20. SUMMARY OF MITIGATION AND RESIDUAL EFFECTS

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A20.1 EFFECTS ON LANDSCAPE CHARACTER (ES ADDENDUM CHAPTER A8)

Identified impacts	Mitigation	Residual effect
Changes to landscape character caused by: • Turbines, anemometry masts and control buildings • Construction activities • Tracks and borrow pits • Grid connection apparatus • Cable laying NB: The design of the proposed Viking Wind Farm has changed since the original ES was submitted. For full details of the proposed design changes please refer to Addendum Chapter A4.	Extensive input to layout design. Proposed secondary mitigation principles, such as woodland screen planting etc. were outlined within Chapter 9 of the 2009 ES but did not form part of the assessment. SNH have advised against these principles and therefore they will not be pursued further. However this does not affect the outcome of the assessment.	No significant impact would be experienced at designated sites such as the National Scenic Areas or Historic Gardens and Designed Landscapes. However, significant impacts would continue to occur on a number of local landscape character areas within 15km of the proposed development, as follows: • The localised reduction in adverse direct and indirect landscape impacts upon the Collafirth quadrant, and to a lesser extent the Delting quadrant, resulting from changes in the layout, would locally reduce magnitude of change to the extent that impacts would no longer be significant in the Collafirth area if looked at in isolation (but impacts would remain significant in Delting). However, when taken as a whole, impacts upon **Landscape Character Area "East and West Kame"**, of which the Collafirth "quadrant" comprises but a small part, would remain as stated in the ES, that is, moderate to substantial adverse impact. Where impacts are indirect, impacts in this character area would be reduced to moderate, but still significant. • Significant impacts would continue to be experienced by the part of **Landscape Character Area Peatland and Moorland** at Pettadale and Kergord. • Elsewhere in the detailed study area: moderate direct and indirect adverse landscape impacts would be experienced by **Coastal Crofting and Grazing Lands and the Scattered Settlements / Crofting and Grazing Land Landscape Character Areas**; and indirect adverse landscape impacts ranging from moderate to moderate-substantial would be experienced in a number of other local character areas.

A20.2 VISUAL IMPACTS (ES ADDENDUM CHAPTER A9)

Identified impact	Mitigation	Residual effect
Impacts on visual amenity caused by: • Turbines, anemometry masts and control buildings • Construction activities • Tracks and borrow pits • Grid connection apparatus • Cable laying • Decommissioning • Cumulative effects with other wind farms NB: The design of the proposed Viking Wind Farm has changed since the original ES was submitted. For full details of the proposed design changes please refer to Addendum Chapter A4.	Extensive input to layout design. Proposed secondary mitigation principles, such as woodland screen planting etc. were outlined within Chapter 9 of the 2009 ES but did not form part of the assessment. SNH have advised against these principles and therefore they will not be pursued further. However this does not affect the outcome of the assessment.	The majority of significant effects upon the visual amenity of Shetland would occur within 15km of the periphery of the proposed Viking Wind Farm. These would generally be located in the central and northern mainland and parts of Yell and Whalsay, where views are orientated towards the proposed development. The revised (2010) design would lead to changes to a large number of views from viewpoints and other receptors compared with the 2009 proposals. However, due largely to the context within which they would occur, these changes, although beneficial when compared to the 2009 proposals, would be relatively minor for the majority of receptors. Therefore the assessed level of visual impact due to the proposed wind farm has changed in only a small number of cases. Four viewpoint receptors, seven residential receptors and one route receptor would receive a change in the level of predicted visual impact compared with that stated in the 2009 ES. Two of these twelve receptors (viewpoint 23 – Hillswick and receptor 272 - Newing) would receive a reduction of impact from a level that is considered significant (i.e. moderate and above) to one considered not significant. In the case of viewpoint 23, the removal of a number of turbines from the view would result in a reduction in the magnitude of change and therefore impact. In the case of receptor 272 the reduction in impact is due to the removal of a previously proposed nearby borrow pit and access track. This latter reduction in significance would be during construction only, as long term impacts were already considered to be slight (and therefore not significant) within the 2009 ES. The relatively small scale of the Burradale and Cullivoe Wind Farms and the Converter Station in comparison with the proposed Viking Wind Farm (and the relatively localised and limited simultaneous and sequential visibility) would have the effect of not increasing the overall significance of the adverse effects upon the landscape and visual resource of the study area.

A20.3 EFFECTS ON NON-AVIAN ECOLOGY (ES ADDENDUM CHAPTER A10)

Identified impact	Mitigation	Residual effect
Direct impacts on non-avian ecology caused by: • Construction of turbines and foundations, control buildings, substations, grid connection infrastructure, transformers, temporary and permanent anemometers, crane hard standings and construction compounds. • On site cabling and access tracks. • Watercourse crossings and borrow pits, including pollution and sediment release into water leading to changes in hydrology and hydrochemistry • Mobile plant operations and traffic. • Temporary noise.	• Extensive input to layout design. • Pre construction surveys. • Work programming and awareness raising. • Micro-siting of infrastructure and demarcation of exclusion zones. • Control of pollution and sedimentation. • Minimising watercourse crossings. • Careful design of tracks, trackside drains and cable trenches. • Habitat reinstatement. • Careful design and reinstatement of borrow pits. • Habitat compensation and enhancement (through the Habitat Management Plan).	No significant adverse residual impacts are predicted for non-avian ecological receptors. For example, no significant impacts at a regional or national level are predicted to occur on the on the blanket bog of regional to national value. However, local adverse impacts, in terms of direct habitat loss to blanket bog of regional to national value would occur within the Viking study area. It is predicted that 197ha of blanket bog (of varying activity) would be lost after the construction areas have been restored and recovered. Blanket bog, as a general habitat type, is protected under European legislation, and there is a growing body of opinion that new developments should deliver net ecological gain, rather than simply be designed to achieve mere damage limitation. Therefore, significant measures to deliver compensation and ecological enhancement have been included in the design of the Viking Wind Farm and are outlined within the Viking Habitat Management Plan (HMP). Please see Appendix A10.9 which has been revised and expanded since the 2009 ES was published.

A20.4 EFFECTS ON ORNITHOLOGY (ES ADDENDUM CHAPTER A11)

<table>
<tr><th>Identified impact</th><th>Mitigation</th><th>Residual effect</th></tr>
<tr>
<td>
• Direct loss of habitat to wind turbine bases, access tracks, site substation, converter station and ancillary infrastructure.
• Modification of habitats that support bird populations, due to hydrological change resulting from the construction of access tracks, cable trenches, etc.
• Indirect loss of habitat due to the displacement of birds by construction works and operation of the windfarm.
• Mortality due to collision with wind turbine blades, overhead wires, guy lines and fencing.
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<td>
• Extensive input to layout design.
• Restriction of construction activity in Schedule 1 birds territories during the breeding period.
• Rescheduling of construction operations in response to surveys to minimise disturbance to breeding whimbrel.
• Habitat management to provide additional breeding habitat for merlin, red-throated diver and whimbrel during operation of the wind farm.
• Widespread crow control.
• Research into whimbrel ecology in Shetland Mainland.
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The summary effects are shown in the table below.
<table>
<tr><th>Potential Effect</th><th>Mitigation</th><th>Residual Significance</th></tr>
<tr><td colspan="3">Land Take</td></tr>
<tr><td>All species</td><td>Offset effect by HMP habitat restoration measures</td><td>Not significant</td></tr>
<tr><td colspan="3">Habitat Modification</td></tr>
<tr><td>All species</td><td>Offset effect by HMP habitat restoration measures</td><td>Not significant</td></tr>
<tr><td colspan="3">Construction Disturbance</td></tr>
<tr><td>Red-throated diver</td><td rowspan="3">At nesting sites, avoid effect by restrictions under the BBP</td><td rowspan="3">Not significant</td></tr>
<tr><td>Merlin</td></tr>
<tr><td>Whimbrel</td></tr>
<tr><td>All other species</td><td>None required</td><td>Not significant</td></tr>
<tr><td colspan="3">Operational disturbance</td></tr>
<tr><td>Red-throated diver</td><td>Micro-siting access roads at 5 lochans and screening along access roads at 3 lochans</td><td rowspan="5">Not significant</td></tr>
<tr><td>Merlin</td><td>Enhance the quality of nesting habitat at 5 territories in Central Mainland</td></tr>
<tr><td>Whimbrel</td><td rowspan="2">Habitat enhancement and crow control over wide areas as described in HMP</td></tr>
<tr><td>Golden plover, curlew, Arctic skua</td></tr>
<tr><td>All other species</td><td>None required</td><td>Not significant</td></tr>
<tr><td colspan="3">Collision</td></tr>
<tr><td>Red-throated diver</td><td>Safeguard and enhance the quality of lochans aimed at increasing occupancy</td><td>Not significant</td></tr>
<tr><td>Whimbrel, golden plover, curlew, Arctic skua</td><td>Habitat enhancement and crow control over wide areas as described in HMP</td><td>Not significant</td></tr>
<tr><td>All other species</td><td>None required</td><td>Not significant</td></tr>
<tr><td colspan="3">Decommissioning</td></tr>
</table>
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</tr>
</table>

		All species	To be determined (and agreed with SNH) in light of best practice guidance at time of decommissioning.	Not significant
		All species	Restrictions under the Bird Protection Plan on the timing and location of decommissioning works	Not significant

A20.5 NOISE EFFECTS (ES ADDENDUM CHAPTER A12)

Identified impact	Mitigation	Residual effect
Noise during construction caused by: • Machinery and vehicles. • Drilling and blasting. • Crushing plant. Noise during operation caused by: • Mechanical and aerodynamic noise from turbines.	• Input to layout design. • Locating equipment to minimise noise impacts, maximising natural screening. • Appropriate phasing of the works, equipment to be employed, working hours, and use and control of blasting. • Using quietest plant and deploying or moving plant at appropriate times. • Appropriate scheduling of operations where noise and vibration may have an adverse effect. • Training and supervision of operatives. • Efficient operation and maintenance of plant.	The adopted noise criteria may be exceeded at three receptor locations during operations at the closest borrow pits. The closest borrow pits to each of these receptors are small borrow pits which would be used for a short time period to provide material for the initial stage of tracks onto the site. Noise impacts would be minimised as much as possible by adopting the mitigation measures described, and all activities would be restricted to appropriate daytime hours to minimise the disturbance caused. It is considered that, due to the temporary nature and the appropriate scheduling of the activities at the borrow pit, the impact can be considered to be of moderate significance. The predicted noise levels at the closest sensitive receptors during the operational phase of the development are below the noise assessment criteria set out in ETSU. The predicted impact at the closest sensitive receptors is, therefore, deemed to be not significant.

A20.6 EFFECTS ON CULTURAL HERITAGE (ES ADDENDUM CHAPTER A13)

Identified impact	Mitigation	Residual effect
• Direct impacts on known and unknown archaeological remains. • Direct and indirect impacts on listed buildings, Scheduled Ancient Monuments and their settings.	• Extensive input into layout design including removal and relocation of turbines to avoid direct impacts on known and potential archaeological remains and to avoid significant impacts on the settings of Scheduled Ancient Monuments. • An Archaeological Clerk of Works would be employed to oversee the archaeological programme of works and would be responsible for the successful implementation of the Archaeological Management Plan (Please see Appendix A13.5). • An Archaeological Walkover Survey would be undertaken to inform micro-siting of access tracks and turbines away from archaeological remains. • Known archaeological remains would be robustly fenced off including a 20m buffer zone around the known remains. • A programme of geophysical survey including Ground Penetrating Radar and Magnetometry would be undertaken prior to development. • Where Geophysical Survey has indicated archaeological potential a programme of archaeological trial trenching and/or watching brief may be required. • A programme of geoarchaeological coring would be undertaken in areas of high archaeological potential in deep peat in order to investigate the effectiveness of coring as a means of locating buried archaeological remains • A major heritage project would be undertaken in the Central Shetland Mainland that would allow people to experience, enjoy and connect with their heritage.	Desk-based archaeological research and archaeological walkover have been carried out in the course of this study. The discovery of hitherto unknown archaeological remains as part of this study has thus raised the possibility of uncovering further unknown remains as part of the groundbreaking works associated with this development. The undertaking of the mitigation measures outlined here prior to and during the construction of the proposed wind farm would lead to *Minor* overall residual effects on known archaeological remains. The employment of an Archaeological Clerk of Works and undertaking of the outlined mitigation proposals would ensure that the archaeological potential of the proposed development area is better understood prior to development. Subsequent mitigation (trial trenching and/or watching brief) would ensure that any archaeological remains within the footprint of the proposed development would be identified and recorded to an appropriate level thus ensuring preservation by record. The undertaking of an experimental coring method into the effectiveness of this technique would further understanding of the usefulness and applicability of coring as a prospection technique. There would be no significant residual effect on the settings of individual nationally important monuments and buildings. There would be a significant residual effect on the overall context in which the heritage of Central Mainland Shetland is viewed. Significant measures to deliver compensation and enhancement of heritage are outlined within the Viking Energy Heritage Strategy and would provide opportunities to promote the heritage of Central Mainland of Shetland. Please see Appendix A13.6.

A20.7 EFFECTS ON SOIL AND WATER (ES ADDENDUM CHAPTER A14)

Identified impact	Mitigation	Residual effect
• Suspended solids discharge. • Soil erosion. • Potential fuel, lubricating oil, chemical, cement or hydraulic oil spillage. • Construction or decommissioning activity triggering peat slide. • Increased surface run off. • Decreased infiltration. • Flooding. • Construction works altering hydrological pathways within peat deposits. • Culverting of watercourses impeding flows. • Creation of temporary drainage route. • Damage to water supply infrastructure.	Extensive input to layout design, with aim to avoid key receptors such as private water supplies, flooding locations, deep peat, steep slopes and water features. Best practice methods in all design and construction activities, including tracks, turbines and construction compounds. Use of floating tracks in appropriate locations, to minimise peat excavation and minimise creation of preferential drainage paths. Appropriate sustainable drainage design techniques, including upslope cut-off trenches, sediment management and attenuation of peak flows. Cable trenches designed so as not to provide preferential drainage paths. Peat management plan to lay down appropriate peat handling and sediment management. Geotechnical engineer on site during key construction activities, creation and maintenance of geotechnical risk register. Best practice followed for borrow pit location and design. Minimised watercourse crossings, appropriate designs for each in preparation for CAR applications, to be discussed individually with	With the proposed mitigation in place the majority of impacts on the soil and water environment would not be significant. There are however three effects evaluated as being of significance. There are two currently active site processes which have potentially significant effects during construction of the wind farm: soil (peat) erosion and peat instability. Although these processes have been assessed as having the potential to cause significant effects, neither has been assessed as being likely to occur as a direct result of wind farm development activity. Erosion is occurring naturally on the site at present. Construction activities may exacerbate this situation. Following the precautionary principle, soil (peat) erosion caused by construction has been identified as having a potentially significant (moderate significance) effect. The Peat Management Plan, within the Habitat Management Plan (Technical Appendix A10.9) gives advice on best practice for this issue along with some innovative techniques that may beneficially influence local peatland habitat and could result in a positive environmental effect in localised areas. It was noted that there are a number of features associated with active peat instability on the site, such as tension cracks. The Peat Stability Technical Appendix (Technical Appendix 14.1 in the 2009 ES) was prepared to provide further details on this matter. Locations of these features have been identified and ongoing monitoring should be undertaken in order to instigate mitigation measures, as may become necessary. It has been identified that, should a peatslide occur, the impact could be significant (moderate significance). This could also have a significant (moderate significance) impact on local watercourses as it could lead to extreme sedimentation and possible channel blockage. The Peat Stability report concluded that the likelihood of a peatslide occurring, as a consequence of the wind farm construction, is unlikely provided the proposed mitigation measures are put in place. In addition, there is also the potential for a significant adverse impact (of moderate significance) from lowering of groundwater levels in the areas adjacent to cut tracks and associated drainage features. The effect would be likely to be localised and the impact

Identified impact	Mitigation	Residual effect
• Dewatering of peatland.	SEPA. Pollution Prevention / Site Environmental Management / Site Waste Management Plans all enforced on site. Further turbines, tracks and other infrastructure deleted from the proposed wind farm design in the 2010 revisions.	may be more limited in areas exhibiting erosion features and/or shallow peat depth which encourage drainage from the peat. This is a process that has occurred to varying degrees at other peatland developments and should be carefully mitigated against and monitored at this site in order to minimise the long-term effects. Following construction of tracks, this effect is likely to become manifest over a longer-term than the other significant effects identified and may become evident during the operational phase and could continue as a permanent feature into the decommissioning phase.

A20.8 EFFECTS ON ROADS AND TRAFFIC (ES ADDENDUM CHAPTER A15)

Identified impact	Mitigation	Residual effect
• Congestion. • Wear and tear to the road network. • Impact on local communities such as Lerwick North and Voe. • Increase in HGVs. • Increase in traffic when site operational. • Impacts on water bodies, including Sand Water SSSI, from public highway upgrades • Cumulative impacts on the B9076 from the TOTAL Sullom Voe development	• Routing; preferred Abnormal Indivisible Load (AIL) route to the site access points is to use the Spine Road Network to reach either a direct access junction or to a side arm junction leading to upgraded carriageway which in turn leads to an access junction. Routing for non-AIL traffic would be agreed with SIC and included in the construction/ traffic management plan. • Road/Junction improvements; mitigation would involve the construction of four new AIL accesses. These are likely to be in the form of widened priority junctions wide enough to handle the abnormal loads as well as general construction traffic. Junction improvement and road widening on the B9075 would only take place to the north of the B9075 • Where road improvements are required in proximity to water bodies they would be carried out in accordance with standard highway management practices in full cooperation with SIC Highways Department, and would include standard mitigation procedures outlined in the 2009 ES section 14.6.1(b). • The Traffic Management Plan would account for any cumulative impacts with the TOTAL development and ensure the efficient transport of components and materials to the site, whilst minimising disruption to other road users and ensuring the safety of contractor personnel and the public. • Opportunities for providing car pooling facilities at the B9075/A970 junction would be explored with SIC.	There would be a short term adverse impact on the local highway network resulting from the construction traffic and movement of abnormal loads. However, a combination of mitigation measures detailed in the Transport Statement can be agreed to minimise any potential adverse impact. It is likely there would be a minor impact on the wear and tear of particular roads. It is expected that this would be covered by a wear and tear agreement to ensure the condition remains as before the scheme. Proposed junction improvements at Sella Ness, the A968/B9076 Junction south of Mossbank and the A968/A970 Junction at Voe would result in larger junctions with increased capacity and potentially safer designs. Localised widening and route improvement at the side roads to two access points would upgrade routes and improve the safety and operation of the roads. Viking Wind Farm HGV movements on the B9076 between Sullom Voe Harbour and Quoys of Garth, considered in combination with those anticipated in respect of the TOTAL development at Sullom Voe, are not expected to result in significant effects. In general, the impacts are relatively minor and are typically confined to the construction period only.

A20.9 EFFECTS ON AIR AND CLIMATE (ES ADDENDUM CHAPTER A16)

Identified impact	Mitigation	Residual effect
• Air quality from dust generation during construction, fugitive emissions from industrial and vehicle movement and dust from traffic. • CO_2 emissions from the impact the development would have on the peat bogs.	Dust control: • Minimise the creation of dust by planning and design; • temporarily suspend the activity or operation if the creation of dust cannot be avoided. • prevention of roads becoming dusty, • control of vehicle speeds. • use of wind breaks CO_2 emission mitigation: • Minimise extraction and disturbance of peat • Appropriate storage and local re-use of peat where disturbance is unavoidable • Habitat improvement.	The impacts of dust would be adequately mitigated by following best practice guidance for dust suppression. Overall, it is estimated that any CO_2 emissions associated with the development would be offset within the first year of the development. This carbon payback period is relatively low, and is a consequence of the high efficiency of the wind farm, the scale of the development and the potential of the habitat improvement measures to substantially improve existing habitats.

A20.10 SOCIO ECONOMIC EFFECTS (ES ADDENDUM CHAPTER A17)

Identified impact	Mitigation	Residual effect
Construction: • New employment and income opportunities • Restrictions on some agricultural activities during construction • Tourist accommodation taken over for workers • Displacement of employment and construction projects • Social impacts: positive – in migration, employment, training, inter-community communication; negative - uncertainty and negative perceptions, disruption, price increases. **Operational:** • Significant revenue generation and income in Shetland. • Significant community and social benefits in Shetland. • Economic and environmental benefits at the national scale.	Construction phase: • Implementation of a communication strategy. • Use of local contractors. • Extended construction period to maximise use of local resources. • Use of raw materials from local sources, where possible. • Possible sharing of specialised accommodation (subject to negotiation) e.g. Total's facility at Sellaness. • Careful planning of vehicle movements through a traffic management plan. Operation phase: • Implementation and monitoring of the community benefit scheme. • Commitment to an access plan to maximise the potential benefits of the development through provision of public access through organised tours, development of mountain bike routes away from restricted areas, promotion of alternative walking routes, improvement in car parking, promotion of Shetland as a sustainable community with respect to energy production to generate energy tourism market and the development of tourism view points. • Employment of local people to fulfil long-term employment roles, where possible. • Ensuring that revenues are used as tax efficiently as possible. • Ensuring that part of the land rental is shared, as is enshrined in crofting law, amongst the crofters and grazing committees as well as landlords. • Active consideration of additional, follow-on developments to encourage wider renewable energy schemes (e.g. in wave and tidal energy) in addition to improvements in household level energy efficiency.	Residual effects arising from the scheme are hard to quantify and are qualitatively described below: • increased perception of the Shetland Islands working towards becoming sustainable with respect to energy production and being of national strategic importance in meeting the UK Government's goals for renewable energy production; • long term socio economic benefits from rentals, community benefit scheme, and recirculation of income created by the project, 50% of which would remain in the Shetland community • long-term, regional socio-economic benefits through the development of follow-on initiatives and other spin-offs associated with development of local manufacturing services.

A20.11 EFFECTS ON TELECOMMUNICATIONS AND AVIATION (ES ADDENDUM CHAPTER A18)

Identified impact	Mitigation	Residual effect
Interference with: • TV and radio Broadcasts • Radio communications • Scatsta airfield	• Provision of alternative means of receiving TV and radio broadcast where it is shown that the wind farm has adversely affected reception. • Re-routing of radio communications links where necessary, by arrangement and negotiation with the operators. • Deletion of turbines and ongoing dialogue with Scatsta airfield owners, licensee and operators re future developments.	Residual effects on all of these issues are, at worst, negligible.

A20.12 EFFECTS ON RECREATION AND TOURISM (ES ADDENDUM CHAPTER A19)

Identified impact	Mitigation	Residual effect
• Restriction of access. • Effects on visitors' perceptions (both positive and negative). • Disturbance of recreational activities.	Mitigation measures during the construction phase include: • the development of a communication strategy to be used by Viking Energy to provide consistent and regular updates to both the public and other interested parties, such as tourists; • careful planning of vehicle movements through a traffic management plan to minimise disruption to both local and tourist traffic during the construction period; and • extension of the construction period to 5 years with a reduction in the number of workers requiring accommodation annually. This would result in adequate construction accommodation being available without accommodation for tourists being affected. Mitigation measures during the operation phase include: • commitment to an access management plan (AMP) that maximises the potential benefits of the development through provision of public access with organised tours, development of tourism view points, development of mountain bike routes away from restricted areas, promotion of alternative walking routes, improvement in car parking. The AMP would take full account of the Habitat Management Plan to prevent disturbance to breeding birds and damage to blanket bog habitats and provide instruction on the appropriate use of signage in compliance with the Scottish Outdoor Access Code; • provision of specific wind farm visitor facilities at an appropriate location near to or within the wind farm; • promotion of Shetland as a sustainable community with respect to energy production; and • promotion of Shetland as a green energy tourist destination.	The Viking Wind Farm development is unlikely to have an overall significant impact on tourism in Shetland. The development is not located within a designated area or close to any of the most popular tourist attractions in Shetland. The turbines are located away from key tourist attractions and based on experience from elsewhere, visitors should not be put off from coming to Shetland. The Viking Wind Farm development would provide opportunities to promote Shetland as a green tourist destination, and the provision of new access tracks would increase and enhance recreation facilities. Given the extent to which ornithological, landscape and visual impact assessments have influenced the design and layout of the wind farm, it is not anticipated that any significant knock-on effects on tourism would be experienced.