National Parks & Wildlife Service

Clara Bog SAC
(Site code 000572)

Raised Bog Restoration Plan (Report)

Version 2

October 2022

Contents

1 Introduction

1.1 Purpose of the Restoration Plan

This restoration plan has been developed by National Parks and Wildlife Service (NPWS) of the Department of Housing, Local Government and Heritage to set out proposals for restoration of raised bog and associated habitats at Clara Bog Special Area of Conservation (SAC) (000572). This plan identifies technically feasible restoration measures for the various zones of the bog including the high bog, cutover bog and surrounding margins and provides details of progress on implementation of the restoration plan.

The restoration measures set out will enable nature conservation targets for Active Raised Bog (ARB) at this SAC to be met. Although the focus of the restoration plan is on ARB habitat, it is anticipated that restoration measures will also benefit other peatland habitats and can contribute to socio-economic benefits for the local community, improvements to biodiversity and reduced carbon emissions. Monitoring of this restoration plan will be undertaken to ensure that the intended restoration measures are successfully contributing to the achievement of the site-specific targets for ARB at Clara Bog SAC.

Clara Bog SAC is one of 12 project sites where comprehensive was funded under the EU LIFE 2014-2020 programme to restore active raised bog in Irelands raised bog SAC network (LIFE Nat/IE/000032).

Action 1.1: Develop restoration plan further in partnership with stakeholders.

This restoration plan will be developed further in conjunction with stakeholders to ensure that restoration is carried out in such a way that the conservation requirements of the site can be met, whilst minimising any impacts on adjacent land and maximising benefits to the local community. The plan will develop and change over time through input from stakeholders and **will be considered a living document**. The primary aim of this restoration plan is to ensure site-specific conservation objectives for Clara Bog SAC can be met.

Section 2 of the restoration plan sets out the restoration measures that have been proposed for Clara Bog. Section 3 outlines how a drainage management plan for Clara Bog has been developed to support the implementation of this restoration plan. Section 4 describes potential for community benefits to be explored through the plan and Section 5 outlines progress with implementation of the plan at Clara Bog.

Map 1 outlines the location and extent of Clara Bog SAC. Map 2 illustrates the restoration measures that have been implemented to date as well as any proposed/outstanding restoration measures to be implemented at Clara Bog.

This document provides an outline of the restoration plan but is supported by detailed datasets that are available on the NPWS Restoration Maps Viewer. This map viewer provides NPWS with an up-to-date view of all restoration plan details and supporting information including status of landowner investigations, landowner consent, progress with construction and details of proposed and remaining restoration measures.

1.2 Clara Bog SAC

Clara Bog (SAC) is situated approximately 2km south of Clara village, County Offaly. The SAC includes the raised bog and an esker ridge that adjoins the northern boundary of the bog running in an east-west direction. Much of the bog is state-owned and designated a Statutory Nature Reserve. To the east of the bog the transition into woodland, and to the north the transition to the esker ridge have been retained. Some excellent examples of esker grassland occur within the SAC to the north of the

bog. Some peripheral farmland is also included in the SAC, because management undertaken in these areas can have an effect upon the rest of the bog. Map 1 outlines the extent of Clara Bog SAC.

The SAC has been selected for five Annex I habitats listed below:

- [7110] Active raised bogs*
- [7120] Degraded raised bogs still capable of natural regeneration
- [7150] Depressions on peat substrates of the *Rhynchosporion*
- [91D0] Bog woodland*
- [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia)* (important orchid sites)*

*Priority habitats

The bog was divided into a western (Clara West) and an eastern section (Clara East) by the construction of a road and installation of associated drainage in the late 18th century, which has caused severe subsidence on both sections of the bog. Clara East has been further damaged by the insertion of a dense network of surface drains in 1983/84. However, extensive restoration on this part of the bog has since been undertaken by NPWS and involved the blocking of drains. Turf cutting, which has been carried out extensively on both Clara East and West, ceased in 2012. The effects of peat cutting and drainage (associated with both peat cutting and agriculture) along the southern margin of the site has been shown to be having a particularly severe impact on the western side of the bog, threatening the soak systems and surrounding ARB habitat (Regan et al., 2019; Regan & Johnston 2010).

This restoration plan has been developed to address restoration measures for these peatland habitats. Restoration at Clara has been substantially completed through past NPWS restoration projects and the EU LIFE funded Living Bog Project (LIFE Nat/IE/000032).

1.3 Site-specific conservation objectives

Detailed site-specific conservation objectives (SSCOs) aim to define the conditions necessary to maintaining or achieving the favourable conservation condition of a habitat or species at site level. The maintenance of habitats and species within sites at favourable condition will contribute to the maintenance of favourable conservation status of those habitats and species at a national level.

A conservation objective has been set for Clara Bog SAC for ARB habitat using attributes and targets based on parameters set out in the Habitats Directive. In summary, one of the key targets is to restore the area of ARB to 179.7 ha. The area of ARB was reported as 111.5 ha during the 2009 monitoring survey and it has been determined that there is potential for 61.3 ha of Degraded Raised Bog (DRB) to be restored to ARB on the high bog following restoration measures. There is also long-term potential for 6.9 ha of bog peat-forming habitats (BPFH) to develop if restoration measures are undertaken on cutover areas. Several targets have been set for other attributes relating to the quality and condition of ARB habitat, including a target to restore adequate transitional areas to support/protect the active raised bog and the ecosystem services it provides. The restoration measures proposed by this restoration plan aim to achieve these targets. Further information on the SSCOs can be found in the Clara Bog SAC conservation objectives document (NPWS, 2015a) and the conservation objectives supporting document – raised bog habitats (NPWS, 2015b).

2 Restoration measures at Clara Bog SAC

2.1 Introduction

Hydrological processes are key drivers of raised bog ecology, as raised bogs are predominately fed by precipitation. For ARB to develop or be maintained, mean water levels need to be near or at the

bog's surface for most of the year. Seasonal fluctuations should not exceed 20cm below ground surface, and water levels in the peat should be within 10cm of the surface, except for very short periods of time (Kelly & Schouten 2002). Gentle slopes that limit intermittent lateral losses of water (through surface run-off) and encourage sustained water-logging are the most favourable to achieve these conditions. These conditions may be maintained on steeper slopes in areas of focused flow (flushes) (Mackin et al., 2017a; Regan et al., 2020). However, it will not be possible to raise the water level to high enough levels across the entire high bog surface, particularly approaching marginal areas, to enable ARB to develop. Even in high bog areas that do not have potential for ARB to form, water levels should be raised as necessary to support habitat for the areas where ARB can occur.

The main aim of restoration on raised bogs is to maintain or improve the quality of existing areas of ARB or improve the hydrological conditions that will allow ARB to develop in areas with suitable topographic conditions (gentle slopes and/or areas of focused flow). This requires measures to be implemented on both the high bog and cutover areas. Measures implemented on selected areas of cutover will also help to minimise the impact that drainage and cutting has had on the hydrological integrity of the high bog and support a diversity of other transitional wetland habitats (e.g. wet woodland and fen), as well as the species they sustain. Once restored, these transitional cutover zones may provide further ecosystem services through flood attenuation and water supply maintenance and purification, increased carbon sequestration and improvements to the site's overall biodiversity value.

The main restoration measures that may be considered for improving hydrological conditions on raised bogs include:

- Drain blocking (includes drains on both high bog and the margins)
- Removal of forestry/tree clearance
- Installation of marginal dams
- High bog excavation/re-profiling
- Inoculation with *Sphagnum* species
- Bunding on high bog or cutover bog.

Further details on each of these measures can be found in the Irish Wildlife Manual No. 99 'Best practice in raised bog restoration in Ireland' (Mackin et al, 2017b). Additional measures may be considered in particular instances where there are specific problems that are causing damage to an SAC. The most relevant restoration measures for Clara Bog SAC are outlined in Section 2.2 – 2.6 below.

2.2 Blocking of high bog drains

Blocking high bog drains slows the flow of water off the surface of the bog and increases the water table in the peat. Drain blocking is a proven and effective restoration measure on Irish raised bogs with minimal maintenance requirements. The approach has been demonstrated at a number of raised bogs in Ireland with very positive results evident in less than 10 years (**Figure 2.1**) as outlined by Fernandez *et al.* (2014a).

Sometimes, there are concerns from local communities living close to raised bogs that drain blocking on the high bog will result in, or exacerbate, flooding. Blocking high bog drains, in fact, slows the flow of water off the bog potentially reducing the frequency and magnitude of flood events by restoring the hydrological function of the bog. To address these concerns NPWS developed a drainage management plan for Clara Bog in advance of the implementation of the restoration plan, with further details of this plan outlined within section 3.

Figure 2.1 Example of a peat dam to block a typical high bog drain

Action 2.1: Continue to monitor dams within high bog drains at Clara Bog SAC.

All high bog drains have been blocked on Clara Bog. However, ongoing monitoring of the drain blocking activity is required to ensure dams do not fail over time. Details of the locations of blocked drains on the high bog can be found in Map 2.

2.3 Blocking of drains on cutover bog

Blocking of cutover drains slows the flow of water off the cutover areas and increases the water table in the surrounding peat. This can help to reduce the rate of infiltration through the high bog and can lead to conditions that allow peat to form on the cutover (**Figure 2.2**).

Drain blocking on cutover areas has been carried out at a number of raised bogs in Ireland to date resulting in the development of peat-forming vegetation on cutover areas. As with blocking of high bog drains, there are sometimes concerns from local communities living close to raised bogs that drain blocking on cutover bog will result in, or exacerbate, flooding. Blocking drains on cutover bog can slow the rate at which water is lost from the bog therefore potentially reducing the frequency and magnitude of downstream flood events. This restoration measure is primarily focused on former spread-grounds and only in very rare occasions, where it is absolutely essential, includes agricultural land. Drains in these areas will only be blocked in agreement with landowners and where there is a suitable hydrological barrier such as a functional drain to prevent impacts outside of the restoration area.

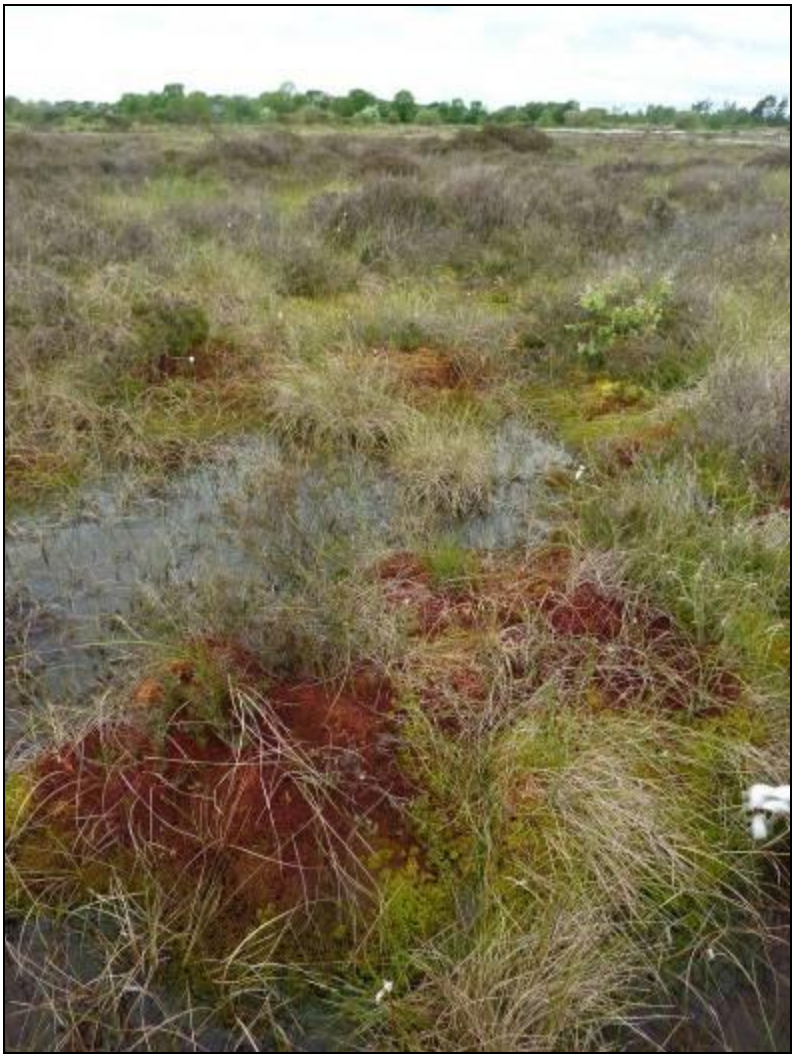


Figure 2.2 Water table at the surface of cutover bog following successful drain blocking resulting in *Sphagnum* development less than 10 years after drain blocking (this was previously an area of bare peat)

Action 2.2: Block drains on selected cutover areas within Clara Bog SAC.

Almost all of the cutover drains have already been blocked on Clara Bog, with only a small number of drains remaining to be blocked. However, ongoing monitoring of the drain blocking activity is required to ensure dams do not fail over time. Some of the drain blocking on the cutover at Clara had to be reversed due to landowners concerns regarding the impact the restoration had on water levels in the agricultural drains adjacent to the SAC. Although these drains were reopened as part of the LIFE project they should be examined in the future for re-blocking if landowner consent can be reached. Blocking of cutover drains may reduce ongoing subsidence of the high bog and in some areas this will also lead to the development of peat forming habitats. It is proposed that these drains are blocked, primarily with peat dams, with some plastic reinforcements where necessary to prevent erosion. The required conditions are for the water table to be maintained at or close to the surface, therefore large areas of standing water or deep pools are not desired. Details of the locations on the cutover where it is proposed to block drains can be found in Map 2.

2.4 Management of subsidence at Clara West

Along the southern margin of Clara West deep drainage associated with former turf-cutting has created an outlet for groundwater to discharge from beneath the peat into the drain (Regan et al., 2019). This upwelling groundwater has resulted in a decline in regional groundwater head (i.e., loss of water pressure in the mineral substrate underlying the peat), which has led to increased vertical infiltration through the peat (more water flowing down through the peat). This has resulted in lower water levels in the peat in these areas causing the peat to sink (subside), which has led to additional problems such as changes to flow patterns causing further drying out of the surrounding areas of high bog. This highlights the groundwater dependence of raised bog ecosystems and the importance of considering the extent of this dependence when considering restoration measures. Further details of the impacts that deep marginal drains have had on Clara West can be found in Regan et al. (2019) and Regan & Johnston (2010).

The ongoing discharge of groundwater into marginal drains at Clara West requires restoration measures to be carried out as this is continuing to cause damage to the bog. Impacts on the surface of the bog have been reported up to 900m away from the location where the cutting was taking place. Management options for this issue were developed by NPWS between 2008 and 2012, and recommendations have been made as part of that study (Streefkerk *et al*, 2012). One of the management options considered as part of that study is to infill the cutover area with a low permeability material and to construct a large dam in order to prevent groundwater upwelling in this area. However, further detailed site investigations and engagement with local stakeholders is required to develop a successful restoration strategy for this unique problem. An interim measure has been proposed to infill drains in this area to reduce the extent of groundwater upwelling and therefore slow the rate of subsidence on the high bog. This will require drains to be infilled with a low permeability material such as highly humified peat.

Action 2.2: Develop detailed restoration strategy to deal with upwelling groundwater at Clara West including infilling of drains as an interim measure.

Various management options have already been developed, but these are at concept stage with further assessment and detailed design required. This restoration strategy will require significant investment therefore it is important that a very detailed strategy is developed to deal with this issue. Detailed assessments will be required to infill the drains e.g., to identify a source of fill material.

2.5 Contour bunding

Contour bunds on the high bog aims to reduce the rate of lateral flow through the upper layers of the peat. In contrast to some other bunding techniques, contour bunding is not intended as a means of impounding surface water. This method involves excavating a trench 1.5-2.0m deep, re-compacting peat into the trench and building a slightly raised bund 25-30cm above the current ground surface. In addition, these bunds have 5m long 'finger bunds' constructed using the same technique at approximately 25m spacing to prevent flow along the bund which may lead to erosion. After 1-2 years it is anticipated that the bund will have subsided close to current ground level and therefore will not appear as a prominent feature on the bog surface.

Figure 2.3 Example of a contour bund constructed at Knockacoller Bog SAC, Co Laois

Contour bunds are most effective where there is cracking or slumping in the upper layers of the peat as the re-compacted trench assists in sealing up these cracks and slows the flow rate through the peat, supporting a higher water table behind the bund. The key issue with this technique is that the extent of the impact extending back into the bog depends on the hydraulic gradient (which is closely correlated to surface slope). As a result, the extent of impact from such bunds is likely to be extremely limited where the surface slope at the margins is steep. This method is best suited to sites with a relatively gentle slope towards the margins or as a means of effectively blocking a dense network of shallow surface drains on the high bog. Ground conditions will play an important factor in whether the bund can be constructed in such circumstances, therefore this method is most effective on drier sites where machines can operate safely and effectively.

Action 2.4: Assess the feasibility of constructing contour bunds at Clara Bog SAC

There may be potential for contour bunding on some areas of the cutover at Clara Bog. This measure was not used on Clara Bog during the Living Bog Project, but ongoing reviews of the restoration plan should determine whether this measure is applicable. Given the importance of this bog internationally and the unique ecological features, it may not be a suitable measure. Further opportunities for implementation of this measure should consider the response of the vegetation to existing restoration measures.

2.6 Cell bunding

Cell bunding involves the creation of individual cells, consisting of a cutoff walls extending into the peat substrate and protruding above the ground surface to create a water table close to or slightly above the gound surface (maximum depth typically 10-20cm). The approach permits the interception of laterally flowing groundwater by low permeability cutoff walls, while the surface

bunds prevent lateral discharge of surface water; this also encourages recharge to the underlying water table, helping contribute to the water balance, while also maintaining an elevated water table in those areas up gradient of standing water. Due to topographic variability the depth of water will also vary resulting in enhanced ecological diversity across the bunded area.

Cell bunds are typically constucted by excavating a trench 1.0-1.5m deep, recompacting the excavated peat into the trench and constucting a bund 0.5-0.6m high above the ground surface (Figure 2.3). Water level control structures (pipes or overflow weirs) are incorporated into these cells as a means to regulate water levels and evenly distribute water across the site.

Figure 2.4 Example of existing cell bund constructed at Cloncrow Bog NHA

Action 2.5: Monitor existing cell bunding at Clara Bog SAC and consider the potential for further implementation of this measure

Cell bunding was trialed in specific parts of the cutover at Clara as part of the Living Bog Project which was carried out along with facebank re-profiling. There may be potential for cell bunding on some additional areas of the cutover at Clara Bog. Further opportunities for implementation of this measure should consider the response of the vegetation to existing restoration measures. Details of the locations of existing cell bunding can be found in Map 2.

2.7 General site management

In addition to the proposed measures, it is important that the restoration plan contributes to improving general site management. This includes considering issues such as:

- Fire prevention and response
- Management of littering/fly-tipping

Burning of the high bog can result in significant damage to a raised bog by removing peat-forming vegetation which reduces the capacity of the peat to retain water. This causes much more rapid surface run-off and therefore can result in more widespread drying out and increased peak flows in surrounding streams. Clara Bog SAC has been damaged on several occasions through burning, particularly along the Clara to Rahan Road and to the south–west of the site. Fernandez & Wilson (2009) reported fire damage to the north-eastern section of Clara West.

Issues such as littering and fly-tipping have occurred in several areas surrounding Clara Bog, particularly in former turf-cutting areas such as the southern margin of Clara West. Depending on the nature of the material dumped this can lead to pollution in surrounding areas.

Action 2.6: Prepare a fire prevention and control plan for Clara Bog SAC in consultation with local stakeholders.

It is proposed that a fire prevention plan is developed for Clara Bog SAC to identify past occurrences of fires, the likely causes and develop an effective plan to prevent fires in future as well as an appropriate response should a fire occur in the future. Issues such as fire prevention and management of littering/fly-tipping also need to be addressed as part of a wider strategy of raising public awareness on the importance of these habitats.

3 Drainage Management Plan

One issue that can cause concerns, particularly for local stakeholders, relates to whether restoration may result in increased flooding in the surrounding area. At Clara Bog there are existing issues of flooding, particularly along the Clara to Rahan Road, and there are concerns that blocking bog drains will exacerbate this. In many instances bog restoration has the opposite effect by returning more natural hydrological conditions whereby flow is attenuated and reaches the surrounding watercourses more slowly than when drains were present. This is evident at bogs such as Killyconny Bog SAC (000006) where extensive restoration has been carried out on cutover bog and there have been no adverse impacts on adjoining agricultural land.

Nonetheless, many individuals may remain unconvinced on these issues until several years after restoration has taken place. Therefore, in order to provide reassurance, an integrated drainage management plan for the bog and its surroundings has been developed as part of this restoration plan. The drainage management plan will be is intended to support the conservation objectives. The plan assesses instances existing impediments to the effective management of the drainage network (e.g., undersized culverts or channels) and provides recommendations in relation to remedial works and maintenance works going forward. Implementation of such measures will ensure that the risk of flooding will be significantly reduced.

Action 3.1: Engage with local stakeholders in relation to the implementation of recommendations of the Drainage Management Plan for Clara Bog SAC.

Implementing the recommendations of this plan will require engagement with local stakeholders to ensure any management actions completed are carried out in line with best practice guidance.

4 Community benefits

Through consultation with the local community and other stakeholders it will be possible to develop ideas for maximising socio-economic benefits for the local community through restoration. These might include building or improving existing facilities, where appropriate (i.e., tracks, board walks, bog bridges), encouraging the creation of small tourism enterprises, promoting the benefits to human health and well-being and enhancing the value of the site as an educational resource. There are many cases where local communities, including local businesses, are actively involved in or supporting the conservation and restoration of raised bogs across the country. Examples of this are found at Abbeyleix Bog (Co. Laois), Carrownagappul Bog SAC (Co. Galway), Girley Bog Natural Heritage Area (NHA) (Co. Meath), Lodge Bog (Co. Kildare) and Scohaboy Bog NHA (Co. Tipperary).

Clara Bog already offers potential for recreation and amenity; based on several existing access tracks and walking routes. This includes the boardwalk on the surface of the high bog that receives over 15,000 visitors every year and offers socio economic benefits to the local community. There is already interpretative signage at the entrance to the boardwalk (**Figure 4.1**) and at certain points

along the route of the boardwalk, which have assisted in increasing the educational value of the facilities. The amenity provision was also expanded as part of the Living Bog Project with the creation of a new boardwalk and upgraded tracks on Clara East. Within Clara village to the north of the bog the Clara Bog Visitor Centre offers walks, talks, workshops and other educational activities for adults and children.

Figure 4.1 Interpretive signage at the entrance to Clara Bog SAC Boardwalk

There are many tracks and roadways around the bog that were previously used to facilitate turf cutting and some are currently in poor condition. There is significant potential for investment in upgrading, expanding and maintaining these tracks as access routes for amenity and recreation. Furthermore, the Clara Bog visitors centre (**Figure 4.2**) is a purpose built interpretative facility that acts as an attraction for both locals and tourists, offering a valuable service including education, promotion of community involvement and providing guided tours of the bog.

Figure 4.2 Clara Bog Visitors Centre

Apart from immediate economic benefits, the restoration of raised bogs can provide many other benefits to the wider community, such as provision of clean water, flood attenuation and water flow regulation, preservation of archaeological artefacts and other sources of historical knowledge and, not least, helping Ireland reduce its national greenhouse gas emissions and, therefore, helping to combat climate change.

Action 4.1: Optimise the community benefits of the restoration plan.

As the restoration plan is further developed and implemented, opportunities to improve the recreation and amenity value of the bog and surrounding areas and promote local initiatives, while protecting and enhancing its natural values, will be explored by and with the local community. Promoting community involvement in the long-term management of the site both during and after restoration measures are carried out, will be encouraged.

5 Restoration Plan Implementation

5.1 Preparatory actions

Prior to implementation of the restoration plan several preparatory actions are required before construction of restoration measures can commence. A summary of these preparatory actions is outlined below:

- Hydrological characterisation – collation of existing hydrological data, hydrological surveys, instrumentation with monitoring data (where necessary);
- Review of proposed restoration measures in line with best practice at the time of implementation (including exploring opportunities to implement enhanced measures);
- Detailed ecological surveys (primarily comprising surveys of cutover areas, but where necessary also includes high bog areas e.g., if ecotopes have not been surveyed in many years);
- Landownership Investigations (investigations into ownership, turbary rights etc.);
- Stakeholder consultation and community engagement (meeting with stakeholders to outline restoration plans and consider any concerns raised by the local community);
- Compensation/land acquisition (compensation or acquisition of lands required to implement the required restoration measures on private lands);
- Appropriate Assessment Screening;
- Compilation of tender/construction documents including preparation of health and safety file;
- Surveying and setting out of the works;
- Implementation of restoration measures (including construction supervision and contract administration);
- Post-works inspections and preparation of as-built survey information;
- Update of restoration plan to outline works completed and remaining works required in future. This includes updating status of all works within the NPWS GIS-based data viewer.

5.2 Progress to date

Significant progress has been made in implementing the proposed restoration plan at Clara Bog SAC

with all standard restoration works now substantially complete. Further work is required to implement a solution to the ongoing subsidence of Clara West. Further reviews of the restoration plan will take place as results from future ecological monitoring determines whether additional actions are needed to achieve site specific conservation objectives for the bog. A summary of progress to date is outlined below:

5.2.1 Hydrological characterisation

Status – Partially complete

Detailed hydrological characterisation of Clara Bog SAC was carried out in 2018 as part of the Living Bog Project. This comprised of detailed surveys of the high bog and cutover to collect data to enable the restoration plan to be refined. A detailed hydrological monitoring network was established in 2018, comprising nine phreatic monitoring wells and twelve deep piezometers to monitor vertical hydraulic gradients across the bog (high bog and cutover). This monitoring network complemented a history of hydrological monitoring that has been carried out at Clara Bog since the late 1980s. Through the Living Bog Project the hydrological monitoring network was monitored manually at monthly intervals, with a subset of six monitoring wells instrumented with automated data logging equipment. This enabled the collection of baseline data to inform restoration plan design as well as assess the hydrological impact of restoration measures. This information was used as a feedback mechanism in reviewing the restoration plan.

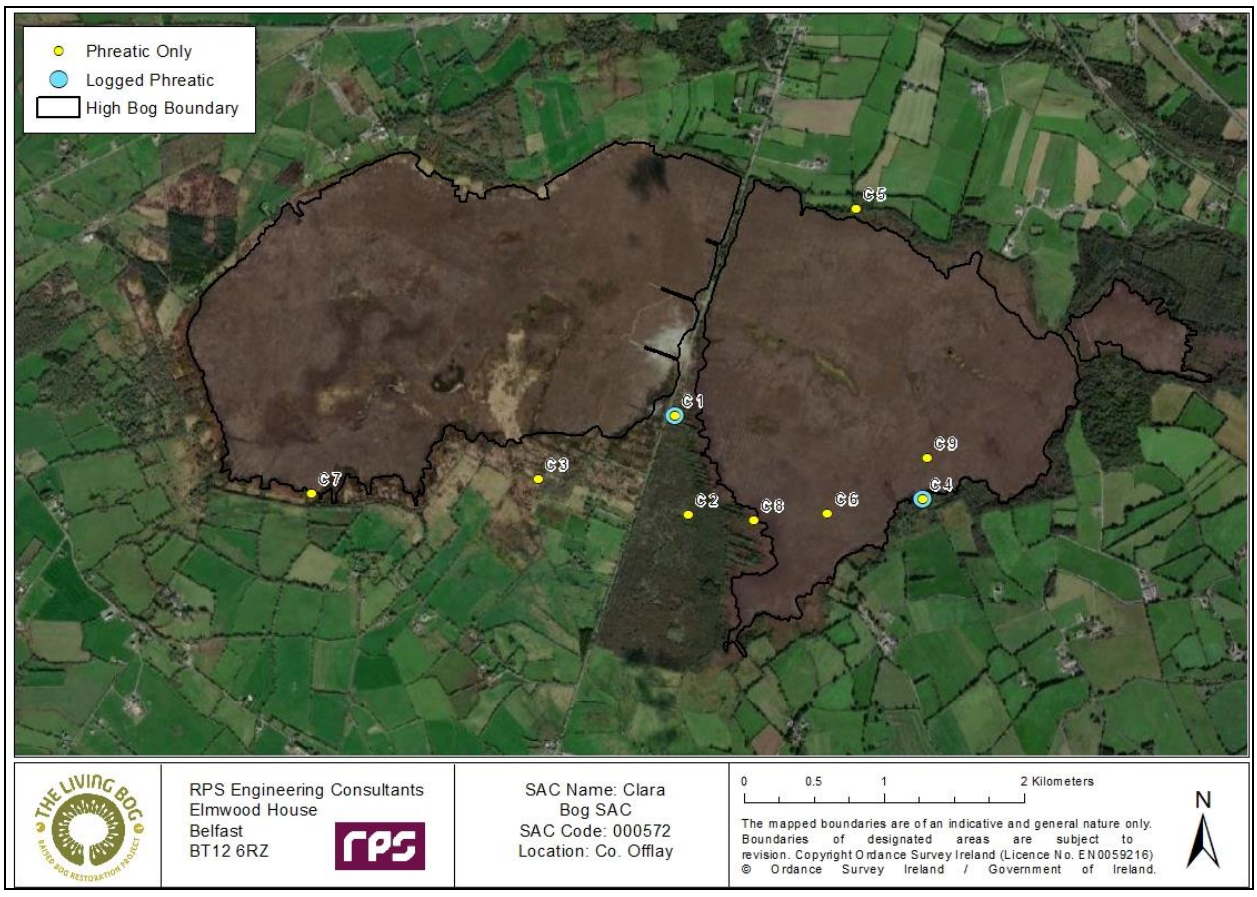


Figure 5.1 Location of hydrological monitoring network at Clara Bog SAC

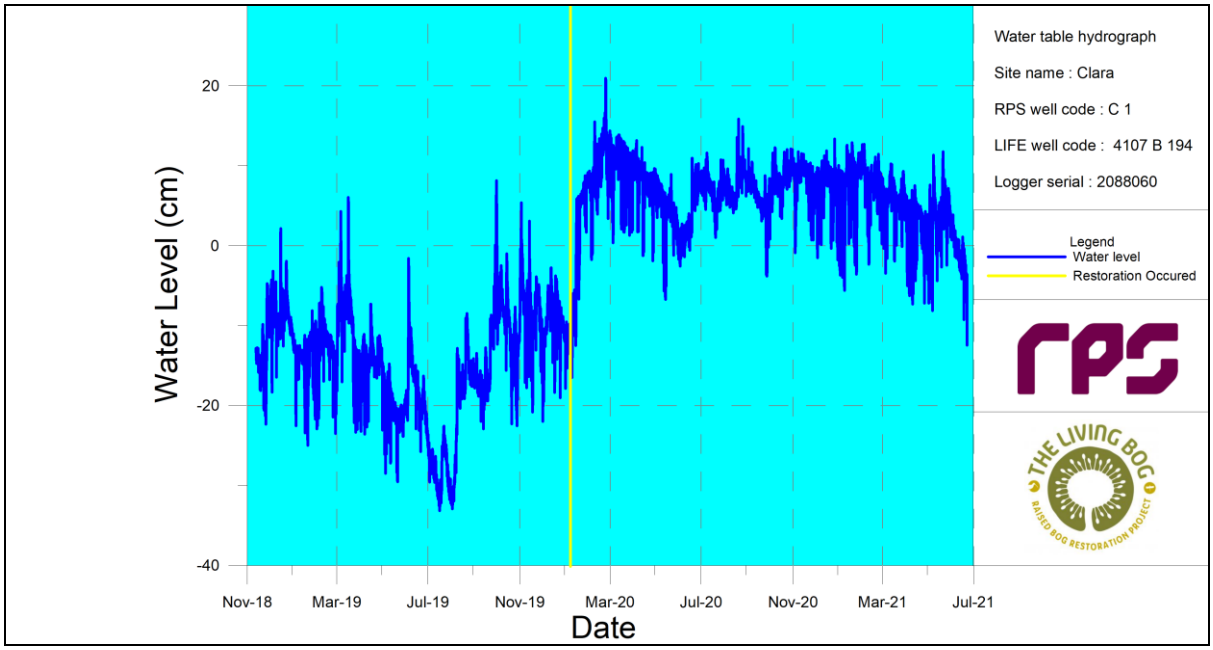


Figure 5.2 Example hydrograph illustrating the response to drain blocking carried out through the Living Bog Project on cutover at Clara Bog SAC

5.2.2 Review of proposed restoration measures in line with best practice at time of implementation

Status – Partially complete

Following detailed hydrological characterisation of Clara Bog SAC in 2018, a comprehensive review of proposed restoration measures was completed which identified some minor modifications required to the restoration plan as well as the potential to implement cell bunding in targeted areas of the cutover. These bunds were completed as trial measures that were not originally proposed as part of the Living Bog Project. Early indications suggest these measures have been very successful on Clara Bog. A further review of restoration measures is required to determine appropriate measures to address the subsidence of Clara West. Details of the restoration measures implemented at Clara Bog are illustrated in Map 2.

5.2.3 Detailed ecological surveys

Status - Complete

The most recent ecotope survey of Clara Bog SAC was completed by the Living Bog Project in 2017, prior to any restoration measures being constructed. This survey determined that active raised bog (7110) covered 102.1ha of the high bog in 2017 (Crowley & Smith, 2022). Future monitoring will be completed by NPWS when the vegetation has had more time to respond to restoration measures, with an ecotope survey scheduled for 2022/23. A full analysis of the increase in extent of ARB scheduled to be carried out by the NPWS raised bog monitoring programme 2022-24.

In addition to the high bog survey, a methodology for detailed vegetation mapping of cutover habitats was developed as part of the Living Bog Project and published as Irish Wildlife Manual No. 128 'The Habitats of Cutover Raised Bog' (Smith & Crowley, 2020). A cutover survey carried out in accordance with this methodology was completed at Clara which identified that there are already 1.9ha of high *Sphagnum* areas throughout the cutover area, 1.0ha of which corresponds to the Annex I habitat active raised bog (7110) according to the definition of Smith & Crowley (2020). The extent of high *Sphagnum* area is expected to increase to 7.9ha as the vegetation begins to respond to rewetting measures (Crowley & Smith, 2022). The high bog and cutover surveys completed as part

of the Living Bog Project provides a baseline status that can be used to monitor the results of restoration measures in future.

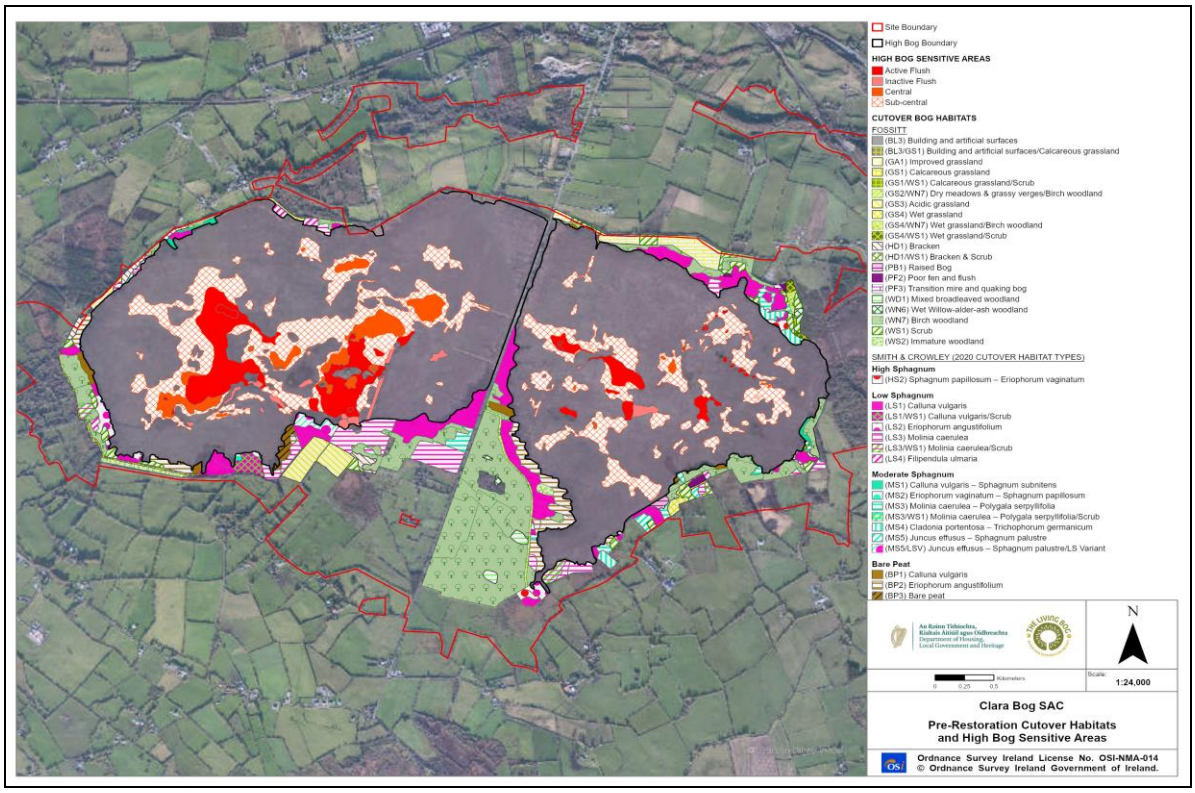


Figure 5.3 Ecological monitoring results (Pre- Restoration) at Clara Bog SAC illustrating high bog and cutover vegetation types

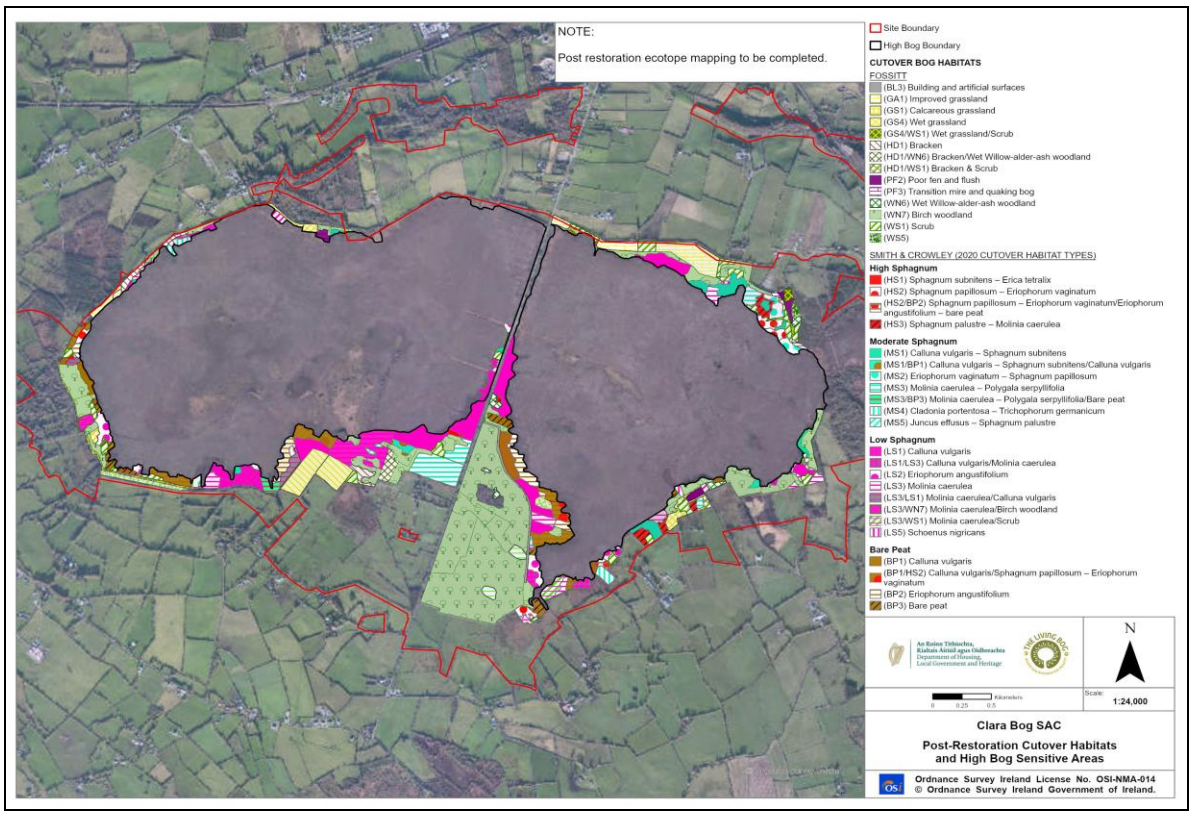


Figure 5.4 Ecological monitoring results (Post Restoration) at Clara Bog SAC illustrating high bog and cutover vegetation types

5.2.4 Landownership Investigations

Status – Complete

Comprehensive landownership investigations were completed at Clara Bog SAC as part of the Living Bog Project. The identified that there is a mixture of public and private ownership across the bog. In addition, there are a large number of turbary right holders. This process allowed identification of key stakeholders to meet during the stakeholder consultation and community engagement phase.

5.2.5 Stakeholder consultation and community engagement

Status – Complete

Comprehensive stakeholder consultation and community engagement was carried out at Clara Bog SAC as part of the Living Bog Project. The Living Bog Project team developed strong working relationships with key members of the local community. The team held meetings with former turf cutters, landowners and interested community groups. At these meetings project aims, and restoration plans were presented to the stakeholders. This has included meeting with all private individuals owning the freehold or having a turbary right at the bog.

5.2.6 Compensation/land acquisition

Status – Complete

Compensation has been offered to and accepted by almost all landowners and turbary right holders within the bog which enabled the restoration works to proceed at the bog.

5.2.7 Appropriate Assessment Screening

Status – Partially complete

An Appropriate Assessment Screening report was prepared to consider the potential for significant effects on any European Sites from the implementation of the restoration plan at Clara Bog SAC. As the bog has been selected as a Special Area of Conservation for the presence of raised bog habitats, the proposal to allow restoration measures to take place in Clara Bog SAC **is directly connected with and necessary to the management of this site as a European site**. The proposed restoration measures are essential to support the reestablishment of appropriate hydrological conditions within the SAC to enable nature conservation targets for Active Raised Bog (ARB) at this SAC to be met.

However, following a precautionary approach and to inform a risk assessment, a screening for Appropriate Assessment report was prepared to assess, in view of best scientific knowledge and in view of the conservation objectives of those European sites considered, whether or not the project, individually or in combination with other plans or projects, is likely to have a significant effect on any European site.

The findings of this screening exercise determined that the proposed restoration measures:

- Will not give rise to potential likely significant effects on the Qualifying Interests/Special Conservation Interests of any other European site within the project's zone of influence, in view of best scientific knowledge and in view of the conservation objectives of those sites; and
- Will not give rise to potential in-combination or cumulative effects with the other plans or projects considered.

5.2.8 Compilation of tender/construction documents and Health & Safety file

Status – Partially complete

A work package comprising details of restoration measures that could be implemented was compiled by the Living Bog Project Team, which included detailed specifications for the proposed measures. In addition, a health and safety file was compiled to ensure the works could be carried out in accordance with the Safety, Health and Welfare at Work (Construction) Regulations. Generally, this work involves the following activities:

- Identify hazards arising from the design of the various schemes.
- Eliminate these hazards, or where not practicable to do so, reduce the risk of these hazards.

5.2.9 Surveying setting/out of the works

Status – Partially complete

The surveying and staking out of drains and dams can be difficult due to the nature of the bog environment. Vegetation and soft ground conditions can make identification of features and surveying of same difficult and potentially dangerous. The setting out of the works is generally done using bamboo stakes to mark the locations of the restoration measures that are to be constructed such as the dams or bunds. All works carried out as part of the Living Bog Project were set out as required which facilitated work being completed. This activity provides an additional opportunity to review the restoration measures in detail on the ground and where necessary minor modifications can be made (e.g., adjusting the placement of particular dams due to dense vegetation coverage or alignment of bunds due to ground conditions). This ensure that the risk of damage to the raised bog is minimized as inadequate planning can increase the risk of machines entering unsuitable areas.

5.2.10 Implementation of restoration measures

Status – Partially complete

Most of the actions proposed as part of the Living Bog Project were completed as required at Clara Bog SAC. This includes construction of 1,428 dams. Trial cell bunding was completed on a small area of cutover bog in the south-east of the bog. A techniques manual which details each of these methods including the methods developed through the Living Bog Project was produced as part of the project (Cushnan et al., 2022).

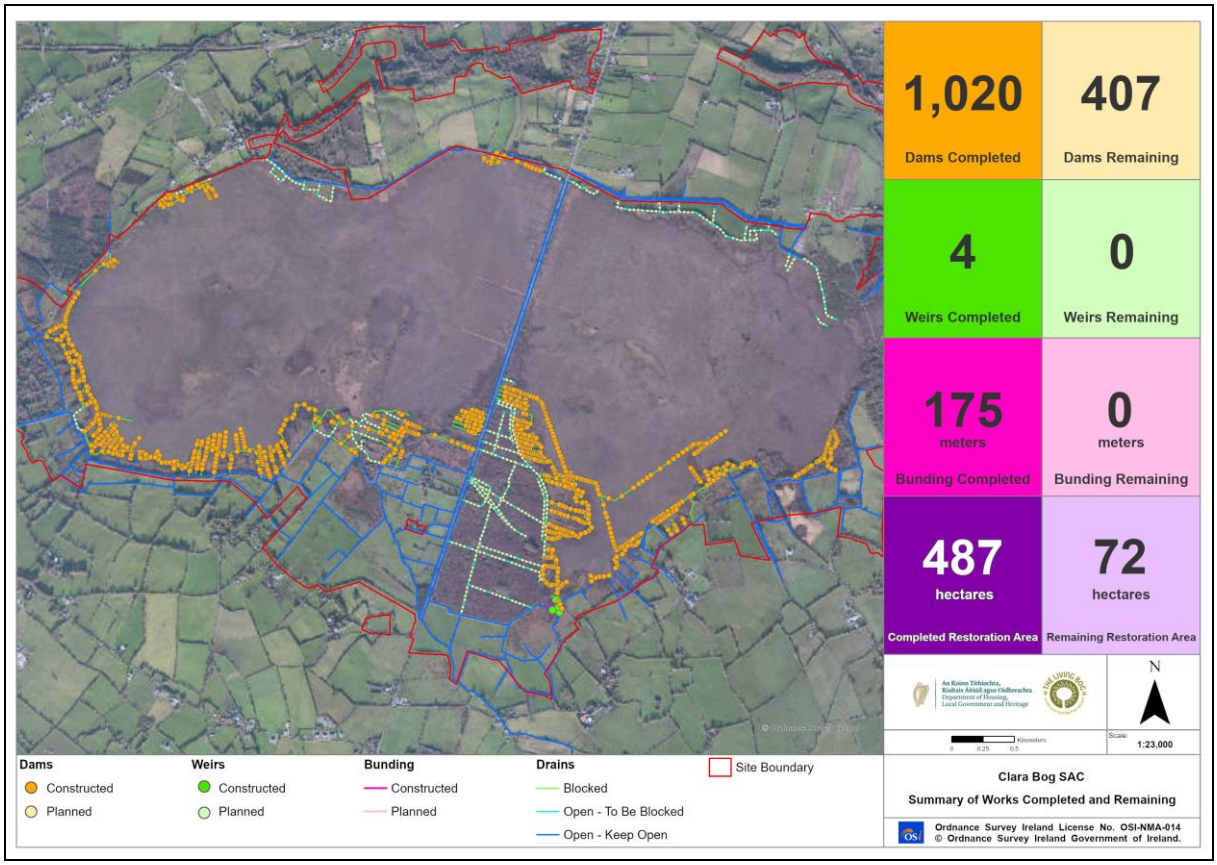


Figure 5.5 Summary of works completed to date

Figure 5.6 Example of cell bunding completed at Clara Bog SAC

Figure 5.7 Example of cutover rewetting at Clara Bog SAC

5.2.11 Post-works inspections and preparation of as built survey information.

Status – Partially complete

Post-works inspections have been completed and an as-built drawing was prepared by Bord na Móna on behalf of the Living Bog Project (summarised in Figure 5.). This included detailed aerial surveys of the bog to collect high-resolution ortho-imagery and to ensure a detailed as-built drawing could be prepared.

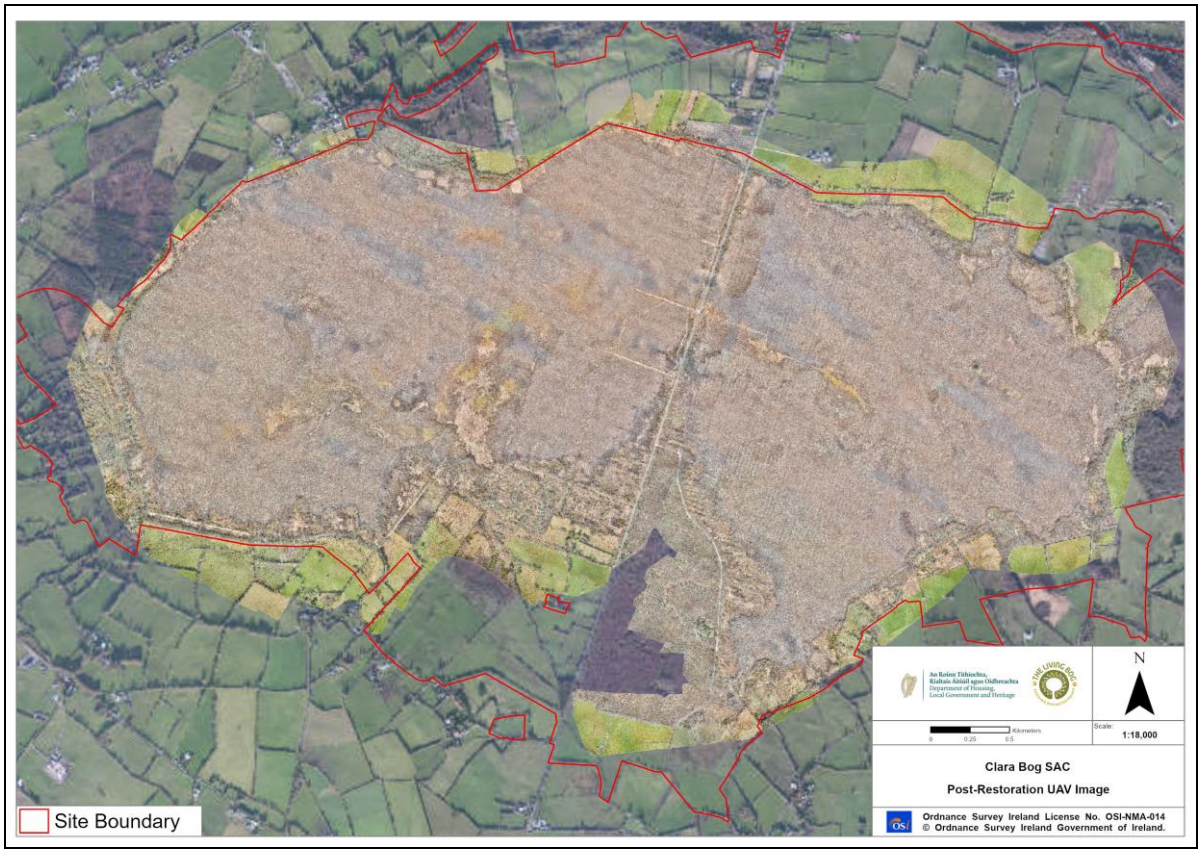
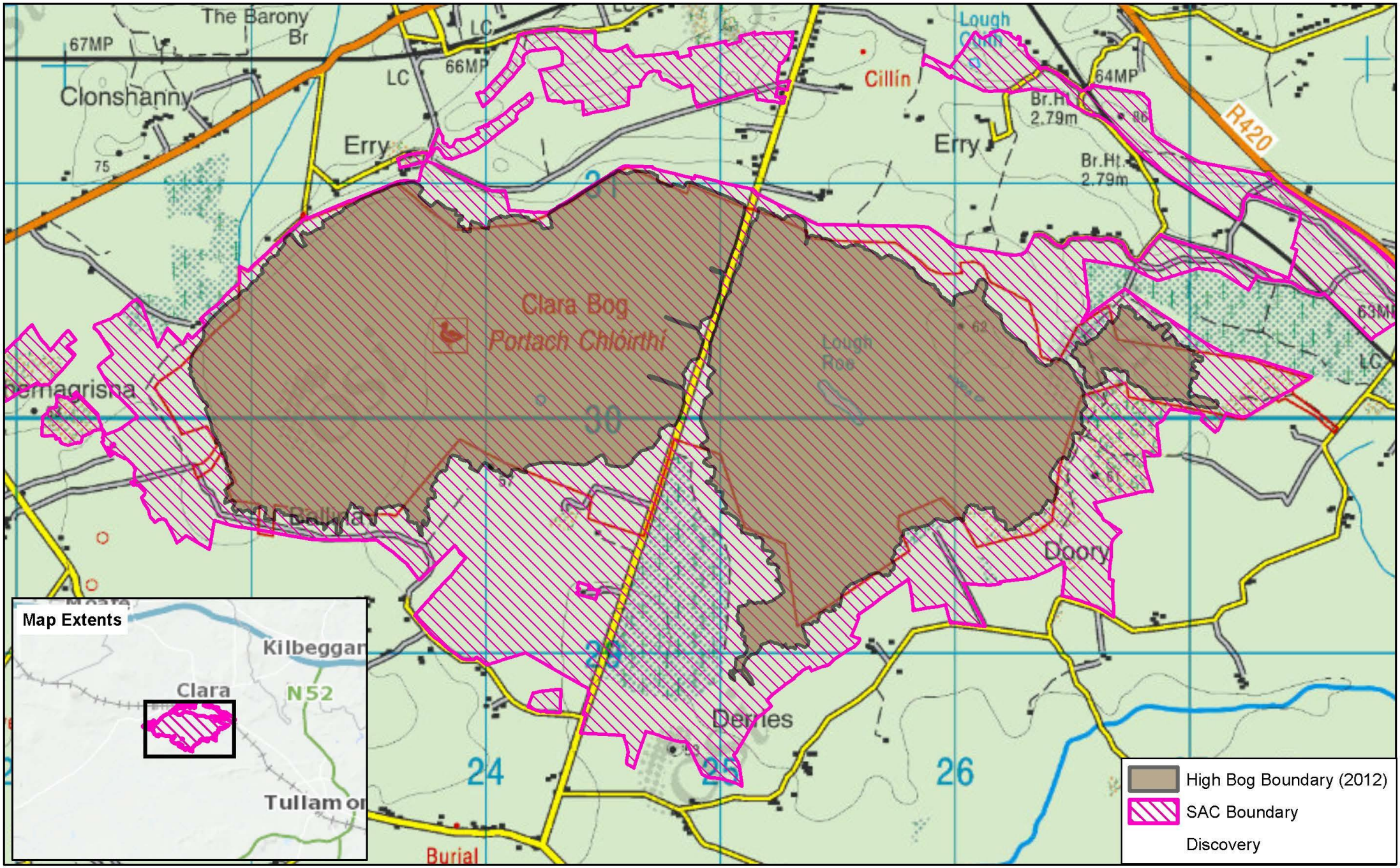


Figure 5.8 High resolution post-works ortho imagery from UAV survey

5.2.1 Update of restoration plan to outline works completed and remaining works required in future.

Status – ongoing

This restoration plan has been updated with the details of the works completed to date as part of the Living Bog and previous NPWS restoration project. At present no significant restoration works are outstanding; however, as future monitoring surveys are completed by NPWS the need for additional restoration measures will be considered and this restoration plan updated as required. This restoration plan will also be reviewed on an ongoing basis as experience and best-practice evolves nationally and internationally.



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Department of Housing, Local Government and Heritage

Map 1
Clara Bog SAC

Site Name: Clara Bog SAC
Site Code: 000572; Version 3
County: Offaly

0 0.425 0.85
kilometers

The mapped boundaries are of an indicative and general nature only.
Boundaries of designated areas are subject to revision.
Ordnance Survey Ireland Licence No OSI_NMA_014

N

Map Version No.1

Site Boundary

Dams

- Constructed (1,020)
- Planned (407)

Weirs

- Constructed (4)
- Planned (0)

Bunding

- Constructed (175 m)
- Planned (0 m)

Drains

- Blocked (20.5 km)
- Open - To Be Blocked (9.8 km)
- Open - Keep Open

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Department of Housing, Local Government and Heritage

THE LIVING BOG

N

Kilometers
0 0.25 0.5

Scale: 1:23,000

Clara Bog SAC

Restoration Progress

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7 Glossary & Acronyms

ACTIVE RAISED BOG (ARB)	Areas of uncut raised bog where the conditions are right for peat to continue to form, and where species of plants and animals typical to intact bogs can thrive. ARB is listed as a priority habitat in Annex I of the Habitats Directive.
ANNEX I	Annex I of the EU Habitats Directive lists natural habitats types of Community interest whose conservation requires the designation of SACs.
ANNEX II	Annex II of the EU Habitats Directive lists animal and plant species of Community interest whose conservation requires the designation of SACs.
BIODIVERSITY	A general term used to describe all aspects of biological diversity including the number of species present in a given environment, the genetic diversity present within a species and the number of different ecosystems present within a given environment.
BOG WOODLAND	Woodland formed on a wet peaty substrate, with permanently high groundwater level. The water is poor in nutrients (ombrotrophic) and the ground surface has high cover of bog moss species, with active peat accumulation taking place. Bog Woodland is listed as a priority habitat in Annex I of the Habitats Directive. It differs from dry woodland on bog where peat accumulation is not taking place.
BUNDING	An impervious embankment of material (peat or other) that provides a barrier to retain water behind it.
CARBON SEQUESTRATION	The capture and long-term storage of atmospheric carbon dioxide, including that accumulated by a bog or fen.
CATCHMENT	An area of land contributing water that drains to a defined point. The term river catchment refers to the area of land that drains into a particular river system and is synonymous with the term drainage basin or watershed.
CUTOVER	Areas of bog that have been previously cut (by hand or by mechanical means), although not down to the underlying inorganic substrate. Cutover areas normally consist of a mosaic of cut areas, face banks, pools, drainage ditches, uncut areas of peat, scrub, grassland etc.
DEGRADED RAISED BOG (DRB)	The area of high, uncut bog which has been damaged by human activities but which could be restored to active raised bog again through restoration measures within a period of 30 years. It is listed in Annex I of the Habitats Directive.
ECOLOGY	The study of the interactions between organisms, and their physical, chemical and biological environment.
ECOSYSTEM SERVICES	Humankind benefits from a multitude of resources and processes that are supplied by ecosystems. Collectively, these benefits are known as ecosystem services and include products like clean drinking water and processes such as the decomposition of wastes.

EROSION	The processes whereby the materials of the earth's crust are dissolved, or worn away and simultaneously moved from one place to another by natural processes which include weathering, solution, corrosion and transportation.
EVAPOTRANSPORATION	Water loss to the atmosphere from soil and other surfaces (evaporation) and vegetation (transpiration).
FACEBANK	Areas at the edge of the high bog where peat cutting has taken place. This is an ecotope that is highly degraded and absent of typical *Sphagnum* species.
FAUNA	Animal life.
FAVOURABLE CONSERVATION CONDITION	This is the condition of a habitat or species considered to be favourable at site level. Favourable conservation condition is defined by site-specific conservation objectives (SSCOs). The maintenance of habitats and species within sites at favourable condition will contribute to the maintenance of favourable conservation status of those habitats and species at a national level.
FAVOURABLE CONSERVATION STATUS	According to the Habitats Directive the conservation status of a natural habitat will be taken as "favourable" when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.
FLORA	Plant life.
FLOW ATTENUATION	Slowing flow of water out of an area. This is a common method for reducing risk of flood in urban areas whereby diversion channels store water in attenuation ponds. Intact peatlands typically offer natural flow attenuation through slowing flow as a result of higher storage capacity and increased hydraulic roughness, while degraded peatlands are much less effective at attenuating flow as the peat is dried out encouraging overland flow.
HABITAT	Refers to the environment defined by specific abiotic and biotic factors, in which a species lives at any stage of its biological cycle. In general terms it is a species' home.
HABITATS DIRECTIVE	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.
HEAD	Hydrological term which is a measure of the height to which water can raise itself above an arbitrary given level or datum.
HIGH BOG	The area of bog which has not previously been cut.
HYDROLOGICAL PROCESSES	The movement of water through a catchment area including freshwater and seawater inputs, water level changes and drainage mechanisms which are all influenced by the underlying geology.

LAGG	A term used to describe the natural habitat that occurs in the transitional zone between the bog and the mineral soil around a raised bog. Few intact lagg zones remain around raised bogs in Ireland as they are typically the first location to be damaged by drainage.
LIDAR	A remote sensing technology that measures vertical surface elevation by illuminating a target with a laser and analysing the reflected light usually obtained using a low-flying aeroplane. This provides detailed information on the surface elevations across an area.
LIFE	An EU financial instrument supporting environmental and nature conservation projects throughout the EU.
MARGINAL DRAIN	Drains on the margins of a raised bog typically on cutover for the purpose of draining spread-grounds to facilitate turf-cutting.
MICROTOPOGRAPHY	Variations in elevation at a relatively small scale. Generally the higher points are no more than a metre higher than the low points, and only a couple of metres across. On a high bog this consists of hummocks, hollows, pools, flats and lawns.
MINEROTROPHIC	Refers to soils and vegetation whose water supply comes mainly from streams or springs. This water has flowed over or through rocks or other minerals, often acquiring dissolved chemicals which raise the nutrient levels and reduce the acidity.
NATURAL HERITAGE AREA (NHA)	These are conservation areas designated for protection under The Wildlife (Amendment) Act 2000. NHAs are considered important for the habitats present or which holds species of plants and animals whose habitat needs protection.
NPWS	National Parks and Wildlife Service.
OMBROTROPHIC	Refers to a type of peatland that receives all of its water and nutrient from precipitation falling directly on its surface.
PIEZOMETER	A piezometer is a device used to measure head. In the case of groundwater a piezometer will provide head at a given point.
PEAT-FORMING HABITAT	These are habitats where peat is actively forming. It includes typical ombrotrophic raised bog vegetation as well as lagg or fen vegetation that indicate that peat is actively forming.
PRIORITY HABITAT	A subset of the habitats listed in Annex I of the EU Habitats Directive. These consist of habitats which are in danger of disappearance and whose natural range mainly falls within the territory of the European Union. These habitats are of the highest conservation status and require measures to ensure that their favourable conservation status is maintained.
RAISED BOG	Rain-fed peatland ecosystems that develop primarily in areas with topographic depressions, where drainage may be impeded by a high groundwater table, or by low permeability of the underlying substrata such as clay. Peat accumulation, over time, elevates the ground surface above surrounding areas to form a raised dome.
RESTORATION ZONE	A specified area within a site where restoration measures have been proposed. Restoration zones have been defined for each raised bog SAC based on factors including hydrological conditions, existing and expected

	habitats following restoration. This allows restoration measures for each raised bog SAC to be split into manageable units.
SITE-SPECIFIC CONSERVATION OBJECTIVE	A site-specific conservation objective aims to define the favourable conservation condition of a habitat or species at site level. The maintenance of habitats and species within sites at favourable condition will contribute to the maintenance of favourable conservation status of those habitats and species at a national level.
SPECIAL AREA OF CONSERVATION	Area designated for the conservation of habitats and/or species under the Habitats Directive.
SPREAD-GROUNDS	Area where turf is spread after cutting to dry out, typically drained cutover bog or agricultural areas adjacent to the high bog.
STATUTORY NATURE RESERVE	A Statutory Nature Reserve is an area of nature conservation interest that has been designated by Ministerial Order under the Wildlife Act, 1976.
SUBSIDENCE	Term referring to the sinking of land resulting from natural activity or human activity. Within peat subsidence occurs due to loss of water for example as a result of drainage.
TILL	Geological term referring to unsorted material deposited by glacial ice and showing no stratification. It is often referred to as boulder clay.
TOPOGRAPHY	The arrangement of the physical features of an area.