Appendix 10.6

Outline Peat Management Plan

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1 Introduction

1.1.1 In support of **Chapter 10** (**Volume 1**) of the Design Manual for Roads and Bridges (DMRB) Stage 3 Environmental Impact Assessment (EIA) report; this technical appendix presents an Outline Peat Management Plan (OPMP) for Project 7 – Glen Garry to Dalwhinnie of the A9 Dualling Programme, hereafter referred to as the Proposed Scheme.

1.1.2 The purpose of the OPMP is to present estimated peaty soil and peat excavation volumes, and demonstrate that management of these during construction of the Proposed Scheme has been considered and shall be treated appropriately. It describes the management approach adopted through design development of the Proposed Scheme related to peat, and presents an outline of options that may further minimise impacts and/ or provide mitigation via potential re-uses.

1.1.3 The information presented herein supports the potential impact assessment within **Chapter 10** (**Volume 1**) and has been prepared utilising available information as described in **Appendix 10.1** (**Volume 2**). This and other relevant aspects of the DMRB Stage 3 EIA should therefore be referred to as necessary.

2 Developments on Peatland

2.1 Definition of Peat

2.1.1 In Scotland, peat is defined as *"an organic soil which contains more than 60 per cent of organic matter and exceeds 50cm in thickness"* (Macaulay Institute, 1984). Scotland's National Peatland Plan also encompasses organic soil less than 50cm, which can support typical peatland vegetation (SNH, 2015a). Organic deposits less than 50cm in thickness are therefore considered in this and related aspects of the DMRB Stage 3 EIA as 'peaty soils'. Joint Nature Conservation Committee (JNCC) (2011) and Scottish Government (2014) guidance on peat surveys also follow this peaty soil definition. 'Deep peat' is considered to be a peat soil with a surface organic layer greater than 1.00m thickness (Bruneau and Johnson, 2014).

2.1.2 The structure of an active peatland typically comprises a thin surface layer of living vegetation (the *acrotelm*) overlying a usually thicker layer of well decayed and humified peat, comprising the consolidated remains of former surface vegetation (the *catotelm*). Below the peat forming layers is the basal *substrate*, either a mineral soil, mineral superficial deposit or bedrock.

2.1.3 The acrotelm is the upper aerobic layer of peat and consists of living and partially decayed plant material. It typically has a higher hydraulic conductivity than underlying peat and is usually defined with relation to the water table. Acrotelm thickness varies with topography – such as hummocks, peat haggs, hollows and with time, especially in dry periods or when it is drained.

2.1.4 The catotelm layer sits beneath the acrotelm and consists of well decayed and humified material, and is denser with a very low hydraulic conductivity. Conditions are anaerobic and anoxic because the catotelm is permanently below the water table. The catotelm is less cohesive than the acrotelm layer and is generally considered to be less suitable for storage and re-use.

2.2 Peat Importance

2.2.1 Over 20% of Scotland's land area is covered by peatlands, and Scotland hosts a significant proportion of the European and world resource. Foremost, peatlands are long-term carbon stores, important to tackling climate change; but they are also important to rural farming, tourism, in providing clean water and in lowering flood risks. Scotland's National Peatland Plan

published by Scottish Natural Heritage (SNH) also notes that they form beautiful landscapes, represent key habitats and are a defining characteristic of wild Scotland (SNH, 2015a).

2.2.2 Drying and physical damage to peat can release greenhouse gases, reduce water quality and diminish a range of other services. Peat is also geotechnically complex, and special consideration must be given to the practicalities of engineering in peat and peat soils, with careful management of construction activities required to avoid such damage.

2.3 Requirement for an Outline Peat Management Plan

2.3.1 The significance of peatlands is most evident in their protection by various legislation, policy and local, national or international initiatives including, but not limited to; the United Kingdom Biodiversity Action Plan (UKBAP), Scotland's National Peatland Plan (SNH, 2015), European Council Habitats Directive 92/43/EEC (Council of the European Communities, 1992), the Scottish Biodiversity List (SBL) (Scottish Government, 2013), Cairngorms Nature Action Plan (CNAP) (CNPA, 2013), the European Council Water Framework Directive 2000/60/EC (Council of the European Communities, 2000), Scottish Government discussion paper on the Management of Carbon-Rich Soils (Scottish Government, 2010), Scottish Soil Framework (Scottish Government, 2009) and the Climate Change Plan (2017-2032) (Scottish Government, 2017).

2.3.1 Indeed, the Scottish Environment Protection Agency (SEPA) has a statutory and legislative duty to ensure that where peat spoil is generated during construction; that it is stored, re-used, treated or disposed of correctly; which may require authorisation or permits.

2.3.2 SEPA's policy on the management of peat spoil is set out within *'Regulatory Position Statement – Developments on Peat'* (SEPA, 2010). This highlights that the best management option for peat spoil is the **prevention** of its production, by seeking to minimise peat excavation and disturbance. Where this is unavoidable, developers should attempt to **re-use** as much of the peat produced on site as is possible, in justifiable and environmentally beneficial ways.

2.3.3 The fact that materials have a potential re-use within the site boundary is not sufficient in itself to determine that they are not waste. For example, where there is no justified requirement or demonstrable need for the peat to be used, or it is clearly not suitable for the identified use, it will likely be classed as a disposal operation, and the proposed activity will require authorisation from SEPA accordingly. In this respect, SEPA will seek to ensure that there are no risks to the environment, or human health associated with the proposed activities, and will identify any regulatory requirements that would affect such activities.

2.3.4 It is therefore strongly recommended that OPMPs are formulated to ensure that peatlands are managed in accordance with best practice and specifically, that damage to peatland habitats and vegetation are, wherever possible, avoided during construction and, where this is not possible, that peat is re-instated effectively with a minimal loss of carbon.

2.4 Construction Considerations

Geotechnical Characteristics

2.4.1 Geotechnically, peat soils are complex as previously noted; comprising broken down plant remains rather than mineral particles. As such, conventional soil mechanics theory does not apply well (Hobbs, 1986), and site specific experience is often as useful in understanding peat behaviour under construction activities as modelled behaviour. The primary geotechnical characteristic of relevance to road construction is the behaviour of peat under loading, which normally occurs as a rapid phase of primary consolidation followed by a much slower phase of secondary compression (SNH, 2013). Scheduling of construction activities must take into account

this behaviour to ensure that infrastructure constructed over peat takes account of its settlement characteristics.

2.4.2 In addition, peat strength plays a role in determining the settings in which certain infrastructures are appropriate. The acrotelm is typically stronger than the catotelm, with the former afforded a degree of tensile strength from its vegetation layer, and the latter lacking this and the cohesion associated with some other soft sediments such as clays.

Construction Methods

2.4.3 The geotechnical characteristics of peat affect the choice of appropriate construction methods that are available for building infrastructure on peatland. Such methods include:

- **Excavation (Cut and Fill):** This is likely to be the most commonly used technique, used in most areas except the deepest peat, or where roads are expected to take low traffic volumes. The technique involves removing peat so that further cuttings can be made into substrate, or so that engineering grade fill can be placed onto a stratum of suitable bearing capacity to achieve the horizontal and vertical alignment required. Auxiliary elements such as Sustainable Drainage Systems (SuDS), compensatory flood storage areas, watercourse diversions and drainage are all likely to be achieved through excavation techniques.
- **Floating:** The technique of floating roads is usually reserved for access tracks, private and low traffic-volume roads. Floating roads can be described as a road that is constructed directly on top of the peat, relying on the strength of the in-situ peat for its support. The road does not actually 'float' on the peat, rather, an equilibrium builds up between the weight of the road and the in-situ strength of the peat whereby the combined system comes into balance. Modern construction practice generally calls for a geosynthetic layer to be placed on the surface of the peat, before the road is constructed, to give a working platform for the road and provide a separation layer between the road and the peat below. This layer, however, does not support the road – the road is supported by the peat (FCS and SNH, 2010).
- **Piling:** Piling techniques are usually reserved for areas where major routes need to cross peat consistently in excess of 2.00m deep. The technique involves the laying of a 'piling mat' over the peat, through which piles are driven to reach a stratum of suitable bearing capacity, without any excavation taking place. The road is subsequently constructed on the piles.
- **Bridging:** Similar to piling, such a technique would only be considered for major carriageways crossing the deepest areas of peat. Bridging would involve creation of bridge abutments either side of peat areas with a bridge deck being created between the two abutments to carry the road over the peat.

2.4.4 Generally; floating, piling and bridging do not require, or at least substantially limit, excavation of peat, and can be key techniques to reduce the impact of road construction in peatlands.

2.4.5 Vibro-replacement is another technique which is sometimes considered to improve the bearing capacity of soft soils. However, such an approach is not considered appropriate in peat due to the lack of lateral confinement offered by the peat material (Vibro Menard, 2017).

Re-use Considerations

2.4.6 Minimising the volumes of peat generated by construction is preferable in order to preserve the various ecosystem services associated with peatlands, and to reduce potential carbon losses associated with construction. The key guiding principle is only to re-use peat where it is suitable for the identified and required use, as previously noted. Careful handling is essential in order to

retain the structure and integrity of the excavated materials and thereby maximise the potential for excavated material to be re-used.

2.4.7 *'Developments on Peatland: Guidance on the Assessment of Peat Volumes, Re-use of Excavated Peat and the Minimisation of Waste'* (Scottish Renewables (SR) and SEPA, 2012) identifies examples of valid re-uses of excavated peat during construction, to potentially include dressing off and re-instating peat on the slopes and edges of constructed infrastructure, such as road and access track verges, re-instatement of service trenches and foundations, and peatland restoration via water table restoration, habitat enhancement or wetland creation.

3 Peat Conditions

3.1 Study Area

3.1.1 The study area for the Proposed Scheme is situated in the Cairngorms National Park, extending from Dalnaspidal in Upper Glen Garry in the south, to south of the existing A9/ A889 junction at Dalwhinnie in the north. The Allt Dubhaig watercourse is present within Glen Garry to the west of the existing A9 carriageway in the south, with the Proposed Scheme passing through Drumochter northward of this and entering Glen Truim, where the River Truim is present to the west. There are also a number of watercourse crossings and hillside tributaries which pass under the existing A9 carriageway.

3.1.2 There are a wide range of predominantly open upland habitats across the Proposed Scheme extents, but also some vegetation and habitat types more typical of lowland areas. Terrain to the west of the existing A9 carriageway is generally lower-lying and flatter than that to the east. It supports a mixture of mires, heaths, grasslands and occasional fen and swamp in the floodplains of the Allt Dubhaig and River Truim. On the hillsides to the east, there are a wide range of upland grasslands, mires and heaths.

3.1.3 As well as the existing A9 carriageway and associated infrastructure, land uses within the study area include grouse moor, and local areas of sheep grazing and plantation woodland. The Proposed Scheme extents are also located within, adjacent to or nearby areas of environmental designation, including the River Spey Special Area of Conservation (SAC) (River Truim) and the Drumochter Hills SAC, Special Protection Area (SPA) and Site of Special Scientific Interest (SSSI) (including the Allt Dubhaig Geological Conservation Review (GCR) site), as shown on **Drawing 5.1** (**Volume 3**)**.** Other land uses in the vicinity of the Proposed Scheme include the Highland Main Line railway, the National Cycle Network Route 7 (NCN7), residential properties and the Scottish and Southern Energy (SSE) Beauly-Denny Power Line and pylons.

3.2 Geomorphology

3.2.1 As the study area is situated within Glen Garry and Glen Truim; glaciation and subsequent deglaciation have been the predominant landscape forming influences. These have created deep, steep-sided valleys in which the River Truim, Allt Dubhaig and River Garry are 'misfits', flowing through comparatively flat and wide valley bottoms to the west of the Proposed Scheme.

3.2.2 As shown in **Drawing 10.1** (**Volume 3**), published BGS mapping indicates the valley bottoms are predominantly comprised of alluvial and glaciofluvial deposits and, in some areas, watercourses have incised through these to create terraces which are now elevated above the contemporary floodplain. Some areas of peat are also indicated to the west, north of the Pass of Drumochter and Balsporran, while areas of alluvial fan are present at the apex and outflows of larger surface water tributaries to the River Truim or Allt Dubhaig, including Allt Coire Chuirn, Allt Coire Mhic

Sith and Allt Coire Bhotie. The hillslopes to the east and west of the study area are mantled with hummocky glacial deposits, till and scree, with peaty soils throughout and areas of peat.

3.2.3 Based on the geology and wider geomorphological context (Evans and Warburton, 2007), the study area provides two principal environments ('macrotopes') in which mosaics of peat forming areas exist; the flatter flood plain and terraces to the west (where areas of peatland are low lying and marshy, comparable to low-lying fens, transition mire and blanket bog), and the hills to the east (where areas of peatland are most comparable to blanket bog). A feature which morphologically resembles a raised bog (but that is ecologically classified as wet heath/ blanket bog mosaic) is also present to the west of the northern tie-in of the Proposed Scheme to Project 8 – Dalwhinnie to Crubenmore, with a low dome perched on a low terrace above the River Truim floodplain.

3.2.4 Peat cover deeper than 0.50m is discontinuous in the mosaic of environments present, with smaller-scale morphological ('mesotope' and 'microtope') features scattered across the Proposed Scheme extents and often occurring as small-scale components of larger mire or heath areas. The features include several springs and flushes on sloping ground to the east, and hummock and hollow complexes to the east and west, where the hollows frequently contain bog pools.

3.2.5 No peat haggs, gullies or pipes have been identified within the Proposed Scheme extents, though several areas are noted to have been affected as a result of anthropogenic impact from historical development (e.g. the existing A9 carriageway and Highland Main Line railway), muirburn, drainage and plantation woodland.

3.3 Habitats and Vegetation

3.3.1 Based on Phase 1 Habitat (CH2M, 2014) and National Vegetation Classification (NVC) Surveys (MacArthur Green, 2015), peatland habitats and peat-forming vegetation types have been identified in the study area. These include mire, blanket mire, wet heaths or mosaics of these, with some of the typical and indicative core vegetation ranges (Bruneau and Johnson, 2014) of **blanket bog** (M17, M19, M20 and M1 to M3), **wet heaths** (M15 and M16), **transition mire, fen and flush** (M4, M5, M6 and M10) and locally, **degraded bog** (M25) represented. Semi-natural vegetation not associated with waterlogged peat formation, but that can occur over peaty soils on shallow peatlands includes **dry heath** (H10 and H12), **acid grasslands** (U2 and U4 to U6), **semi-natural grasslands** (MG9 and MG10) and **bracken** (U20).

3.3.2 The distribution of habitats and vegetation types is shown in **Drawings 12.7** to **12.24** (**Volume 3**) and described in **Chapter 12** (**Volume 1**). In summary however, those representing blanket bog and other mire types (in isolation and/ or mosaic) account for around 13% of the study area, wet and dry heaths up to 50% and flushes, fens and swamps up to 3%. Some of the vegetation has been impacted anthropogenically over time as noted. However, areas of blanket bog, transition mire and wet heath located to the west of the Proposed Scheme, through the Pass of Drumochter, appear sufficiently wet and contain bog pool communities indicative of good condition. This includes an expanse of blanket bog, transition mire, swamp and wet heath/ blanket bog mosaic complex between ch. 3,000 and ch. 4,500; which corresponds to a site containing an important pollen record, identified by Walker (1975) and described in **Chapter 10** (**Volume 1**).

3.4 Hydrology

3.4.1 A detailed hydrological catchment baseline survey for the study area, based on field visits (CFJV, 2016 and 2017) and desk-based data assessments, is presented in **Appendix 11.4** (**Volume 2**). This indicates that the study area in the south drains to the River Garry, via the Allt Dubhaig,

within the wider River Tay catchment. In the north, the study area drains to the River Truim valley within the wider River Spey catchment. There are at least sixty-three minor and/ or major surface watercourses present; the majority of which are direct tributaries to the River Truim and **Chapter 11** identifies individual sub-catchments for each of these.

3.4.2 Few well-defined natural watercourses drain areas of peat within the Proposed Scheme, with the notable exception of the River Truim; whose headwaters drain the expanse of blanket bog, transition mire, swamp and wet heath/ blanket bog mosaic noted to the west of the existing A9 between ch. 3,000 and ch. 4,500.

3.4.3 A network of artificial drainage channels of varying continuity and length also exist across the study area, variably draining to existing watercourses and the points at which they cross the existing A9; as illustrated in **Drawing 10.5.8** (**Volume 3**). These are most frequent at the margins of existing or recent infrastructure, areas of grouse moor; and some are located in areas of peat. This suggests channels have been cut to reduce levels of saturation for, or associated with these purposes, or to transfer run-off to culverts from the upslope to the downslope side of the A9.

3.4.4 Where present, artificial drainage will lower water table levels in areas of peat to make areas more amenable for a particular purpose, but they can also degrade it. Groundwater levels from standpipes in, or nearby, peat areas indicate standing water table depths of between 0.43m and 3.90m. Water has also been observed at, or near, the surface in or nearby bog pools, and struck at shallow depths between 0.20m and 3.50m within or below peat profiles elsewhere; indicating local saturation through these and intact hydrological systems.

3.4.5 No sub-surface peat pipes were identified in the peat profiles during available investigation, peat probing or other walkover surveys completed to date.

3.5 Peat Depth and Characteristics

3.5.1 All available data has been used to generate a detailed map of peat and peaty soil depth for the Proposed Scheme. This is shown in **Drawings 10.17** to **10.23** (**Volume 3**) and the methodology used to create the map is described in **Appendix 10.1** (**Volume 2**). Approximately 7% of the permanent and temporary works boundaries of the Proposed Scheme do not have peat depth data coverage. However, desk-based information and ecological surveys indicate that peat greater than 0.50m is unlikely to be present in these areas.

Peat Depth

3.5.2 The peat depth model and data indicate that the full range of recorded peat and peaty soil depths, across areas investigated, varied from 0.00m to 8.40m, as illustrated in **Drawings 10.17** to **10.23** (**Volume 3**). The vast majority of areas (approximately 65%) within the permanent and temporary works boundaries are underlain by peaty soil or topsoil less than 0.50m thickness, and approximately 10% is underlain by no peat. Shallow peat is present underlying approximately 12% of the areas, and only 6% is underlain by deep peat.

3.5.3 The occurrence of peaty soils and peat generally correspond well with published mapping and ecology surveys; with peaty soils and topsoil (less than 0.50m thickness) predominant in areas of dry and wet heaths or grassland transitions. These ranged from 0.01m to 0.50m in thickness and have been generally described as silty, clayey, sandy, gravelly, frequently peaty topsoil or soil containing pockets of peat, but also thin fibrous or pseudo-fibrous peat horizons. Discontinuous and localised pockets of shallow peat (between 0.50m and 1.00m thickness) are also present in similar areas, as well as wet heath/ blanket bog mosaics.

3.5.4 Deep peat (greater than 1.00m thickness) is present within and adjacent to the Proposed Scheme most frequently in areas of blanket bog, transition mire, swamp, and blanket bog/ wet heath mosaics. Notable areas include the hillslopes to the east at Dalnaspidal (ch. 500 to ch. 1,100), to the west through the Pass of Drumochter (ch. 3,000 to ch. 4,500), to the west near Balsporran (ch. 7,050 to ch. 7,250), and to the east and west at Drumochter (ch. 7,500 to ch. 7,700).

3.5.5 The peat depth model is based on a substantial dataset of real data points acquired in the field and is therefore believed to be of very high quality. The interpolation methods used have been shown to be suitable for this kind of assessment in other peat related assessments (RWE, 2013). However, it should be noted that the peat depth model is, by its nature, an interpolation between real data points and there remains the possibility that deeper or shallower peat than that represented by the model may be present between the real data points.

Peat Characteristics

3.5.6 Where identifiable from investigation information and against the von Post Scale (Hobbs, 1986); the acrotelm in areas of peat has been recorded to predominantly comprise relatively thin (0.05m to 0.30m) undecomposed to moderately decomposed (H1 to H5) layers and variably distinct semi-natural vegetation. Some decomposition ratings are higher than would be expected for acrotelm that is healthy, and actively peat-forming; but slightly thicker (0.10 to 0.40m) layers showing no or only very slight decomposition (H1 to H3) and distinct vegetation were observed within or adjacent to larger blanket bog, mire and swamp areas to the west of the Proposed Scheme through the Pass of Drumochter and beyond the Highland Main Line railway.

3.5.7 The acrotelm is underlain by catotelm layers varying between spongy, plastic and firm condition. The type of peats also varied from reddish to dark brown and black fibrous to pseudo-fibrous, and locally amorphous peat; with highly variable root and wood content.

3.5.8 Pseudo-fibrous peat was typically described as H4 to H5 on the von Post scale (slight to moderate decomposition), fibrous peat was typically H3 to H6 (very slight to moderate decomposition), while more amorphous peat or amorphous content within it was described as H7 to H8 (strong to very strong decomposition). Evidence of H9 to H10 peat (nearly complete to completely decomposed) has been observed at locations within blanket bog, transition mire and swamp to the west of the Proposed Scheme in the Pass of Drumochter and beyond the Highland Main Line railway. These correspond to the deepest areas of peat encountered within the study area, and were generally observed at depths greater than 5.00m within the profiles.

3.5.9 Estimated water contents in core samples have covered the full range of possible values on the Von Post scale, from B1 (dry) to 5 (very high).

Laboratory Testing

3.5.10 Laboratory testing of peaty soil and peat samples for all, or a selection of, organic matter, loss on ignition, moisture content, bulk density, pH, total carbon and total organic carbon from selected trial pit/ borehole and peat core locations was undertaken as part of ground investigation (GI) works for the Proposed Scheme, as described in **Chapter 10** and **Appendix 10.1** (**Volume 2**).

3.5.11 Peaty soil/ topsoil samples were recovered across a range of habitat types, including dry and wet heath, grassland transitions and mire/ heath mosaics. The testing results indicate bulk densities for these ranging between 0.2 and 0.78 Mg/m^3, dry densities between 0.08 and 0.27 Mg/m^3 and moisture contents of between 8 and 1481%. Results for total organic carbon ranged from 0.3 to 48%, from 0.3 to 57% for total carbon content and from 16 to 92.6% for mass loss on ignition. pH values ranged from 3 to 6.7.

3.5.12 Shallow peat samples were recovered across a similar range of habitat types, with bulk densities ranging between 0.57 and 0.98 Mg/m^3, dry densities ranging from 0.08 to 0.48 Mg/m^3 and moisture contents of between 64 and 994%. Results for total organic carbon ranged from 3.4 to 54%, from 4.8 to 62% for total carbon content and from 26.8 to 96.6% for mass loss on ignition. pH values ranged from 3.3 to 5.7.

3.5.13 Within deeper peat profiles in areas of mire, wet heath, mosaics of these or swamp, bulk densities ranged between 0.2 and 0.94 Mg/m^3, dry densities ranged from 0.02 to 0.44 Mg/m^3 and moisture contents were recorded between 106 and 4912%. Results for total organic carbon varied between 1 and 63%, between 2.2 and 64% for total carbon content and from 12.3 to 98.6% for mass loss on ignition. pH values ranged from 3.2 to 6.3.

4 Peat Management

4.1 Management Approaches

4.1.1 The hierarchy of management approaches in relation to developments on peat provided by SEPA is as follows (SR and SEPA, 2012; SEPA, 2010):

- **Prevention:** avoiding generating excess peat during construction (e.g. by avoiding areas of peat or by using construction methods that do not require excavation, such as floating tracks)
- **Re-use:** use peat produced on site in specific areas, in environmentally beneficial and suitable ways, in the restoration of temporary works areas or as part of landscaping strategies
- **Recycling/ recovery/ treatment:** modification of peat produced on site for use as a fuel, or as a compost/ soil conditioner, or dewater peat to improve its mechanical properties in support of re-use
- **Storage:** temporarily store peat on-site (for example, during short periods in the construction period) and then, re-use.

4.1.2 Throughout the DMRB Stage 3 design development process for the Proposed Scheme described in **Chapter 4** (**Volume 1**); a number of environmentally-led workshops considered each aspect of the developing design and made recommendations for certain features to be included, or aspects of the design to be reconsidered. Peat was afforded significant consideration throughout this process and was informed by the progressive collection of peat survey information as described in **Appendix 10.1** (**Volume 2**).

4.1.3 The OPMP for the Proposed Scheme has therefore been developed as part of an iterative and informed process, and has adopted prevention, minimisation and re-use as the core management principles, together with an element of temporary storage as means of managing peat excavated during construction.

4.2 Prevention

4.2.1 Prevention and avoidance of peat excavation or other impacts altogether has been achieved through detailed assessment of the distribution of peat across the Proposed Scheme and adjacent areas. This has informed a number of infrastructure layout and positioning changes such as widening of the carriageway to the east (instead of the west) between ch. 3,800 and ch. 4,400 in the Pass of Drumochter, as well as micrositing of SuDS basins and compensatory flood storage areas where possible. The peat conditions also informed several alternatives that were considered for particular scheme elements, including the location of the Balsporran Cottage/

Drumochter Lodge junction and the Balsporran Telecoms Mast and Drumochter Estate access tracks, as further described in **Chapter 4** (**Volume 1**).

4.2.2 It is difficult to be precise given the iterative nature of the design development process, the progressive collection of peat survey information and the stages at which estimated excavation volumes were calculated. However, it is estimated that these changes and the consideration of alternatives have collectively resulted in at least of **20,000m^3** reductions of estimated peaty soil and peat excavation volumes. Further actions to avoid or reduce excavation may also still be achievable during detailed design, and through the use of construction techniques such as floating road construction for access tracks, and through the use of piling or bridging for sections of the mainline and associated embankments, wherever peat conditions and depths permit. These will be undertaken where practically achievable from an engineering perspective and not economically prohibitive.

4.2.3 In this respect, *'A Report into Good Practice in Design, Construction and Use of Floating Roads on Peat with particular reference to Wind Farm Developments in Scotland'* (Forestry Civil Engineering and SNH, 2010) states that there is no consensus about the depth of peat over which a road should be floated. This study indicated that while depths ranging between 0.60m and 1.50m are typically proposed, the decision to float a road would not wholly rest on depth but on other criteria such as the type and characteristics of the peat, the length of the road section, the construction equipment available and the associated haul distances.

4.2.4 Sections of mainline and embankment with peat depths consistently greater than 2.00m may be suitable for either piling or bridging.

4.3 Re-instatement

4.3.1 Although the Proposed Scheme layout prevents and avoids peat excavation as far as is practicable at this stage, the nature of the various other constraints detailed in **Chapter 4** (**Volume 1**) has meant that some infrastructure is located within or adjacent to areas where peat is present. As this cannot be avoided in these instances, the subsequent management option adopted for the Proposed Scheme is to re-instate that peat at the point of excavation wherever possible. This will principally be limited to the following instances:

- Where peat or peaty soil must be excavated to accommodate embankment slopes which must be taken below existing ground level; once constructed, a proportion of the peat excavated can be re-instated at the embankment toe.
- Where excavation must occur for compensatory flood storage areas, peaty soil or peat turves up to 0.50m thickness can be set aside and re-instated once excavation of the substrate or deeper material is removed.

4.4 Re-use

4.4.1 Where the excavation of peat cannot be prevented or avoided, and re-instatement at the point of excavation cannot be achieved; the management option for the Proposed Scheme is for excavated peat and peaty soil to be re-used in suitable and environmentally beneficial ways, that aim to maintain their provisioning, regulating, cultural and ecosystem services. In this respect, the following have been identified as the core potential opportunities for re-use as part of the Proposed Scheme:

- **Landscaping Restoration:** Re-instatement and re-use of peaty soils and topsoil as dressing for widening, cutting and embankment slopes and verges to assist in creating tie-ins with the

surrounding topography, landscape and habitats to reduce visual impacts. It may also be possible for proportions of excavated and sympathetically handled shallow peat finished with acrotelm peat turves, to be re-used for verge re-instatement on particular sections of access track, where consistent with adjacent soils and vegetation, and where the adjacent substrate (placed or *in situ*) is peat.

- **Habitat Re-instatement, Restoration and Creation:** Candidate areas considered to be of suitable slope, existing and surrounding ecology and hydrology have been identified; where the re-use of peat, along with selected local water table restoration could re-instate, restore and/ or create extended peat-based habitats. These areas include blanket bog and wet heath/ mire mosaics within or at the margins of the Proposed Scheme boundaries, or where temporary works will take place, and selected sections of the disturbed/ grubbed up Beauly-Denny Power Line track through the Pass of Drumochter within the Drumochter Hills SAC. Re-instatement, restoration and creation of such peatland habitats is also likely to have the further benefit of reducing run-off rates to watercourses.

- **Sustainable Drainage System (SuDS) Basins:** Re-use of peat as a natural filter material in the main basin of selected permanent SuDS for the Proposed Scheme, to reduce the rate at which road run-off is discharged and improve the quality of the water discharged to watercourses. The method for peat placement in the SuDS basins will require detailed design consideration, but should aim to maximise the filtration surface area and where possible, and be lined with vegetated acrotelm turves.

- **Compensatory Flood Storage Areas:** Re-use of peat for creation of wetland-based habitats within proposed compensatory flood storage areas, which by their nature, will be lower-lying than surrounding areas. The specific design and practice of peat re-use in each area will be developed during detailed design, but this should include consideration of whether sufficient hydrological conditions can be achieved to maintain the condition of the peat that is re-used.

4.4.2 It is the intention that all peat excavated during construction of the Proposed Scheme can be re-used in one of the above ways, as set out within this OPMP. However, should none of these, or suitable alternatives, be achievable for a particular portion of the excavated peat, then this peat will be considered as 'waste' and an appropriate licence or exemption for the re-use of the material would be applied for.

4.5 Temporary Storage

4.5.1 Temporary storage of peat should be avoided wherever possible by transporting to an allocated re-use location as soon as is practicable, to help retain as much structural integrity within the peat as possible, minimise the volumes in storage and minimise the likelihood of drying. However, this should not be undertaken at the expense of re-instatement, restoration or other re-use outcomes (i.e. if, on balance, storage will produce a better long-term outcome, then it should be used prior to the re-use).

4.5.2 For instances where this may be required during construction of the Proposed Scheme therefore, provisional locations for the temporary storage of peat have been identified and are shown in **Drawings 10.38** to **10.44** (**Volume 3**). These take into account land available within the permanent and temporary works boundaries, the proximity to points of excavation and the level of peat landslide risk determined in **Appendix 10.5** (**Volume 2**). Where temporary storage is necessary, it will be undertaken in line with the outline measures provided in Paragraph 6.3.5 to Paragraph 6.3.8, and **Annex 10.6.2**, of this OPMP.

5 Peat Balance

5.1 Proposed Scheme Elements

5.1.1 The development of a peat balance for the Proposed Scheme has involved calculation of volumes excavated during construction, volumes re-instated during or following construction, volumes not required for re-instatement and requiring re-use, and volumes of re-use that may be achieved via re-use for landscaping restoration, habitat re-instatement, restoration and creation, or re-use within selected SuDS basins and/ or compensatory flood storage areas.

5.1.2 Taken together, these describe whether the Proposed Scheme may have a positive, negative or neutral peat balance (i.e. produces more, less or approximately the same amount of peat as can be appropriately re-used within the boundaries of the land made available).

5.1.3 The following sub-sections describe the calculations for each element of the Proposed Scheme. Mean peat depths referred to are derived from the peat depth model shown in **Drawings 10.17** to **10.23** (**Volume 3**) and are specific to the footprint of each Proposed Scheme element considered, which are as follows:

- Mainline alignment, including embankments, widenings and cuttings, but excluding the part of the mainline which runs through either of the proposed junctions
- Dalnaspidal and Balsporran Cottage/ Drumochter Lodge junctions, including embankments, cuttings and link roads
- Permanent SuDS basins and SuDS access tracks, including embankments and cuttings
- Other access tracks, including the re-aligned NCN7 track
- Watercourse diversions and drainage, including cut-off drains
- Compensatory flood storage areas.

5.1.4 Each element required a slightly different approach to, as accurately as possible, represent the initial peat excavation that will be required and any subsequent re-instatement at the point of excavation that may be possible, to arrive at residual excavation volumes.

5.1.5 The linear nature and extent of some elements such as the mainline, junctions and access tracks means that peat depth varies throughout their footprint. These features were therefore divided into 50m sections, such that total volumes and the mean depth of peat beneath each 50m section could be used to calculate the required excavation.

5.1.6 Estimated volumes are expressed to the nearest m^3. However, the unavoidable uncertainty in the figures makes it prudent to consider any figure as correct to the nearest $10m^3$ where less than $100m^3$, the nearest $100m^3$ where less than $10,000m^3$ and the nearest $1,000m^3$ where over $10,000m^3$.

5.1.7 The initially presented excavation volumes also assume that the proposed Drumochter Estate access track (which follows the alignment of an existing temporary track constructed for the Beauly-Denny Power Line development in the area of Allt Coire Chuirn) would not be re-instated prior to construction of the Proposed Scheme. The use of floated access tracks, piling and bridging techniques are a matter for detailed design. As such, the excavation volumes initially presented also assume no floating, piling or bridging; but estimates of the potential reduction in excavation volumes through the use of these techniques, and the consequent impact on the overall volumes, are presented.

5.1.8 Opportunities to float access tracks and reduce peat excavation volumes should be taken at the detailed design stages wherever practical in engineering terms and where not cost prohibitive.

5.2 Excavation and Re-instatement Volumes

5.2.1 The estimated volumes of peaty soil and peat, and the way they have been calculated for each element of the Proposed Scheme are described below and supported with schematic diagrams where necessary. In all instances, the excavation volumes have been uprated to account for the areas not yet covered by the peat depth model. This uprating assumes that excavation volumes (and their distribution between peaty soil, shallow and deep peat) is proportionally the same in the 'no data' area as it is in the area where data is available.

Mainline Alignment

5.2.2 The mainline alignment for the Proposed Scheme covers approximately 10km, with an additional 900m southern tie-in to the existing dual carriageway at Glen Garry and a 241m northern tie-in to Project 8 – Dalwhinnie to Crubenmore. For the purposes of this assessment, the mainline alignment scheme element comprises embankments, widenings, cuttings and 'other earthworks' (areas of cut or fill between embankments, widenings or cuttings such as verges, carriageways and the central reserve).

5.2.3 It is assumed that under the embankments and other earthworks, all peat will be excavated in order to found construction on strata of a suitable bearing capacity.

5.2.4 Additionally, in areas of embankment fill where peat is present, the embankment will be required to continue below existing ground level to support structural elements and landscape fill above ground. Due to the slope of the structural embankment required below ground (assumed to be 1:2), this will require a lateral extension of the excavation footprint equivalent to twice the depth of the peat, in order to accommodate the below-ground part of the embankment. A further lateral extension to accommodate a return slope which will be formed from a series of 0.50m high benches will also be required. To calculate the distance of this lateral extension, the mean peat depth under a 50m section of embankment or at grade stretch of road has been used.

5.2.5 **Figure 1** shows a schematic diagram to illustrate the considerations in this calculation and also shows that, following construction, some excavated peat can be re-instated at the point of excavation. The volume of peat that will be re-instated is therefore included within the initial excavation volumes but not in the net residual excavation volumes.

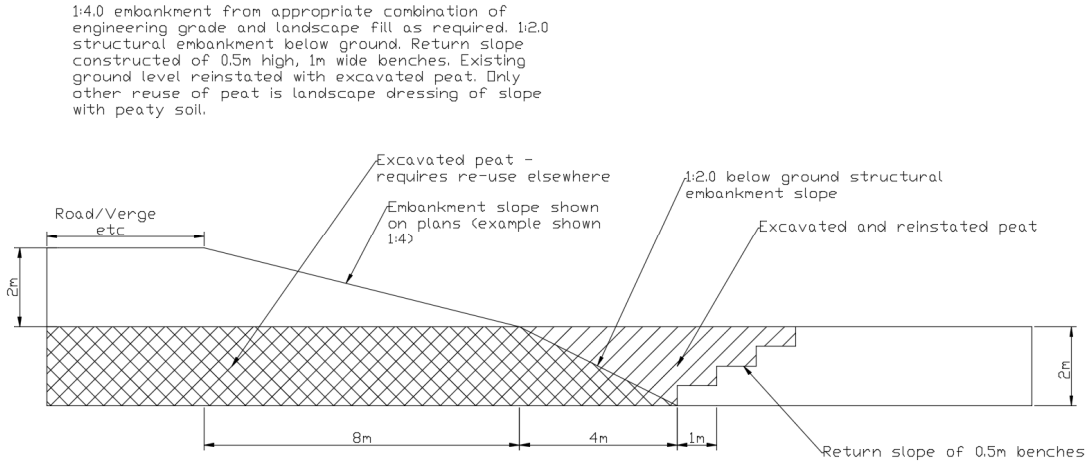

Figure 1: Calculation of Excavation and Re-instatement Volumes (Embankments and At Grade)

5.2.6 Where cut slopes are present on either side of the mainline, it is assumed that total excavation of peat will be required, with the exception of a band at the top of the cutting equivalent to four times the depth of the peat, where only 50% of the peat will require excavation. **Figure 2** shows a schematic diagram of the considerations in this calculation on the assumption that the part of the cut slope in peat is at 1:4 – considered the most likely to be applied within areas of peat.

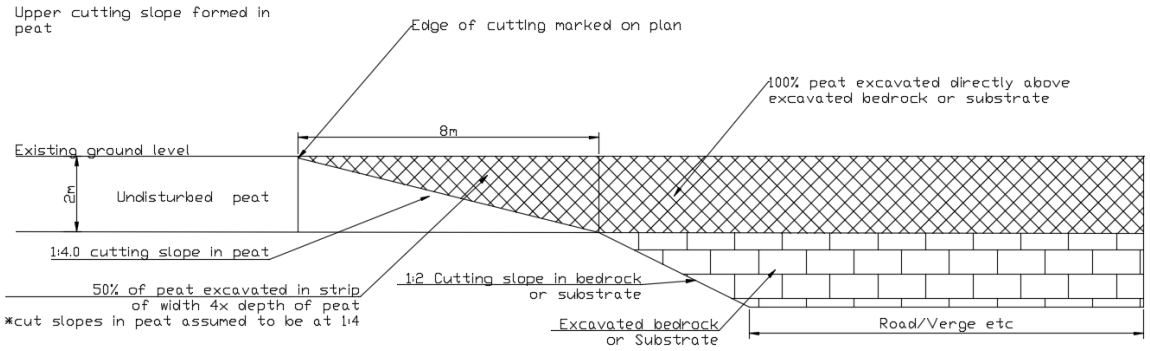

Figure 2: Calculation of Excavation and Re-instatement Volumes (Widenings and Cuttings)

5.2.7 The excavation volumes for the mainline alignment in **Table 1** assume that no floating, piling or bridging is implemented. However, estimates of the potential for reducing peat excavation volumes through the use of such techniques in certain areas is presented in later sub-sections.

Dalnaspidal Junction

5.2.8 The proposed Dalnaspidal Junction between ch. 50 and ch. 900 includes embankments, cuttings and variable earthworks associated with slip roads required to provide access to residential properties west of the existing A9 and land to the east. The volumes presented for the Dalnaspidal Junction also include the mainline alignment between ch. 50 and ch. 900. The same considerations as shown in **Figure 1** and **Figure 2** for the mainline alignment have been applied to embankments and cuttings associated with this.

Balsporran Cottage/ Drumochter Lodge Junction

5.2.9 The proposed Balsporran/ Drumochter Lodge junction includes cuttings, embankments and other slip road earthworks between ch. 6,800 and ch. 7,600 to provide access from the A9 carriageway to the properties at Balsporran Cottage and Drumochter Lodge. The volumes presented for the Balsporran/ Drumochter junction also include the mainline alignment between ch. 6,800 and ch. 7,900 and the same considerations shown in **Figure 1** and **2** have been applied to embankments and cuttings.

Access Tracks

5.2.10 Access tracks are proposed at several locations throughout the Proposed Scheme. These are often parallel to the mainline alignment and provide access for SuDS basin maintenance access, landowner access and widening/ re-alignment of the existing NCN7.

5.2.11 The volumes of peat that will need to be excavated for the access tracks have been calculated on the same basis as for the mainline alignment, insomuch as the access tracks are formed of embankments, widenings, cuttings and 'other earthworks'. In this respect, embankments and other earthworks in peat will require excavation beyond the design footprint to accommodate a below-ground core embankment, and widenings or cuttings will have a band equivalent to a width four times the depth of the peat, in which only 50% of the peat need be excavated.

5.2.12 The excavation figures presented in **Table 1** assume that any access tracks or parts thereof will not be floated, as this is a matter for detailed design. However, estimates of the potential for reducing peat excavation through the use of floating roads in areas where peat exceeds 1.00m in depth are presented in later sub-sections.

Permanent SuDS Basins

5.2.13 The permanent SuDS basins proposed are considered to consist of a combination of cuttings and bunds to form enclosed basins in which road run-off can be temporarily retained to filter solid and solute contaminants, and reduce the rate of run-off to watercourses.

5.2.14 Under the footprint of bund areas, it is assumed that, similar to embankments where they are constructed in areas of peat, there will need to be a lateral extension of the footprint to accommodate a below ground extension of the bund to a stratum of sufficient bearing capacity. Under the footprint of cuttings, it is assumed that all peat will be excavated except in a band equivalent to four times the depth of the peat at the top of the cutting slope. Within this band it is assumed that only 50% of the peat will need to be excavated, as shown in **Figure 3**.

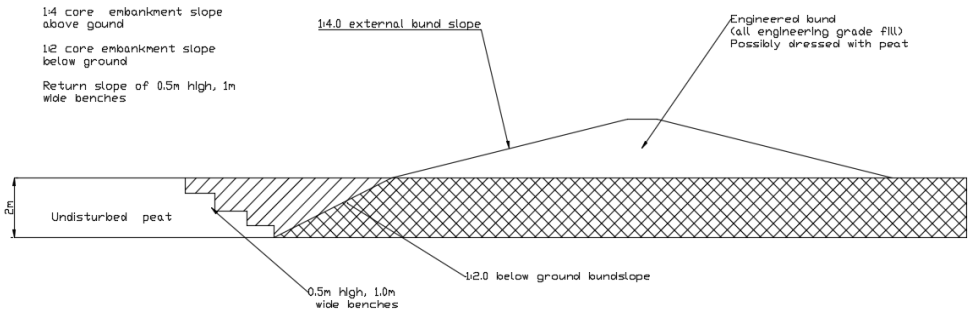

Figure 3: Calculation of Excavation and Re-instatement Volumes (Permanent SuDS Basins)

Drainage

5.2.15 Throughout the Proposed Scheme, there are a series of open cut-off drains to capture upslope run-off before it reaches the tops of widenings and cuttings, and to capture run-off from embankments on the downslope side. The linear nature, and consistent cross-sectional geometry of these drains, allows for peat excavation volumes to be calculated using the average peat depth within a 50m long section of drain and area of the trapezoidal cross-section of the drain occupied by that depth of peat.

5.2.16 **Figure 4** shows the considerations in this calculation and it is assumed that all peat excavated to create the drain must be re-instated or re-used elsewhere.

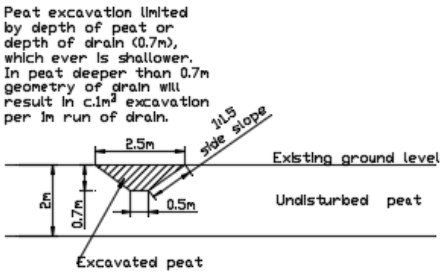

Figure 4: Calculation of Excavation and Re-instatement Volumes (Cut-off Drains)

5.2.17 In addition to the cut-off drains, a number of cross-drain culverts with the specific purpose of maintaining hydrological pathways for flush overland flow are proposed along the proposed Drumochter Estate access track to the east of northern portions of the Proposed Scheme. Each of these have dispersal trenches located on the downslope side which are approximately 45m^2. The assumed excavation depth is an average of 0.45m and the excavated volumes for these features will therefore be the trench area multiplied by the average peat depth or 0.45m, whichever is greatest. It is assumed that all peat is excavated to create the drain and must be re-instated or re-used. However, wherever possible, drains will be lined with peat turves stripped during their creation.

Watercourse Diversions

5.2.18 The Proposed Scheme crosses numerous existing watercourse features; some of which are artificial drains cut to facilitate the existing road, and some of which are natural surface watercourses. Watercourse diversions have been designed to ensure the continued transfer of flow from the upslope/ upstream side to the downslope/ downstream side via bridges or culverts. These watercourse diversions are of varying dimensions and so have been assessed individually, with the required excavation volumes calculated based on peat depth as it varies throughout the footprint of the watercourse diversion and the dimensions of the watercourse diversion. It is assumed that all peat excavated for the watercourse diversion will require re-instatement or re-use.

Compensatory Flood Storage Areas

5.2.19 Several compensatory flood storage areas are proposed throughout the Proposed Scheme, to compensate for the loss of existing flood storage capacity through construction within the extent of the 1:200 return period flood level. Each of these areas will be subject to detailed design and are likely to be terraced in nature. However, it is presently assumed that their construction will typically require removal and setting aside of soils or peat turves, to a maximum depth of 0.50m, removal of the underlying material (be that deeper peat, substrate or bedrock) by a further 1.00m, before re-instatement of the soils or peat turves to create an area 1.00m lower than existing ground level. Peat turves to be reinstated should be stored in accordance with the guidance given in Paragraph 6.3.5 to Paragraph 6.3.8, and **Annex 10.6.2**, of this plan.

5.2.20 In most instances, they are proposed to cut into existing sloping ground adjacent to watercourses and **Figure 5** shows the considerations applied in the calculation of excavation volumes.

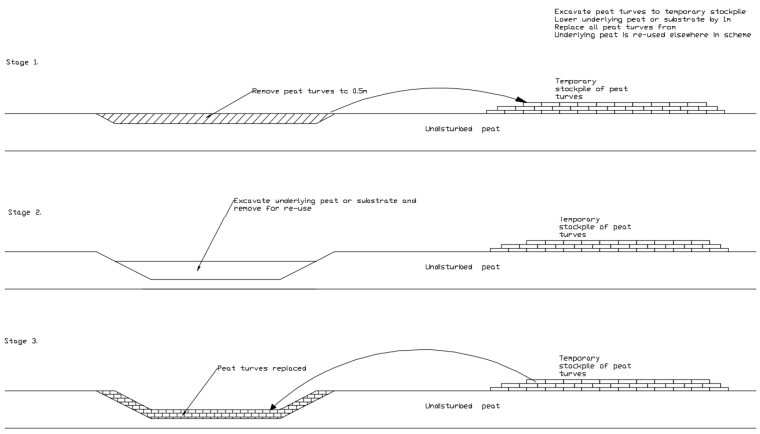

Figure 5: Calculation of Excavation and Re-instatement Volumes (Compensatory Flood Storage)

Temporary Works

5.2.21 Although land is included within the Proposed Scheme boundaries for temporary works, the locations and nature of temporary activities do not form part of the design at this stage. The impacts of these activities on peat excavation volumes therefore cannot be quantified. However, it is anticipated that the following temporary works activities may result in impacts on peat:

- Temporary SuDS requirements
- Haul roads for construction traffic and material transport
- Temporary storage of excavated materials (including peat).

5.2.22 For temporary SuDS and related drainage, peat disturbance shall be avoided by additional micro-siting during detailed design and construction to avoid excavation in areas of peat and, where this is not possible, the use of above-ground solutions requiring no or limited excavation, such as siltbusters. Any areas of peat which are unavoidable, and in which excavation is required for temporary SuDS, shall be fully re-instated by the Contractor following construction.

5.2.23 In the case of haul roads, these shall avoid areas of peat wherever possible and, where they must cross areas of deep peat (deeper than 1.00m), floated track construction shall be considered and implemented where peat depth and conditions permit. It is anticipated that all temporary access roads will be fully re-instated following construction.

5.2.24 As previously noted, temporary storage of peat shall also be avoided wherever possible by transporting excavated peat and peaty soil to allocated potential re-use locations. However, for instances where this may not be possible during construction, provisional locations which are likely to be suitable for temporary storage have been identified and are shown in **Drawings 10.38** to **10.44** (**Volume 3**). Analysis of these areas indicates that there is sufficient space within the permanent and temporary works boundaries for all shallow and deep peat and the vast majority of peaty soil. The remaining amount of peaty soil, which is a small proportion of the overall volumes generated, should be able to be accommodated through sensible sequencing of construction.

Excavation and Re-instatement Volumes

5.2.25 The excavation and re-instatement volumes for the Proposed Scheme are presented as volumes of peaty soil and topsoil (less than 0.50m thickness), shallow peat (between 0.50 and 1.00m thickness) and deep peat (greater than 1.00m thickness) in **Table 1**. The residual estimated excavation volumes for each category are also highlighted and illustrated for each section and element of the Proposed Scheme considered in **Drawings 10.6.1** to **10.6.12** (**Volume 3**). Each category refers to the total peat depth in a given m^2 area. As such, all volumes in **Table 1** include both acrotelm and catotelm, with this further considered below.

Table 1: Estimated Peaty Soil/ Topsoil and Peat Excavation and Re-instatement Volumes

Scheme Element[1]	Initial Excavation (m^3)			Volume of Re-instatement at the Point of Excavation (m^3)			Residual Excavation Volume Requiring Re-use (m^3)		
	Peaty Soil/ Topsoil	Shallow Peat	Deep Peat	Peaty Soil/ Topsoil	Shallow Peat	Deep Peat	Peaty Soil/ Topsoil	Shallow Peat	Deep Peat
Mainline Alignment	58,684	26,775	63,437	579	1,541	19,347	57,805	25,234	44,090
Dalnaspidal Junction	12,743	6,050	3,217	214	137	139	12,529	5,912	3,078
Balsporran/ Drumochter Junction	5,840	6,468	9,991	170	702	1,506	5,670	5,767	8,485

Scheme Element[1]	Initial Excavation (m^3)			Volume of Re-instatement at the Point of Excavation (m^3)			Residual Excavation Volume Requiring Re-use (m^3)		
	Peaty Soil/ Topsoil	Shallow Peat	Deep Peat	Peaty Soil/ Topsoil	Shallow Peat	Deep Peat	Peaty Soil/ Topsoil	Shallow Peat	Deep Peat
Permanent SuDS Basins	6,401	7,261	3,800	514	1,101	248	5,887	6,160	3,553
SuDS Access	1,177	1,863	0	134	483	0	1,043	1,380	0
Underpass (ch. 3,000)	273	0	0	9	0	0	263	0	0
Watercourse Diversions	3,410	2,676	2,437	0	0	0	3,410	2,676	2,437
Compensatory Flood Storage Areas	3,349	3,699	6,160	3,349	2,327	2,517	0	1,372	3,644
Drainage	5,364	2,395	1,323	0	0	0	5,364	2,395	1,323
Totals	**97,241**	**57,187**	**90,365**	**4,969**	**6,291**	**23,757**	**91,971**	**50,896**	**66,610**

Table Notes:

1. All estimated volumes assume the existing Beauly-Denny Power Line access track is not re-instated prior to construction of the Proposed Scheme.

5.2.26 Based on acrotelm-catotelm contact observed within the study area to date and the total estimated excavation volumes, **Table 2** provides details of the estimated volume split between these two layers for shallow and deep peat. In doing so, an average acrotelm depth of 0.17m has been applied across all Proposed Scheme elements.

Table 2: Estimated Peat Excavation and Re-instatement Volumes (Acrotelm-Catotelm)

Scheme Element	Initial Excavation (m^3)		Volume of Re-instatement at the Point of Excavation (m^3)		Residual Excavation Volume Requiring Re-use Elsewhere (m^3)	
	Acrotelm[1]	Catotelm	Acrotelm[1]	Catotelm	Acrotelm[1]	Catotelm[2]
Mainline Alignment	13,817	76,394	2,945	17,942	10,872	58,452
Dalnaspidal Junction	2,401	6,866	123	153	2,278	6,713
Balsporran/ Drumochter Junction	3,494	12,964	683	1,525	2,812	11,440
Permanent SuDS Basins	3,073	7,988	672	677	2,401	7,312
SuDS Access	614	1,248	268	215	347	1,033
Underpass (ch. 3,000)	0	0	0	0	0	0
Watercourse Diversions	1,775	3,337	0	0	1,775	3,337
Compensatory Flood Storage Areas	1,938	7,922	1,862	2,982	76	4,940
Drainage	1,787	1,931	0	0	1,787	1,931
Totals	**28,899**	**118,650**	**6,553**	**23,494**	**22,348**	**95,158**
Ratio (acrotelm: catotelm)	**1:4**		**1:4**		**1:4**	

Table Notes:

1. Although acrotelm layer depths have been not been recorded in all locations, and were occasionally impacted or thin; it is recommended that for the purposes of construction, re-use and re-instatement, that where a sufficient peat depth exists, the top 0.50m should be treated as acrotelm. This will allow excavation of intact turves for re-instatement purposes which may facilitate quicker regeneration of disturbed areas or areas where peat is re-used. If this were applied to the above, the acrotelm volumes would increase and catotelm would decrease.

2. Based on data presented in **Appendix 10.1** (**Volume 2**), evidence of nearly complete to completely decomposed (amorphous) peat (H9 or H10) has been observed at depth in selected areas based on von Post (Hobbs, 1986) classifications. Of the calculated residual catotelm quantities, approximately 10% (equivalent to **9,515m³**) may be more strongly decomposed (H7 or greater) and for which re-use options may be more limited than less decomposed peat.

Potential Reductions in Excavation Volumes

5.2.27 The estimated excavation volumes have the potential to be reduced if floated track construction techniques are used. If this is possible where peat depth exceeds 1.00m, floated sections of track have the potential to achieve a reduction of up to **12,564m³** in the estimated residual deep peat excavation volume across the locations summarised in **Table 3.**

Table 3: Potential Volume Reductions using Floating Tracks

Approximate Chainage	Location	Potential Reduction in Residual Deep Peat Excavation (m³)
ch. 3,850 to ch. 3,900	NCN7 access track, west of mainline alignment	938
ch. 3,900 to ch. 3,950	NCN7 access track, west of mainline alignment	2,792
ch. 3,950 to ch. 4,000	NCN7 access track, west of mainline alignment	4,490
ch. 4,000 to ch. 4,050	NCN7 access track, west of mainline alignment	2,801
ch. 4,050 to ch. 4,100	NCN7 access track, west of mainline alignment	1,543
	Total	**12,564**

5.2.28 The estimated excavation volumes also have the potential to be reduced if piling or bridging construction techniques are used for sections of embankment on the mainline. If this is possible where peat depths consistently exceed 2.00m, potential reductions of up to **9,008m³** in the residual deep peat excavation volume may be achieved at the locations summarised in **Table 4**.

Table 4: Potential Volume Reductions using Piling or Bridging

Approximate Chainage	Location	Potential Reduction in Residual Deep Peat Excavation (m³)
ch. 3,900 to ch. 3,950[1]	Mainline alignment northbound	578
ch. 3,950 to ch. 4,000	Mainline alignment northbound	1,325
ch. 4,000 to ch. 4,050	Mainline alignment northbound	1,737
ch. 4,250 to ch. 4,300[2]	Mainline alignment northbound, NCN7 access track	1,760
ch. 7,100 to ch. 7,150	Mainline alignment northbound	808
ch. 7,150 to ch. 7,200	Mainline alignment northbound	2,800
	Total	**9,008**

Table Notes:

1. Deep peat limited under embankment footprint, but much greater under the embankment buffer which would be required.
2. Deep peat is under the NCN7 access track parallel to the mainline, but which is part of a contiguous earthwork, so it is assumed piling is likely to be more appropriate than floating.

5.2.29 Combined, floated track and piling or bridging construction solutions therefore have the potential to further reduce residual deep peat excavation volumes by up to **21,572m³**. The peat material that would not require excavation as a consequence of these techniques would also be the deepest within the infrastructure footprint of the Proposed Scheme, contain more amorphous material and may be the most difficult to handle, store and re-use, as per **Table 2**.

5.2.30 With the potential reductions above, the estimated residual volumes requiring re-use would be **91,971m³** for peaty soil and topsoil, **50,896m³** for shallow peat and **45,038m³** for deep peat.

5.3 Residual Excavation and Re-use Volumes

Landscaping Restoration

5.3.1 Residual peaty soil and topsoil volumes are proposed to be re-used as dressing for widening, cutting and embankment slopes and verges within the Proposed Scheme; to assist creating tie-ins with surrounding topography, habitats and landscape. This would be undertaken in accordance with the requirements of the Outline Habitat Management Plan (OHMP) in **Appendix 12.11** (**Volume 2**) and soils would be removed as turves where necessary and possible, to keep as much of these with the vegetation mat, and re-instated as such.

5.3.2 It is estimated that the Proposed Scheme has capacity for all peaty soil and topsoil generated to be used this way, based on a topsoil depth of 0.20m; which can be increased if a greater volume is generated, or where turves are of a greater thickness. Additional capacity may also be available for re-use this way surrounding SuDS basins or in re-instatement of temporary works areas.

5.3.3 It additionally may be possible for small proportions of excavated and sympathetically handled shallow peat finished with acrotelm peat turves, to be re-used as dressing and re-instatement for selected sections of access tracks – particularly if these are floated (**Table 3**), and if selected lengths of the existing Beauly-Denny Power Line track at Drumochter are suitable. In such instances, peat and acrotelm peat turves would be deposited where consistent with adjacent soils and vegetation, and where the adjacent substrate (placed or *in situ*) is peat. These would be placed on one or both sides of the track, adjacent to the track surface and used to form gentle slopes (minimum 1:5) which gradually grade raised verges into surrounding land and retain existing habitat and vegetation. Low angles of re-instated slopes would reduce run-off and therefore, reduce peat loss and improve the likelihood of successful vegetation regeneration.

5.3.4 Finally, in areas where new planting or woodland is proposed, it may be possible for more strongly decomposed peat (**Table 2**) to be used as an add mixture to the replanting areas as a soil improver, to ensure success of the vegetation being planted.

Habitat Re-instatement, Restoration and Creation

5.3.5 Residual volumes of shallow peat and deep peat are also proposed to be re-used, and candidate areas for this have been identified as shown in **Drawings 10.38** to **10.44** (**Volume 3**). The areas include existing blanket bog, wet heath/ mire or other mosaic vegetation types overlying peaty soils or some peat, some of or proportions of which are also degraded and located within or adjacent to areas where proposed permanent or temporary works will take place.

5.3.6 The areas are considered to be within reasonable proximity to areas of anticipated excavation and are of suitable slope, existing and surrounding ecology and hydrology; thus representing areas where peat re-use, along with selected local water table restoration, has the best potential for re-instating, restoring and creating extended or improved peat-based habitats. Selected sections of the disturbed former Beauly-Denny Power Line track to the east of the Proposed Scheme through the Pass of Drumochter within the Drumochter Hills SAC have also been identified based on their poor condition, surrounding habitats and hydrology, and with the potential to reconnect these and reduce the fragmentation which is currently visible.

5.3.7 The locations and extents of the candidate areas are shown in **Drawings 10.38** to **10.44** (**Volume 3**) and photographs of each are provided in **Annex 10.6.1**. The Contractor may also identify additional or alternative areas for peat re-use within the temporary and permanent boundaries of the Proposed Scheme or elsewhere, by agreement prior to or during construction. However, the outline objectives in proposing utilisation of the candidate sites presently identified is to:

- Ensure residual volumes of excavated peat from the Proposed Scheme are re-used in areas where ecological benefits can be realised and carbon losses minimised
- Promote the re-use of excavated peat materials and avoid their disposal to landfill
- Promote the use of novel and best practices, and ensure that benefit is made from experience on other sites in re-using materials for ecological enhancement
- Complement planned mitigation identified in the OHMP in **Appendix 12.11** (**Volume 2**) and **Drawings 6.1** to **6.12** (**Volume 3**); to contribute to an existing mosaic of habitats within the Drumochter Hills SSSI, SAC and SPA and promote the re-instatement, restoration or extension of blanket bog and/ or wet heath communities that may be impacted at the margins of the Proposed Scheme, for integration with and enhancement of adjoining areas

5.3.8 Based on these objectives, the potential outline re-use activities that may be undertaken within the areas include:

- Placement, spreading and appropriate profiling/ tapering of excavated peat, with local removal of acrotelm turves where necessary for re-capping, or capping with otherwise excavated acrotelm turves, as available from nearby, to variable depth. The use of mulchings or cuttings from healthy heath/ bog habitats as a seed source for restoring sphagnum to bare peat should also be considered, with local Cairngorms Peatland projects having trialled this with some success
- Blocking of minor active drains using peat turves, plastic piling and/ or heather bales to restrict drain flows and raise water levels sufficiently where present, to create conditions for sphagnum, cotton grasses and cross-leaved heather development (as appropriate). Where appropriate, such drains may also be smothered with peat to ensure a continuous peat cover
- The inclusion of check-dams or off-takes in major drains, watercourse diversions and cut-off drains which flow through some areas, to assist maintaining high water tables, but allow excess flow to pass through
- Following peat placement, temporary fencing around the areas and cessation of burning activities will be considered, to aid the restoration process, with seed/ vegetation cut from nearby areas and used as a mulch to protect any bare ground present and act as a seed source

5.3.9 These outline activities are consistent with the basic OHMP objectives in **Appendix 12.11** (**Volume 2**) and particular attention would be given to the nature of the peat being re-used. In this respect for example, nutrient-rich peat (i.e. that excavated from floodplain areas) would only be considered suitable for re-use in areas with similar hydrological conditions, and would not be re-used where nutrient-poor ombrotrophic conditions prevail.

5.3.10 Based on the above, **Table 5** presents the outline objectives, potential re-use activities and maximum potential capacity of peat re-use within each candidate area that has been identified. Existing vegetation and requirements for seeding would be managed in accordance with the requirements of and the target NVC communities within the OHMP in **Appendix 12.11** (**Volume 2**), while also considering the nature of temporary construction activities (material storage etc.) that may be undertaken within or adjacent to them.

Table 5: Candidate Peat Re-use Areas – Objectives, Activities and Re-use Volumes

Area Ref.	Area (m^2)	Existing Conditions	Designations	Objectives[1]	Potential Re-use Activities[2]	Estimated Re-use Volume (m^3)[3]	Comments/ Considerations for Re-use
P1	280	Mixture of mire and degraded blanket bog	-	Restore area of degraded blanket bog	Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required.	140	On hillslope – more suitable for nutrient-poor peat. Hollow in topography between SuDS 001 access track and Highland Main Line railway, likely to receive and retain water.
P2	7,837	Disturbed ground, former Beauly-Denny track	Drumochter Hills SSSI, SAC and SPA	Restore grubbed up Beauly-Denny track to wet heath and reconnect with adjacent mire/ wet heath above and below the track	Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	3,919	On hillslope – more suitable for nutrient-poor peat. Deposited peat should receive water via overland flow. Specific assessment of stability important, together with profiling considerations.
P3	6,157	Grassland next to blanket bog with some peat	Drumochter Hills SSSI	Create wet heath to grade into and extend area of blanket bog located adjacent to permanent and temporary works	Placement of peat up to 1.00m, with reduction in depth and appropriate profiling towards railway, capping with acrotelm turves and vegetation, seeding as required.	6,157	On hillslope – more suitable for nutrient-poor peat. Should receive downslope drainage towards adjacent watercourse. Lower areas likely to be flooded in high water conditions. Taper peat depth towards stream and possibly set back to avoid potential for erosion.
P4	1,188	Blanket bog with grassland over shallow peat next to areas of deeper peat	Drumochter Hills SSSI	Restore and extend areas of blanket bog located adjacent to permanent and temporary works	Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required.	1,188	On hillslope – more suitable for nutrient-poor peat. Should receive downslope drainage. Hollows present in existing topography which should allow possible placement of deeper peat and used to assist retention of water.
P5	5,964	Dry heath and blanket bog over shallow peat next to areas of deeper peat	Drumochter Hills SSSI	Restore and extend areas of blanket bog located adjacent to and within permanent/ temporary works and in compensatory flood storage area	Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required. Partially incorporated within compensatory flood storage area.	5,964	On hillslope – more suitable for nutrient-poor peat. Consider cross-track drainage or off-takes from small watercourses in the north and south of the area, together with compensatory flood storage area proposals with regards re-use volumes, levels and hydrology.
P6	8,956	Disturbed ground, former Beauly-Denny track	Drumochter Hills SSSI, SAC and SPA	Restore grubbed up Beauly-Denny track to wet heath and reconnect with adjacent mire/ wet heath above and below the track	Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	4,478	On hillslope – more suitable for nutrient-poor peats. Deposited peat should receive water via overland flow. Specific assessment of stability important, together with profiling considerations.
P7	4,511	Dry heath, mire and blanket bog over shallow peat next to areas of deeper peat	Drumochter Hills SSSI	Create area of wet heath to connect with blanket bog and restore and extend area of blanket bog located adjacent to and within permanent works	Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required.	4,511	Low lying ground – more suitable for nutrient-rich peat. Slight overlap with area of moderate peat landslide risk where peat >1.00m exists and may require adjustment following additional assessment. Removal of cut-off drain or off-takes from this would improve water supply. If adjacent track is floated, cross-drainage will require consideration at detailed design in relation to hydrology.
P8	10,241	Disturbed ground, former Beauly-Denny track	Drumochter Hills SSSI, SAC and SPA	Restore grubbed up Beauly-Denny track to create area of wet heath and reconnect with adjacent wet heath	Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	5,120	On hillslope – more suitable for nutrient-poor peats. Deposited peat should receive water via overland flow. Specific assessment of stability important, together with profiling considerations, but former cutting for access track may provide opportunity for local greater thicknesses to be re-used.
P9	415	Disturbed ground, former Beauly-Denny track	Drumochter Hills SSSI, SAC and SPA	Restore grubbed up Beauly-Denny track to create area of wet heath and reconnect with adjacent wet heath	Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	208	On hillslope – more suitable for nutrient-poor peats. Deposited peat should receive water via overland flow. Specific assessment of stability important, together with profiling considerations.
P10	274	Disturbed ground, former Beauly-Denny track	Drumochter Hills SSSI, SAC and SPA	Restore grubbed up Beauly-Denny track to create area of wet heath and reconnect with adjacent wet heath	Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	137	On hillslope – more suitable for nutrient-poor peats. Deposited peat should receive water via overland flow and minor channelised drainage. Specific assessment of stability important, together with profiling considerations.
P11	1,401	Disturbed ground, former Beauly-Denny track	Drumochter Hills SSSI, SAC and SPA	Restore grubbed up Beauly-Denny track to create area of wet heath and reconnect with adjacent wet heath	Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	701	On hillslope – more suitable for nutrient-poor peats. Deposited peat should receive water via overland flow and minor channelised drainage. Specific assessment of stability important, together with profiling considerations.
P12	2,058	Disturbed ground, former Beauly-Denny track	Drumochter Hills SSSI, SAC and SPA	Restore grubbed up Beauly-Denny track to create wet heath and reconnect with adjacent wet heath	Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	1,029	On hillslope – more suitable for nutrient-poor peats. Deposited peat should receive water via overland flow and minor channelised drainage. Specific assessment of stability important, together with profiling considerations.
P13	3,520	Grassland and mire over peaty soils adjacent to disturbed ground	Drumochter Hills SSSI, SAC and SPA	Create area of wet heath to grade into area of blanket bog located adjacent to permanent and temporary works	Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required.	3,520	On hillslope – more suitable for nutrient-poor peats. Deposited peat should receive water via overland flow and minor channelised drainage. Reduction in re-use depth towards top of cutting slope would be required and avoidance of locally steeper slopes.
P14	9,892	Disturbed ground, former Beauly-Denny track	Drumochter Hills SSSI, SAC and SPA	Restore grubbed up Beauly-Denny track to create wet heath and reconnect with adjacent blanket bog/ wet heath	Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	4,946	On hillslope – more suitable for nutrient-poor peats. Deposited peat should receive water via overland flow and minor channelised drainage. Specific assessment of stability particularly important, together with profiling considerations.
P15	5,395	Disturbed ground, former Beauly-Denny track	Drumochter Hills SSSI, SAC and SPA	Restore grubbed up Beauly-Denny track to create wet heath and reconnect with adjacent mire/ wet heath	Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	2,698	On hillslope – more suitable for nutrient-poor peats. Deposited peat should receive water via overland flow. Specific assessment of stability particularly important, together with profiling considerations.
P16	5,012	Area of wet heath and blanket bog over shallow peat	-	Re-instate, restore and extend area of blanket bog/ wet heath located adjacent to and within temporary works boundary	Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required.	5,012	On hillslope – more suitable for nutrient-poor peats. Water supply could be assisted by removal of proposed cut-off drain at embankment toe or off-take from this. Profiling of peat in the area must also consider tie-in to existing NCN7 levels.

Area Ref.	Area (m^2)	Existing Conditions	Designations	Objectives[1]	Potential Re-use Activities[2]	Estimated Re-use Volume (m^3)[3]	Comments/ Considerations for Re-use
P17	13,110	Area of degraded blanket bog and wet heath over shallow peat	Drumochter Hills SSSI	Restore area of degraded bog/ wet heath adjacent to proposed Drumochter Estate access track	Placement of peat to a depth of up to 0.50m within degraded areas (ca. 49% of polygon), with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	3,179	On hillslope – more suitable for nutrient-poor peats. Downslope of Drumochter Estate access track which incorporates cross-drainage to maintain overland/ shallow groundwater flow supply.
P18	11,841	Area of wet heath and blanket bog over shallow peat	-	Re-instate, restore and extend area of blanket bog/ wet heath located adjacent to and within temporary works boundary	Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required.	11,841	On hillslope – more suitable for nutrient-poor peats. Removal of cut-off drain at toe of mainline embankment would assist with maintenance of suitable hydrological conditions, together with off-takes or inclusion of check-dams in watercourse diversions to the north and south. Profiling of peat in the area must also consider tie-in to existing NCN7 levels.
P19	11,059	Wet heath with degraded blanket bog over shallow peat	Drumochter Hills SSSI	Restore area of wet heath adjacent to proposed Drumochter Estate access track and to connect with blanket bog	Place 0.50m peat/ peat turves within degraded areas (ca. 20% of polygon), with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required.	1,217	On hillslope – more suitable for nutrient-poor peats. Downslope of Drumochter Estate access track which incorporates cross-drainage to maintain overland/ shallow groundwater flow supply. Profiling, placement and re-use must be tailored to avoid significant alteration to existing alluvial fan landform, meaning re-use may be more localised.
P20	16,701	Wet heath with degraded blanket bog over shallow peat	Drumochter Hills SSSI	Restore area of degraded bog/ wet heath adjacent to proposed Drumochter Estate access track	Local placement of peat to a depth of up to 0.50m within degraded areas (ca. 10% of polygon), with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required.	835	On hillslope – more suitable for nutrient-poor peats. Numerous drainage pathways would provide water supply to the area, assisted by the cross drainage incorporated within Drumochter Estate access track.
					Totals	**66,800**	

Table Notes:

1. The objectives for each area are outline and shall be subject to additional consideration and design by the Contractor via the construction-stage Peat Management Plan and Habitat Management Plan.

2. The potential re-use activities are outline and shall be subject to additional consideration and design by the Contractor via the construction-stage Peat Management Plan and Habitat Management Plan, which would enable refinement of where identified re-use areas overlap slightly with Proposed Scheme infrastructure elements.

3. The potential re-use activities are outline and the estimated re-use volumes are potential maximums, which have been adjusted where relevant based on the current understanding of existing habitat/ vegetation conditions. Both shall be subject to additional consideration and design by the Contractor via the construction-stage Peat Management Plan and Habitat Management Plan, which would enable refinement of the re-use volumes, accounting for appropriate profiling, compression and blading off etc.

Potential Re-use for Other Purposes

5.3.11 A total of twelve SuDS detention basins form part of the Proposed Scheme, with some of these potentially representing an opportunity to re-use a proportion of deeper excavated peat in an environmentally beneficial way, and in locations close to or at the points of excavation. In such circumstances, peat could potentially be included within the main (downstream) basin, which may carry the following benefits:

- Unlike the sediment forebay, which receives run-off directly from the road, the main basin of the SuDS would not require periodic maintenance emptying and would receive already filtered water. The predominant function of the peat and the main basin more generally would be to reduce the rate of run-off from the road and to capture any remaining carbon based contaminants which pass through the sediment forebay
- SuDS basins can be over-excavated (over-deepened) by up to 2.00m into substrate or bedrock, to generate the capacity for the peat, at the same time generating additional fill for use in road construction should this be required. Where peat is removed from the footprint of the basin in this respect, it could be placed directly back into the basin
- The detailed design of the main basins can be such that the outfall is above the level of the re-used peat, ensuring that saturated conditions exist in the peat before any water is drained
- Depending on the location of the basin and the nature of the excavated peat, detailed design of the main basin can either incorporate lining, to prevent seepage to surrounding soils and prevent nutrient inputs from groundwater sources, or leave the basin unlined so that exchange of nutrients from shallow groundwater can take place. Discussions with SEPA Regulatory Services and water team will be required during detailed design, to determine whether a lining is required

5.3.12 At the locations of proposed SuDS 004 and SuDS 092 to the west of the Proposed Scheme in particular, excavations of shallow and deep peat are anticipated and re-use would be possible for some of this, very close to or at the points of excavation – with opportunities to re-create existing wet heath/ blanket bog habitats they may disturb. Based on this, **Table 6** presents the maximum potential capacity of potential peat re-use within SuDS basins at varying depth.

Table 6: SuDS Basin Potential Capacity for Peat Re-use

SuDS Ref.	Approximate Chainage	Maximum Potential Capacity for Re-use			Comments/ Considerations
		0.50m deep (m^3)	1.00m deep (m^3)	2.00m deep (m^3)	
SuDS 000	ch. 0	108	216	432	On hillslope – more suitable for nutrient-poor peats
SuDS 001	ch. 100	437	874	1,747	On hillslope – more suitable for nutrient-poor peats
SuDS 003	ch. 300	72	143	287	On hillslope – more suitable for nutrient-poor peats
SuDS 004	ch. 400	860	1,720	3,440	Deep peat present in proposed SuDS footprint, with potential for re-use at point of excavation and re-creation of wet heath/ blanket bog habitat. Possible peat stability issue in the area would need investigation/ resolution prior to being adopted.
SuDS 020	ch. 2,000	508	1,016	2,031	On hillslope – more suitable for nutrient-poor peats

SuDS Ref.	Approximate Chainage	Maximum Potential Capacity for Re-use			Comments/ Considerations
		0.50m deep (m^3)	1.00m deep (m^3)	2.00m deep (m^3)	
SuDS 042	ch. 4,200	631	1,262	2,523	Raised, level ground above blanket bog, transition mire and swamp complex. Potential for re-use close to point of excavation (i.e. peat excavated nearby can be re-used within the SuDS basin).
SuDS 060	ch. 6,000	385	770	1,539	Raised ground above River Truim floodplain – may be suitable for nutrient-rich or nutrient-poor peat.
SuDS 063	ch. 6,400	476	952	1,904	Within River Truim floodplain – more suitable for nutrient-rich peat. Lack of lining would allow groundwater exchange, subject to assessment that hydrological condition of the peat could be maintained
SuDS 065	ch. 6,500	233	465	930	Low terrace above River Truim floodplain – more suitable for nutrient-rich peat. Lack of lining would allow groundwater exchange, subject to assessment that hydrological condition of the peat could be maintained.
SuDS 069	ch. 6,900	436	872	1,744	Within River Truim floodplain – more suitable for nutrient-rich peat. Lack of lining would allow groundwater exchange, subject to assessment that hydrological condition of peat could be maintained.
SuDS 077	ch. 7,800	565	1,130	2,260	On sloping ground above River Truim floodplain – more suitable for nutrient-poor peat.
SuDS 083	ch. 8,300	115	230	460	On sloping ground above River Truim floodplain – more suitable for nutrient-poor peat.
SuDS 092	ch. 9,200	335	669	1,339	Deep peat present in proposed SuDS footprint, with potential for re-use at point of excavation, and re-creation of wet heath/ blanket bog habitat.
	Totals	**5,161**	**10,319**	**20,636**	

5.3.13 There are also a number of proposed compensatory flood storage areas which form part of the Proposed Scheme. It is already assumed in the excavation calculations that the top 0.50m of peat (or the maximum depth of peaty soil) will be re-instated following excavation of these areas to the required depth. However, there is also the possibility of over-excavating some, or some parts, of the storage areas to create low-lying wet areas which may be able to receive groundwater or surface water inputs from surrounding ground.

5.3.14 Not all the areas identified for compensatory flood storage will be appropriate for over-excavation, and it is recognised that over-excavation of some may require excavation of peat additional to that already estimated. Notwithstanding, and in outline, initial estimates indicate that there is potential capacity for the re-use of approximately **12,000m³** of shallow and deep peat, if additional re-use depths are limited to 0.50m within this context, and a potential capacity of approximately **24,000m³** if re-use depths are limited to 1.00m. Detailed design of the compensatory flood storage areas would be required to consider the net peat balance of each one, their capacity to accommodate additional peat of an appropriate nature and expected fluctuations in water table depth to ensure the re-used peat does not dry out.

5.4 Net Balance

5.4.1 At this stage, it is not possible to be any more precise about the exact volumes of peat that will be re-used in the various ways and opportunities identified. Further stages of design beyond this OPMP will be required to refine the re-use proposals and identify those which are most suitable.

5.4.2 It is considered that the peat balance (after assumed reductions for floated access track sections, piling/ bridging of the mainline in certain areas and re-use of the existing Beauly-Denny access track) indicates there is sufficient capacity in the permanent and temporary works boundaries and candidate areas identified, for re-use of the residual **91,971m^3** peaty soil and topsoil, **50,896m^3** shallow peat and **45,038m^3** deep peat.

5.4.3 For shallow and deep peat, the balance is comprised from a maximum potential capacity for re-use of **66,800m^3** in candidate habitat re-instatement, restoration and creation areas, and **17,000** to **44,000m^3** potential capacity re-use if SuDS and compensatory flood storage areas are over-excavated. Additional, though unquantified, capacity is also likely to be possible via local floated access track-side verge re-instatement, planting areas and other re-instatement and restoration required for temporary work or storage areas. In particular, this may include areas of wet heath and blanket bog re-instatement and restoration outlined in the OHMP in **Appendix 12.11** (**Volume 2**) and illustrated in **Drawings 6.1** to **6.12** (**Volume 3**).

5.4.4 As a result, the estimates indicate that no, or very little, surplus peat will be generated from excavation, resulting in no, or a very limited, net loss from construction. However, the estimates also indicate that the balance is delicate, with some degree of understandable uncertainty. As such, it will be essential that all opportunities to avoid and/ or minimise peat disturbance during detailed design and construction of the Proposed Scheme are taken by the Contractor.

6 Excavation, Storage, Re-use and Monitoring

6.1 General

6.1.1 While the peat balance has estimated that the Proposed Scheme has provision for peat excavated during construction, it will be essential that good practice measures are employed by the Contractor prior to, during and following the construction period. The following sections outline minimum good practice measures that the Contractor shall adopt in this respect, to ensure that peat deposits are appropriately handled, managed and re-used. Additional detail on these measures is also included in **Annex 10.6.2**.

6.2 Good Practice Prior to Construction

Peat Model Refinement

6.2.1 Prior to construction, the peat depth model for the Proposed Scheme shall be refined by the Contractor in light of any additional ground investigation or survey information that becomes available in preparation for construction. The revised model should then provide even more sufficient information to enable additional refinement of the volume estimates for all Proposed Scheme elements, such that additional design and micro-siting can be employed to further minimise excavation volumes where possible.

Construction-stage Peat Management Plan

6.2.2 Prior to construction, and based on any additional refinement of the peat model that is possible, and further detailed design, the OPMP shall be refined by the Contractor in consultation with SEPA, SNH and CNPA as necessary. This will become the construction-stage Peat Management Plan (PMP) and shall include as a minimum, refinement of estimated volumes of peat that will be excavated, detailed statements of where and how excavated peat will be used in landscaping, re-instatement, habitat re-instatement, restoration and creation or other ways, and detailed

method statements related to its excavation, storage, transportation, handling and monitoring for doing so.

Monitoring

6.2.3 Outline monitoring requirements for additional baseline establishment prior to construction, assessing change to peatland areas during construction and following construction, and for monitoring the candidate habitat re-instatement, restoration and creation areas following peat placement post-construction are provided in sub-section 6.4. To obtain the greatest value from the monitoring, it is essential that baseline conditions, particularly ecology and hydrology, are well understood and used to set realistic targets for post-construction mitigation and restoration.

6.3 Good Practice during Construction

Excavation

6.3.1 During the construction of all infrastructure, the Contractor shall adopt the following good practice in relation to peat excavation:

- Peat turves shall be excavated as intact blocks of upper peat comprising the surface vegetation layer (acrotelm) and adjoining upper catotelm
- Underlying turves shall be extracted as close to intact as is feasible, with remoulding by the excavator kept to a minimum
- Excavation of contaminated peat turves (those incorporating substrate) shall be avoided if possible, and where unavoidable, these shall be stored separately to non-contaminated peat turves to avoid further contamination upon re-instatement or re-use, or during transport

6.3.2 Where possible and practical, a technique known as 'macroturfing' (large scale cutting and re-laying of turf blocks) (Bruelheide and Flintrop, 2000) shall be employed during construction, to extract intact full depth acrotelm layers from the top surface of the peat deposits. This technique would maintain connectivity between the surface vegetation and the partially decomposed upper layers of the catotelm.

6.3.3 Classification of excavated materials will depend on their identified re-use or re-instatement. For the Proposed Scheme, it is anticipated that the material to be excavated will comprise peaty soils and topsoil, peat (which may be sub-divided into fibrous, pseudo-fibrous, locally amorphous peat and turf), mineral soils (substrate) and rock.

Temporary Storage

6.3.4 Temporary storage of peat shall be avoided where possible by re-instating or transporting it to allocated re-use locations, to minimise the volume in storage, retain as much structural integrity within the peat as possible and to minimise the likelihood of drying. However, this shall not be undertaken at the expense of re-instatement, re-use or restoration outcomes (i.e. if, on balance, storage will produce a better long-term outcome, then it shall be used prior to re-use).

6.3.5 Provisional locations for temporary storage have been identified within the permanent and temporary works boundaries of the Proposed Scheme as shown in **Drawings 10.38** to **10.44** (**Volume 3**). These take into account available land, setbacks from excavations, proximity to the point of excavation and the level of peat landslide hazard determined by **Appendix 10.5** (**Volume 2**); covering a footprint of sufficient collective area to store excavated peat from nearby locations at a height no greater than 1.00m.

6.3.6 These areas, or alternative and additional ones identified by the Contractor shall be documented in the refined, construction-stage PMP, which shall apply the following outline good practice:

- Peat shall be stored at sufficient distance from excavation faces to prevent overburden induced failure. Slope analysis based on geotechnical characteristics derived from additional detailed ground investigation shall be employed to assess failure potential and stand-off distances set appropriately
- Local gullies, diffuse drainage lines (or very wet ground) and locally steep slopes shall be avoided for peat storage
- Upper turves incorporating vegetation shall be stored vegetation side up and organised and labelled according to NVC community, under supervision of the Contractor's Environmental Clerk of Works (EnvCoW) and Ecological Clerk of Works (ECoW), for re-instatement adjacent to like communities within intact surrounding peat
- Stores of catotelm peat shall be smoothed or 'bladed off' to reduce their surface area and minimise desiccation. Where and when required, additional measures to prevent drying such as light irrigation should be used
- Where transport cannot be undertaken immediately, stored peat shall be irrigated to limit drying and stored on a geotextile mat to promote stability, although this is unlikely to be critical for peat stored less than two months
- Monitoring of peat storage areas during all weather conditions will be required and shall be undertaken as necessary by the Contractor, to identify any early signs of drying and peat instability
- Run-off from the temporarily stored peat should be managed to avoid impacts to adjacent habitats or watercourses
- Locations for temporary storage should avoid good quality habitat (incl. moderately and/ or highly dependent groundwater dependent terrestrial ecosystems (GWDTE)) where possible and buffers around watercourses appropriate to the location should be determined according to the terrain and sensitivity of the watercourse, and storage within these avoided

6.3.7 It is anticipated that peat will not be stored for more than three years and therefore, will not require a permit under The Landfill (Scotland) Regulations 2003.

Handling

6.3.8 Following refinement of the peat depth model and preparation of the construction-stage PMP, a detailed storage and handling plan shall be prepared by the Contractor as part of the Construction Environmental Management Plan (CEMP), specifying details of the following:

- The refined estimated excavation volumes at each infrastructure location (including volumes of acrotelm, turf and catotelm)
- The volumes that may require storage and volumes that may be transferred directly upon excavation to re-instatement, re-use or restoration areas, in order to minimise handling
- The refined location and size of storage areas (or additional areas) if considered to be required, relative to points of excavation, watercourses, drainage features and slope

- Irrigation requirements and methods to minimise desiccation of excavated peat during short term storage

Re-instatement, Re-use and Restoration

6.3.9 The locations and extents of the candidate peat re-use areas are shown in **Drawings 10.38** to **10.44** (**Volume 3**) and photographs of each are provided in **Annex 10.6.1**. The Contractor may also identify additional or alternative areas for peat re-use within the temporary and permanent boundaries of the Proposed Scheme or elsewhere, by agreement prior to or during construction.

6.3.10 The following principles shall apply wherever peat is being re-instated or re-used in these areas, or elsewhere as part of construction, for habitat re-instatement, restoration or in other ways:

- Re-instatement of peat turves shall ensure that surface vegetation is incorporated and where possible, peat turves with vegetation communities similar to the communities present on the intact peat at receiver sites should be used
- Re-seeding of any significant areas of bare peat shall be undertaken with species appropriate to the surrounding peatland and habitats
- Grazing, muirburn and the application of substances that may alter soil acidity would need to be prevented by installation of fencing, until the peat has fully recovered
- If peat does become dewatered/ desiccated, it shall not be exposed at the top of any re-instatement or re-use areas

Access Tracks

6.3.11 For floated sections of access track, existing vegetation shall be left in place under the new running surface and adjacent vegetation under the planned shoulder footprint shall be rolled back for emplacement of peat beneath. The rolled vegetation shall then be re-lain over the emplaced peat. For cut-and-fill tracks, any bare peat surfaces created during the construction of side drains shall be re-instated with peat turves to stabilise the surface and prevent drying.

Drainage Features

6.3.12 As part of the detailed design, a survey of artificial drainage extent and drain slopes shall be undertaken by the Contractor, to fully define the scope of drain re-instatement and volumes of peat (and brash) required to restore them, where proposed or considered possible. Depending upon local slope and proximity of watercourses to drain outflows, the need for plastic or other dam types, and required spacings, shall be determined following the guidance in Armstrong *et al.*, 2009.

Timing

6.3.13 The available best practice guidance makes various recommendations regarding the preferred seasons in which peat management work should be undertaken, whether for ease of construction or the efficacy of re-instatement or restoration activities. In practice, these seasonal preferences often conflict. For example, restoration guidance generally indicates that peat turve cutting is best conducted in autumn or winter to minimise drying. However, most construction guidance suggests that major excavation activities should be conducted in drier months, typically during spring and summer.

6.3.14 This scheduling conflict is often difficult to resolve. However, the adoption of the good practice measures outlined in this OPMP, and as shall be refined by the Contractor in the construction-stage PMP, especially concerning irrigation, will minimise effects of these seasonal dependencies.

6.4 Monitoring Requirements

6.4.1 Prior to construction, monitoring of groundwater levels in areas of peat should be undertaken monthly, ideally for a twelve-month period; in order to understand the expected annual cycle of fluctuation in groundwater levels in the context of the planned construction and proposed peat re-use activities.

6.4.2 The groundwater monitoring shall continue during the construction period, when frequent and repeat visual inspections of adjacent peat and habitat re-instatement, restoration and creation areas by a team of suitably qualified and experienced geotechnical engineers, EnvCoWs and ECoWs shall also be undertaken – to monitor for signs of settlement, instability or other impact, to oversee all peat management, placement and re-use activities and to conduct repeat vegetation/ NVC surveys in accordance with the OHMP in **Appendix 12.11** (**Volume 2**).

6.4.3 **Table 7** identifies typical monitoring requirements for particular elements of the Proposed Scheme (SNH/ FCS, 2010) during and following construction, and **Table 8** presents example threshold 'stop conditions' under which construction may require to be stopped.

Table 7: Monitoring During Construction and Post-Construction

Scheme Element	Monitoring During Construction	Potential Mitigation	Monitoring Post-Construction	Potential Mitigation
All excavations	• monitor water table drawdown around excavation perimeter • monitor free faces for signs of instability (cracking, settlement, standing water) • monitor stored peat for signs of drying or local slumping and collapse	• consider irrigation of peat if signs of drying • reinforce excavation or drain	• monitor backfilled excavation for water table relative to surrounding non-excavated peatland to determine recovery • monitor vegetation cover to ensure acrotelm remains functional	• consider re-routing local surface drainage into former excavation to maintain water levels
Access tracks (cut and fill)	• monitor upslope sides of tracks traversing slopes for waterlogging from impeded subsurface drainage • monitor transitions to floating track sections for settlement	• undertake maintenance of under-track drainage as necessary • undertake remedial work to track as necessary	• monitor upslope sides of tracks traversing slopes for waterlogging from impeded subsurface drainage	• undertake maintenance of under-track drainage as necessary
Access tracks (floating)	• monitor shoulders for drying • monitor upslope sides of tracks traversing slopes for waterlogging from impeded subsurface drainage • monitor track for lateral displacement and rate of vertical settlement (using line of sight pegs) • monitor for evidence of lateral migration into cable trenches	• consider irrigation of dried shoulders, or re-seeding dry areas with nurse crops tolerant of drier peat • if waterlogging leads to enhanced settlement, consider installation of drains	• monitor shoulders for drying • monitor upslope sides of tracks traversing slopes for waterlogging from impeded subsurface drainage • monitor track for lateral displacement and vertical settlement	• consider irrigation of dried shoulders, or re-seeding dry areas with nurse crops tolerant of drier peat • if waterlogging leads to enhanced settlement, consider installation of drains

Table 8: Threshold 'Stop' Conditions (Used in Ireland) for Floating Road Construction

Stop Rule	Requirements[1]
High Intensity Rainfall	Rainfall during construction >10mm hour
Long Duration Rainfall	Rainfall in the preceding 24 hours >25mm
7-day Cumulative Rainfall (1)	Rainfall 7-days of rainfall >50% of monthly average

Stop Rule	Requirements[1]
7-day Cumulative Rainfall (2)	Preceding 7-days of rainfall >50mm

Table Notes:

1. Monitoring of rainfall for stop conditions would require an appropriate meteorological station to measure these conditions on site, or a suitable local source of data to allow identification of these conditions being exceeded, so that appropriate action can be taken.

6.4.4 Monitoring intervals during construction and post-construction shall be determined by the Contractor via the refined construction-stage PMP.

6.4.5 The Contractor shall also be required to undertake monitoring of the water table within proposed or adopted habitat re-instatement, restoration and creation areas following construction and the implementation of peat re-use works. This shall be undertaken for a period of at least 5 years following peat placement, but a committed monitoring frequency, duration and approach shall be established and implemented by the Contractor with agreement from SEPA, SNH and CNPA as necessary.

6.4.6 As a minimum, monitoring shall involve the use of pressure transducers and fully perforated dipwells where appropriate, so that a continuous picture of the hydrology in the areas re-instated, restored and created can be obtained. The monitoring shall cover all major areas of restoration and re-use, and comprise a systematic grid-based approach.

6.4.7 A range of additional treatment work may be required during the monitoring period to help understand the long-term prognosis for excavated peat that has been placed and re-used. This may include:

- Flattening of the re-instated surfaces to try and reduce the degree to which local surface drawdown in the summer will lead to local oxidative wastage of placed peat
- Compacting the peat in places where there are a high degree of void spaces, if evident
- Tapering of the peat masses at its edges
- Re-seeding
- Removal of any invasive species present, if and as they colonise.
- Temporarily fencing off of areas where peat has been re-used and re-seeded or cuttings or mulch have been placed, to prevent grazing of young vegetation and enable heath/ bog vegetation to establish as necessary

6.4.8 The implementation of these additional treatments and their timing shall be subject to ongoing discussions with SEPA, SNH and CNPA and vegetation-based post-placement care measures and monitoring shall also be undertaken in tandem with this work, as detailed in the OHMP in **Appendix 12.11** (**Volume 2**).

6.4.9 It is important that good record keeping is undertaken to ensure that the most can be made of the data collected during construction. In relation to peat, these shall include photographs and records of as-built and post-construction peat condition around all infrastructure locations, collected by suitably qualified and experienced EnvCoWs and ECoWs.

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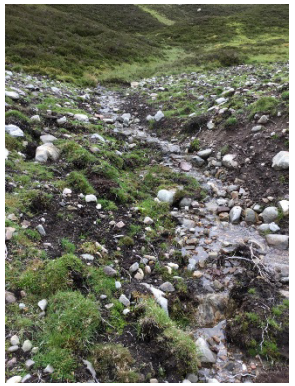
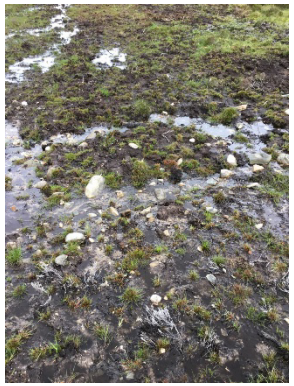
Annex 10.6.1

Candidate Peat Re-use Areas

Area Ref.	Photographs, Observations and Comments
P1	 Photograph taken from a distance, but area is located in a hollow at the base of the embankment between the Highland Main Line railway underpass and the mast, likely to receive and retain water. Mixture of mire and degraded blanket bog Restore area of degraded blanket bog Placement of peat to a depth of up to 0.50m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required.
P2	     Disturbed ground, former Beauly-Denny track Restore grubbed up Beauly-Denny track to wet heath and reconnect with adjacent mire/ wet heath above and below the track Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required. Deposited peat should receive water via overland flow. Specific assessment of stability important, together with profiling considerations.

Area Ref.	Photographs, Observations and Comments
P3	 Grassland next to blanket bog with some peat Create wet heath to grade into and extend area of blanket bog located adjacent to permanent and temporary works Slightly sloping ground in hollow, peat re-used would need to be tapered towards stream to the south. Placement of peat up to 1.00m, with reduction in depth and appropriate profiling towards railway, capping with acrotelm turves and vegetation, seeding as required. Should receive downslope drainage towards adjacent watercourse.
P4	 Blanket bog with grassland over shallow peat next to areas of deeper peat Restore and extend areas of blanket bog located adjacent to permanent and temporary works Slightly sloping undulating topography, with several hollows Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required. Should receive downslope drainage.
P5	 Slightly elevated and slightly sloping ground. Dry heath and blanket bog over shallow peat next to areas of deeper peat Restore and extend areas of blanket bog located adjacent to and within permanent/temporary works and within compensatory flood storage area Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required. Consider cross-track drainage or off-takes from small watercourses in the north and south of the area.

Area Ref.	Photographs, Observations and Comments
P6	   Disturbed ground, former Beauly-Denny track Restore grubbed up Beauly-Denny track to wet heath and reconnect with adjacent mire/ wet heath above and below the track Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required. Deposited peat should receive water via overland flow. Specific assessment of stability important, together with profiling considerations.
P7	  Dry heath, mire and blanket bog over shallow peat next to areas of deeper peat Create area of wet heath to connect with blanket bog and restore and extend area of blanket bog located adjacent to and within permanent works Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required. Slight overlap with area of moderate peat landslide risk where peat >1.00m exists and may require adjustment following additional assessment. Removal of cut-off drain or off-takes from this would improve water supply. If adjacent track is floated, cross-drainage will require consideration at detailed design.
P9 to P12	 Disturbed ground, former Beauly-Denny track Restore grubbed up Beauly-Denny track to create area of wet heath and reconnect with adjacent wet heath Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required. Deposited peat should receive water via overland flow and minor channelised drainage. Specific assessment of stability important, together with profiling considerations.

Area Ref.	Photographs, Observations and Comments
P8	     Disturbed ground, former Beauly-Denny track Restore grubbed up Beauly-Denny track to create area of wet heath and reconnect with adjacent wet heath Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required. Deposited peat should receive water via overland flow, with evident areas of water supply. Specific assessment of stability, together with profiling considerations, but former cutting for access track may provide opportunity for local greater thicknesses to be re-used.
P13	   Grassland and mire over peaty soils Create area of wet heath to grade into area of blanket bog located adjacent to permanent and temporary works Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required Deposited peat should receive water via overland flow. Reduction in re-use depth towards top of cutting slope would be required and avoidance of locally steeper slopes.

Area Ref.	Photographs, Observations and Comments
P14 & P15	  Disturbed ground, former Beauly-Denny track Restore grubbed up Beauly-Denny track to create wet heath and reconnect with adjacent blanket bog/ wet heath Surface scrape of existing disturbed material and removal of track make-up below, followed by placement of peat to a depth of up to 0.50m with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required. Deposited peat should receive water via overland flow. Specific assessment of stability particularly important, together with profiling considerations.
P16	 Area of wet heath and blanket bog over shallow peat Re-instate, restore and extend area of blanket bog/ wet heath located adjacent to and within temporary works boundary Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required Water supply could be assisted by removal of proposed cut-off drain at embankment toe or off-take from this. Profiling of peat in the area must also consider tie-in to existing NCN7 levels.
P17	   Area of degraded blanket bog and wet heath over shallow peat Restore area of degraded bog/ wet heath adjacent to proposed Drumochter Estate access track Placement of peat to a depth of up to 0.50m within degraded areas (ca. 49% of area), with tapering at upslope and downslope interfaces, capping with acrotelm turves and suitable vegetation, seeding as required. Downslope of Drumochter Estate access track which incorporates cross-drainage to maintain overland/ shallow groundwater flow supply.

Area Ref.	Photographs, Observations and Comments
P18	  Area of wet heath and blanket bog over shallow peat Re-instate, restore and extend area of blanket bog/ wet heath located adjacent to and within temporary works boundary Placement of peat up to 1.00m with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required. Removal of cut-off drain at toe of mainline embankment would assist with maintenance of suitable hydrological conditions, together with off-takes or inclusion of check-dams in watercourse diversions to the north and south. Profiling of peat in the area must also consider tie-in to existing NCN7 levels.
P19	  Wet heath with degraded blanket bog over shallow peat Restore area of wet heath adjacent to proposed Drumochter Estate access track and to connect with blanket bog Place 0.50m peat/ peat turves within degraded areas (ca. 22% of polygon), with appropriate profiling, tapering and capping with acrotelm turves and suitable vegetation, seeding as required. Downslope of Drumochter Estate access track which incorporates cross-drainage to maintain overland/ shallow groundwater flow supply. Profiling, placement and re-use must be tailored to avoid significant alteration to existing alluvial fan landform, meaning re-use may be more localised.
P20	 Wet heath with degraded blanket bog over shallow peat Restore area of degraded bog/ wet heath adjacent to proposed Drumochter Estate access track Local placement of peat to a depth of up to 0.50m within degraded areas (ca. 10% of polygon), with tapering at upslope and downslope interfaces, Numerous drainage pathways would provide water supply to the area, assisted by the cross drainage incorporated within Drumochter Estate access track.

Annex 10.6.2

Good Practice for Developments on Peatland

Sources of Good Practice Information

In the last decade, considerable guidance material relating to developments on peatland have been produced, particularly in Scotland. This has typically focused on wind farm developments, but where relevant to the Proposed Scheme, this section summarises advice from Scottish and other sources that together effectively constitute UK-wide best practice. Relevant guidance documents referenced as part of this OPMP are identified in **Table 1**.

While much of this guidance is less than ten years old, it is also supplemented where appropriate by older, but still relevant, academic and industry literature that provides case studies on many aspects of peat relevant to built infrastructure, including its geotechnical behaviour, hydrological response to disturbance and ability to recover ecologically. A number of manuals and guidelines have also been prepared to promote effective peat restoration (Quinty and Rochefort, 2003; Schumann and Joosten, 2008; Peatlands and Uplands Biodiversity Group, 2010).

Table 1: Sources of Good Practice Information in Relation to Developments on Peatland

Source	Indicative Content
Guidance on the assessment of peat volumes, re-use of excavated peat and the minimisation of waste (SR/ SEPA, 2012)	Guidance on pre-consent, post consent and post construction assessment in support of evaluation of the peat resource in order to minimise waste
SEPA Regulatory Position Statement – Developments on Peat (SEPA, 2010)	Outline guidance on peat as a by-product of development, with specific focus on peat as a waste material, and with steer on re-use, recycling, storage and disposal
Floating roads on peat (SNH/ FCS, 2010)	Detailed guidance on floating road construction over peatlands, suitable to aid road design at the design stage
Constructed tracks in the Scottish Uplands, Second Edition (SNH, 2013) (updated in September 2015)	Outline guidance on track construction in all types of Scottish upland, with emphasis on minimising impacts on landscape and natural heritage
Good practice during windfarm construction (SR/SNH/SEPA/FCS, 2010)	Outline guidance on all aspects of wind farm construction (although not always related to peat), suitable to identifying good practice at the consenting stage
Calculating carbon savings from wind farms on Scottish peat lands, a new approach (Nayak *et al.*, 2008)	Context to and detailed guidance on calculation of carbon losses associated with wind farm construction (in support of carbon balance calculations)
Peat landslide hazard and risk assessments: best practice guide (Scottish Government, 2006)	Guidance on undertaking peat landslide hazard assessments to support assessment of potential wind farm development sites
Guidelines for the Risk Management of Peat Slips (MacCulloch, 2006)	Outline guidance on minimising the likelihood of local and more extensive instability of peat during construction of excavated and floating tracks
Investigating the impacts of windfarms on peatlands (Natural England, 2010)	Guidance for Natural England to support consenting decisions on wind farms in England, based on understanding of wind farm impacts on peat
CCW Guidance Note: Assessing the impact of wind farm developments on peatlands in Wales (CCW, 2010)	Guidance on assessment methodology for characterising peatland resource and identifying hydrological, stability and carbon impacts of proposed wind farms, and guidance on the content of habitat management plans
A Strategic Assessment of the afforested peat resource in Wales (Vanguela *et al*, 2012)	Review of the status of peatlands under the Assembly Government Woodland Estate (AGWE) and their potential for restoration

Good Practice Prior to Construction

Many of the concerns associated with peat on a development site can be addressed by modifying the scheme layout to avoid sensitive areas. Such areas would include:

- areas of deep peat, requiring potentially large volumes of excavation
- areas of very wet peat such as flushes, pool and hummock complexes and gullied peatland
- areas of moderately sloping deep peat where site infrastructure might increase the chance of peat instability
- areas of sensitive habitat in which planning consent may be difficult to achieve

Avoiding these areas requires sufficient baseline data and investigation at the planning and design stage. In relation to this, SEPA make a number of recommendations for best practice in relation to the assessment of peat depths and the means of mitigation and compensation at developments in peatland, which are detailed below.

Peat Depth Model

In relation to peat depth assessment as an input to design, the following is recommended:

- That peat depth probing should be undertaken to provide a 'low resolution' survey, to identify where peat is present and provide information on peat depth variability (SNH/SEPA/JHI, 2014)
- A detailed survey at 50m intervals along proposed track and road locations using 10m right-angled offsets (SNH/SEPA/JHI, 2014)
- That a representative sample of cores be logged to assist in classification of the peat characteristics (e.g. through the von Post method) (CCW, 2010)
- That the collated peat data be used to develop a peat depth model for the site, and that the method used to prepare the model be clearly stated (CCW, 2010)
- That the peat model be used to undertake preliminary excavation and re-use calculations and to identify intended methods of re-use (SR/SEPA, 2012) through preparation of a peat management plan (an example format for which is provided in Annex 1 of the SEPA guidance).

Layout Planning

Given preparation of a site wide peat model, the following principles are recommended by CCW in relation to layout planning:

- Minimise infrastructure overlap with peat
- Minimise construction of/ the area covered by permanent crane pads and consider piling construction methodologies as alternatives to bulk excavation of foundations
- Minimise carbon loss by re-use of excavated peat in compensatory restoration (e.g. in use as peat dams, for infilling grips and drains)
- Minimise protracted storage of excavated peat by careful phasing of ditch blocking/ filling
- Minimise the width of peat batters on floating roads
- Employ best practice construction and restoration methodologies.

Good Practice during Construction

Assuming that the Proposed Scheme has been designed to take best advantage of site conditions, there are a number of ways in which detailed design and construction activities can be specified, to further minimise adverse effects on peatlands. The sections below consider specific good practice measures in relation to access tracks. Guidance is generally focused on floating tracks and cut-and-fill tracks (CCW, 2010), and is summarised below.

Floating Tracks

Over deeper peat (typically >1.00m), floating tracks provide a good option for minimising peat excavation and the potential disruption of hydrological pathways. The success of construction requires careful planning to take account of the unique characteristics of peat soils. Specific guidance is available on design, the duration and timing of construction, the sequence of construction and the re-use of peat as shoulders at the margin of the floating track (SNH/FCS, 2010). This is summarised below:

Design

The following issues should be considered during detailed design:

- Adoption of conservative values for peat geotechnical properties during detailed design (post-consent) (SNH/FCS, 2010)
- Use of a maximum depth rule whereby an individual layer of geogrid and aggregate should not normally exceed 450mm without another layer of geogrid being added
- The routing of access tracks on flat ground in order to avoid any requirement for drainage design and works (SNH/FCS, 2010)
- Where sloping ground cannot be avoided and where the track runs transverse to the prevailing slope, the protection of natural hydrological pathways such as flushes and peat pipes through the installation of a permanent conduit within or underneath the floating road (SNH/FCS, 2010)
- Ensuring transitions between floating tracks and excavated tracks (or other forms of track not subject to long term settlement) are gentle (e.g. 1:10 basal transition slope) in order to minimise likelihood of track failure at the boundary between construction types (SNH/FCS, 2010)
- The scheduling of track construction to accommodate for peat settlement characteristics (see below) (SNH/FCS, 2010).

Further detail is provided in *Floating Roads on Peat* (SNH/FCS, 2010) and *Guidelines for the Risk Management of Peat Slips* (MacCulloch, 2006).

Duration and Timing of Construction

The critical factor in the successful construction of floating tracks is the timescale of construction, to which end the following good practice guidance is provided:

- the settlement characteristics of peat (see earlier sections) should be accommodated by appropriate scheduling of track construction, as follows:

- allowing peat to undergo primary consolidation, which takes place in a matter of days, by adopting rates of road construction appropriate to weather conditions (SNH/FCS, 2010)
- monitoring the effects of secondary compression on track integrity, which will follow the primary consolidation phase and continue through the life of the development while the tracks are utilised (up to 25 years) (SNH/FCS, 2010)
- identifying 'stop' rules, e.g. weather dependent criteria for cessation of track construction based on local meteorological data (SNH/FCS, 2010)
- maximising the interval between material deliveries over newly constructed tracks that are still observed to be within the primary consolidation phase (SNH/FCS, 2010)
- prior to construction, setting out the centreline of the proposed track to identify any ground instability concerns or particularly wet zones (SR/SNH/SEPA/FCS, 2010)

Adoption of an appropriate track construction rate will generally prevent the need for drainage under floating roads on flat ground.

Sequence of Construction

The sequence of construction is normally stipulated in guidance provided by the supplier of the geotextile or geogrid layer, and suppliers are often involved in the detailed track design. Good practice in relation to the sequence of track construction is as follows (SNH/FCS, 2010; SR/SNH/SEPA/FCS, 2010):

- Retaining rather than stripping the vegetation layer (i.e. the acrotelm, providing tensile strength), and laying the first geotextile/geogrid directly on the peat surface
- Adding the first rock layer and incorporating culverting if any major surface or near surface drainage pathways have been identified during the set-out phase prior to construction (see above)
- Adding the second geotextile/ geogrid, and add overlying graded rockfill as a running surface
- Heavy plant and HGVs using the tracks during the construction period should be trafficked gently to minimise dynamic loading from cornering, breaking and accelerating
- Ensuring wheel loads should remain at least 0.5m from the edge of the geogrid, and markers should be laid out, monitored and maintained on the track surface to emphasise these boundaries
- 'Toolbox' talks and subsequent feedback to construction and maintenance workers and drivers to emphasise the importance of the implementing the above measures

Use of Peat as Trackside Shoulders

A key opportunity to re-use peat is to employ it in landscaping of constructed access tracks. Wedge-shaped berms at the margins of a floating track (which is elevated above the peat surface) are termed shoulders, and good practice guidance is as follows:

- Re-use peat excavated from elsewhere on site as shoulders adjacent to the floating track
- Peat shoulders should taper from just below the track sides to join the surrounding peat surface, thereby preventing over high shoulders from causing ponding on the track surface (SR/SNH/SEPA/FCS, 2010)

- Limiting the width of peat shoulders to avoid the unnecessary smothering of intact vegetation adjacent to the floating track

Cut and Fill Tracks

Cut-and-fill tracks require the complete excavation of peat to a competent substrate. This peat will require storage ahead of its re-use or disposal. Good practice guidance relates mainly to drainage in association with excavated tracks, as follows (SNH/FCS, 2010; SR/SNH/SEPA/FCS, 2010):

- Trackside ditches should capture surface water from within the acrotelm before it reaches the road
- Interceptor drains should be shallow, flat bottomed and preferably entirely within the acrotelm to limit drawdown of the water table
- Any stripped peat turves should be placed back in the invert and sides of the ditch to assist regeneration
- Culverts should be installed under excavated tracks to maintain subsurface drainage pathways (such as natural soil pipes or flushes)

Although excavation is normally undertaken in peat of limited depth (< 1.00m), there is a possibility of minor slippage from the cut face of the peat mass. Accordingly:

- Free faces should be inspected for evidence of instability including cracking, bulging, excessive discharge of water or sudden cessation in discharge (Scottish Government, 2006) and
- Where substantial depths of peat are to be stored adjacent to an excavation, stability analysis should be conducted to determine the Factor of Safety (FoS) and an acceptable FoS adopted for loaded areas (MacCulloch, 2006)

Peat Excavation, Storage and Transport

If peat is to be re-used or reinstated with the intention that the habitat it supports continues to be viable, the following good practice applies (SEPA, 2010):

Excavation

- Excavated peat should be excavated as turves, including the acrotelm (surface vegetation) and a layer of adjoining catotelm (humified peat) typically up to 300mm thick in total (SR/SNH/SEPA/FCS, 2010), or as blocks of catotelm; the acrotelm should not be separated from its underlying peat
- The turves should be as large as possible to minimise desiccation during storage (Peatlands and Uplands Biodiversity Group, 2010)
- Contamination of excavated peat with substrate materials should be avoided (SR/SNH/SEPA/FCS, 2010)
- Consider the timing of excavation activities to avoid very wet weather, to minimise the likelihood of excavated peat remoulding into peat slurry (with potential consequences off site) (SR/SNH/SEPA/FCS, 2010).

Storage

- Peat turves should be stored in wet conditions, for example, within waterlogged former excavations, or should be irrigated in order to prevent desiccation (once dried, peat will not rewet) (SR/SNH/SEPA/FCS, 2010)
- Peat should be stockpiled in large volumes to minimise exposure to wind and sun which can lead to desiccation, but with due consideration for slope stability (SR/SNH/SEPA/FCS, 2010)
- Excavated topsoils should be stored on geotextile matting to a maximum of 1.00m thickness (SNH, 2013)
- Stores of non-turf (catotelm) peat should be bladed off to reduce the surface area and desiccation of the stored peat (SR/SNH/SEPA/FCS, 2010)
- Peat storage areas and areas of steep peat should be monitored during periods of very wet weather, or during snowmelt, to identify early signs of peat instability (Scottish Executive, 2006)

Transport

- Movement of excavated turves should be kept to a minimum, and it is preferable to transport peat intended for translocation to its destination at the time of excavation (Peatlands and Uplands Biodiversity Group, 2010)
- If vehicles that are used for transporting non-peat material are also to be used for peat materials, measures should be taken to minimise cross-contamination of peat soils with other materials

Restoration

- Carefully evaluate potential restoration sites for their suitability, and agree that these sites are appropriate with landowners and relevant consultees (SR/SNH/SEPA/FCS, 2010)
- Undertake restoration and revegetation work outside winter months
- Consider the exclusion of livestock from areas of the site undergoing restoration, to minimise impacts on revegetation (SR/SNH/SEPA/FCS, 2010)
- Where feasible, restoration should be carried out concurrently with construction rather than at its conclusion

Peat Restoration and Good Practice Post-Construction

Once project design and construction activities have been optimised with respect to the preservation of peat, the remaining good practice opportunities relate to the restoration of degraded parts of the development site, where there is opportunity to do so, and to the monitoring of peatland adjoining scheme elements to determine if there is a need for further mitigation. Good practice guidance indicates the following:

Restoration

- If a development is sited on degraded peatland, it is desirable to implement measures to restore the peatland for biodiversity and to improve the carbon balance of the development (SR/SNH/SEPA/FCS, 2010)

- Any opportunities to enhance local habitats by rewetting former drained peatland, such as by drain blocking, should be considered (SR/SNH/SEPA/FCS, 2010)
- Where peat drains are extensive and frequent, and generally on shallow slopes, peat should be considered the preferred blocking material from the perspective of minimising peat wastage, rather than other alternatives such as plastic sheeting (SR/SNH/SEPA/FCS, 2010)
- Where drain blocking is identified as a possibility, re-used peat should comprise humified catotelm peat which retains sealing properties, in preference to desiccated or dried peat which would be buoyant (SR/SNH/SEPA/FCS, 2010)
- Critical to the restoration of viable peatland is raising and maintaining water tables to a level sufficient to support peat forming vegetation communities (SR/SNH/SEPA/FCS, 2010; SNH, 2013)
- Also critical is the maintenance of a functioning acrotelm, and therefore careful excavation that supports this should be encouraged (SR/SEPA, 2012)

Monitoring

Peat habitat restoration can be a slow process and monitoring might need to be specified over a long period. Monitoring refers to ongoing restoration measures and to inspection of the integrity of the Proposed Scheme and the peatland adjoining it. Good practice guidance suggests:

- Monitoring should be put in place around major scheme components located in peat to check for water table drawdown, and this should trigger mitigation, if required (SR/SNH/SEPA/FCS, 2010)
- The settlement of floating tracks during and post-construction should also be monitored to determine if consolidation is occurring as expected, and to identify signs of lateral displacement (SNH/FCS, 2010)
- Comprehensive inspection and maintenance records should be kept for all floating tracks on site to enable reasons for track degradation to be identified (e.g. heavy rainfall) (SNH/FCS, 2010)
- There should be a commitment to the monitoring of rehabilitating peatland through the life of the development, given the typical timescale for peat restoration projects to achieve their objectives (from 5 - 30 years) (SR/SNH/SEPA/FCS, 2010)