VIKING WIND FARM LLP (VEWF):

IMPLEMENTATION PLAN for the HABITAT MANAGEMENT PLAN

(FINAL NOVEMBER 2019)

GRANT OF PLANNING PERMISSION
APPROVED
BY SHETLAND ISLANDS COUNCIL AS PLANNING AUTHORITY UNDER THE PROVISIONS OF THE TOWN AND COUNTRY PLANNING (SCOTLAND) ACT 1997 IN ACCORDANCE WITH THE ATTACHED DECISION NOTICE

TEAM LEADER DEVELOPMENT MANAGEMENT

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VIKING WIND FARM HABITAT MANAGEMENT PLAN: IMPLEMENTATION PLAN

1. INTRODUCTION

The purpose of the Habitat Management Plan (HMP) is to compensate for the loss and modification of blanket bog habitat and mitigate the potential impacts on the whimbrel population as a result of the original 150 turbine wind farm application. The revised and approved Viking Energy Wind Farm development currently stands at 103 turbines; however, the area of blanket bog habitat targeted for restoration still stands at 260 ha, proposed to offset the 239 ha of loss predicted by the original 150 turbine proposal. The HMP also includes habitat enhancement measures specifically targeted for improved breeding success of whimbrel, red-throated diver and merlin. Other species of bird that are likely to benefit from the various habitat enhancements include golden plover, dunlin, greenshank, curlew and red grouse. This document covers the actions required to satisfy the HMP produced by RPS in July 2017[1]. This document clarifies the objectives given in the HMP and how they may be achieved. This implementation plan details the specific targets and methods for carrying out the mitigation and enhancement measures as well as the monitoring work for assessing the success of the various management actions that are given in this document. It also makes it clear what can be achieved within the HMP.

This document will not consider the re-instatement of track sides, turbine bases, hard standings, borrowpits or any other works associated with the construction of the Viking Energy Wind Farm. The re-instatement works will be covered by the Construction Environmental Management Plan (CEMP) and proposed peat re-uses are detailed in the Peat Management Plan (PMP). The only overlap with the CEMP and PMP is the use of some of the peat removed for the construction of turbine bases, hard standings, tracks, etc, in the restoration of some of the blanket bog habitat. The CEMP defines how this peat will be excavated and stored, i.e. in accordance with recognised good practice.

Re-instatement of the vegetation along the batters to tracks, hard standings, turbine bases, anemometer masts, etc will re-utilise the vegetation that will be stripped from the ground to carry out the construction work. Due to the prevalence of bare peat across Mainland Shetland there will almost certainly be a shortage of turves for re-instatement work. Consequently, there will be no turves available for the re-vegetation of extant areas of bare peat immediately beyond the construction area as part of the planned HMP works.

The HMP for the Viking Energy Wind Farm covers the area within the S36 boundary and the areas within the blue lines shown in Figure 1. This is what is termed as the Habitat Management Area (HMA).

The two main aspects to the HMP for the Viking Energy Wind Farm are:

1) Blanket bog restoration; and

[1] Lockwood, S. (2016). Viking Wind Farm Habitat Management Plan 2016. Final Version 1. Unpublished report by RPS and Natural Research Projects Limited to Viking Energy Partnership.

2) Habitat improvement for breeding whimbrel (*Numenius phaeopus*), red-throated diver (*Gavia stellata*) and merlin (*Falco columbarius*).

The assessment of barriers to the migration of migratory fish, principally salmon and sea trout, and the provision of proposals to remove or modify those structures considered to be significant (Condition 20 of the Planning Consent) will be covered by a separate report and will not be part of the implementation plan for the HMP.

2. HABITAT MANAGEMENT PLAN OFFICER AND REPORTING

The complexity and quantity of work involved in the implementation of the HMP means that a person (the HMP Officer) preferably based on Mainland Shetland will be dedicated to managing and implementing the HMP for at least the first three years of the life of the wind farm. At the end of this period the implementation of the HMP will be reviewed. One of the duties of the HMP Officer will be to keep a record of all the works carried out as part of the HMP and this will include as to when, where, what was done and how it was carried out, as outlined on page 30 of the HMP (RPS, 2017). The HMP Officer will also prepare an annual report for the SWEAG each winter as described on page 30 of the HMP. This report will include a description of the HMP prescriptions described in this Implementation Plan that have been completed, the results of monitoring work described in the Implementation Plan and those from the breeding bird monitoring.

The HMP Officer will work closely with the civil contractor to advise fine-scale detail relating to the implementation of the HMP, e.g. recommending techniques and approaches that will encourage an optimal peat surface roughness that is likely to promote vegetation re-establishment.

Viking Energy Wind Farm will undertake reviews of both the HMP and the associated the Implementation Plan at regular intervals not greater than 3 years commencing from the date of initial approval.

The purpose of such reviews will focus on the operation and effectiveness of the plans and the findings will be submitted to the SWEAG.

3. BLANKET BOG RESTORATION

3.1 Rationale

The restoration of areas of blanket bog within the Viking Energy Wind Farm HMA is important for the following reasons:

- ‘Active’ blanket bog is a Priority Habitat under Annex I of the EU Habitats Directive.
- It is a priority habitat in the UK Biodiversity Action Plan (BAP).
- Blanket bog is a globally important habitat.
- Estimates for the amount of carbon that are stored in Scotland’s peatlands range from 1.7 to 4.5 billion tonnes, with most of this in blanket bog peat (Smith *et al*., 2007a).
- Peat is the largest terrestrial carbon store in the UK (Worrall *et al*., 2010).

- The HMP calculated that 1,500 ha of blanket bog habitat (20% of the S36 area) is actively eroding (>20% bare peat). Using the IUCN Peatland Code that uses a figure of 24 tonnes of carbon dioxide equivalents (CO_2 eq.) being emitted per ha per year for actively eroding blanket bog year, the blanket bog habitat within the S36 is probably emitting 36 ktonnes CO_2 eq. per year.
- The Shetland Island Council's Biodiversity Duty Report (2015-17) recognises the value of blanket bog in terms of ecosystem services and its value for biodiversity.
- There has been a major decline in the extent of blanket bog habitat across the UK, but it may have declined by as much as 27% between the 1940s and 1980s, principally due to afforestation.
- For peat to function as a carbon store, blanket bog must be 'active' i.e. decomposition is slower than the rate of input of dead plant material. Degraded bog is a net source of atmospheric carbon (carbon dioxide and methane) rather than being a net sink for carbon.
- Maintaining and enhancing the area and rates of peat accumulation will increase carbon sequestration and therefore the restoration of blanket bog within the Viking Energy Wind Farm will contribute to reducing the rates of release of greenhouse gas emissions in Scotland.
- Restoration of blanket bog habitat will increase the cover of species that provide food or shelter for many upland birds, especially breeding waders, as well as providing broader biodiversity benefits in the diversity and abundance of typical species of blanket bog habitat.
- Hare's-tail cotton-grass or 'draw-moss' is an important constituent of blanket bog and is a valuable source of winter grazing for sheep.

Continued erosion of gullies and peat haggs is due to the action of surface run-off, heavy rain, the drying action of the wind and the trampling and rubbing by sheep resulting in the continued disturbance of the peat which all results in the undermining of the peat at the base of the gullies and haggs. The return of a bog to being a net sink for carbon depends on the development of suitable bog vegetation and this largely depends on the establishment of appropriate water-levels. The restoration of 260 ha of blanket bog should reduce carbon emissions from this area by about 5 ktonnes CO_2 eq. per year. The restoration of blanket bog habitat in the north of England by United Utilities' Sustainable Catchment Management Programme (SCaMP) has also been shown to have a very significant positive impact on the numbers of breeding birds, especially dunlin, curlew and golden plover[2].

The National Vegetation Survey Report (Highland Ecology, 2018) is provided in Appendix 1.

3.2 Over-arching Aim

The aim of blanket bog restoration is to re-establish a vegetation cover on areas of bare peat and to raise water-levels within the peat with the longer term aim of returning the habitat to a near 'active' condition as is feasibly possible within the timescale of the wind farm. This will

[2] Joint report by SCaMP and RSPB available at: https://ww2.rspb.org.uk/Images/restoring-bogs_tcm9-401009.pdf

be achieved through intervention restoration works. The aim of restoring a minimum of 260 ha of blanket bog habitat within the S36 site is stated on page 25 of the HMP (RPS, 2017).

3.3 Intervention Restoration

Intervention restoration involves the use of various physical activities/measures to help to restore a habitat rather than just using changes to existing land management practices. The restoration of the blanket bog habitat will utilise four methods:

1) restoration of bare peat flats (areas of bare peat and bare mineral subsoil that are at least 5 metres wide);
2) blocking of eroding gullies;
3) re-profiling eroding peat haggs (single vertical cliffs of peat) and the sides of gullies; and
4) fencing-off areas of blanket bog habitat from livestock.

All of this work will be carried out outside of the re-instatement works that is part of the construction work and Construction and Environmental Management Plan (CEMP). Some of the areas of blanket bog restoration are designed to stop or prevent the drainage of lochans that have or potentially been used by red-throated divers for breeding. The areas of blanket bog restoration around lochans used or potentially used by breeding red-throated divers amounts to approximately 24.5 ha, including 4 areas outside the S36 boundary but within the original HMP. In some cases the blanket bog restoration will be carried out in conjunction with works to raise the water of the lochans to close to those originally present before erosion lowered them.

3.3.1 Aim

The aim is to carry out intervention restoration across 260 ha of blanket bog habitat, as given on page 9 of the HMP (RPS 2016). The areas identified for potential intervention restoration of the blanket bog habitat are shown in Figure 3. These were chosen on the basis of being most practicable for restoration of bare peats, with a low risk of peat slides and also being located in areas with some of the worst erosion. Consequently, they are located in close proximity to the wind farm tracks and therefore potentially accessible to track machinery directly off the wind farm tracks. This would help to reduce damage to areas of intact blanket bog vegetation. The areas shown in Figure 3 are categorised into four groups:

i. areas that are largely composed of bare peat flats (circa 54 ha);
ii. areas that are a mixture of bare peat flats and gullies (circa 165 ha);
iii. areas which are made up of only eroding gullies and peat haggs (circa 75 ha); and
iv. areas where livestock proof fencing will be erected (219 ha).

The areas identified for potential restoration is presently greater than the target area of 260 ha. This is to ensure that sufficient area is identified to meet the target, once detailed ground truthing and survey has been carried out to determine the suitability of areas for restoration. Restoration areas may also move up to 50 metres as a result of any micro-siting of tracks,

hard standings and turbine bases. Only after detailed on-the-ground measurements of peat depths, ground-truthing of erosion features and consideration of risk of peat slides, micrositing and accessibility will it be possible to provide detailed maps of the finalised 260 ha of bog restoration work.

The erection of livestock proof fencing will overlap most, but not all of these areas identified for restoration. The areas shown in Figure 3 for livestock proof fencing may exceed the area that will finally be erected as some of the areas marked for restoration of bare peat flats may not proceed for the reasons given above. Considering the preliminary fencing estimates, the area of land taken up by livestock proof fencing in any one common grazing does not exceed 7% of the individual common grazing. However, for the reasons previously outlined, the initial estimate of the length of new fencing is likely to be greater than that which is finally installed.

3.3.2 Potential Methods

3.3.2.1 Bare Peat Flats

On page 25 of the HMP (RPS, 2017) there is an 'aim to reduce the extent of bare peat'. This will be achieved using two different methods will depend on the depth of the extant peat remaining in the area. Bare peat flats are those areas of bare peat with or without bare mineral soil that are at least 5 metres wide. Where the remaining bare peat is less than 0.5 metres thick (shallow peat) it will be built-up with peat excavated from the engineering works within the wind farm. Where the remaining peat is more than 0.5 metres thick (deep peat) it will be re-profiled accordingly.

The establishment of vegetation on the bare peat flats is hindered by a) a lack of local source of seed, b) the bare peat flats being very low in nutrients and c) any seedlings establishing die due to being washed away or dried out by the strong winds that rapidly dry out the surface layers of peat. A vegetation cover needs to be established relatively quickly on the bare peat in order to stabilise the surface and prevent new or on-going erosion of the bare peat. A generally accepted method for establishing vegetation on relatively inhospitable substrates or environments is to establish a nurse-crop within which local, native species can establish (Gilbert & Anderson 1998).

It is neither practical or feasible to establish species typical of blanket bog habitats straight away on to the areas of bare peat on mainland Shetland for the following reasons:

1) Typical blanket bog species (i.e. heather, cotton-grasses and deer-grass) are relatively slow to germinate compared to native species of grass (Phillips 1954, Gimingham 1960, Bannister 1966, Wein 1968, Barbara *et al*. 1983, Grime *et al*. 1988).
2) Typical blanket bog species are inherently slow-growing species with low relative growth-rates (rgr = 0.35 to 0.67 g g^{-1} $week^{-1}$) compared to grassland species which are usually around 1 g g^{-1} $week^{-1}$ (Grime 1979, Grime *et al*. 1988).
3) A nurse crop of grasses typical of acid grassland will stop the less readily available seeds of any bog species that can be acquired from being washed and/or blown away in the first storms.
4) Seeds and seedlings of hare's-tail cotton-grass (*Eriophorum vaginatum*) have been shown to establish better on moss mats than in bare organic soils (Gartner *et al*. 1986).

5) Similarly the root mat provided by a nurse crop will help to stop frost heave of the bare peat from killing any small seedlings of bog species that have been established from seed.

For vegetation to successfully establish on areas of bare peat, the peat needs to be stabilised. This is because the combined actions of frost and wind drying out the peat surface usually result in the desiccation of seedlings and young plants that may germinate from what little remnant seed bank may be present in the re-worked peat, as well as any seeds naturally falling on the bare peat surface. Heavy rain can also destabilise the bare peat surface. Initial trials using old netting from salmon farms on East Kame within the S36 boundary have been successfully used to stabilise bare peat surface. It is anticipated that this method will be replicated for some areas of bare peat flats as part of this HMP. Geo-jute will also be trialled in some areas as this has the advantage of eventually decomposing *in situ*. However, it has the disadvantage of being lighter than old netting from salmon farms and therefore has the potential to be blown away during storms. There is apparently no shortage of old netting from salmon farms. Both the salmon farm netting and geo-jute netting will be held in place using the standard practice of using wooden pegs.

Where it is available locally, waste sheep's wool, e.g. daggs, will be placed under the netting to provide a manure to aid the establishment of native vegetation as well as providing a source of some seeds of native grass that are often present in the wool.Although bare eroding peat surfaces can be highly acidic as a consequence of the oxidation of the organic matter, this is considered not to be a significant issue on Mainland Shetland. Initial discussions with Sue White of Shetland Amenity Trust involved in peatland restoration on Shetland indicate that the pH of the surface peats are not particularly acidic and are close to a value of 5. It is, therefore, considered to be unnecessary to apply granulated lime at low rates, but it will remain an option if investigations show that low pH could have contributed to a poor re-vegetation of areas of bare peat.

The application of heather brash to help stabilise the bare peat surface is not likely to be feasible within the Viking Energy Wind Farm. This is for three reasons:

- firstly there is a lack of suitably tall bog vegetation that is not heavily grazed;
- secondly the strong winds on Shetland means that much of the brash is likely to be blown off the areas of bare peat onto the surrounding bog vegetation; and
- thirdly the severely eroded and uneven surface of any remaining areas of bog on Shetland makes the harvesting of bog vegetation with a brush harvester almost impossible.

The use of plug plants for re-vegetating on the scale required for the Viking Energy Wind Farm, approximately 50 to 60 hectares, is also considered not to be viable. Plug plants were successfully used for the re-vegetation of bare ground on Great Dun Fell in the north Pennines, but this was over an area of a few hectares (Gilbert & Anderson 1998).

It may be possible to use small turves of intact bog vegetation taken from islands of peat within the areas of peat flats and to plant them on to the bare peat to act as an inoculum for the re-vegetation bare peat through vegetative spread. However, this cannot be used as a main mechanism for the re-vegetation of the large bare peat flats. The high levels of grazing and poor climate mean that the seed rain on to the bare peat from the surrounding vegetation cannot be guaranteed. Also, it would be very risky to rely on any viable seeds or

vegetative propagules still present in the bare peat as much of the bare eroded peat may be many hundreds or thousands of years old and therefore very unlikely to contain any viable seeds or vegetative propagules.

Therefore, the only viable means is to rely on sown seeds to rapidly establish a nurse crop of grasses typical of acid grassland to help stabilise the peat surface. The application of an acid grassland seed mix with added heather seed is the only viable option for the rapid re-vegetation of the bare peat flats. The use of a nurse crop with fertiliser and lime has been found to be the most effective method of restoring areas of bare peat in many situations in the UK (Lunt *et al.* 2010).

All of the proposed species of grass are native to Shetland and should readily establish on bare peat:

- wavy hair-grass (*Deschampsia flexuosa*) – 40% of seed mix by weight
- common bent (*Agrostis capillaris*) – 30% of seed mix by weight
- red fescue (*Festuca rubra*) – 15% of seed mix by weight
- Yorkshire fog (*Holcus lanatus*) – 15% of seed mix by weight

Wavy hair-grass can often be a frequent component in bog vegetation. Although red fescue, Yorkshire fog and common bent do not normally occur within blanket bog, they will readily establish on bare peat or any other bare substratum. As time progresses they will be out-competed by the larger bog species as they become shaded out and nutrient levels in the surface peat are depleted over time (Schipper *et al*. 2002, Caporn *et al.* 2007, Lunt *et al.* 2010). The use of a nurse crop for the stabilisation of bare peat is standard practice used by the Yorkshire Peat Partnership and Moors for the Future[3]. The suggested rates of application of seed (10 kg per ha) are the same as those recommended by the Yorkshire Peat Partnership[4] (see Appendix 3). For small areas the seed may be applied by hand, but for large areas it will be hydro-seeded from areas of relatively firm ground.

Commercially available heather seed will be included in the mix, but currently there is no commercially available cotton-grass (*Eriophorum* species) seed. If there is the possibility of obtaining sufficient seed harvested from bog vegetation dominated by hare's-tail cotton-grass (*Eriophorum vaginatum*) and heather (*Calluna vulgaris*) it may be included in the seed mix. To help establish bog species areas of intact bog vegetation around the bare peat flats will be included within the fenced areas to exclude sheep from entering these areas (see section 2.3.2.1.3). The exclusion of the sheep should allow these stands of vegetation to flower and set seed more freely. It is anticipated that these stands of vegetation will provide a much larger source of seed that will be allowed to establish 'naturally' without any intervention. Where it is considered viable and appropriate some harvesting of seed from these stands of vegetation may be carried out if it does not compromise the integrity of the vegetation.

[3] https://www.moorsforthefuture.org.uk/__data/assets/pdf_file/0011/1423649/Bare-peat-revegetation-factsheet.pdf

[4] Yorkshire Peat Partnership Technical Specification 3 available at https://www.yppartnership.org.uk/sites/default/files/2018-07/171011%20Technical%20Specification%203%20Flat%20or%20gently%20sloping%20bare%20peat%20stabilisation%20%26%20re-vegetation%20TT.pdf

Species of bog-moss (*Sphagnum*) readily propagate from individual leaves and stem fragments as well as from spores present in the atmosphere (Rochefort *et al*. 2003). Where the hydrology of the peat is considered to be suitable for the establishment of bog-mosses the re-vegetation of the bare peat flats may be boosted by the application of bog-moss. This will be done by obtaining bog-mosses from a suitable donor site where the impact of harvesting the bog-moss would not compromise the integrity of the donor site. The small quantities of bog-moss can be effectively spread over a large area by breaking the bog-moss into small fragments with a suitable liquidiser in water and then pouring the mixture on to the receptor site. Again this is likely to be only feasible over relatively small areas and will be undertaken in accordance with recommendation from the HMP Officer.

Although bogs are normally thought of as habitats of very low nutrient status, it has been shown that the addition of phosphate has not hindered the establishment of bog vegetation on bare peat of cut-over restiad peat bogs (Schipper *et al*. 2002). Also concentrations phosphate of between 0.2 to 1.6 mg P l^{-1} actually stimulated the growth of bog-moss in peat cuttings (Money 1994). The accepted practice of adding a phosphate fertiliser (P_2O_5) at a low rate of application (20 kg per ha), will be used here as this is necessary to get the grass seedlings to a sufficiently large size to resist erosion and frost heave. The fertiliser is usually applied after seeding. It has also been shown that 90% or more of the rock phosphate is retained in the vegetation or uppermost layers of drained peatlands and there is therefore little danger of it eutrophicating any watercourses or lochs and lochans downstream (Malcolm & Cuttle 1983).

3.3.2.1.1 Restoration of shallow peat flats

Where the remaining areas of bare peat are relatively shallow, i.e. less than 0.5 metres deep, peat excavated from the engineering works within the wind farm will be deposited across these areas to a maximum final depth of 0.75 metres. A minimum depth of 0.5 metres is required so that the re-established bog vegetation is isolated from the underlying mineral layers, but the depth of redistributed peat should not exceed 1 metre to avoid large masses of peat that could potentially result in a peat-slide. Therefore, the restoration of these areas can only be carried out safely where there is a low risk of peat slide, and this includes slopes less than 2° and certainly no more than 5°. The initial estimated total area where this approach will be used is about 57 ha and it will therefore have the potential to reuse (for ecological improvement) about 300,000 m^3 of peat excavated from elsewhere within the development.

The restoration of the shallow bare peat flats will require large vehicles to bring in native rock and peat from elsewhere within the S36 boundary. Therefore, the areas of shallow bare peat and mineral soil have been carefully chosen so that they can be easily accessed immediately or within a few metres of the proposed wind farm tracks. This will minimise damage to extant areas of deep peat with intact vegetation. If necessary, short sections of peat may need to be removed to allow appropriate vehicles to gain access to the bare peat flats without machinery sinking into any deep peat.

Re-used peat excavated as part of the development will be spread within cells that will use broken native rock to construct rock dams/walls to prevent the movement of peat downslope via exit gullies and to contain the peat in cells of a size that prevents any movement. The re-establishment of deep peat across areas of shallow bare peat and mineral soils will involve

the following as a general design, but the specific requirements will be determined by the contractor in consultation with suitably qualified civil design engineers:

a) The downslope gaps between blocks of intact blanket bog vegetation on the downslope side of the bare peat flats, usually wide gullies, will be blocked using rock dams/walls. The dimensions of the rock dams will be designed specifically for each gully depending on the slope and nature of the substratum. The broken rock will typically use stones 200 to 500 mm in dimension, but may be larger depending on the size of the gullies that need to be blocked. The gaps between the larger blocks will be filled with smaller rock fragments, but the gaps in the rock walls and dams will allow water to pass through and also help to trap suspended peat fragments into the rock walls and dams as the water seeps through the rock wall/dam.

b) The dimensions of each cell of re-deposited peat will be calculated depending on the specific conditions of the exact location with respect to the peat slide risk. The cells of re-deposited peat will be divided up using rock walls constructed using a method similar to that used for blocking the exit gullies.

c) Peat excavated from the other parts of the Viking Energy Wind Farm will be deposited into these cells so that the total depth of extant and re-used peat is no more than 0.75 metres. The lower layers of peat will be compacted so that during heavy rainfall events as much rain washes over the peat surface rather than percolating through cracks in the peat down to the interface between the peat and mineral subsoil. This will help to reduce the risk of a peat slide. The upper layer (100 to 200 mm) of peat with low Von Post humification values (typically H5 or less) will be added without compaction so that there is a greater success of re-vegetating the surface with seeds applied to the surface. Fine-scale roughening of the surface of the bare peat will be agreed at a site-level between the HMP Officer and Contractor, but it is envisaged that the use of teeth on the bucket of excavator will be sufficient to create the necessary roughness to aid the establishment of plant seedlings.

d) The rock dams and walls may be covered with a thin layer of re-used peat to hide the structures and to allow native vegetation to establish on them.

e) Finally the areas of bare peat will be re-vegetated as described in section 2.4.2.1 above.

A separate geo-technical method statement will be produced by the contractor that will give more detail on the specific dimensions and methods used to produce cells of peat at least 0.5 metres thick that are safe in areas where the existing peat mantle has largely or wholly been lost through erosion. Figures 4 and 5 show indicative access routes and possible location for rock dams and walls for two contrasting areas identified for restoration of bare peat flats. It is not possible at this stage to give final designs, i.e. deep or shallow peat or peat slide risk, as the depth of remaining peat in these areas is not known. These variables will be determined by the contractor as part of the detailed design process.

The alkalinity of the bedrock used in the creation of the rock dams and walls is an important consideration, but the only borrow pit that is in an area of metamorphosed limestone is NBP01 on South Filla Runnie (see Table 5 for grid reference). Most of the proposed borrow pits are in pelite, semipelite and psammite metamorphosed sedimentary rocks of Dalradian age, but a few (NBP03, NBP04 and NBP06) are in granite and gneissose types of igneous

rock (Table 5). Therefore, the rock from borrowpit NB P01 will not be used for the rock dams and walls in the restoration of the bare peat flats.

3.3.2.1.2 Restoration of deep peat flats (greater than 0.5 metres thick)

Where the remaining areas of bare peat are more than 0.5 metres thick then these areas will be re-profiled and re-vegetated. Again work on these areas will be restricted to those areas with a low risk of peat slides, i.e. with slopes less than 5°.

In terms of the HMP and the restoration of degraded blanket bog, areas of deep peat are those where the peat is consistently more than 0.5 metres thick. This is the accepted threshold in the ecological community for defining deep peat. These will be restored through stabilisation of the surface and re-vegetated. This will be achieved by re-profiling the surface of the peat into shallow depressions with maximum dimensions of 10 m x 10 m. These depressions will have a shallow bund/raised margin, typically less than 100 mm high. These raised margins will help slow the rate of surface run-off and hold back some water. Preferential channels for water movement will be removed when the cells are re-profiled.

The areas of bare peat will finally be re-vegetated as described in section 2.4.2.1 above.

3.3.2.1.3 Fencing around bare peat flats

It is recommended that all areas where the peat surface is bare and seeded are fenced off from livestock to allow the vegetation to establish. The fencing will also have safety notices warning people not to enter these areas due to the danger of becoming entrapped in soft peat and this is another reason for excluding livestock from these areas. The fencing for these areas will incorporate some intact blanket bog habitat and vegetation. It is anticipated that the extant vegetation within the fencing will flower and set seed more profusely as a consequence of sheep being excluded and therefore these areas may act as a potential seed source for the re-vegetation of bare peat. Once a near complete vegetation cover has been established the relatively firm root mat upon should provide sufficient support that livestock and people can walk on these areas. As these areas of bare peat do not have vegetation before the restoration work there is no effective loss of grazing land to the graziers.

3.3.3 Monitoring

The success of the restoration of bare peat flats will be monitored in year's 1, 2, 3 and 5. Monitoring will involve the following:

i. check that livestock proof fencing is intact and that all safety signs are still in place and visible;
ii. any signs of cracking of the peat and/or slumping of the peat surface will be recorded and reported immediately to the appropriate manager at the time (construction or operations) who will arrange for an assessment to be made by an appropriately qualified engineer;
iii. fixed-point photographs of the re-vegetation of areas;
iv. objective assessment of the amount of vegetation cover by recording the presence/absence of plant species. The plant species will be identified as one of the appropriate positive indicator bog species as defined in the footnote to Table 1 or as

a non-bog species of plant. This will enable the development of bog species to be monitored over time. A minimum of 50 points per transect will be used for each bare area.

SWEAG will consider the results of the monitoring and make recommendations to potential methods to improve the re-vegetation and restoration of the areas of bare peat. Appropriate remedial action will be taken by the contractor to stabilise any apparently unstable peat or block routes for water-loss which may be resulting in the drying out of the peat surface/s.

Photographs will help provide an immediate visual assessment of the rate of re-vegetation of the bare peat surface/s. Point transects placed at random across the areas of bare peat (at least one per peat cell) will provide an objective quantitative measure of the rate of re-vegetation. Surveyors and any staff monitoring the areas may need to take appropriate measures to prevent sinking into the soft peat using either snow-shoes or walkboards, if necessary.

Subsequent monitoring will be every 5 years or until there is more than 50% vegetation cover. Where peat flats have not reached at least 50% vegetation cover after 5 years since they were restored the reasons for the lack of progress will be investigated and reviewed. This may include checking the pH of the peat, levels of seed germination and nutrients in the peat. Appropriate remedial action will be taken, such as an application of lime or an additional application of seed and/or nutrients. The final aim will be to have at least 50% of the vegetation to be composed of positive bog indicator species by year 25.

3.4 Gully blocking

3.4.1 Aim

To achieve fully vegetated gully floors to stop or reduce the downward erosion of the gullies. This should help improve the condition and peat forming of vegetated areas of poor quality blanket bog habitat immediately adjacent to these gullies as stated on page 25 of the HMP (RPS, 2017). However, the blocking of the gullies is unlikely to replace the erosion patterns with surface patterning typical of healthy blanket bog habitat, as suggested on page 25 of the HMP (RPS, 2017). This is because the erosion features are for the most part on slopes that are too steep for typical hummock and hollow surface patterns to develop on.

3.4.2 Rationale

The blocking of gullies will reduce the rate of run-off down the gullies and produce fully vegetated gully floors. This will halt downward erosion and help stop side-wards erosion of the gully by preventing under-cutting of the gully sides. It also has the added effect of helping to result in the sedimentation of eroded peat into the bottom of the gullies. This has the benefit of preventing the eroded peat accumulating in the shallow lochans further downstream as well as helping to reduce the continued loss of organic matter as carbon dioxide to the atmosphere.

3.4.3 Method

The proposed methods for blocking gullies will largely follow the guidance produced by the Yorkshire Peat Partnership (Technical Specification Number 1). This guidance is based on

many years of experience of carrying out this sort of work throughout the Pennine hills of northern England. The type of dam for blocking eroding gullies depends for the most part on the depth of peat at the bottom of the gully, the width of the gully and the steepness of the gully sides. The spacing of dams varies depending on the slope of the ground and will vary from a maximum of 12 metres apart on level ground to 5 metres apart on steeper ground. Typical spacing is about every 7.5 metres. The individual type of dam and baffle required at each location will be assessed and decided by the suitably qualified and experienced contractor in collaboration with the HMP officer.

Untreated timber sediment traps are usually used for gullies less than 3 metres wide with vegetated peat at the bottom. However, for the Viking site, it is proposed to use, where possible, the black plastic pipes (diameter 30 cm) from salmon farms that are cut length-wise, rather than using plastic sheet piling (see Figure 2). These pipes will be cut in half lengthways and cut to suitable lengths with pointed ends. A series of inter-locked sections of split pipes will be driven into the bottom of the gullies and held in place with further lengths of split pipe pushed into each side of the gully (see Figure 2). This method has been used successfully on East Kame within the S36 boundary. Untreated timber sediment traps will be used when and where there is insufficient waste plastic piping.

Peat dams will be used for gullies up to a maximum width of 3 metres where the bottom of the gully has bare peat that is at least 0.3 metres thick[5]. Peat dams are not appropriate for gullies on slopes greater than 5° and in these instances either split plastic piping dams (deep peat) or stone dams (shallower peat (<30cm thick) and mineral) should be used. Well humified peat that has not been oxidised/dried out must be used to make the dam walls. This well humified peat must be taken from a part of the bog that has not been affected by erosion within reach of the excavator to one side of the gully. Peat removed from elsewhere on the construction site should not be used for constructing peat dams because it will have lost its putty/plastic nature which is vital to it forming an effective cohesive seal to the peat dams (see Appendix 2).

Where there is easy access to gullies for low pressure trucks carrying stone, rock dams (stone sediment traps) will be used for gullies that are less than 3 metres wide and have bare mineral soil or peat less than 30 cm deep in the bottom of the gully. Where gullies are beyond reasonable access to vehicles needed to move the stone, options of using a helicopter with cargo nets or other methods of moving the stone will be explored. It may also be possible to excavate stone from the bottom of gullies with bare eroded bottoms to construct some of the stone flow baffles.

Trials will be carried out using coir rolls filled with crushed glass as an alternative to crushed rock to block gullies with shallow peat or mineral/bare rock at the bottom. These coir rolls have been used successfully elsewhere on Shetland in peatland restoration work and there is a plentiful supply of crushed glass available on Shetland (A McBride pers. comm.). The advantage of the crushed glass is that is relatively inert and the coir will ultimately decompose.

Stone and timber flow baffles are used for gullies that are more than 3 metres wide. The principle of the baffles is to slow the rate of water flow down the gully and to enhance the

[5] Yorkshire Peat Partnership Technical Specification 1. Gully & Grip Blocking or Sediment Trapping techniques.

deposition of peat and any eroded mineral soil from further up the gully. Stone baffles are used for those gullies where there is bare mineral soil or peat that is less than 30 cm thick in the bottom of the gully. Timber baffles are used for those gullies with deeper peat in the bottom of the gully.

Where the dams will result in the ponding of water behind the dam, i.e. peat dams or split plastic piping dams, then either of the following situations should be engineered:

a) peat dams are higher than the sides of the gully so that water is dispersed across the surface of the vegetated bog either side of the gully; or
b) a spillway composed of rock or split piping or similar material is incorporated on the downslope side of the dam; or
c) dams are sufficiently close so that overflowing water falls into the pool created by the downslope dam.

Before any restoration works are carried out a desk survey will be completed using high resolution aerial imagery and LiDAR data that have now been collected. This will be analysed by the contractor to produce a detailed design/model for the restoration works. It is normal practice for contractors to use this information as well as the results of field surveys. Field surveys would need to ground-truth gully widths, steepness of gully sides and haggs, as well as determining the type of substrate in the bottom of gullies, the depth of any peat present at the bottom of gullies. This information will be used by the contractor to decide on the type and size of dams used to block gullies. It is, therefore, not appropriate to pre-determine the exact number, type and location of dams to be constructed at this stage as this will be decided by an expert practitioner in peatland restoration. In addition the file sizes generated from high resolution imagery and LiDAR measurements are too large to be included in this plan at this stage.

Interlocking plastic piling dams will be used very sparingly, and only for small gullies where it is difficult to transport the larger and heavier split plastic pipes. The most appropriate locations are likely to be the areas of blanket bog to be restored around lochans well away from the wind farm tracks and hard standings and for the work associated with enhancing the bog habitat for whimbrel.

Plastic sheeting will not be used for sealing peat or other types of dam as it can rip, fragment and is often not effective.

The high resolution aerial imagery and LiDAR data will be supplied to the contractor commissioned to carry out the gully blocking work.

3.4.4 Final Results

All gullies should have vegetated peat or shallow pools of water held back by dams and baffles by the end of the HMP. Small pools of water held back by the dams will be shallow, typically less than 300 mm deep, and given the moderate slopes upon which the gullies are located, they are unlikely to extend to more than a few metres in length upslope. One advantage of peat dams is that they provide routes for animals, including sheep, to easily cross gullies without descending into steep sided and deep gullies.

3.4.5 Monitoring

Each dam or baffle will be examined at least twice in the first year and once every year thereafter for the next 4 years after their construction. The monitoring of the dams and baffles will then only be carried out once every 5 years after the first 5 years of monitoring. The monitoring will involve checking their effectiveness and integrity. Where dams or baffles are leaking or have been washed away they will be repaired or replaced.

The amount of vegetation within the gullies that have been blocked will be monitored using fixed-point photographs taken once a year, preferably in late summer. The cost of direct monitoring of water-levels upslope of every dam would be prohibitively expensive. The most effective measure of the success of increasing the wetness within the gullies is to use the collective cover of all species of bog-moss (*Sphagnum*). Also, the bog-mosses are the most important group of plants in the establishment of a blanket bog habitat that is in an 'active' state, i.e. working as a sink for carbon dioxide. The monitoring of the vegetation in the floor of the gullies will be carried out in years 1 and 5 and then once every 5 years thereafter.

3.5 Re-profiling gully edges and peat haggs

3.5.1 Aim

To produce angles of slope to gully sides and exposed haggs that are less than 30° that are partially vegetated with the aim of achieving a complete vegetation cover within the life-time of the HMP.

3.5.2 Rationale

The reduction in the slopes of the sides of the gullies and peat haggs should stop continued erosion through under-cutting of the slopes and help with its natural re-vegetation.

3.5.3 Method

Low ground-pressure, typically less than 5.5 psi, 360° excavators will be used for this work. The excavators will follow the procedures as described by the Yorkshire Peat Partnership (Technical Specification 2). Re-profiling of gullies usually has to be done in conjunction with blocking the gullies where the gullies are less than 3 metres wide. Wider gullies can generally be re-profiled to have stable (<33°) or moderate (33 to 45°) sloping sides. All peat haggs can be re-profiled so that they have stable slopes, but there may not be enough turf to re-vegetate the whole of the re-profiled face of bare peat. In these instances the toe of the slope will need protecting as described in Technical Specification 2.

Further details of the methods used for re-profiling the slopes of gullies and haggs are given in Appendix 3.

3.5.4 Final results

The aim will be to have all re-profiled slopes to be stabilised by year 10 and to have the majority of re-profiled slopes with a vegetation cover and to be no longer eroding by year 25 of the wind farm. During the monitoring period, gullies experiencing headward erosion from the same or other gullies in the restoration area where gullies and haggs have been re-

profiled and blocked may be identified. Therefore, these gullies may need additional work outside the original blanket bog restoration areas.

3.5.5 Monitoring

The monitoring of re-profiled gully sides and haggs will be at least once a year for at least the first 5 years after restoration or until there is at least 50% vegetation cover, whichever is the sooner. The monitoring will involve the use of fixed-point photographs. Percentage vegetation cover will be determined by recording the presence or absence of plant species (including mosses and liverworts) at 50 points (point transects) along each re-profiled gully or hagg.

3.6 Restoration through exclusion of livestock (fencing)

The restoration of eroding blanket bog will also be achieved by excluding livestock, principally sheep. This will be done by erecting standard livestock fences (c. 1m high post and wire (rylock)). Most of the fencing will surround areas with peat-flat restoration works, but for practical reasons of installing the fencing, it will include some areas of gully blocking and/or hagg and gully re-profiling. Most, if not all of the areas of gully blocking and/or hagg and gully re-profiling away from the wind farm tracks will not have any fencing erected. Also, none will be erected around those areas restored close to lochans and lochs that are or could be potentially used by nesting red-throated diver.

Figure 3 shows the areas chosen for excluding livestock. They have been selected on the basis that they have the greatest proportion of bare and/or eroding peat and are within particular common grazings and/or individual ownerships where agreements have been achieved. The exact alignment of fences and which areas will have livestock fencing erected will alter slightly depending on the suitability of the ground for erecting fences as well as where re-used peat will be spread onto areas of thin bare peat.

Furthermore, the area of blanket bog that has been identified for potential livestock proof fencing is just under 300 ha, but significantly less than this will be carried depending on the location of areas of peat flat restoration and gully blocking as indicated in section 2.3.1. No more than 7% of any one particular common grazing has been allocated for this type of intervention restoration and for most of the common grazing areas it will be significantly less.

3.6.1 Monitoring

The integrity of the fence will be checked once within a year after erection and then once every 5 years. More regular checks may need to be carried out to ensure that sheep have not entered the exclosures. Any breaches or damage to the fence will be reported to the appropriate manager at the time (construction or operations) for the Viking Energy Wind Farm. The appropriate manager will then arrange for a contractor to perform the necessary repairs.

As suggested on page 30 of the HMP (RPS, 2017), the condition of the vegetation on areas of intact blanket bog habitat will be monitored using a slightly modified set of targets taken from the Common Standards Monitoring (CSM) guidance (see Table 2 for details) issued by the Joint Nature Conservation Committee (JNCC) for Upland Habitats (JNCC 2009).

A minimum of 30 semi-permanent sample plots (4 m^2) located at random within fenced areas on areas of intact bog vegetation will be used to monitor the condition of the blanket bog habitat. A similar number of sample plots will be set up outside the livestock proof fencing, but within areas where restoration works, i.e. gully blocking, re-profiling of haggs and gullies, will be carried out outside of the fenced areas.

The response of the bird populations to the bog restoration work (page 31 of the HMP) will be monitored through the bird monitoring programme.

4. RED-THROATED DIVER

4.1 Ecological Requirements (summary)

Red-throated divers breed on lochs and lochans, and visit nearby (up to approximately 10 km away) inshore marine waters to feed on fish. Diver chicks are fed by the adults on small fish prey brought back from the sea. Consequently the adults regularly commute between the breeding site and inshore feeding areas. The divers at a particular breeding site, typically take the same flight path or paths to and from their marine feeding areas. This is usually the most direct and therefore energetically the most economical route to the sea.

Red-throated divers typically nest on small lochans on Shetland, but they will also nest on the larger lochs if there are suitable nest sites. Studies of the red-throated divers breeding on Central Mainland Shetland indicate that the number of breeding pairs is probably limited by the availability of potential breeding sites. Therefore, measures to either prevent the deterioration in quality and/or to increase the quality of existing or formerly used breeding lochans for red-throated diver to breed, is the priority in the HMP for this species.

Red-throated divers require at least 15 metres of open water in order to get airborne in calm conditions. This, therefore, sets a lower limit for the size of any lochan that may be used for breeding. Many of the breeding sites on Shetland are peatland lochans that are small and some are at or close to these limits. Lochans and lochs also have to be at least 0.5 metres deep in order that chicks are able to dive when escaping from predatory birds, such as great skuas. Due to the water-levels in some lochans having lowered as a consequence of erosion they are no longer sufficiently deep for breeding to be successful.

The red-throated divers that breed on Shetland spend the winter at sea away from Shetland. They return to the breeding grounds in the early spring (March and April) and depart in the late summer (August and September). This means that work immediately around lochs and lochans should be carried out between August/September and March/April.

The main factors limiting the availability and quality of breeding sites are considered to be the following:

1) Many of the extant or former breeding lochans have been partly or wholly drained as a result of continued headward erosion of peat along gullies in the blanket bog habitat immediately around these lochans. Unchecked, peat erosion poses a high risk of water level reduction (and thereby reducing suitability for breeding divers) at many of the regularly used breeding sites. Some otherwise suitable lochans are not currently used as there is an insufficient depth of water.
2) Some very small lochans have low occupancy rates and breeding success. This is likely to be linked to the adults having difficulty in taking off from the water, especially when there is little or no wind.
3) Breeding success and occupancy rates tends to be lower at sites where there are no islands for nesting and as a consequence birds are obliged to nest on the main shore, where eggs are vulnerable to trampling by sheep or people, and to predators patrolling the shore. This is particularly so on the larger loch sites, that typically have stony shorelines.

Red-throated diver breeding sites (existing or potential) were selected for potential inclusion in the HMP programme on the following basis:

1. those with historical use by red-throated diver that will have a high likelihood of being used;
2. those lochans which will have a high suitability for use by red-throated diver once restored;
3. those more than 400 metres from any wind turbine, or for which associated regular flight routes that are more than 200 metres from wind turbines;
4. those lochans on peat that have been or are likely to be drained in the future through the headward erosion of the surrounding blanket bog habitat;
5. those lochs where it is judged the divers would benefit from the provision of a floating nest platforms.

The aim of the works described in this plan are to protect and enhance the breeding sites of red-throated diver on central Mainland Shetland (page 28 of the HMP).

4.2 Management Prescriptions

Five management prescriptions are proposed for red-throated diver breeding sites, and these cover the actions given on page 28 of the HMP (RPS, 2017):

1. raising the water level at former or potential breeding lochans which have been drained through erosion so that the average depth is more than 0.5 metres;
2. restoring/re-vegetating the blanket bog habitat surrounding the lochan/loch to prevent in-filling of the shallow lochans with eroded peat and to prevent drainage through downward erosion of gullies immediately downslope of the lochan;
3. enlarging small lochans that are considered to be at or just below the minimum size required for breeding in order that there is at least 25 metres of clear water for birds to take-off;
4. the creation of small islands for birds to nest on at lochans within blanket bog habitat that lack any natural islands by carefully cutting away the bankside peat; and,
5. the provision of one or more artificial floating islands at certain larger lochs used for breeding and that lack natural islands.

In some instances management prescriptions 1 and 2 will be used in combinations, especially where blocking exiting gullies will result in the raising of water-levels.

A number of lochans/lochs were previously identified for management/restoration works, but have been rejected as they reside outside the S36 boundary or are in unsuitable locations. Figure 6 shows the location of the lochs and lochans for the various management prescriptions for enhancing the breeding success of red-throated diver.

4.2.1 Restoration of water-levels

Where a lochan is too shallow and has been drained as a result of erosion the water-level will be raised by no more than 0.5 metres above present levels. However, the increased amount of stored water above the existing level of the lochan must be less than 10,000 m^3. The former requirement is so that the works will only require a simple CAR licence (The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended)) from

SEPA[6]. The latter requisite is so that the works do not result in the lochan falling under the conditions of a controlled reservoir (Reservoirs (Scotland) Act (2011))[7].

The restoration of the water-level will be achieved by using one or more of the following methods for blocking gullies:

a) peat dams; or
b) untreated wooden post and rail; or
c) cut sections of salmon farm piping used to create the equivalent of plastic piling in two parallel rows with peat used to fill the inside section.

Before any of the proposed lochans are considered for raising of the water levels a desk study will be carried out to determine the likely increase in storage of water through raising water levels by only 0.5 metres. An initial survey has indicated than none of the lochans are likely to result in an increase in storage capacity of no more than 10,000 m^3. However, for those lochans where the raising of water levels would result in an increase of at least 5,000 m^3, a detailed topographic survey of the current water storage capacity as well as the potential new storage capacity will be carried out. This will be achieved by using suitably qualified surveyors using laser surveying equipment to establish the topography of the land immediately around the lochan. The depth of the lochan will also be surveyed manually using high accuracy GPS and a staff gauge. From this data the current storage capacity of the water body and potential new storage capacity can be calculated for different sizes and locations of structure used to raise water levels. Where the changed water body has an increased storage capacity of less than 10,000 m^3 it will not fall under the definitions of a controlled reservoir. However, a simple CAR licence will have to be applied for each of these structures/lochans before work commences.

A peat slide risk assessment will be carried out for each of the lochans where the water-levels will be raised and if there is a significant risk of a peat slide being generated as a result of the increased water burden in the lochan then the raising of the water-level will not be carried out.

The lochans that will initially be considered for restoring the water levels are:

i. lochan north of Loch of Andris (HU 4274,5636) – originally 1 m deeper than present
ii. Loch of Hookame (HU 4256,5880) – originally 0.8 m deeper than present
iii. North Black Water (HU 4474,6011) – originally 1.5 m deeper than present
iv. South Black Water (HU 4447,5987) – originally 0.7 m deeper than present
v. a drained lochan south of South Shuns (HU 4306,6033) – originally 0.8 m deeper than present
vi. the eastern one of the two Lochs of Waters East (HU 4818,5863) – originally 0.8 m deeper than present
vii. lochan east of Loch Haabuttons (HU 4504,6192) – originally 0.7 m deeper than present
viii. lochan on west side of Flaw Hill (HU 4532,6779) – originally 0.5 m deeper than present
ix. Mini loch (HU 4416,5933)

[6] Available at: https://www.sepa.org.uk/media/34761/car_a_practical_guide.pdf
[7] Available at: http://www.legislation.gov.uk/asp/2011/9/contents

The feasibility and type of structures used to raise the water levels will need to be considered and approved by a qualified structural engineer. If it is not possible to install suitable structures to safely raise water-levels at a lochan then water-levels at the particular lochan will not be raised and consequently the number of lochans where water-levels will be raised may be less than nine.

Each of the lochans are either on separate watercourses and most are likely to be beyond those used by migratory fish as they have no clearly defined drainage channel. Only South Black Water and South Shuns are shown as being connected to a watercourse on the Ordnance Survey (OS) 1:50,000 scale maps. South Black Water lochan is shown to have watercourses draining both to the south and north on the 1:25,000 scale OS map. South Shuns and South Black Water lochans are within the catchment of Gossa Water (Figure 6). North Black Water, Minni Loch and Loch of Hookame are on Gossa Water's watershed, but in which direction they drain is not clear. There may, therefore, be a requirement to survey the South Black Water and South Shuns lochans for populations of migratory fish before they are considered for raising of water-levels.

4.2.2 Bog restoration works

The restoration of the blanket bog habitat immediately surrounding lochans/lochs in danger of being in-filled or drained as a result of blanket bog erosion will be carried out as per the guidelines given in section 2.4. In most instances this will require the re-profiling of gully sides and blocking of the eroding gullies. The method of gully blocking will have to take account of the accessibility of the gullies to machinery, in particular the provision of rock for rock dams or baffles as well as the depth and width of the gully and depth of peat in the gully bottom. Plastic piling may have to be used for small gullies where it is not possible to get split plastic piping to the site. Where existing lochans are used for breeding by red-throated divers and are considered at risk from being drained as a result of the headward erosion of gullies, all of the peat haggs and erosion gullies within a suitable buffer zone around these lochans will be re-profiled and blocked with the appropriate techniques as described above in sections 2.4.3 and 2.5.3.

The 13 lochans/lochs where the surrounding blanket bog habitat within the HMA that have the potential to be restored are as follows:

i. lochan north of Loch of Andris (HU 4274,5636)
ii. North Black Water (HU 4474,6011)
iii. South Black Water (HU 4447,5987)
iv. a drained lochan south of South Shuns (HU 4306,6033)
v. Long Loch (HU 4379,5971)
vi. Mini-loch (HU 4416,5933)
vii. Loch of Hookame (HU 4256,5880)
viii. the eastern one of the two Lochs of Waters East (HU 4818,5863)
ix. lochan east of Loch Haabuttons (HU 4504,6192)
x. lochan on the west side of Flaw Hill (HU 4532,6779)
xi. lochan on the north side of Logie Hill (HU 4337,6701)
xii. lochan on the south side of Logie Hill (HU 4324,6586)
xiii. lochan on Clubb of Tronister (HU 4524,6595)

The above list of lochans targeted for blanket bog restoration works (gully blocking and re-profiling) may be reduced after the eroding blanket bog habitat has been assessed by a peatland restoration contractor as to the practicalities of carrying out the proposed restoration works.

4.2.3 Lochan enlargement

Lochans that are considered to be at or just below the minimum size, i.e. less than 20 metres along their longest length but that are otherwise suitable for breeding divers, will be enlarged by digging out peat to lengthen them to around 25 metres. The amount of peat that would need to be removed to achieve the required length at any one site is anticipated to be relatively small, at between 10 and 25 m^3. The excavated peat would be used in the restoration of nearby areas of blanket bog habitat affected by peat erosion.

Two lochans have been identified for consideration for this type of restoration work as they are just a few metres too small and do not have outflow streams:

a) the lochan on the west side of Muckle Hill at HU 4367,5864; and
b) a small lochan north-west of Laxo at HU 4409,6413

4.2.4 Creation of nesting islands

For peatland breeding lochans where there are no islands for the red-throated divers to nest on, one or more islands will be created by cutting away a small section of bank, leaving at least a 1 metre gap between the bank of the loch to create the island. The island(s) created will be up to 4 m^2 in area, have shallowly sloping sides and will retain the extant bog vegetation. Advantage will be taken of the opportunities afforded by the shape of the existing shoreline to create a natural looking island(s) with the minimum amount of intervention. At any one site the amount of peat that would need to be removed to create an island would be small. It is anticipated it would be less than 5 m^3. The excavated peat would be used in the restoration of nearby areas affected by peat erosion.

This method of island creation was used on a small roadside lochan near Voe a few years ago and the island created has since been successfully used several times by nesting red-throated divers.

The cutting of bankside islands will be considered for the following lochans:

i. lochan on the west side of Muckle Hill at HU 4367,5864;
ii. lochan north-west of Laxo at HU 4409,6413;
iii. Loch of Hookame (HU 4256,5880);
iv. the eastern of the two Lochs of Waters East (HU 4818,5863);
v. the lochan on East Kame (HU 4264,5700);
vi. the lochan at Hughie's Know (HU 4278,5942);
vii. the lochan on the west side of Flaw Hill (HU 4532,6779);
viii. the lochan on the east side of Flaw Hill (HU 4557,6793);
ix. the lochan on Clubb of Tronister (HU 4524,6595);
x. the lochan at Haa Buttons (HU 4495,6186).

4.2.5 Provision of artificial floating nest platforms

The large loch-type breeding sites that have been identified as potentially benefitting from the provision of islands are all rock basins and are subject to small to moderate changes in water level in response to rainfall events. These sites may be provided with one or two artificial floating nest platforms of a similar design and construction to that used by RSPB for nesting divers on mainland Scotland (Hancock, 2000). Each island would be approximately 2m x 2 m in size, covered with turves of living bog vegetation and installed at the loch approximately 10 to 20 metres from the shore in a location that is relatively sheltered from the prevailing westerly and southerly winds (to reduce the effects of waves).

Floating nest platforms will be installed at the following lochs that are within the S36 boundary:

i. Gossa Water (HU 4374,6070);
ii. Petta Water (HU 4153, 5915); and
iii. Loch of Lunklet (3796, 5700).

Four loch breeding sites outside the S36 boundary may be considered for floating nest platforms. Installing floating nest platforms at these sites will be dependent on permission of the landowner and acceptance of other interested parties. These lochs are:

i. Loch of Gonfirth (HU 3854,6231);
ii. Loch of Voe (HU 4158,6274);
iii. Smerla Water (HU 3828,6080); and
iv. Whitelaw Loch (reservoir) (HU 3590, 5400).

Each of the floating nest platforms will need to be removed during the winter for maintenance and repair, as suggested on page 32 of the HMP (RPS, 2017).

4.2.6 Removal/changing fencelines

On page 28 of the HMP it was suggested that fence-lines close to lochans used by breeding red-throated divers could be removed so that birds do not collide with them when they take off. The fences across the open moorland are along the boundaries between various commons. Changing the line of these fences would require the ownership boundaries as well as the commons to be altered. It is not within the jurisdiction of Viking Energy to achieve such a change, but where fencelines may need to be changed negotiations to change the line of a fenceline cannot necessarily be guaranteed to be successful. The only lochans and lochs within the S36 boundary where red-throated diver have bred and have a fenceline close by are:

- Long Loch;
- Minni Loch; and
- Gossa Water.

In the case of Long Loch the fenceline runs parallel to the longest length of the east side of the loch at the base of a moderately steep slope. Red-throated divers are very unlikely to take-off across the shortest width of the loch, especially in an easterly direction when winds are less likely to be blowing from that direction. Also the divers will have to get sufficient lift to avoid the hill-slope immediately behind this fence.

Gossa Water is a relatively large loch where red-throated divers are very unlikely to collide with the three fences when taking off from the water. This is because the fences run down perpendicular to the margin of the loch and therefore unlikely to present a risk to red-throated divers taking off from the loch.

At Minni Loch the fence is within a couple of metres of the southern edge of the lochan and could present a collision risk to birds taking-off to the south and south-west. There is about 40 to 50 metres of open water for the birds if they take off in a south or south-westerly direction. This is the only loch/lochan where it is considered necessary to alter the fenceline, to reduce the risk of red-throated divers colliding with the fence. However, if it were to be moved further south the amount of land lost to the West Nesting common grazing would have to be compensated by a change in the fenceline further to the north-west or south-east so that an equal amount of land is taken from the Grunnafirth Park common grazing.

4.3 Screening nest sites

Pre-defined construction areas considered likely to be within line-of-sight of breeding red-throated diver lochans will be screened via the construction of peat bunds, as suggested on page 28 of the HMP (RPS, 2017). However, this work stream has been specified in the civil construction contract and is not considered to be part of the HMP.

4.4 Monitoring

The integrity and functioning of the dams used to raise the water levels within the lochans will be checked within the first three months of installation and then once a year for the following four years. The monitoring of the success of gullies blocked and re-profiled around lochans will be monitored at the same frequency and length of time as that for bog restoration as described in sections 2.4.5 and 2.5.5. The success of the various management prescriptions will in part be measured by the breeding success of red-throated divers which will be covered by the bird monitoring programme.

5. WHIMBREL

5.1 Nesting and chick rearing requirements

The whimbrel that breed on Mainland Shetland typically breed within blanket-bog or wet heath habitat that has a good number/area of mossy pools, depressions or wet channels (Massey *et. al.* 2016). The vegetation where the nests are located is usually rather short (typically 5 to 10 cm) and typically has a large proportion of heather (*Calluna vulgaris*), woolly hair-moss (*Racomitrium lanuginosum*) and/or reindeer lichens (*Cladonia portentosa, C. arbuscula* and *C. uncialis*) in the sward. These stands of vegetation are normally within tens of metres of wet channels, pools and depressions that have a good cover of mosses, usually the bog-mosses *Sphagnum cuspidatum, S. fallax* and/or *S. denticulatum*. These wet features are used by the chicks for feeding where there are presumably sufficient numbers of invertebrates, especially insects. Where there is a lot of bare peat in the pools, depressions and channels they do not normally support breeding whimbrel. The work of Massey *et. al. (*2016) has shown that the shortage of suitable small, wet linear features with a good cover of bog-moss or other mosses may be limiting productivity of whimbrel on Mainland Shetland.

It is considered likely that if the number and quality of wet features in habitats that are generally suitable for breeding whimbrel (i.e. with regard to general vegetation composition, structure and extent) were to be increased, it is likely that the numbers of nesting adults is likely to increase and probably increase breeding success. Incidentally, several other wader species are also known to favour wet areas with a good cover of mosses for feeding and rearing chicks (e.g. dunlin, snipe, redshank), and therefore increasing the cover of wetland mosses through stabilising water-levels are also expected to benefit other species.

As indicated on page 27 of the HMP (RPS, 2017), the aim of the HMP is to improve the habitat for breeding whimbrel through various enhancement works. The HMP (page 32) includes a proposal for ‘a research programme on this species aimed at improving the understanding of whimbrel habitat and conservation requirements’. This will help inform the effectiveness of management actions aimed at increasing the breeding performance of whimbrel. This will be considered as a separate action within the HMP.

5.2 Management prescription

There are two management prescriptions to help improve the productivity of whimbrel within the HMA of the Viking Wind Farm:

i. stabilising water-levels in gullies and ditches in order to increase the cover of mosses; and
ii. use of manual cutting to optimise vegetation height, and indirectly the relative contribution of different species of plant to the vegetation structure.

It is not feasible to change the numbers of sheep on the common grazings and therefore manipulations to grazing intensity of extensive moorland areas, as indicated on page 27 of the HMP will not be carried out. Figure 8 shows the areas where the management prescriptions may be applied. The total area for all these areas where management prescriptions will be carried out or sought is about 974 ha.

5.2.1 Manipulation of sward height

There are a number of areas on Central and West Mainland Shetland that have fundamentally suitable habitat for breeding whimbrel (blanket bog and wet-dwarf shrub heath), but where the breeding density of whimbrel is low because the height and structure of the vegetation is not optimal. In particular, the sward in these areas is either too tall and dense, or there is insufficient cover of dwarf-shrubs. Sward height may be manipulated by carrying out a cutting regime where the height of the heather is too high.

The sward height may by reduced through carrying out small-scale cutting of suitable areas with a brush cutter. The cutting of small areas (less than 1 hectare) of heather dominated blanket bog vegetation or heath will have to be carried out using a hand-held brush-cutter. These areas will not be in any areas suitable for merlin or other species that require tall heather for nesting.

5.2.2 Stabilisation of water-levels

The absence or scarcity of suitable wet features and associated mosses, especially the bog-mosses (*Sphagnum* spp.) is largely due to drainage and consequent erosion of the gully network in areas of blanket bog habitat. This can be largely rectified by carrying out gully blocking. The installation of small check-dams will stabilise the water-levels in the wet features which is necessary for the growth of mosses.

5.2.2.1 Method

The favoured method of blocking the gullies for the achievement of the management goals will be to install peat dams every 7 to 12 metres where there are drained gullies on relatively flat ground. Where there are ditches permission will also be sought to block these. Where the gully is too wide the option of using split plastic piping will be used. The details for the installation of peat and plastic pipe dams follow those described in section 2.5.3 and Appendix 2.

The creation of shallow (<200mm) water-retaining scrapes may be considered where there is little scope for the blocking of gullies or drains to create suitable wet features for whimbrel.

5.2.2.2 Sites

The areas where the blocking of drained gullies or ditches will be carried out within the S36 boundary are:

- Petta Dale (confirmed and within the S36 boundary);
- Upper Kergord valley (confirmed and within the S36 boundary);

The four areas where permissions will be sought to put in dams to stabilise the water levels within gullies are within the HMA, but are outside the S36 boundary, are:

- the HMA area between Grass Water and Loch of Collaster (outwith S36);
- the HMA area around Seggie Burn to the north-west of Laxo (outwith S36);
- the HMA area between Loch of Voxterby and Loch of Flatpunds (outwith S36);
- the HMA area to the north of Culswick (on West Mainland outwith S36).

All of these areas are shown in Figure 8.

Two areas that have so far been identified as potentially suitable for the creation of shallow pools are:

- Parts of the Upper Kergord valley (within S36 boundary);
- The western end of the HMA near Sandness on West Mainland (outwith S36)

5.2.3 Predator control

The control of hooded crows is not covered by this plan to improve the reproductive output of whimbrel, because it is thought that it is unlikely to result in a significant increase in reproductive success for this wader. Also, crofters and landowners are still be able to exercise the right to control hooded crows under existing legislation.

5.2.4 Monitoring

The success of the various interventions will be monitored in terms of the breeding success of whimbrel and a limited number of variables to assess the structure and composition of the vegetation.

The number of whimbrel and other wader species breeding will be monitored using a modified (3 survey visit) moorland breeding bird survey method, as suggested on page 31 of the HMP (Brown & Shepherd 1993). This will be carried out in years 1, 3 and 5 after the application of the treatments and thence every year five years. There is currently sufficient data to act as a pre-treatment baseline.

The height of the sward will be measured in areas where whimbrel potentially nest by taking measurements with a dropping disk at a minimum of 30 sample locations immediately before the breeding season. The composition of the vegetation should be assessed once before the treatments are applied and then five years after the treatment has been applied.

For the gullies which are blocked the collective cover (%) of all bog-mosses (*Sphagnum* spp.); 'brown' mosses (e.g. *Scorpidium* spp.; *Drepanocladus* spp.; *Calliergon* spp.; etc); and all species of sedge, including cotton-grasses (*Eriophorum* spp.) will be assessed by eye and using fixed-point photography. This will be carried out at the end of the breeding season once before the treatments are applied and then again five years after the gullies have been blocked.

The results from monitoring the bird populations and vegetation should be reviewed after five years and decisions made as to the success and failures of the various treatments and whether any recommendations should be made for future management that can be taken forward to enhance breeding populations of whimbrel. This should be done in conjunction with the results of the research work carried out under the studentship as proposed below.

5.3 Research Project

It was suggested in the HMP that a research project (page 32) to investigate the breeding requirements of whimbrel on Shetland should be carried out. To this end Viking Energy will fund, or possibly co-fund with a funding body, a research studentship (PhD) that will be placed in a British university. Some of the possible hypotheses that the research project could investigate are:

a) Why have the numbers of breeding whimbrel declined on Shetland?
b) What are the optimal habitat requirements for whimbrel?

c) What do whimbrel chicks feed on and where are the greatest abundances of their main food items located?
d) Are whimbrel significantly affected by wind turbines?

An appropriate academic at a British university will have to be sought who is willing to supervise such a PhD studentship.

6. MERLIN

6.1 Nesting requirements

This species of small falcon requires relatively tall heather, at least 30 cms, to nest in. Stands of tall heather should ideally be several hectares in extent. On the Shetland Islands nest sites are normally on south to east facing slopes as these provide the greatest shelter from cold northerly winds and strong westerly winds that can chill the adults and chicks. The adults require territories of at least several km^2 to provide enough prey, largely meadow pipits and skylarks, to rear their chicks. There is a shortage of an adequate number of nest sites on Mainland Shetland, and habitat quality at several formerly used breeding sites has deteriorated due to grazing pressure and/or burning.

The aim for this species is to re-establish suitable nesting habitat at up to four locations on central Mainland Shetland (page 28 of the HMP).

5.2 Management Prescription

The Viking HMP intends to address the shortage of a suitable nest sites by increasing the height of heather on suitable slopes. This will be achieved by erecting a fence around the stands of relatively short heather to keep out sheep and other livestock. These exclosures will cover areas of between 1.6 and 5 ha. One location has been identified as being suitable for such work within the S36 boundary and another three locations within other parts of the original HMA where originally agreements have been arranged with landowners and crofters to fence off areas for nesting merlin.

These areas will need to be surveyed by a fencing contractor to establish the feasibility of establishing fences in these locations. One or more gates will be installed as part of the fencing to allow access for people and livestock as and when it is considered desirable to graze the area.

Figure 7 shows the location of the four areas where the erection of stock exclosures are considered suitable for nesting merlin and where possible agreements to install them put in place with owners, graziers and other parties with legitimate interests.

5.2 Monitoring

As suggested on pages 31 and 32 of the HMP, the height of the heather canopy will be measured every 5 years at a minimum of 30 random sample points within the exclosures using a dropping disk at the end of the breeding season (August/September). The height of the heather canopy will be measured in stands of heather immediately outside the exclosures using the same method and sample size. The cover of heather within and

immediately outside these exclosures will also be assessed. The use of the plots by breeding merlin will be monitored in years 1, 3 and 5 and thence every five years as part of the post-construction monitoring programme for birds. Additional monitoring of the occupancy of the livestock exclosures by merlin may be monitored in the intervening years by other interested parties.

The integrity of the fences and gates will be monitored every year for the first 5 years and checks for livestock within the exclosures may be carried out at more frequent intervals by the HMP officer.

7. FISH BARRIERS

Only those barriers to fish movement within the HMA can be considered for removal. However, the feasibility and desirability of removing those barriers to fish movement outside the S36 can be assessed and put forward to SEPA for removal. The removal will depend on the agreement of the land-owners and SEPA. One of the two barriers, the one at Weisdale Mill, identified in the HMP has already been removed. The only other barrier to the potential migration of fish in the HMA is on the Burn of Sand Water/Stromfirth Burn. The removal of this barrier will require the approval and agreement of owners, SEPA and other parties with interests in the stretch of the Burn of Sand Water/Stromfirth Burn. Appropriate surveys will have to be carried out to assess the feasibility and risks associated with its removal and they would include, but not limited to, the following:

- Geomorphological assessment to see if there would be an increased flooding risk as a result of the removal of the barrier and whether there would be increased erosion of the stream bed when the barrier is removed;
- An ecological assessment of whether any protected species (e.g. otter holts) could be affected.

8. RARE PLANT SPECIES

The rare species of hawkweed, including the Shetland hawkweed (*Hieracium zetlandicum*), are located within the Burn of Lunklet SSSI. These species of plant and the habitat in general within the Burn of Lunklet SSSI, should not be affected by HMP works within the S36 boundary. The avoidance of this area by contractors carrying out construction work will be covered by the CEMP, i.e. via toolbox talks by the site Ecological Clerk of Works. Sampling of the water within the Burn of Lunklet SSSI will be carried out as part of the WQMP. The risks of potentially damaging the features of interest within this SSSI will be made known to all of those carrying out the sampling within and immediately upstream of the SSSI. There is, therefore, no need to cover the conservation or impacts on these plants or the SSSI any further within the HMP.

The presence and location of notable species of plant, such as stag's-horn clubmoss (*Lycopodium clavatum*) should be made known to the Ecological Clerk of Works (ECoW) at the beginning of construction. To ensure sensitive ecological and archaeological features and recorded and protected, the CEMP prescribes a requirement for pre-construction checks by the project ECoW and ACoW prior to construction work being carried out. Stag's-horn club moss was recorded by the project ECoW at Hill of Sound.

9. TIMETABLE

The outline timetable of works given in Table 4 is provisional and will have to be flexible in light of geotechnical difficulties and agreements obtained with the various interested parties.

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11. TABLES

Table 1. The prescription, targets and methods for monitoring the condition of blanket bog under intervention restoration.

Prescription	Monitoring (methods and targets)	Management
Development of cover and number of species of plant so that the blanket bog shows an improvement in condition to 'moderate' or 'recovering' condition.	Monitoring: • Check the effectiveness of dams and blocked drains (years 1 to 5). Future monitoring of the dams and blocked drains will be reviewed after year 5 with only further monitoring carried out every 5 years where it is considered necessary. • Monitor the amount of bare peat within restored bare peat flats/re-worked peat. Monitoring will be carried out in years 1, 2, 3, 5, 10, 15, 20 and 25. • Monitor the amount of bare peat within gullies and the base of peat haggs. Monitoring will be carried out in years 1, 5, 10, 15, 20 and 25. • Monitor the species composition and cover of key positive indicator species in sample quadrats within areas of intact bog vegetation between restored gullies, haggs and bare peat flats (years 1, 5, 10, 15, 20 and 25). Targets: • Reduce the average area of bare peat to less than 50% with the aim of achieving an average of less than 10% bare peat by year 25. • Increase the average number of blanket bog positive indicator species above baseline conditions in areas of intact blanket bog vegetation with the aim to achieve at least 6 positive indicator taxa* per 4 m^2 in areas of intact bog where it is below this target for M17, M19 and M20 vegetation types. • Reduce the combined cover of graminoids below baseline conditions, with the aim of achieving a combined cover of less than 75%. • Increase the cover of bog-mosses (*Sphagnum*) above baseline conditions towards the aim of achieving an average combined cover of 25% or more.	• Determine the type of blocking method most appropriate for each particular gully, hagg and bare peat flat. • Re-profile the sides of erosion gullies and haggs where they are bare and above an angle of 30°. • Lime, fertilise and seed areas of bare peat flats and re-worked peat as described in Appendix 3. • Stabilise bare peat surfaces using netting as described in Appendix 4. • Erect stock-proof fencing around all areas of re-worked peat. • Erect stock-proof fencing around all areas of bare peat where seed has been applied and/or netting. • Block gullies with the most appropriate method described in Appendix 2. • Maintain dams within gullies.

* The positive indicator taxa (species or groups of species) are: heather (*Calluna vulgaris*); other heathers (*Erica* spp.); crowberry (*Empetrum nigrum*); blaeberry (*Vaccinium myrtillus*); hare's-tail cotton-grass (*Eriophorum vaginatum*), common cotton-grass (*E. angustifolium*); deer-grass (*Trichophorum*

germanicum); stiff sedge (*Carex bigelowii*); bog asphodel (*Narthecium ossifragum*); sundews (*Drosera* spp.); cloudberry (*Rubus chamaemorus*); bog-mosses (*Sphagnum* spp.); woolly hair-moss (*Racomitrium lanuginosum*); pleurocarpous mosses (e.g. *Hylocomium splendens*); non-crustose lichens (e.g. *Cladonia* spp.).

Table 2. The monitoring variables and targets as modified from the CSM guidance (JNCC 2009) that will be used to assess the condition of blanket bog vegetation on areas of intact blanket bog peat (within and outside livestock proof fencing).

Attributes	Monitoring variables and targets
Vegetation composition – frequency of positive indicator species.	The presence of at least six positive indicator taxa* present per 4 m^2 plot as listed above in Table 1. *Sphagnum fallax* (*sensu lato S. recurvum*) does not score if it is the only species of *Sphagnum* present.
Vegetation composition – cover of positive indicator species.	At least 50% of the vegetation cover should consist of at least three of the positive indicator taxa* listed above (Table 1). Any one of *Eriophorum vaginatum*, Ericaceous species collectively, or *Trichophorum* should not individually exceed 75% of the vegetation cover.
Vegetation composition – cover of negative indicator species.	Less than 1% of vegetation cover should be made up of non-native species, including heath star-moss (*Campylopus introflexus*). Record the non-native species and estimate the proportion of the plot occupied by the species using the interval scale given in Table 3.
Vegetation structure – indicators of browsing.	Record the proportion of the previous season's long-shoots of heather (*Calluna vulgaris*) browsed using the interval scale given in Table 3. The target is for less than half (50%) being browsed.
Physical structure – indicators of ground disturbance due to herbivore and human activity.	Record the proportion of bog-moss (*Sphagnum*) cover crushed, broken, and/or pulled-up. The target is for less than 10% of the cover showing evidence being damaged.
	Record the proportion of the plot with bare peat and what proportion of this is disturbed. The target is for less than 10% of the ground cover should be disturbed bare ground. This consists of hoof, foot or vehicle imprinted bare humus, bare peat and soil covered only by algal mats.

Table 3. The class intervals used to monitor the cover of species or the amounts of bare ground or the proportion of long-shoots shoots of heather that are browsed.

Interval score	Proportion (%) range
1	< 1%
2	1 – 5%
3	5 – 10%
4	10 – 25%
5	25 – 50%
6	50 – 75%
7	75 – 95%
8	95 – 100%

Table 4. A draft outline[8] timetable of works to be carried out as part of the Habitat Management Plan over the life-time of the Viking Wind Farm.

Target habitat/species	Prescription	Task	Construction Phase (Years)			Operational Phase (Years)																							
			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Bog Restoration	Peat Flats	Identifying restoration areas																											
		Installation of stone walls/dams																											
		Filling shallow peat flats with peat																											
		Application of lime, seed and fertiliser																											
		Installation of stabilising netting																											
		Monitoring of restoration works and vegetation																											
	Blocking erosion gullies	Identifying gullies for restoration works																											
		Field survey of erosion gullies and haggs																											
		Installation of dams and baffles																											
		Monitoring of restoration works and vegetation																											
	Re-profiling gullies and haggs	Identifying restoration areas																											
		Re-profiling gullies and haggs																											
		Monitoring of restoration works and vegetation																											
	Livestock proof fencing	Survey of potential fencelines																											
		Erection of fencing																											
		Monitoring of fences (annual) and vegetation																											
Red-throated diver	Blocking erosion gullies	Identifying gullies for restoration works																											
		Field survey of erosion gullies and haggs																											
		Installation of dams and baffles																											
		Monitoring of restoration works and vegetation																											
	Raising water levels	Desk study of current and potential lochan volumes																											
		Ground-truthing desk study lochan volumes																											
		Ecological impact surveys (fish and otter)																											
		Applications for CAR licences																											
		Construction of dams																											
		Monitoring of restoration works																											
	Lochan enlargement and creation of nesting islands	Excavators cutting islands and lochan enlargement																											
	Artificial floating islands on lochs	Negotiation with interested parties																											
		Construction and installation																											
Whimbrel	Stabilisation of water-levels	Negotiation with interested parties																											
		Installation of peat dams and plastic pipe dams																											
		Monitoring																											
	Manipulation of sward height	Negotiation with interested parties																											
		Application of cutting regimes																											
		Monitoring																											

[8] This programme is considered outline and shall be reviewed and updated in accordance with contractor programmes once available.

	Research project	
Merlin	Exclusion of livestock	Negotiation with interested parties
		Erection of fencing
		Monitoring

Table 5. *The underlying solid geology at each of the proposed borrowpit locations.*

ID2	Easting	Northing	Solid geology
KBP01	40673	60664	Granofelsic, psammite and granofelsic semipelite
KBP02	39187	57611	Psammite, pelite,schistose and semipelite
KBP03	38363	55341	Pelite, sermipelite and psammite
KBP04	37831	50480	Pelite, sermipelite and psammite
KBP05	39116	55964	Pelite, sermipelite and psammite
NBP01	41999	61448	mostly metalimestone
NBP03	42119	56195	Granite and gneissose
NBP04	42109	55863	Granite and gneissose
NBP05	43787	56817	Granofelsic, psammite and granofelsic semipelite
NBP06	46549	56245	Granite and gneissose

12. FIGURES

Figure 1. *Map showing the location of the S36 part of the Habitat Management Area (HMA) and the HMA outwith the S36 boundary (areas with blue outline).*

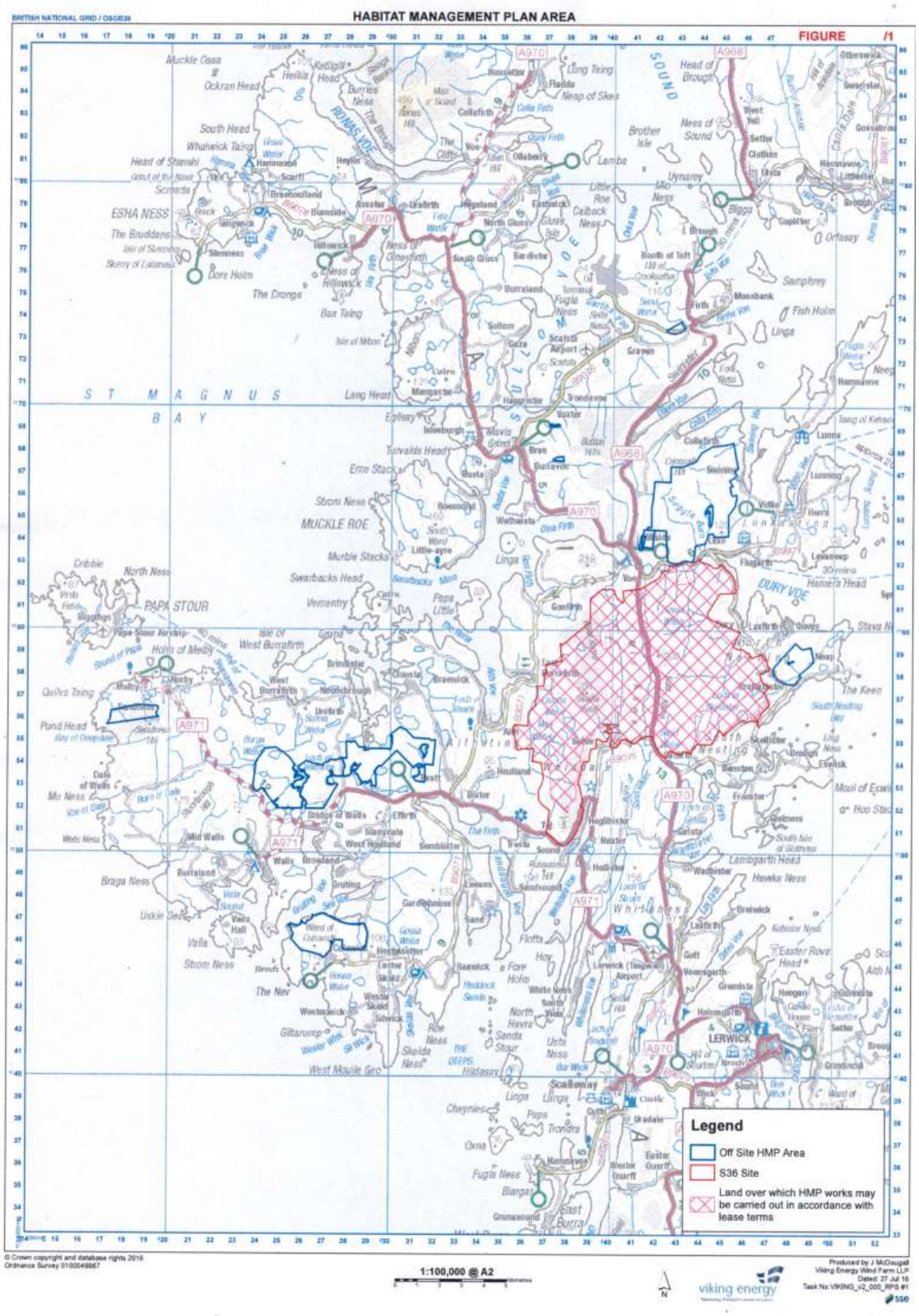


Figure 2. *An example of a dam in a gully on East Kame constructed from waste plastic piping that comes from fish farms. The plastic pipes have been cut lengthways and interlocked to form a dam that is less prone to leakages and bowing under the pressure of the water upstream compared to plastic piling.*

Figure 3. *Map showing the areas of search for where intervention restoration of blanket bog habitat will be carried out. This includes restoration of bare peat flats and/or gullies and haggs will be blocked and re-profiled and where livestock exclosures are likely to be erected.*

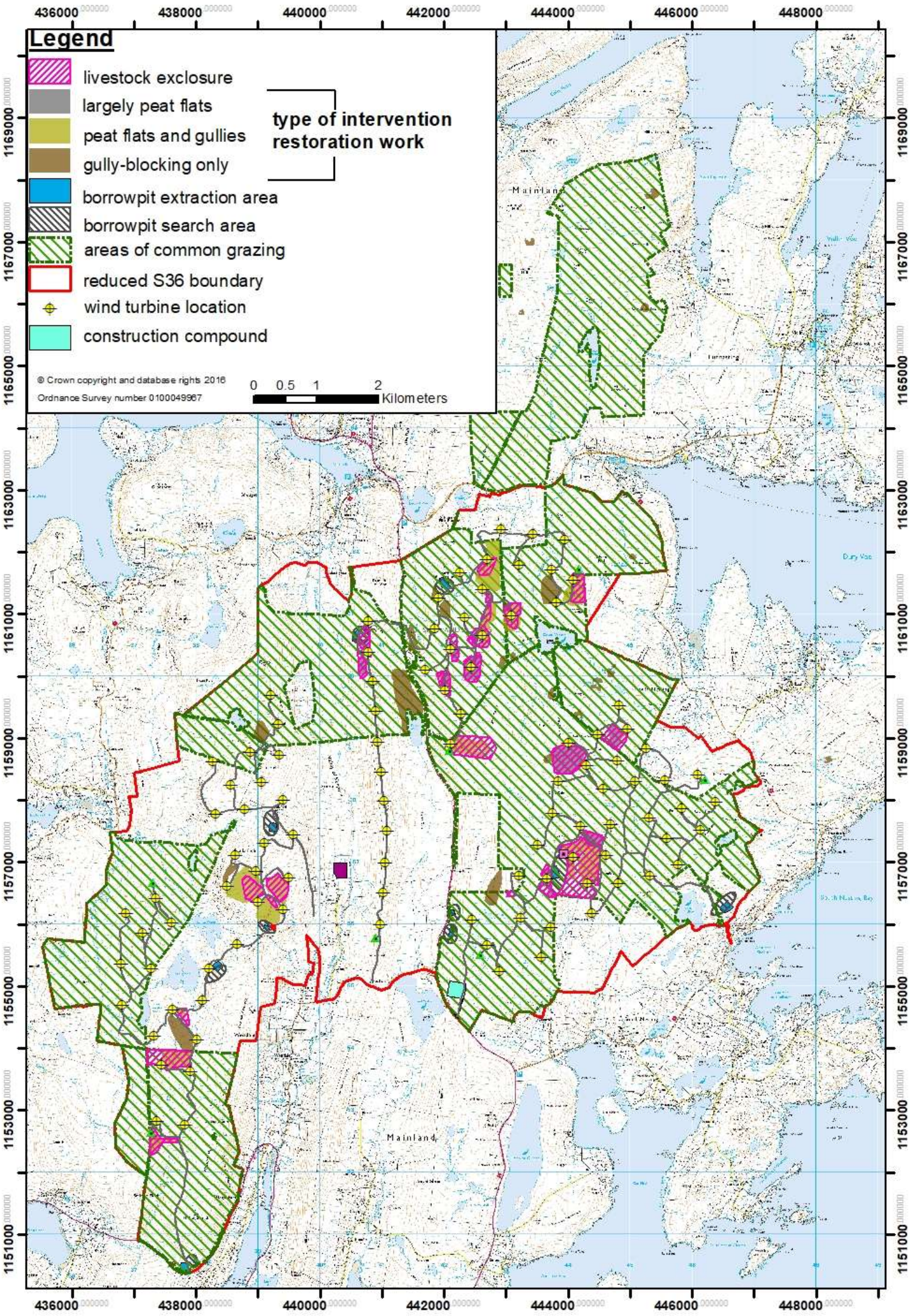


Figure 4. *An example of the proposed indicative access routes, location of rock dams and areas where bare peat flats will be restored at Vats Houl.*

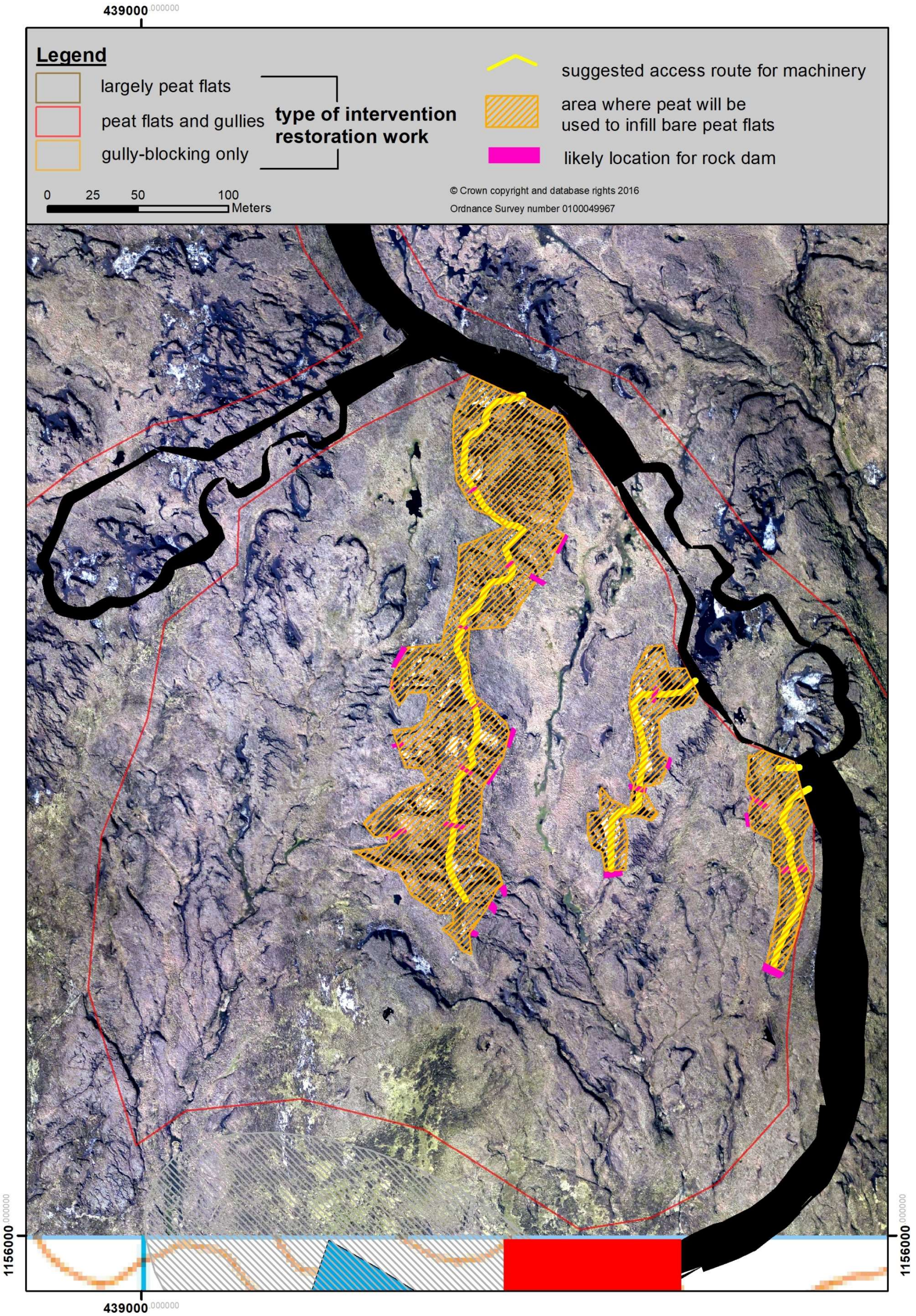


Figure 5. *An example of the proposed indicative access routes, location of rock dams and walls, and areas where bare peat flats will be restored on Muckle Hill.*

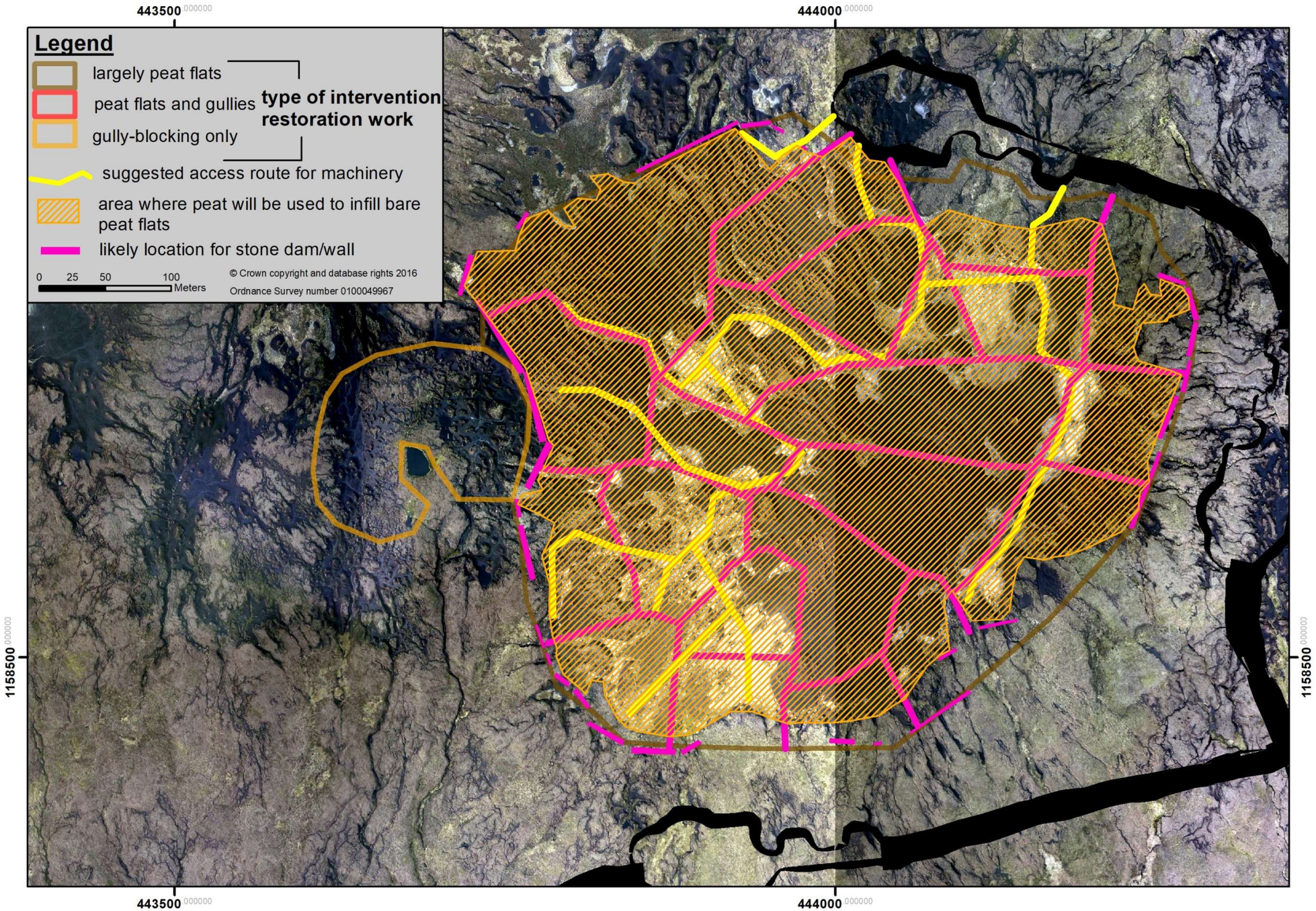


Figure 6. *Map showing the lochans where water-levels may be increased and/or blanket bog habitat will be restored around the lochan. The map also shows those lochans where islands may be created and those lochs where floating platforms have the potential to be installed for breeding red-throated diver.*

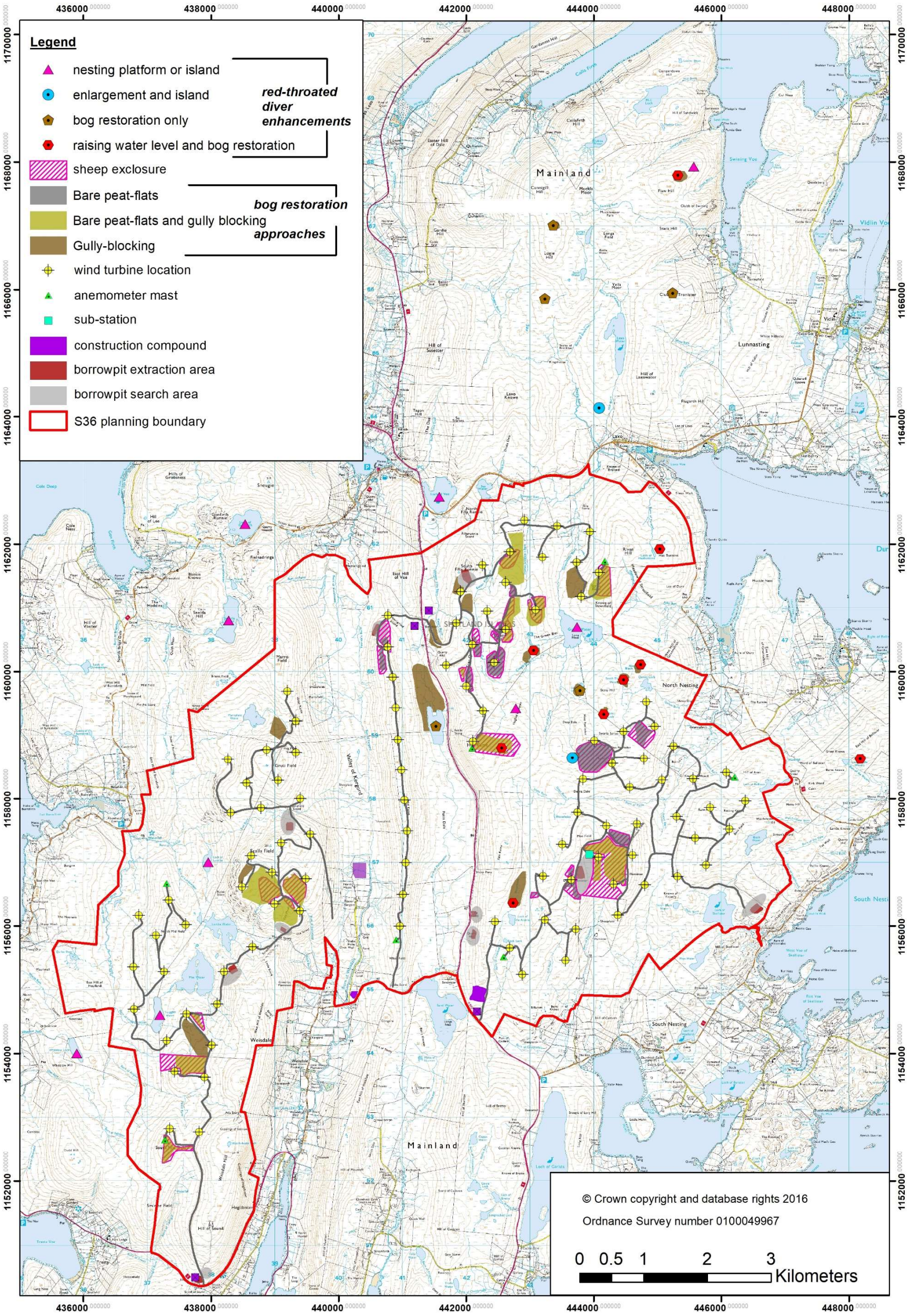


Figure 7. *Map showing the location of proposed exclosures for nesting merlin.*

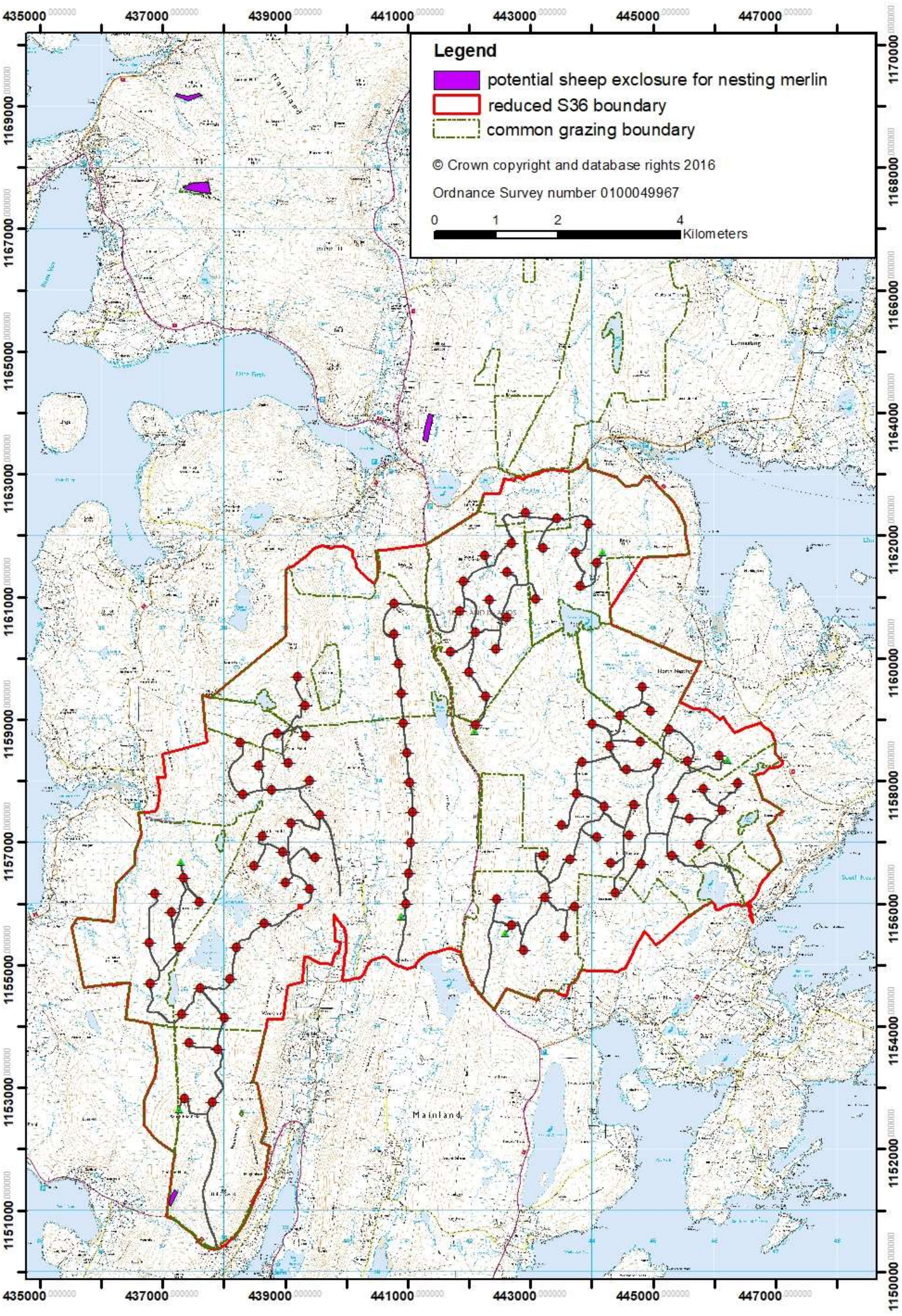
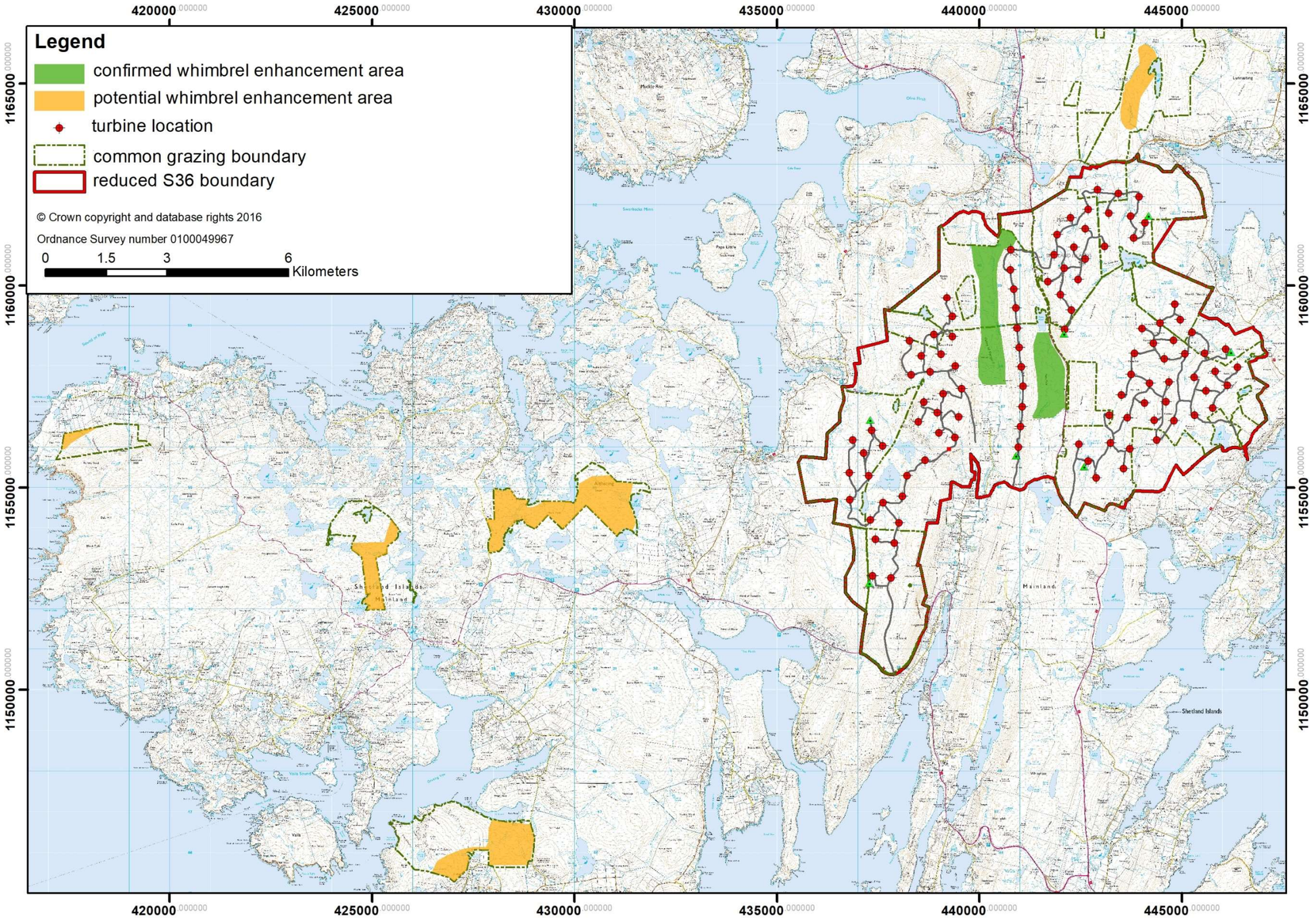


Figure 8. *Map showing the areas where habitat enhancement may be carried out for whimbrel and other wading birds.*



APPENDICES

Appendix 1

Viking Energy Wind Farm, National Vegetation Classification (NVC) Survey Report, Highland Ecology 2008.

Appendix 2.

Yorkshire Peat Partnership Technical Specification 1 for gully & grip blocking or sediment trapping techniques

12.1 Appendix 3.

Yorkshire Peat Partnership Technical Specification 2 for large gully and hagg stabilisation and re-vegetation

12.2 Appendix 4

Yorkshire Peat Partnership Technical Specification 3 for flat or gently sloping bare peat stabilisation and re-vegetation