Technical Appendix 8.7

Habitat Management Plan

www.scottishpowerrenewables.com

SCOTTISHPOWER RENEWABLES

Table of contents

Habitat Management Plan

Map 1: Overview Layout

Map 2: Habitats Layout

Map 3: Management Measures

Clauchrie Windfarm

Habitat Management Plan

November 2019

Version 1

CONTENTS

1 INTRODUCTION 1

2 LAND OWNERSHIP 1

3 SITE LOCATION AND HMP AREA 1

4 HABITAT CONDITION 1

5 AIMS AND OBJECTIVES 3

6 HABITAT MANAGEMENT MEASURES 9

7 MONITORING PROPOSALS 11

APPENDIX A: WAVE DAMMING SUMMARY 13

List of Figures and Maps

Figure 1: Process for monitoring and management to achieve habitat restoration, redrawn from Hurford and Schneider (2007).

Map 1: Site overview
Map 2: Peat depth
Map 3: Management measures

1 Introduction

The overall purpose of the Clauchrie Habitat Management Plan ("the HMP") is to implement positive land management for the benefit of landscape and nature conservation which will mitigate any adverse impacts that the Windfarm may have had. In addition to purely mitigating against any adverse impacts, ScottishPower Renewables is also committed to enhancing the nature conservation and landscape value of the Windfarm site. The HMP defines the Aims and Objectives of the land management that will be implemented on site to achieve this overall purpose.

1.1 Background

Clauchrie Windfarm comprises the construction and operation of 18 turbines (Map 1). The HMP was developed to describe how potential impacts the Development may have on the surrounding habitat will be mitigated during the operational phase of the project. The focus on the mitigation measures is to improve the condition of degraded peatland habitats.

2 Land Ownership

Land within the site boundary is wholly owned by the Scottish Ministers and is managed by Forestry and Land Scotland, and has been leased to SPR for the duration of the proposed windfarm development. The lease agreements include a provision which enables SPR to implement management works in agreed areas to improve the habitat quality.

3 Site Location and HMP area

The site is located within the Galloway Forest Park approximately 5.5km northeast of Barrhill. The Habitat Management Area ("the HMA") is located within the Application boundary and although encompassing a range of habitat classifications, the HMA predominantly comprises degraded peatland habitat (Map 2). The HMA is located at altitude of approximately 350-400m and covers an approximate area of 45ha. The Development footprint (including a 10m buffer around infrastructure) is 27.64ha, of which 23.17ha is commercial conifer plantation which will be compensated for offsite. The remaining area comprises 4.47ha of which there is 2.0ha wet heath and 2.42ha dry heath which will be compensated for through the implementation of this HMP. The rationale behind the selection of the HMA is twofold; to provide connectivity with existing habitat and to prevent further degradation. Approximately 0.05ha of NVC W2 (*Salix cinerea - Betula pubescens – Phragmites australis)* is also predicted to be lost as part of the development and will be compensated for through tree planting along suitable riparian corridors on the lower slopes.

4 Habitat Condition

4.1 Overview

Prior to developing the HMP SPR commissioned a Phase 1 habitat survey to classify habitat types across the Development. The majority of habitat is commercial forestry plantation and will continue to remain under normal forestry operations for the duration of the windfarm. Where potentially sensitive habitats such as peatland or heath were identified, further surveys were carried out to

inform condition and provide more detailed information on peat depth, vegetation composition and the underlying site hydrology.

4.2 Peatland habitat

The HMA comprises an area of deeper peat habitat (>50cm) on an open area on the flatter, lower slopes to south-east of Fell Hill and Cairn Hill. There is evidence of historical management activities including grazing and drainage across the HMA with a number of drains still visible and active (Photo 1). Drains are on average 70cm wide and 50cm deep, with spacing ranging from 20 – 40m apart. The drains continue to have a negative impact on the surrounding habitat by drawing water from the peat, resulting in a modified peatland habitat. The area is further degraded through the presence of regenerating conifers (primarily Sitka spruce of 1 – 4 m in height) across the open ground which are likely to have seeded from the adjacent forestry (Photo 2).

Photos 1 & 2: Drainage ditches and regenerating conifers

4.3 Riparian habitat

There are a few watercourses across the site, including within the HMA. Some riparian planting has been carried out previously along one of the tributaries of the Fardin Burn with mixed success. The planting has been carried out approximately 20m from the watercourse on peaty soils (>50cm) and it is apparent that a number of trees have failed (Photos 3 & 4). Soils adjacent to the watercourses are variable across the Development; some areas are peaty while others have good mineral soils.

Photos 3 & 4: Example of a failed tree in a tube and the wider planting area

5 Aims and Objectives

5.1 Delivery Process

The delivery of an HMP is based on achieving the various Aims, which are assessed by measuring the extent to which clearly defined Objectives and their associated condition indicators have been met. The definition of each Objective is therefore a key requirement for an HMP to allow progress to be assessed in a quantified, objective way which has clear implications for whether the overall Aims are likely to be met and any management measures which need to be put in place or amended.

A summary of the stages is shown in Figure 1 which has been applied to each Objective within this HMP. For Objectives where the required management is not obvious, or the processes not well enough understood to allow them to be defined in detail, a programme of trials is advocated to allow the methods, costs, rates and effects of management measures to be assessed before being implemented more widely.

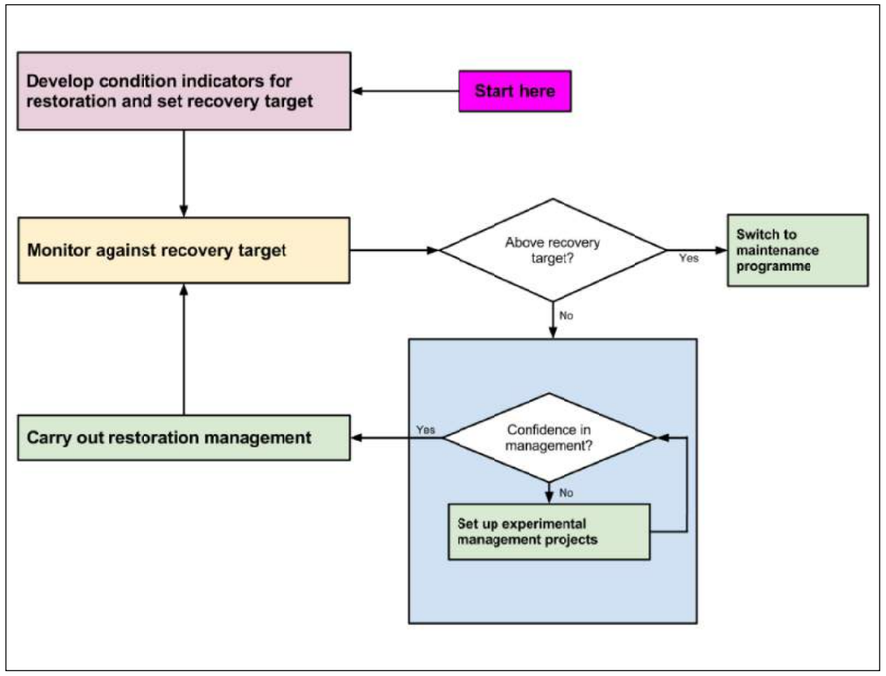


Figure 1: Process for monitoring and management to achieve habitat restoration, redrawn from Hurford and Schneider (2007).

5.2 Quantifying restoration outcomes

Some Objectives are considered to be more fundamental than others to achieve in order for habitats to be restored, and have therefore been weighted accordingly (see individual Objectives within each Aim for the weighting). This allows an overall weighted average score for the entire site to be produced out of 100 and compared against Table 2 below, with a score of 100 indicating that each Objective has been met at every sample location. This method allows an overall assessment of restoration progress to be made.

Condition Class	Weighted Average Score
Very poor	< 60.0
Poor	60.01-70.0
Acceptable	70.01-80.0
Good	80.01-90.0
Excellent	90.01-100

Table 1: Scoring system for HMP targets

Table 2 shows the breakdown of each individual Objective along with the weighting which is based on the relative importance of the Objective to the function of peatland habitat. The highest weighting is given to Objective relating to the water table as a high water table is critical to restoring the hydrological function of a healthy peatland habitat. Higher weighting is also given to Objectives relating to Sphagnum moss as these plants are a critical indicator of the quality of the peatland habitat and also indicate the hydrology function.

Aim	Group	Objective	Short Description	Weighting
Aim 1: Underlying Conditions	Water Table	1.1	WT in drought: <20cm	20%
		1.2	WT in drought: <10cm	15%
		1.3	WT in drought: 0cm	5%
	Tree regeneration	1.4	Trees absent	5%
		1.5	Trees <1m	5%
Aim 2: Conservation Status	Sphagnum & Peat	2.1	Sph. present on plots	10%
		2.2	Thick sph. present on plots	5%
		2.3	Sph. cover >30% on plots	10%
		2.4	Sph. trampling absent on plots	2.5%
		2.5	Bare peat cover <1% on plots	5%
	Higher Plants	2.6	Eri. present on plots	5%
		2.7	Cal. present on plots	5%
		2.8	Cal. >20cm & <20% browsed	2.5%
		2.9	True grass cover <5% on plots	2.5%
		2.10	Key plant cover <75%	2.5%

Table 2: Weighted score given to each Objective

The score for a treated area is therefore calculated as follows:

Weighted Average Score = Sum (% Samples which meet Obj. 1.1 * 0.20, % Samples which meet Obj. 1.2 * 0.15..., % Samples which meet Obj. 2.4 * 0.025)

Aims and Objectives are described for the areas of modified peatland habitat below. The management measures for each area are described in Section 6, and a description of the monitoring is included in Section 7.

Aim 1: Restore conditions for modified peatland habitat

Definition and Distribution
There is an area of land within the application boundary which has been identified as supporting modified peatland habitat which would benefit from positive management activities (Map 3).

Background
The condition of the peatland habitat across the HMA is generally poor, with the majority of the site classified as M15 or H18, although the latter is frequently found on peat >1m. This suggests the area would historically have comprised intact peatland habitat which has since been extensively degraded as a result of historical management activities including grazing, drainage and commercial forestry. In order to create the underlying conditions required for the re-establishment of typical peatland species, works will need to be carried out to reverse the negative historical management activities and prevent further degradation.

Condition Requirements
The primary condition required to support peatland habitat is a water table depth which is close to the surface throughout the year, including the drought period (typically April – June). Based on this requirement, a set of Objectives has been defined which will allow progress against this requirement to be monitored.

Objectives
The Objectives for peatland conditions are shown in the table below along with the weighting. An Objective is considered to be met when at least 70% of sample plots meet the criteria.

	Objective	Description	Weighting
Water table	1.1	The water table should be no deeper than 20cm from the surface of the main peat mass on each sampled plot when assessed in summer 'drought conditions' (defined as the time at which water table levels on site are considered to in the lowest 10% of their measured range, and rainfall has been negligible for at least 3 weeks; surveys undertaken any time between 1st April and 31st August).	20%
	1.2	The water table should be no deeper than 10cm below the surface of the main peat mass on each sampled plot when assessed in summer 'drought conditions'.	15%
	1.3	The water table should be at or above the surface of the main peat mass on each sampled plot when assessed in summer 'drought conditions'.	5%
Tree regeneration	1.4	Conifer trees, broadleaf trees and exotic shrubs (e.g. Rhododendron) should be absent from each sampled plot.	5%
	1.5	Conifer trees, broadleaf trees and exotic shrubs (e.g. Rhododendron) should be < 1m in height if present.	5%

Aim 2: Improve quality of modified peatland habitat

Definition and Distribution
The HMA is an area of land within the application boundary which has been identified as supporting modified peatland habitat which would benefit from positive management activities (Map 3).

Background
The long-term aspiration (>5 years) is to restore the habitat to high quality peatland habitat and prevent further degradation of the peat. However, the precise vegetation assemblage which would be expected is difficult to define and variation is expected due to localised conditions (e.g. altitude, slope, aspect, mesotope position). The response of a set of common indicators of peatland habitat quality will therefore be monitored which will ultimately help to gauge success. These common indicators have been incorporated into Objectives below.

Objectives
A number of indicators have been used to formulate Objectives which reflect different aspects of peatland habitat quality over time. An Objective is considered to be met when at least 70% of sample plots meet the criteria.

	Objective	Description	Weighting
Sphagnum and peat	2.1	At least one species of Sphagnum should be present (predicted community M17, 18 or 19) on each sampled plot.	10%
	2.2	*Sphagnum papillosum* or *S. magellanicum* should be present (where expected type is M17 & 18) on each sampled plot.	5%
	2.3	Sphagnum spp. should account for at least 30% of basal cover on each sampled plot.	10%
	2.4	Visible trampling or uprooting impacts of large grazing mammals on Sphagnum hummocks (or lawns) should be absent on each sampled plot.	2.5%
	2.5	Bare peat should comprise <1% of 'basal' cover on each sampled plot, in situations where it is arising due to trampling effects or disturbance by machinery	5%
Higher plants	2.6	*Eriophorum* spp. should be present on each sampled plot.	*5%*
	2.7	*Calluna vulgaris* should be present on each sampled plot.	5%
	2.8	*Calluna vulgaris* of at least 20cm average canopy height and with < 20% leading shoots browsed by deer/sheep on average should be present on each sampled plot.	2.5%
	2.9	'True grasses' foliar cover should be less than 5% on each sampled plot. %	2.5%
	2.10	The combined cover of *Calluna vulgaris*, *Eriophorum* spp. and *Tricophorum cespitosum* should account for no more than 75% of foliar cover on each sampled plot.	2.5%

Aim 3: Establish and maintain riparian woodland habitat

Definition and Distribution
The definition of riparian woodland habitat covered by Aim 3 is defined as areas adjacent to watercourses soils suitable for tree planting (peat depth <50cm) and covers an area of approximately 0.07 ha (Map 3).

Background
In order to compensate for a small area of W2 habitat that will be lost for the Development, new riparian woodland habitat will be created on suitable soils along watercourses within the HMA where woodland could be expected to establish. This distribution is shown on Map 3. Following the initial planting works, a monitoring and maintenance programme will be executed until trees are considered established, achieving the criteria set out in the below Objectives.

Objective	Description	Weighting
3.1	Achieve target density of 1250 stems/ ha	55%
3.2	Achieve mean height of >1m after 10 years	30%
3.3	Achieve mean height of >1.8m after 15 years	10%
3.4	Invasive species should be absent from all plots	5%

6 Habitat Management Measures

The management approaches taken by SPR reflect the different requirements of the variable site conditions. Management units are split according to treatment type and underlying habitat.

6.1 Management Units

Management units have been defined according to areas which require different types of active management, as shown in the table below.

Unit	Habitat	Size
A	Degraded peatland	45ha
B	Riparian area	0.7ha
	Total area	**45.5ha**

6.2 Physical Interventions on degraded peatland habitat

Physical interventions are defined as measures which comprise mechanical treatment to an area of land.

6.2.1 Drain damming

There are a number of drains across the HMA which would benefit from being dammed in order to prevent further damage to the hydrological regime of the peatland habitat. The drains measure a total length of approximately 5180m, with an approximate size of 70cm wide x 50cm deep. By attributing a 10m zone of influence around each drain it is possible to estimate that approximately 10.45ha will benefit from drain damming work.

SPR has developed a technique to successfully restore drained peatland habitats, termed “wave damming” which has proven successful on a number of similar sites (Photos 5 & 6). The method rapidly creates dams within existing drains to prevent water flow, which helps stabilize the hydrology and support typical peatland forming species such as *Sphagnum* mosses. SPR initially tested this method at Black Law windfarm where a comprehensive monitoring programme was set up to verify the technique. The results proved the method to be successful in raising the water table and showed that the pools quickly occluded with peatland vegetation. SPR have now treated approximately 192km of drains at sites including Black Law and Whitelee windfarms and have found the technique to be consistently effective across different sites. Throughout the development of peatland restoration techniques, SPR have engaged stakeholders including Scottish Natural Heritage, Peatland Action and the Royal Society for the Protection of Birds, by demonstrating techniques and sharing the results of monitoring. Peatland Action has now adopted the wave damming technique for use on a number of sites[1]. A further description of the wave damming technique is provided in Appendix A.

[1] http://www.iucn-uk-peatlandprogramme.org/sites/www.iucn-uk-peatlandprogramme.org/files/file_attach/Session%208%20Combined%20Workshop%20Presentation.pdf

Photos 5 & 6: Area of wave damming at Black Law windfarm immediately following treatment (left) and two years post treatment (right)

6.2.2 Removal of regenerating conifers

There are number of regenerating Sitka spruce trees which have self-seeded within the HMA from the adjacent forestry. Based on the size and spread of the trees, SPR consider that hand clearance using a combination of chainsaws and brush cutters is the most appropriate method of removal across the HMA (Photo 7).

Photo 7: Example of regenerating conifer cut below the lowest whorl

6.3 Riparian planting

Prior to planting, a soil survey will be carried out to determine appropriate locations for trees along the watercourses within the HMA. Trees will be staked and tubed to protect against deer and vole damage. Exact species composition will be determined following the soil survey but will likely include species such as birch and willow.

7 Monitoring Proposals

7.1 Vegetation monitoring

SPR has developed a protocol to monitor vegetation in relation to the Objectives set out within this Habitat Management Plan based on extensive experience monitoring similar habitats across Scotland.

Monitoring will be undertaken on a set of n=30 permanent 1m radial samples across the HMA.

At each 1m radial sample the following information is collected for species relevant to the Objectives (target species):

1. Presence/absence of target species
2. By eye cover targets of key metrics (see 2a below)
3. Height and offtake of *Calluna*
4. Depth to water table (using fixed dipwell)
5. 3 pin hits of foliar and basal vegetation cover equally spaced along a 20m transect (long format only)

There are two monitoring methods used: a long monitoring protocol and short monitoring protocol. The short monitoring protocol only records items 1, 2, 3 and 4. The protocols will be applied according to the programme below.

Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Method	Long	Short	Long	Short	Long		Short		Long

<u>Field protocol</u>

1. Frequency Assessment

At each monitoring sample plot a rope demarcated at 0.25m, 0.50m and 1m will be used to form a radial quadrat. Starting with the smallest distance and working up to 1m, the presence of each target species is to be recorded, noting the smallest distance found. This nested unit size allows different sizes of sampling units to be applied to species of differing abundances for trend monitoring i.e. common species are assessed in smaller units, rarer species are assessed in larger units.

2. General Cover Assessment
   a) Record each by eye cover assessment within each frequency point (1m circle):
      i) is sphagnum cover > 30% (if unsure record lower)
      ii) is bare peat cover < 1% (if unsure record higher)
      iii) is true grass cover (excluding Molinia) < 5% (if unsure record higher)
      iv) is the combined cover of Calluna, Eriophorum and Tricophorum < 75% (if unsure record higher)

3. Calluna height and offtake

Record the height of a representative *Calluna* plant within each 1m radial plot. Record *Calluna* height from top of the basal layer the depth of the basal layer to peat surface separately. Record the percentage of *Calluna* long shoots browsed.

4. Dipwell protocol

Permanent dipwells will be installed at each monitoring sample plot. During a drought period where there has been no limited rainfall in the preceding 14 days (typically between April and June, although can occur at other times), the dipwells will be measured by measuring from the top of the dipwell to the water table (termed "water depth"), and from the top of the dipwell to the main peat mass surface (termed "peat offset"). By subtracting the peat offset from the water depth it is possible to calculate the true value of the water table. On a quality peatland the water table should remain within 20cm of the surface of the peat mass throughout the year.

5. Pin hits

At each monitoring sample plot a rope demarcated at 1m, 11m and 19m is set out to the west. At each marker point a laser pointer is stood on the north side of the rope and used to record any living plant species, litter or bare peat that it hits directly below. Both basal layer and higher vegetation are to be recorded.

7.2 Tree establishment monitoring

SPR will undertake annual inspections to check tree condition and inform management requirements. Additional monitoring will be carried out on a regular basis to gather detailed information on tree condition and stature, until trees are considered to be established. Monitoring will be carried out between June and September using the following methodology:

- Locating each sample point
- Attaching a 5.64m length rope to the centre point
- Counting the number of trees in each plot
    - Each tree will be assessed for health, species, height and condition
    - Any damage or disease will be noted

Appendix A: Wave damming summary

The process

1. Identify the drain. The excavator has tracked down the drain, flattening the vegetation and exposing the oxidised peat slope either side of the cut channel. The excavator will straddle the drain, facing upslope. The operator will begin working at the top of the slope, building the dams as they move downhill.

2. The operator will start work on one side of the dam, on the oxidised peat slope. The operator uses the bucket to cut into the peat mass circa. 800mm depth. The bucket is then used to pull the peat towards the excavator, thrusting material upwards. Care should be taken to ensure that the operator does not flip the peat during this process, and the vegetated surface remains on top.

3. Using the back of the bucket, the operator pushes the back of cut peat towards the machine so that it is compressed into place with a ramped face.

4. The operator will repeat this action a second time, in the middle of the drain.

5. The operator will then repeat this action a third time on the other side of the drain, on the oxidised peat slope. The dam is now three bucket widths wide, although additional width can be achieved using additional bucket widths.

6. The operator then uses the bucket to flatten and compress the top of the dam.

7. The operator then uses the bucket to flatten the edge of the cut face behind the dam. This will enable any livestock a way to climb out of the dam.

8. The finished process.

Further Information

Timing

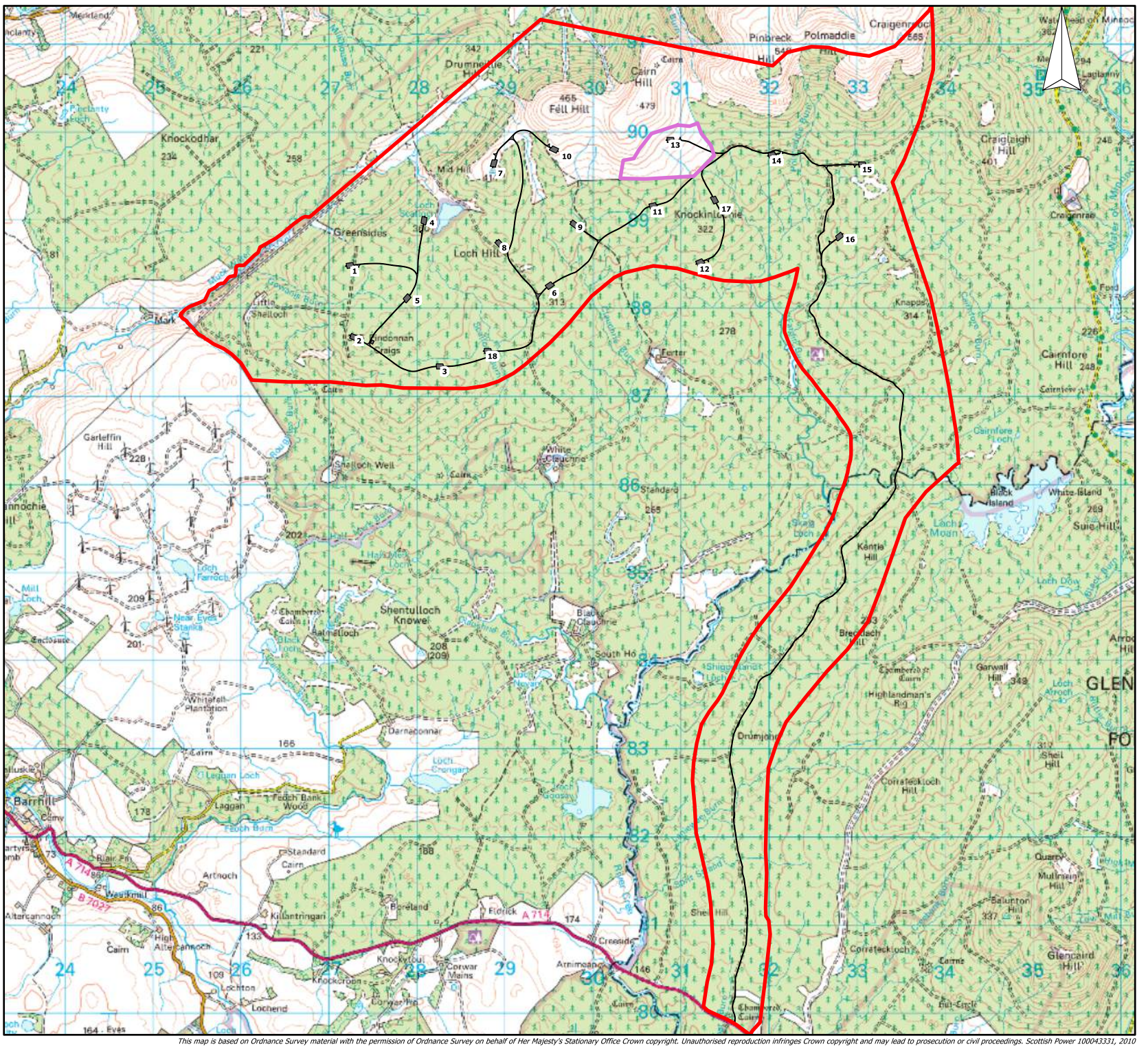
The time taken to build a wave dam is on average about 1minute; significantly faster than traditional dams which take over ten minutes to build.

Spacing

The wave dams are installed close together, roughly every 3-4m. This spacing was specified so that there was not more than a 10cm drop in ground level between each dam location so that water stored behind the dam can re-wet the intermediate drain space and adjacent ground. The spacing of dams is also dependent on local gradient.

Width

The width of the dam ensures that not only the ditch itself is blocked, but also the collapsed oxidised slopes on either side of the channel. This reduces the likelihood of a new hydrological flow around the side of the dam and encourages the water to spread out and rewet the wider habitat.



SCOTTISHPOWER RENEWABLES

Legend

- Site boundary
- HMP boundary
- Infrastructure

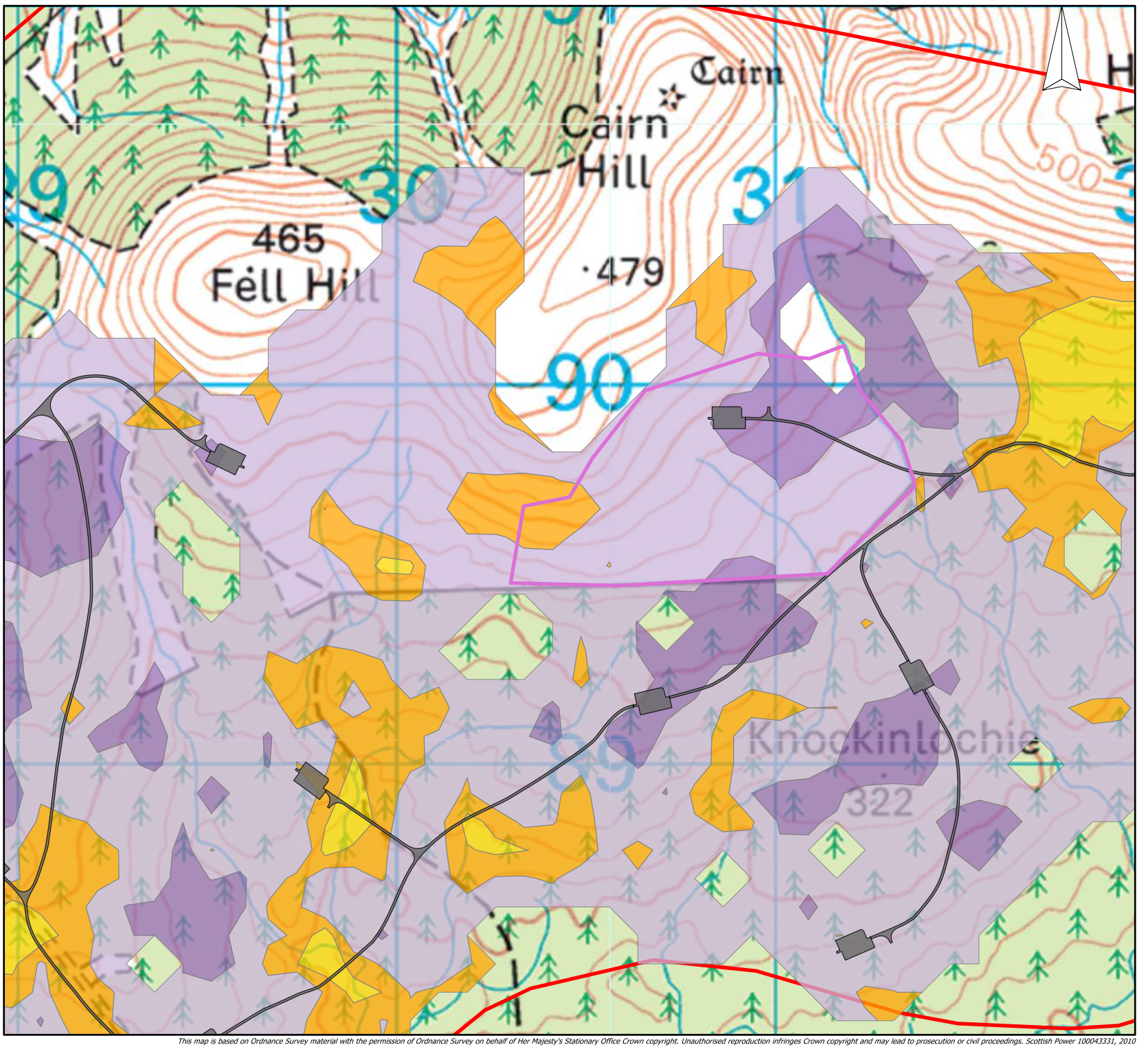
Scale: 1:59000 @ A4

Status	Date	Dr.	Ch.	Apj
FINAL	Nov 2019	SR	CB	PR

Site overview

Clauchrie Windfarm HMP
Version 1.0

Map 1



SCOTTISHPOWER RENEWABLES

Legend

- Site boundary
- HMP boundary
- Infrastructure

Peat depth (cm)

- < 30.00
- 30.00 - 50.00
- 50.00 - 100.00
- 100.00 - 200.00
- 200.00 - 400.00
- 400.00 - 600.00
- > 600.00

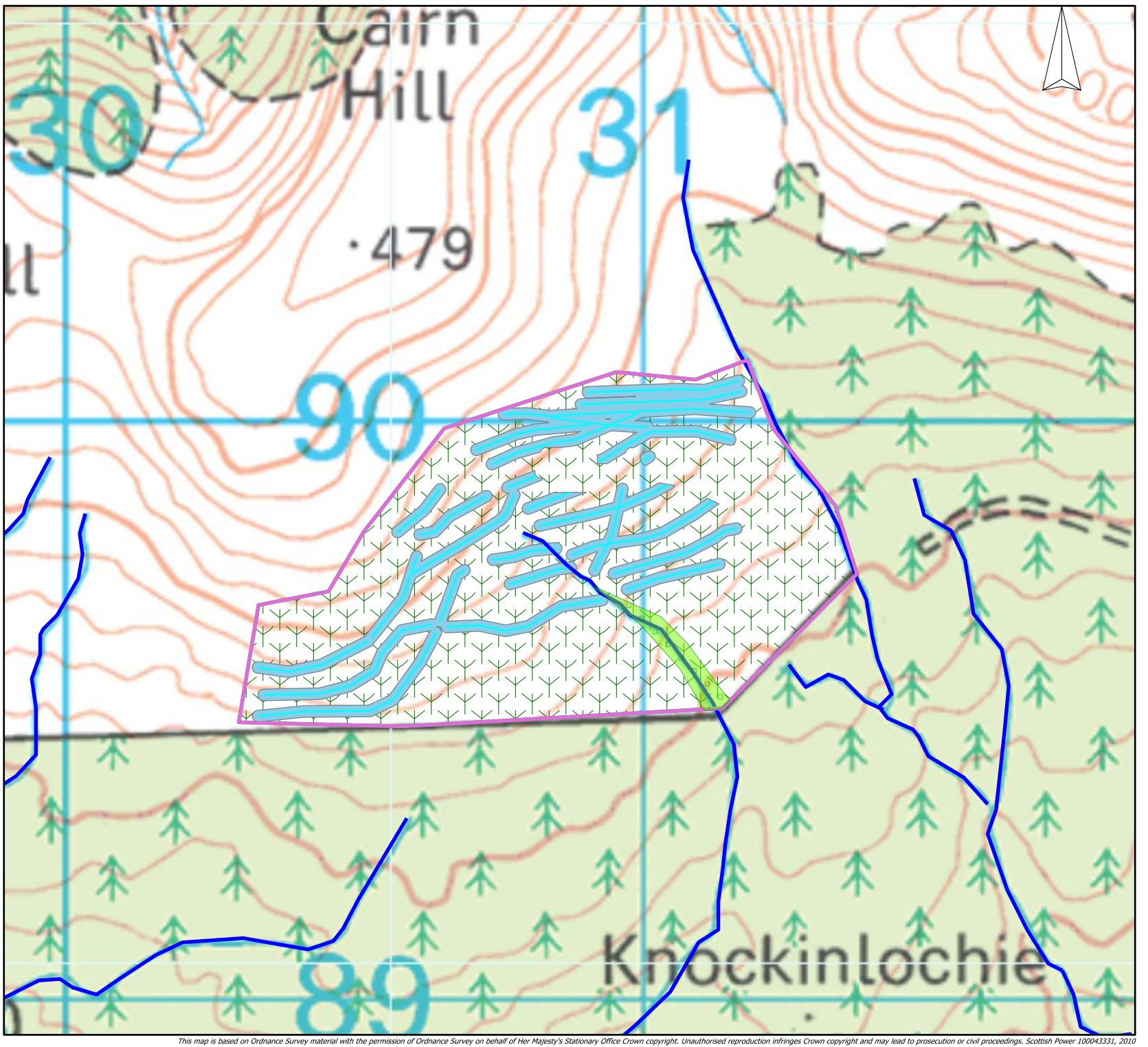
Scale: 1:14000 @ A4

Status	Date	Dr.	Ch.	Apj
FINAL	Nov 2019	SR	CB	PR

Peat depth

Clauchrie Windfarm HMP
Version 1.0

Map 2



SCOTTISHPOWER RENEWABLES

Legend

- Site boundary
- HMP boundary
- Regen removal
- Drain blocking
- Watercourse
- Riparian planting

Scale: 1:9000 @ A4

Status	Date	Dr.	Ch.	Apj
FINAL	Dec 2019	SR	CB	PR

Management measures

Clauchrie Windfarm HMP
Version 1.0

Map 3

Clauchrie Windfarm Project Team

ScottishPower Renewables
9th Floor Scottish Power Headquarters
320 St Vincent Street
Glasgow
G2 5AD

clauchriewindfarm@scottishpower.com

www.scottishpowerrenewables.com

SCOTTISHPOWER RENEWABLES