situ and extractive	To monitoring water quality upstream of all development works. To be used as quality control location.
WQ4	253264	927208	Moorland & commercial forestry		River Vagastie	Visual, in-situ and extractive	To monitor water quality draining from construction activity in the western and southern section of the Development.

ID	Easting	Northing	Comment	Photo	Watercourse	Proposed level of monitoring	Rationale for Inclusion
WQ5	251854	927838	Moderate flow. Banks noted to be undercut with recent collapse evident		Allt Bealach an Fhuarain	Visual, in-situ and extractive	To monitor water quality draining from construction activity in the north and west of the Development. WQ4 will enable monitoring of water quality south of this point.
WQ6	253277	927404	Moorland, narrow incised channel. Channel was noted to be heavily vegetated and demonstrating low flows during survey.		Unnamed (River Vagastie)	Visual, in-situ and extractive	To monitor water quality draining from construction activity in the south east of the Development.
WQ7	256340	933079	Moorland with channel set in slight bedrock ravine		River Vagastie	Visual, in-situ and extractive	To monitor water quality draining from construction activity associated with the proposed borrow pit to the north of the Development

3.2. Visual Inspection

During the construction phase of the development, as per Item 1 in Table 3.1, the ECoW, or other nominated person, will carry out a visual check of the watercourses within the Development site for the following:

- Oils;
- Scum;
- Turbidity; and
- Algal blooms.

The frequency of visual inspections undertaken by the ECoW will be a mixture of daily and post heavy rainfall events.

Visual inspections will include an assessment from the river bank of the condition of the water, with photographic records taken, facing upstream and downstream of the monitoring point, for reference.

Where any higher risk activities are being undertaken that may result in a pollution incident in the vicinity of nearby watercourses, such as concrete pouring, stockpiling of materials, refuelling, felling and any in-channel works, visual inspections will be focussed in these areas and immediately downstream by the ECoW, or other nominated person, during the supervision of these works.

If any of the visual inspection checks during construction indicate a potential pollution incident, onsite sampling will be undertaken at these specific locations to help identify the source and type of contamination, and inform the corrective/remedial actions.

Aside from the detail above during the construction phase of the Development visual information will be collected during each phase of the water quality monitoring programme. Visual field monitoring will include the following:

- Field measurements of parameters listed in Section 3.3;
- Date and time of monitoring and name of person undertaking monitoring;
- Construction activities occurring in the catchment areas of the monitoring location;
- Rainfall (as recorded at Rhain Bridge rain gauge[1] situated 15 km south east of the Development) and weather conditions preceding and during monitoring;
- Observations of flow rate (high, moderate, or low compared to baseline/steady state at comparative time of year) and any visual/olfactory observations on water quality or potential pollution;
- Whether any samples have been taken for laboratory analysis; and
- Whether site management are to be informed of pollution concerns.

A pro-forma will be developed prior to the commencement of monitoring to ensure consistency of data recording and ease of reporting.

3.3. In-Situ Monitoring

In-situ handheld monitoring as per Item 2 in Table 3.1 will be undertaken by a nominated person trained in the use of the handheld equipment. The sampling will be undertaken from a stable bank location and no in-river working will be required as all sensors are attached to a 4 m cable that allows measurements to be collected away from potentially unstable banks or periods of high flow.

The following parameters can be monitored using the handheld equipment:

- Dissolved Oxygen

[1] SEPA. 2019. Available at https://apps.sepa.org.uk/rainfall (accessed 25/07/2019).

- Electrical Conductivity;
- pH;
- Temperature; and
- Turbidity.

Further details on the justification for inclusion of the above parameters is given in Appendix B.

The use of handheld water quality monitors allows for the collection of instantaneous water quality, providing a real-time indication of water quality in the sampled watercourses.

The in-situ monitoring equipment is calibrated on a regular basis in order to maintain accuracy of the data being recorded. The results of the in-situ sample collection will be captured using an App which transfers data from the field to the office using mobile data. This pre-determined form will be used in conjunction with the visual monitoring indicators described in Section 2.2. This will provide additional information which can be put into context with the conditions at the time of sample collection to fully appreciate the effects of natural climatic fluctuations on water quality as well as the influence of construction activities.

3.4. Water Sample Collection

Water sample collection, as per Item 3 in Table 3.1 will be followed in accordance with sample collection methods for surface water sampling. Water samples are collected using an extendable pole (up to 3 m) with a beaker attached to the end. Collecting samples in such a manner ensures that the sampler is away from the bank edge and do not need to enter the watercourses. All samples will be dispatched to the laboratory, under chilled conditions accompanied with the relevant chain of custody documentation. All samples will be dispatched to the laboratory within 24 hours of being collected. There is a standard turnaround of 5 working days to receive the results of the analysis. The laboratory will analyse the collected water samples for the following parameters:

- Ammoniacal Nitrogen;
- Biological Oxygen Demand;
- Chloride;
- Dissolved Aluminium;
- Dissolved Organic Carbon;
- Nitrate;
- Soluble Reactive Phosphate;
- Sulphate;
- Total Alkalinity;
- Total Organic Carbon;
- Total Oxidised Nitrogen
- Total Suspended Solids; and
- Total Petroleum Hydrocarbons.

Further details on the justification for inclusion of the above parameters is given in Appendix B.

Sampling should be undertaken under a range of flow conditions, such as immediately after a period of heavy rainfall and after a period of no to minimal rainfall, in order to collect a representative dataset.

4. Monitoring Frequency & Duration

4.1. Baseline (Pre-construction)

Baseline monitoring will comprise of all monitoring locations and all parameters as detailed in Section 3. The monitoring shall commence for a period of at least 6 months prior to the commencement of construction.

All watercourse monitoring locations will be collected for in-situ and laboratory analysis on a monthly basis during the baseline (pre-construction) phase.

4.2. Construction

During construction daily visual monitoring of watercourses will be undertaken when construction activities (i.e. ground-breaking and or erection works) are within 500 m or upstream of a monitoring location by the ECoW. Weekly visual monitoring will be undertaken at all locations by the ECoW.

All watercourse monitoring locations will be collected for in-situ and laboratory analysis on a monthly basis during the main construction phase.

Additional monitoring will be undertaken in the event that a potential pollution incident is reported during any of the daily checks by the ECoW or following periods of heavy rainfall.

4.3. Post-Construction

All watercourse monitoring locations will be collected for in-situ and laboratory analysis bi-monthly (once every 2 months) during the post-construction phase for a period up to 1 year.

5. Reporting

The following reporting regime is proposed for the water quality monitoring programme, subject to agreement:

- Baseline report – following collection of at least 6 months of data;
- Quarterly reports during main construction period;
  - Data summaries will be communicated following monthly site visit to ensure any issues and/or trends are reported as soon as practical;
- Final report will provide an overall summary of construction works prior to entering the post-construction phase of water quality monitoring.

Weekly environmental reports will be prepared by the ECoW and as such will assist in the preparation of the monthly report as well as targeted laboratory sampling in the week(s) ahead. Laboratory and monitoring results shall be monitored for trends with regards to baseline levels. Should these be exceeded immediate contact shall be made with the ECoW to inform of situation and take appropriate action on site.

A quarterly report is proposed during construction. This report will consider all field monitoring and results of the laboratory analysis completed in that period. Reports shall describe how the results compare to the baseline data as well as the previously collected construction period data on water quality. The results will also detail any deterioration or improvement in water quality which has been observed and whether any effects are attributable to construction activities and, if so, what remedial measures or corrective actions have been implemented.

The baseline, construction (monthly and summarised quarterly) and final report (prior to post-construction) will report on the field monitoring and laboratory analysis quality monitoring data.

Any significant results and observations will be communicated as soon as possible by the relevant personnel to the onsite team (during construction).

Watercourse pollution incidents are preventable and a pro-active water quality monitoring campaign (inclusive of visual inspections, sampling and reporting) alongside the development and implementation of mitigation measures will ensure the water environment does not suffer any adverse impacts as a result of the Development.

In line with available guidance, best practise measures would be employed to ensure a comprehensive coordinated approach to the management of the hydrological aspects of the Creag Riabhach Wind Farm and the surrounding environment.

Appendices

A. Water Quality Sampling Map

B. Construction and Operational Fish Management Plan

C. Suite of Determinants for Monitoring

Table C.1: Suite of parameters for analysis

Suite	Units	Description/Justification
Dissolved Oxygen	mg/l	A measure of the free oxygen within water, necessary to aquatic life.
Electrical Conductivity	µS/cm	Useful indicator of the overall salinity of surface water and can be used as a proxy for total dissolved solids.
pH	pH Units	Overall water quality parameter which could indicate effects of water acidity due to changes with forestry removal and disturbance of peat soils.
Temperature	ºC	General physical indicator.
Turbidity	NTU	A control mechanism most measurable on site. The most noticeable indicator of impact to a watercourse.
Ammoniacal Nitrogen	mgNH4/	Ammoniacal Nitrogen (NH3) can be toxic to aquatic life, depending on temperature and pH.
Biological Oxygen Demand	mgO2/l	A measure of the biologically degradable substances in water and a standard surface water quality parameter.
Chloride	mg Cl/l	Chloride as indicator of rainfall inputs and site weathering, often related to geology of catchments, partly controls electrical conductivity readings.
Dissolved Aluminium	µg/l	Solubility affected by pH. Of concern in forested areas where low pH surface water can lead to significant level of aluminium.
Dissolved Organic Carbon	mg/l	Key component of carbon cycle and known to be sensitive to development on peatland. Organic carbon can help reduce metal toxicities. May correlate closely with Colour.
Nitrate	mgNO3/l	Nitrate end product of nitrogen pollution. Principal nutrient and standard nutrient parameter. Indicator of background pollution and needed for assessing any impact of forestry removal or ground disturbance during construction.
Soluble Reactive Phosphate	µg/l as P	Known to occur as pulse after ecosystem disruption and may lead to eutrophication (algal blooms), can increase with felling.
Sulphate	mgSO4/l	Useful determinant for dilution factor indications.
Total Alkalinity	mgHCO3/l	Acid neutralising capacity of water.
Total Organic Carbon	mg/l	Inclusive of all carbon compounds and is important in the assessment of the organic pollution of water.
Total Oxidised Nitrogen	mg/l	The sum of the nitrate and nitrite present, increased TON can contribute to excessive algal growth in waterways.
Total Suspended Solids	mg/l	Is a measure of water quality for construction developments and hence a limit is generally specified for discharges from construction sites.
Total Petroleum Hydrocarbons	mg/L	Can be indicative of pollution arising from the spillage of fuels or oils associated with construction. More complex naturally occurring fatty acid molecules can exist naturally within some soils including peat.

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