Volume IV AEE Technical Appendices

Appendix 1.1 CVs

CURRICULUM VITAE **GRAEME BLACKETT**

QUALIFICATIONS: BA Hons Economics, University of Strathclyde
Member Institute for Economic Development
Member Economic Development Association Scotland

CAREER SUMMARY:

2002-	Director, BiGGAR Economics
2000-2001	Senior Consultant, Deloitte
1998-1999	Consultant, Deloitte
1993-1998	Consultant, Segal Quince Wicksteed Limited
1991-1992	Parliamentary Researcher and Freelance Consultant

Graeme Blackett co-founded BiGGAR Economics in 2002. He was previously manager of Deloitte's economic consulting practice in Scotland and Northern Ireland and a consultant with SQW Limited. Graeme is an economist with over 25 years of experience in economic development. Graeme has also been a member of the Advisory Board of the leading think tank Reform Scotland and economic advisor to the Sustainable Growth Commission, established by the First Minister of Scotland to advise on improving Scotland's economic performance.

Selected Project Experience

- study of the potential socio-economic benefits to Iceland of developing an onshore wind energy sector and a review of international evidence on any implications for the tourism, on behalf of Landsvirkjun;
- assessment of the socio-economic impacts of the proposed wind farm on the island of Yell, on behalf of Element Power and Energy Isles;
- socio-economic assessment of the Seagreen Offshore wind farm development in the outer Firth of Forth;
- expert witness on socio-economic and tourism issues at the Scottish Land Court hearing into the proposed Viking Energy wind farm on Shetland;
- baseline economic and exchequer impacts of the North Sea oil and gas sector and scenario analysis to assess potential future economic and exchequer impacts as part of an assessment of the case for public sector support for R&D for the UK oil and gas sector;
- economic impact assessment of the University of the Highlands and Islands and its academic partners, including Shetland College and NAFC Marine Centre;
- economic impact assessment of the European research-intensive universities, based on analysis of the 23 members of the League of European Research Universities (LERU);
- assessment of the contribution to the economy of France made by the 18 members of the association of French research-intensive universities (CURIF);
- assessment of the economic contribution of the Swiss Federal Institutes of Technology (ETH) Domain institutions;

- cost-benefit analysis model and report for a Major Project Application by the University to find funding for the Scottish Centre for Regenerative Medicine;
- economic impact assessment of Aberdeen Innovation Hub, which aims to facilitate innovation and collaboration in the three key sectors: life sciences, food and drink and oil and gas;
- socio-economic impact assessment of a major hospital investment programme in Edinburgh for the National Health Service in Lothian;
- modelling future trends in the Scottish life sciences cluster for Scottish Enterprise, based on analysis of global trends and Scottish competitiveness in key sub-sectors;
- assessment of the economic impact of the Malthus Uniteam workers accommodation facility in Shetland;
- economic impact assessment, followed by and socio-economic assessment, of the proposed Nigg Bay development at Aberdeen Harbour;
- economic impact assessment of the proposed Carters yard student accommodation development in Stirling;
- economic appraisal, stress testing and business planning for the national Innovation Centre for Ageing in Newcastle;
- economic impact assessment for the proposed Edinburgh Park South development in the west of Edinburgh
- economic appraisal and impact assessment of the proposed mixed-use development St Andrews West in Fife;
- economic impact study of Peterborough United Football Club, including its current impact on the town and region and potential future economic impacts;
- economic and well-being impact assessment for Buccleuch, covering its four estates and Buccleuch Property;
- economic impact assessment of Scottish Government consultation on proposals to introduce a charge on single use plastic bags.

CURRICULUM VITAE

Dr Peter J Cosgrove

Name: Dr Peter J Cosgrove, FCIEEM
Date of Birth: 19 June 1969
Profession: Environmental Scientist
Specialisation: Ecologist, Fellow of the Chartered Institute of Ecology and Environmental Management (FCIEEM)

Recent Career Summary:

2011–present day	Director of Ecology with Alba Ecology.
2009-2011	Principal Ecologist with Alba Ecology.
2005–2009	Principal Ecologist with EnviroCentre.
1998-2009	Freshwater Ecologist, Independent Ecological Consultant.
2004-2005	Ecology and Landscape Advisor, Cairngorms National Park Authority, UK.
1998-2003	Cairngorms Biodiversity Officer, Cairngorms Partnership, Cairngorms National Park Authority, UK.
1998	Wildlife Crime Investigations Officer, RSPB.
1995-1998	Ecological Research Fellow, Aberdeen University.

Education:

1991-1995	PhD. Zoology, University of Aberdeen, UK.
1987-1991	BSc. (Hons) 2[1] Environmental Studies, University of Hertfordshire, UK.

Profile:

Peter is a highly skilled ecologist with over twenty years experience in wildlife and habitat research, land-use management, conservation planning and policy development and environmental assessments. He has managed many large projects and budgets from conception through to completion and has a strong proven track record of delivery in both the public and private sector, producing over 150 peer-reviewed scientific papers, commissioned reports and books (Appendix 1). In particular, Peter specialises in bringing consensus to difficult conservation issues through innovative approaches to partnership working, negotiation and conflict resolution. In the last decade Peter has focussed his efforts on freshwater pearl mussels, invasive species, species reintroduction, environmental impact assessment, ecological clerks of work, forestry management and renewable energy developments.

Peter's work has concentrated primarily in six areas: (1) Peter co-ordinated the development and implementation of over 100 action plans with partners, for a quarter of the UK's most threatened habitats and species; (2) Peter provided advice and guidance on conservation, planning and development control issues in designated and non-designated areas and has a thorough working knowledge of national and international designation issues, especially Natura 2000 sites and carrying out Appropriate Assessments; (3) Delivery of ecological elements of EIAs, the production of Environmental Statements, Ecological Clerks of Work and negotiation with statutory authorities and private sector; (4) Peter has specialised in invasive species issues in Ireland, the UK and internationally; (5) Communication of often complex biodiversity/conservation information and messages effectively to different audiences; and (6) Peter is recognised as an international authority on the survey and conservation of the endangered freshwater pearl mussel and its aquatic habitat.

Relevant Experience:

- *Freshwater pearl mussel advisor*

Over 100 commissioned pieces of work for the public and private sector on aquatic casework issues for development control, surveying and conservation management of this endangered species. During the last decade this has included Site Condition Monitoring for all of Scotland's SACs and SSSIs where *M.*

margaritifera is a feature. Recently advisory work has included developing, testing and publishing standard deepwater survey methods for the species, advising on the removal of a fish counter on an SAC and a feasibility study for improving fish passage on another two pearl mussel SAC rivers and producing leaflet and on-line guidance on freshwater pearl mussels for developers operating in rivers in Scotland. Since 2000, Peter has been on special 'call-off' contract for the provision of expert advice on freshwater pearl mussels to the Scottish Natural Heritage and Forestry and Land Scotland and has recently concentrated on developing and implementing a project entitled the '*Restoration of freshwater pearl mussels in selected Scottish rivers*'. During 2013-2015 Peter completed SNH's 2nd national freshwater pearl mussel survey across Scotland and has recently published the findings. In 2020, Peter wrote CIEEM's COVID-19 freshwater pearl mussel survey guidance.

- *Invasive species*

Provision of expert advice leading to the development and implementation of this best-practice cross-border invasive species programme in Northern Ireland and the Republic of Ireland.

- *Ecological project co-ordination*

Project co-ordination and logistical management of large scale development projects, including the management of Ecological Clerks of Work teams across Scotland. For example, completed the delivery of biodiversity/habitat management plans for two large developments near Glasgow. The first for a 900 housing unit application and the second for a new road. The work involved updating old ES's and negotiating detailed and costed timetabled action plans for delivery of the mitigation measures outlined in the ES and also the concerns raised by the regulators (primarily local authorities and the statutory nature conservation agency). In 2012, Peter successfully completed delivery of ECoW support for the Trump Golf Development on Menie Estate, Aberdeenshire. Peter is currently providing ECoW support on several large scale projects in northern Scotland, ranging from wind farms, housing developments, a whisky distillery and bridge repair works.

- *Biodiversity Action Plan work, habitats and species*

A thorough working knowledge of most of Scotland's terrestrial and aquatic protected species and habitats, the experts who work on them and the UK BAP process. Development of standardised ecological survey methodologies and conflict resolution strategies for 'problematical' high-profile species. Development of project briefs, securing funding, management and implementation of many practical biodiversity projects in the north of Scotland. In 2020 Peter co-authored, with Alba Ecology a feasibility study for reintroducing cranes into the Cairngorms National Park.

- *Provision of expert advice on national and European conservation designations*

Provision of expert advice to competent authorities (e.g. Cairngorms National Park Authority, The Crown Estate, Irish Sea Fisheries Board and SNH) on conservation designation issues in relation development control. Peter has completed ca. 50 Appropriate Assessments for competent authorities. Peter has also provided expert witness testimony at Public Local Inquiries in Scotland (e.g. Achany Wind Farm, Caplich Wind Farm, Coul Links Golf Course).

- *Delivery of ecological elements of renewable energy EIA and ES*

In the last decade Peter has successfully completed the delivery of ten large onshore wind farm ES's (range in size from 36-103 turbines) and many small-medium sized wind farms.

Examples of recent commissioned work:

- Principal ecological/ornithological advisor on 2 on-shore wind farm, Peel Energy.
- Principal ecological/ornithological advisor on 3 on-shore wind farm, ABO Wind.
- Principal ecological advisor on-shore wind farm, WKN AG.
- Principal ecological advisor on 5 on-shore wind farms, SSE Renewables.
- Freshwater pearl mussel guidance for numerous clients operating in and around rivers.
- Site Condition Monitoring for all Scottish freshwater pearl mussel SACs, SNH and led surveys of all of Scotland's known pearl mussel rivers as part of the SNH 2nd national survey for the species.

- Developed, co-ordinated and implemented the first successful Scottish reintroduction for the globally threatened freshwater pearl mussel, SNH.
- Co-ordination and production of 44 Appropriate Assessments for aquaculture operations in Scottish Natura 2000 sites, Crown Estate.
- Development of Irish Screening Protocol for Aquaculture operations in Natura 2000 sites, Irish Sea Fisheries Board.
- Ecological Clerk of Works co-ordinator for Menie Estate, Trump International Golf Links Scotland.
- Expert ornithological witness, on-shore windfarm, N Scotland, Scottish and Southern Energy.
- Ecological advisor and ECoW co-ordinator for new road, Kirkintilloch Initiative.
- Project manager writing and reviewing the Highland Biodiversity Action Plan, Highland Council.
- As Biodiversity Officer and Ecology and Landscape Advisor in the Cairngorms National Park, provided advice and guidance on conservation and casework issues to the Cairngorms National Park Board as well as writing policies for the development of the National Park Plan, the Local Plan and writing and producing the Cairngorms Biodiversity Planning Guidance Note.
- Co-ordinated the production, development and implementation of 26 Habitat and 100 Species Action Plans in the Cairngorms on behalf of stakeholder and partner organisations. This covered collaborative biodiversity work on a quarter of the UK's most threatened species.
- Developed, co-ordinated and contributed to seven projects on non-native species: (1) Strategic water vole and American Mink plan for Cairngorms, (2) Developed and implemented Cairngorms non-native fish programme, (3) Investigated impact of non-native Mandarin ducks on native Goldeneyes in Scotland, (4) Seabird conservation and rat eradication, Eynhallow Island, Orkney, (5) Research into non-native *Ranunculus* on freshwater pearl mussels and salmon, (6) Invasive Species in Ireland, (7) UK Overseas Territories invasive species prevention.

Other qualifications:

Full, clean driving licence (Lantra 4 wheel-drive off-road trained). Fully licensed freshwater pearl mussel surveyor. Construction Skills Certification Scheme/ROLO H&S Trained: Professionally Qualified Person (Reg No: 13290751; Expires: April 2025). Fellow of Chartered Institute of Ecology and Environmental Management. Winner of the RSPB's 2014 Nature of Scotland Species Champion Award. Winner of the 2018 Neil Findlay Trophy, Scottish Forestry sectors awards. At the 2018 Chartered Institute of Ecology and Environmental Management (CIEEM) Awards, Peter and Alba Ecology were Highly Commended in the Best Practice Award for Knowledge Sharing.

Computer skills:

Peter is a skilled user of PC desktop systems; using standard packages such as Windows Excel, Word, Powerpoint etc. Peter is proficient in desktop publishing and has edited and published numerous bulletins, newsletters, reports and press releases.

Media and presentation skills:

Peter is highly experienced with all forms of contemporary media, having appeared on dozens of TV and radio programmes, as well as broadsheet and blog media. Peter is a well respected public speaker and lectures in Great Britain, Ireland and internationally on a variety of conservation topics.

Personal interests and hobbies:

Hill walking and camping, ornithology, fishing, cycling, cricket, football, public speaking, wildlife guiding.

References available on request

Appendix 1: **SCIENTIFIC WRITING**

PEER REVIEWED SCIENTIFIC PUBLICATIONS:

- **Cosgrove, P.** 2019. Black Redstart breeding in the Cairngorms. Scottish Birds 39:3-7.

- **Cosgrove, P.**, Kortland, K., Shields, D., Potter, R., Murray, J. and Cosgrove, C. 2017. Response of incubating golden and white-tailed eagles to forest road traffic: results of a pilot study. Scottish Birds 37: 14-25.

- **Cosgrove, P.,** McInnes, N., Dolby, S., Gunn, D., Shields, D., Cosgrove, C. and Kortland, K. 2017. Forest management and freshwater pearl mussels: a practitioners' perspective from the north of Scotland. Scottish Forestry 71: 14-21.

- Massey, K., **Cosgrove, P.**, Massey, F., Jackson, D. and Chapman, M. 2016. Habitat characteristics of breeding Eurasian Whimbrel *Numenius phaeopus* on Mainland Shetland, Scotland, UK. Bird Study 63: 500-508.

- **Cosgrove, P**., Watt, J., Hastie, L., Sime, I., Shields, D., Cosgrove, C., Brown, L. Isherwood, I. and Bao, M. 2016. The status of the freshwater pearl mussel *Margaritifera margaritifera* (L.) in Scotland: extent of change since 1990s, threats and management implications. Biodiversity and Conservation 25: 2093-2112.

- **Cosgrove, P.** 2016. Do adult Golden Eagles teach their offspring to hunt? Scottish Birds 36:10-11.

- **Cosgrove, P.,** Shields, D., Cosgrove, C., Farquhar, J., Jarrett, D., Jancke, S., Mitchell, A. and R Moggach. 2014. *Population size, structure and distribution of an unexploited freshwater pearl mussel* Margaritifera margaritifera (L.) *population in Scotland*. Journal of Conchology 41: 1-12.

- **Cosgrove, P.**, Doyle, P., Cosgrove, R., Goff, R., Veen, J. and Manneh, L. 2013. *Tanji River Bird Reserve, The Gambia – a globally important breeding site for Royal Tern* Thalasseus maximus. Bulletin of the African Bird Club 1: 27-30.

- **Cosgrove, P.**, Hastie, L, Watt, J., Sime, I. and Boon, P. 2012. *Scotland's freshwater pearl mussels: the challenge of climate change*. In: River Conservation and Management. Wiley-Blackwell.

- **Cosgrove, P.**, Hastie, L. and Sime, I. 2012. Wildlife Crime and Scottish Freshwater Pearl Mussels. British Wildlife 24: 10-13.

- Jahn, O., **Cosgrove, P.**, Cosgrove, C., Muses Cevallos, T. And Santander Garcia, T. 2010. *First record of Brown Pelican* Pelecanus occidentalis *from the Ecuadorian Highlands*. Cotinga 32: 108.

- **Cosgrove, P.** 2008. *Grenada Dove* Leptotila wellsi *response to non-native ground predators.* Cotinga 30: 72-73.

- Laughton, R., **Cosgrove, P.J.**, Hastie, L.C. and Sime, I. 2008. *Effects of aquatic weed removal on freshwater pearl mussels and juvenile salmonids in the River Spey, Scotland*. Aquatic Conservation: Freshwater and Marine Ecosystems 18: 44-54.

- **Cosgrove, P.**, Hastie, L. and Sime, I. 2007. *Recorded natural predation of freshwater pearl mussels* M. margaritifera (L.) *in Scotland.* Journal of Conchology 39: 469-472.

- **Cosgrove, P.J.** and Harvey, P.V. 2005. *The rediscovery of freshwater pearl mussels* Margaritifera margaritifera (L.) *in Shetland*. Shetland Naturalist 2:2 pp 57-64.

- **Cosgrove, P.** and Harvey, P. 2003. *An unusual freshwater pearl mussel* Margaritifera margaritifera (L.) *population in Scotland.* Journal of Conchology 38: 139-146.

- **Cosgrove, P.J.**, Butler, J.R.A. and Laughton, R.L. 2004. *Canoe and walking surveys of wintering Goosanders, Red-breasted Mergansers, Great Cormorants and Common Goldeneyes on the River Spey*, 1994-2003. Scottish Birds 24:2 pp1-10.

- **Cosgrove, P.** 2003. *Mandarin ducks in northern Scotland and the potential consequences for breeding Goldeneye*. Scottish Birds 24:1 pp 1-10.

- **Cosgrove, P.** and McGregor, R. 2003. Short note: *Unusual behaviour of Common Redshanks and Common Starlings towards dead Common Redshank.* Scottish Birds 24:1 pp 40.

- Hastie, L.C., **Cosgrove, P.J.**, Ellis, N. and Gaywood, M.R. 2003. *The threat of climate change to freshwater pearl mussel populations.* Ambio 32: 40-46.

- Hastie, L.C. and **Cosgrove, P.J.** 2002. *Intensive searching for mussels in a fast-flowing river: an estimation of sampling bias*. Journal of Conchology 37: 309-316.

- Anderson, A. and **Cosgrove, P.** 2002. *The Fulmar*. In: The Migration Atlas: movements of the birds of Britain and Ireland. Ed: Marchant, J.H. *et al.* BTO. *Poyser publishing.*

- Young, M.R., **Cosgrove, P.J.**, Hastie, L.C. and Henninger, B. 2001. *A standardised method for assessing the status of freshwater mussels in clear, shallow rivers*. Journal of Molluscan Studies 67: 395-396.

- **Cosgrove, P.J.** and Hastie, L.C. 2001. *Conservation of threatened pearl mussel populations: river management, mussel translocation and conflict resolution*. Biological Conservation 99:183-190.

- Young, M.R., **Cosgrove, P.J.** and Hastie, L.C. 2001. *The extent of, and causes for, the decline of a highly threatened najad:* Margaritifera margaritifera. In: Ecology and Evolutionary Biology of the Freshwater Mussels Unionoidea. Eds Bauer, G and Wachtler, K Springer-Verlag, Heidelburg, Germany. Ecological Studies 145:337-357.

- Hastie, L. and **Cosgrove, P.** 2001. *The decline of migratory* Salmonid *stocks: a new threat to pearl mussels in Scotland*. Freshwater Forum 15: 85-96.

- **Cosgrove, P.** and Oswald, J. 2001. *Capercaillie captures in snares*. Scottish Birds 22: 40-42.

- **Cosgrove, P.J.**, Young, M.R., Hastie, L, C., Gaywood, M. and Boon, P.J. 2000*. The status of the freshwater pearl mussel* Margaritifera margaritifera *Linn. in Scotland*. Aquatic Conservation: Freshwater and Marine Ecosystems 10:197-208.

- Hastie, L.C., Young, M.R., Boon, P.J. **Cosgrove, P.J.** and Henninger, B. 2000. *Sizes, densities and age structures of Scottish* Margaritifera margaritifera *(L.) populations*. Aquatic Conservation: Marine and Freshwater Ecosystems 10:229-247.

- **(Cosgrove, P.)** Dick, D. and Stronach, A. 1999. *The use, abuse and misuse of crow cage traps in Scotland*. Scottish Birds 20:1 pp 6-13.

- Watson, A., Marquiss, M. and **Cosgrove, P.J.** 1998. *North-east Scottish counts of Goldeneye, Goosander, Red-breasted Merganser and Cormorant in 1944-50 compared with 1988-97*. Scottish Birds 19:5 pp 249-258.

- **Cosgrove, P.J.** 1997. Short note: *Long-tailed Duck eating eel*. British Birds 90:9 pp 357*.*

- **Cosgrove, P.J.** 1997. *A winter survey of sawbill ducks and Cormorants on the River Deveron, north-east Scotland.* Scottish Birds 19:2 pp 93-100.

- **Cosgrove, P.J.** 1996. *A winter survey of Goldeneyes on the River Deveron, north-east Scotland*. Scottish Birds 18:4 pp 242-246.

COMMISSIONED CONTRACT REPORTS:

- Alba Ecology, 2020. Cairngorms Crane Project: Feasibility Study for Crane Reintroduction. A commissioned report by Scotland: The Big Picture and the Cairngorms National Park Authority.
- **Cosgrove, P.**, Shields, D., Anderson, D. and Massey, K. 2020. Understanding the impact of the 2018 drought on key freshwater pearl mussel populations in Scotland. SNH Research Report.
- **Cosgrove, P.** and Shields, D. 2020. Borgie Forest Freshwater Pearl Mussel Forest Management plan Update. Forestry and Land Scotland Commissioned Report.
- Alba Ecology, 2020. Protected Terrestrial Mammal Survey Report - 40 unit housing development Alvie Estate, Kincraig. Cairngorm Residential LLP Commissioned Report.
- Alba Ecology, 2020. Cambus Bird Survey Report. Diageo Commissioned Report.
- **Cosgrove, P.** and Massey, K. 2020. River Spey, Boat O'Brig freshwater pearl mussel translocation, 2020. Network Rail Commissioned Report.
- Massey, K. and **Cosgrove, P.** 2020. Freshwater pearl mussel survey of the Abhainn Bheag an Tunns, Argyll, 2020. Scottish Woodlands Commissioned Report.
- **Cosgrove, P.** and Massey, K. 2019. Freshwater Pearl Mussel Survey, Clashnessie Burn. Scottish Water Commissioned Report.
- Alba Ecology, 2019. Lairg Wind Farm Environmental Statement. Energie Kontor Commissioned Report.
- Alba Ecology, 2019. Lerwick, Mossy Hill Wind Farm Environmental Statement. Peel Energy Commissioned Report.
- Alba Ecology. 2019. Protected Terrestrial Mammal, Woodant and Rare Plant Survey Report for Proposed Glenmore Footpath. FLS Commissioned Report.
- **Cosgrove, P.,** Anderson, D., Shields, D. and Massey, K. 2019. Freshwater pearl mussel survey of Forestry and Land Scotland Badenoch and Strathspey Watercourses. Forest and Land Scotland Commissioned Report.
- Alba Ecology 2019. Project Novus, Grantown on Spey Distillery Environmental Statement. Speymalt Whisky Distributors Limited Commissioned Report.
- Alba Ecology, 2019. Reptile Survey Report and Species Protection Plan: Dulnain Bridge 2019. JHO Architects Commissioned Report.
- **Cosgrove, P.,** Shields, D., Anderson, D. and Massey, K. 2019. Boat O'Brig Freshwater Pearl Mussel Survey, River Spey, 2019. Network Rail Commissioned Report.
- Alba Ecology, 2019. Protected Terrestrial Mammal Survey Report for a Proposed Housing Development, Cromdale.
- Alba Ecology, 2019. Protected Terrestrial Mammal Survey Report for Proposed Development Lynstock Crescent, Nethy Bridge. M.C. Hastie, Chartered Quantity Surveyors Commissioned Report.
- Alba Ecology, 2019. Breeding Bird Survey Report for a Proposed Housing Development, Cromdale.
- **Cosgrove, P.** 2019. River Meig Freshwater Pearl Mussel Survey, 2019. Galbraith Commissioned Report.
- **Cosgrove, P.** and Massey, K. 2019. 2019 Freshwater Pearl Mussel Survey, Aberlour. Aberlour Distillery Commissioned Report.

- **Cosgrove, P.,** Massey, K. and Shields, D. 2018. Coul Links Environmental Statement. Coul Links Ltd. Commissioned Report.
- **Cosgrove, P.** and Shields, D. 2018. Kercock, River Tay Freshwater Pearl Mussel Survey, 2018. Glenprosen Estate Commissioned Report.
- **Cosgrove, P.** and Anderson, D. 2018. Dunkeld, River Tay Freshwater Pearl Mussel Survey, 2018. Commissioned Report.
- **Cosgrove, P.** 2018. River Fiddich Abstraction, Otter Survey 2018. Mott MacDonald Commissioned Report.
- Alba Ecology, 2018. Liberty BA Lochaber: Allow Wheel Plant Breeding Bird Protection Plan 2018. Commissioned Report.
- **Cosgrove, P.** 2018. AWPR SWD 02 CSO Freshwater Pearl Mussel Survey. Scottish Water Commissioned Report.
- **Cosgrove, P.** and Massey, K. 2018. Blarghour Wind Farm Environmental Statement. Coriolis Energy Commissioned Report.
- Shields, D., Cosgrove, C. and **Cosgrove, P**. 2018. An evaluation of Forestry Management for Freshwater Pearl Mussel in Borgie Forest Watercourses. FCS Commissioned Report.
- **Cosgrove,** P and Anderson, D. 2018. Technical Note: Freshwater pearl mussels and water quality – a literature review. CH2M Commissioned Report.
- **Cosgrove, P**. 2017. Balmenach Distillery Otter Survey 2017. Balmenach Distillery Commissioned Report.
- **Cosgrove, P**. 2017. Lochaber Smelter Protected Terrestrial Mammal Survey. Commissioned Report.
- **Cosgrove, P**. 2017. Inverallan Church 2017 Red Squirrel Survey. Seafield Estate Commissioned Report.
- **Cosgrove, P**. 2017. Grantown East protected terrestrial mammal survey 2017. Commissioned Report.
- **Cosgrove, P**. and Potter, R. 2017. Loch Lussa 2015-2017 Goose Study. FCS Commissioned Report.
- **Cosgrove, P**. and Shields, D. 2017 Freshwater pearl mussel survey of the Conon Bridge Railway Bridge, Highland. JBA Commissioned Report.
- **Cosgrove, P**. 2017. Burn of Inverton freshwater pearl mussel survey, 2017. CNPA Commissioned Report.
- **Cosgrove, P**. and Shields, D. 2016. Freshwater pearl mussel survey deep-water survey of the River Spey Kingussie A9 crossing. CH2M Fairhurst JV Commissioned Report.
- **Cosgrove, P**. 2016. Beachen Court Otter Species Protection Plan. RS McLeod Ltd. Commissioned Report.
- **Cosgrove**, P.J., Hastie, L.C. and Watt, J. 2016. Surveys of high risk freshwater pearl mussel populations. Scottish Natural Heritage Commissioned Report.
- **Cosgrove, P.J.** and Massey, K. 2016. *Beaw Field Wind Farm Environmental Statement*. Peel Energy Ltd Commissioned Report.
- **Cosgrove, P.** and Shields, D. 2016. *Freshwater pearl mussel survey of the Conon Bridge Railway Bridge, Highland*. JBA Commissioned Report.
- Shields, D. and **Cosgrove, P.** 2016. *Freshwater pearl mussel and otter survey of the River Dee at Ballater Bridge, Aberdeenshire*. Aberdeenshire Council Commissioned Report.

- Shields, D. and **Cosgrove, P**. 2016. *Freshwater pearl mussel and otter survey of the River Dee at Aboyne Bridge, Aberdeenshire*. Aberdeenshire Council Commissioned Report.

- **Cosgrove, P**. and Shields, D. 2016. *Freshwater pearl mussel and otter survey of the River Dee at Old Brig O' Dee, Aberdeenshire*. Historic Environment Scotland Commissioned Report.

- Shields, D. and **Cosgrove, P**. 2016. *Freshwater pearl mussel habitat suitability assessment and survey of the Water of Dye at the proposed Glendye Wind Farm*. Land Use Consultants Commissioned Report.

- Watt, J., Hastie, L.C., and **Cosgrove, P.J.** 2016. *Monitoring the success of freshwater pearl mussel reintroductions*. SNH Commissioned Report.

- **Cosgrove, P**., and Shields, D. 2016. *Freshwater pearl mussel survey of the Culrain Burn, Highland*. FCS Commissioned Report.

- **Cosgrove, P.** 2015, 2016, 2017, 2018 and 2019. *Glenfalloch Estate breeding bird and butterfly survey report*. Glenfalloch Estate Annual Commissioned Reports.

- **Cosgrove, P.** and Shields, D. 2015. *Freshwater pearl mussel survey of the River Truim and River Spey, A9 Dualling – Glen Garry to Dalraddy*. CH2M Fairhurst JV Commissioned Report.

- Watt, J, **Cosgrove, P.J** and Hastie, L.C. 2015. *A national freshwater pearl mussel (Margaritifera margaritifera, L.) survey of Scotland*. SNH Commissioned Report.

- **Cosgrove, P**. and Cosgrove, C. 2014. *Carron freshwater pearl mussel survey*. Chivas Bothers Ltd Commissioned Report.
- **Cosgrove, P.** and Massey, K. 2014. *Woodlands Wind Farm Environmental Statement*. ABO Wind Commissioned Report.

- **Cosgrove, P.** and Massey, K. 2014. *Hartwood Wind Farm Environmental Statement*. ABO Wind Commissioned Report.

- **Cosgrove, P**. Shields, D. and Cosgrove, C. 2013. *Freshwater pearl mussel survey of Borgie Forest watercourses*. A Forestry Commission Scotland Commissioned Report.

- Shields, D. **Cosgrove, P.** and Jarrett, D. 2013. *Freshwater pearl mussel survey of selected watercourses in the River Moriston catchment*. A Forestry Commission Scotland Commissioned Report.

- Shields, D and **Cosgrove, P.** 2013. *Freshwater pearl mussel survey of watercourse at the proposed Balnacoil Windfarm, Highland*. Vento Ludens Commissioned Report.

- Bingham, C. and **Cosgrove, P.** 2013. *Drumoak Phase 1 and Protected Mammal Survey Report*. Stewart Milne Homes Commissioned Report.

- **Cosgrove, P.** 2012. *Shetland 2012 Freshwater pearl mussel survey*. SNH Commissioned Report.

- **Cosgrove, P.** and Shields, D. 2012. *Freshwater pearl mussel survey and assessment of selected water bodies at the A'Chruach Windfarm, Argyll*. Terence O'Rourke Commissioned Report.

- **Cosgrove, P.** and Shields, D. 2012. *Freshwater pearl mussel survey of additional watercourses at the Muaitheabhal Windfarm, Eisgein Estate, Lewis*. Beinn Mhor Power Commissioned Report.

- **Cosgrove, P.** and Shields, D. 2012. *Farr micro hydro freshwater pearl mussel survey*. Green Highland Renewables Commissioned Report.

- **Cosgrove, P.** 2012. *Freshwater pearl mussel survey for the Beauly to Kintore Reconductoring Project*. Scottish Hydro Electric Transmission Ltd Commissioned Report.

- Bingham, C., Shields, D. and **Cosgrove, P.** 2012. *Glenmore Forest Formica exsecta survey report*. Forestry Commission Scotland Commissioned Report.

- **Cosgrove, P.** 2012. *Environmental Statement Ornithology Chapter, Stronelairg Wind Farm*. SSE Renewables Commissioned Report.
- **Cosgrove, P.** 2012. *Environmental Statement Ecology Chapter, Stronelairg Wind Farm*. SSE Renewables Commissioned Report.
- **Cosgrove, P.** 2012. *Environmental Statement Ecology Chapter, Bhlaraidh Wind Farm*. SSE Renewables Commissioned Report.
- **Cosgrove, P.** 2012. *Environmental Statement Ornithology Chapter, Bhlaraidh Wind Farm*. SSE Renewables Commissioned Report.
- **Cosgrove, P.** 2012. *Environmental Statement Ecology Chapter, Glencassley Wind Farm*. SSE Renewables Commissioned Report.
- **Cosgrove, P.** 2012. *Environmental Statement Ornithology Chapter, Glencassley Wind Farm*. SSE Renewables Commissioned Report.
- **Cosgrove, P.** 2012. *Burn of Whilk crossbill survey*. WYG Environment Planning Transport Ltd Commissioned Report.
- Shields, D and **Cosgrove, P.** 2012. *Phase 1 Habitat Survey Report, Corhulloch Farm, Dumfries and Galloway*. RES Commissioned report.
- McGregor, R and **Cosgrove, P.** 2012. *Auchenlosh Otter and Badger Survey*. A2 Environmental Commissioned Report.
- **Cosgrove, P.** 2012. *Inverailort Protected Mammal Survey*. Flichity Estates Partnership Commissioned Report.
- Shields, D and **Cosgrove, P.** 2011. *Freshwater pearl mussel survey of Gruinard River, Wester Ross*. Gruinard Estate Commissioned Report.
- **Cosgrove, P.** 2011. *Freshwater pearl mussel survey of watercourses at the proposed Dalnessie Wind Farm*. SSE Renewables Commissioned Report.
- **Cosgrove, P.** 2011. *Freshwater pearl mussel survey of additional watercourses at the Muaitheabhal Windfarm, Eisgein Estate, Lewis*. Beinn Mhor Power Commissioned Report.
- **Cosgrove, P.** 2011. *Environmental Statement Ecology Chapter, Sallachy Wind Farm*. WKN AG Commissioned Report.
- **Cosgrove, P.** 2011. *Environmental Statement Ornithology Chapter, Sallachy Wind Farm*. WKN AG Commissioned Report.
- **Cosgrove, P.** 2011. *Foyers Red Squirrel Survey*. SSE Generation Limited Commissioned Report.
- **Cosgrove, P.** 2011. *Freshwater pearl mussel survey of the Beauly-Dounreay Phase 2 Reinforcement Project: Cambusmore substation*. Scottish Hydro Electric Transmission Limited Commissioned Report.
- **Cosgrove, P.** 2011. *Freshwater pearl mussel survey of watercourses at the proposed Allt Duine wind farm, Kincraig.* RWE Npower Renewables Commissioned Report.
- (**Cosgrove, P.**). 2010. *Freshwater pearl mussel guidance for professionals working in and around Scottish rivers*. SNH Commissioned Leaflet and On-line guidance.
- Hastie, L.C., Watt, J. and **Cosgrove, P.J**. 2010. *Restoration of freshwater pearl mussels in selected Scottish rivers – Phase 2A – pilot study on reintroduction*. SNH Commissioned Report.
- (Webley, J., Dale, K. and **Cosgrove, P.**). 2009. *Glen Lyon Hydro Grid Connection freshwater pearl mussel survey*. EnviroCentre Commissioned Report for Ash design+assessment.

- **Cosgrove, P.** and Mitchell, A. 2009. *Freshwater pearl mussel survey of additional selected water bodies at the Muaitheabhal windfarm, Eisgein Estate, Isle of Lewis*. Land Use Consultants Commissioned Report.

- **Cosgrove, P.** and Watt, J. 2009. *Freshwater pearl mussel and fish habitat survey of Coire Fearna proposed hydro-electric scheme, Glenmoirdart, Lochaber*. TradeLink Solutions Ltd Commissioned Report.

- **Cosgrove, P.** 2009*. Site Condition Monitoring of freshwater pearl mussels in the River Ba, Rannoch Moor Special Area of Conservation.* SNH Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2009*. Freshwater pearl mussel survey of the River Moriston, Highland*. SSE Commissioned Report.

- **Cosgrove, P.** and Mitchell, A. 2009*. Site Condition Monitoring of freshwater pearl mussels in the Foinavon Special Area of Conservation.* SNH Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2009*. Site Condition Monitoring of freshwater pearl mussels in the North Harris Special Area of Conservation.* SNH Commissioned Report.

- Hastie, L. and **Cosgrove, P.** 2009. *Site Condition Monitoring of freshwater pearl mussels in the River Oykel Special Area of Conservation.* SNH Commissioned Report.

- (**Cosgrove, P.**) 2009. *Deepwater freshwater pearl mussel survey of the River Tay, Perth*. EnviroCentre Commissioned Report for Atkins.

- **Cosgrove, P.** on behalf of EnviroCentre. 2008. *Freshwater pearl mussel survey of selected water bodies at the proposed Viking Wind Farm, Shetland*. SSE Commissioned report.

- **Cosgrove, P.J.** and Hastie, L.C. 2008. *Site Condition Monitoring of freshwater pearl mussels in the Abhainn Clais an Eas and Allt a' Mhuilinn Special Area of Conservation*. SNH Commissioned Report.

- Hastie, L.C and **Cosgrove, P.J.** 2008. *Site Condition Monitoring of freshwater pearl mussels in the Loch Stack Site of Special Scientific Interest*. SNH Commissioned Report.

- **Cosgrove, P.J.** and Hastie, L.C. 2008. *Site Condition Monitoring of freshwater pearl mussels in the Ardvar and Loch a' Mhuilinn Woodlands Special Area of Conservation*. SNH Commissioned Report.

- **Cosgrove, P.J.** and Hastie, L.C. and Mitchell, A. 2008. *Site Condition Monitoring of freshwater pearl mussels in the Inverpolly Special Area of Conservation*. SNH Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2008. *Freshwater pearl mussel survey of the River Spey, at Kingussie*. Scottish Water Solutions Commissioned report.

- **Cosgrove, P.** and Mitchell, A. 2008. *Freshwater pearl mussel survey of the Abhainn Shlatach and Allt na h-aire at a proposed hydro-electric scheme, Glenfinnan, Lochaber*. Tradelink Solutions Ltd Commissioned Report.

- **Cosgrove, P.** 2008. *Freshwater pearl mussel survey of a proposed bridge crossing, Kilbraur, Gordonbush, Sutherland*. SSE Commissioned Report.

- **Cosgrove, P.** 2008. *Freshwater pearl mussel survey of selected waterbodies at the proposed Pairc Wind Farm, Isle of Lewis*. SSE Commissioned Report.

- **Cosgrove, P.** and Mitchell, A. 2008. *Freshwater pearl mussel survey of selected water bodies at proposed hydro-electric schemes, Kinlochmoidart, Lochaber*. Tradelink Solutions Ltd Commissioned Report.

- **Cosgrove, P.** 2008. *Freshwater pearl mussel survey of the Glenforslan River and River Moidart at a proposed hydro-electric scheme, Kinlochmoidart, Lochaber*. Tradelink Solutions Ltd Commissioned Report.

- **Cosgrove, P.** 2008. *Freshwater pearl mussel survey of selected water bodies at the proposed Pairc wind farm, Isle of Lewis*. SSE Commissioned report.

- **Cosgrove, P.** and Farquhar, J. 2008. *Southwest Scotland Project freshwater pearl mussel survey*. Land Use Consultants Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2008. *Freshwater pearl mussel survey of the Ullapool River and Rhidorroch River, NW Scotland*. Rhidorroch Estate Commissioned Report.

- **Cosgrove, P.**, Hastie, L., MacDougal, K. and Kelly, A. 2007. *Development of a remote, deep-water survey method for freshwater pearl mussels*. SNH Commissioned Report No 263 (ROAME No. F06AC606).

- (**Cosgrove, P.** and MacDougal, K.) EnviroCentre. 2007. *Feasibility study for improving fish passage in two rivers: Mingarry Burn and Allt Grigadale*. SNH Commissioned Report No 250 (ROAME No. R06AC611).

- **Cosgrove, P.** and Farquhar, J. 2007. *Freshwater pearl mussel survey of selected water bodies in the Kinlochbervie Water Resource Zone, NW Scotland*. Mott MacDonald Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2007. *Freshwater pearl mussel survey of selected water bodies in the Lochdornoch Water Resource Zone, River Evelix*. Mott MacDonald Commissioned Report.

- **Cosgrove, P.** and Hastie, L. 2007. *Freshwater pearl mussel survey of selected water bodies at the Muaitheabhal Windfarm, Eisgein Estate, Isle of Lewis*. Land Use Consultants Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2007. *Freshwater pearl mussel survey of the River Spey at Aviemore and Allt na Criche at Lynwilg*. Scottish Water Solutions Commissioned Report.

- **Cosgrove, P.** and Hastie, L. 2007. *Freshwater pearl mussel survey of the River Spey at Grantown on Spey*. Scottish Water Solutions Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2007*. Freshwater pearl mussel survey and assessment of selected water bodies at the A'Chruach Windfarm, Minard, Argyll*. Terence O'Rourke Commissioned Report.

- **Cosgrove, P.J.** and Hastie, L.C. 2007. *Freshwater pearl mussel survey of the River Spey, South Bank, at Carron, Aberlour, Moray. Part I.* Diageo Commissioned Report.

- **Cosgrove, P.J.** and Hastie, L.C. 2007. *Freshwater pearl mussel survey of the River Spey, South Bank, at Carron, Aberlour, Moray. Part II*. Diageo Commissioned Report.

- Hastie, L. and **Cosgrove, P.J.** 2007. *Freshwater pearl mussel survey of the River Spey at Arndilly, Moray*. Smiths Gore Commissioned Report.

- Hastie, L.C. and **Cosgrove, P.J.** 2007. *Freshwater pearl mussel survey of the Coladoir River, Isle of Mull*. SNH Commissioned Report.

- **Cosgrove, P.J.** and Jackson, S.J. 2007. *Freshwater pearl mussel survey of the River Cree, Dumfries*. SNH Commissioned Report.

- **Cosgrove, P.J.** and Jackson, S.J. 2007. *Freshwater pearl mussel survey of the Palnure Burn, Dumfries*. SNH Commissioned Report.

- **Cosgrove, P.J.** 2007. *Freshwater pearl mussel survey of the River Bellart, at Dervaig, Isle of Mull*. SNH Commissioned Report.

- ERA/**Cosgrove and Hastie Associates**. 2007. *Restoration of freshwater pearl mussel in selected Scottish rivers Phase I(A): candidate rivers for restoration*. SNH Commissioned Report.

- (**Cosgrove, P.**) EnviroCentre. 2007. *The KLR Biodiversity/Habitat Management Plan*. EnviroCentre Commissioned Report for The Kirkintilloch Initiative.

- (**Cosgrove, P.**) EnviroCentre. 2006. *Irish Screening Protocol for Aquaculture*. EnviroCentre Commissioned Report for The Irish Sea Fisheries Board.

- (**Cosgrove, P.**) EnviroCentre. 2006. *Woodilee Biodiversity/Habitat Management Plan*. EnviroCentre Commissioned Report for Cala Homes.

- (**Cosgrove, P.** and McMullan, R.) EnviroCentre. 2006. *Aquaculture Appropriate Assessments of the implications for the conservation interests of Scottish Natura 2000 sites*. EnviroCentre Commissioned Report for The Crown Estate.

- **Cosgrove, P.** and Hastie, L. 2006. *Freshwater pearl mussel survey of the River Dee at Waterside, Aberdeen.* Dee District Salmon Fishery Board Commissioned Report.

- **Cosgrove, P.** and Hastie, L. 2006. *Freshwater pearl mussel survey of the River Dee, South bank, at Dee Street Bridge, Banchory, Aberdeenshire.* The Banchory Fishings Commissioned Report.

- (**Cosgrove, P.**) 2005. Biodiversity Planning Guidance Note for the Householder. Cairngorms National Park Authority.

- **Cosgrove, P.** 2005. *Freshwater pearl mussel survey of the River Dee at Dee Street Bridge, Banchory, Aberdeenshire.* Byzak Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2005. *Conservation of Atlantic Salmon in Scotland LIFE project: freshwater pearl mussel survey.* Dee District Salmon Fishery Board Commissioned Report.

- **Cosgrove, P.** and Moggach, A. 2005. *Freshwater pearl mussel survey of the River Spey at Dipple, Fochabers*. Mott MacDonald Ltd Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2005. *Freshwater pearl mussel survey of the Maldie Burn and Abhainn a' Ghlinne Dhuibh, Glendhu, Sutherland.* ASH Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2005. *Freshwater pearl mussel survey* of the Kilmartin River and Rivers Snizort and Ord. SNH Commissioned Report.

- **Cosgrove, P.**, Moggach, A. and Hastie, L. 2004. *Freshwater pearl mussel survey for the Rothes Flood alleviation scheme*. Posford Haskoning Ltd, Royal Haskoning Commissioned Report.

- **Cosgrove, P.J.**, Moggach, A. and Farquhar, J.E. 2004. *Freshwater pearl mussel survey of the Inverpolly candidate Special Area of Conservation.* SNH Commissioned Report.

- **Cosgrove, P.J.** and Moggach, A. 2004. *Freshwater pearl mussel survey of the Ardvar and Loch a'Mhuilinn woodlands candidate Special Area of Conservation.* SNH Commissioned Report.

- **Cosgrove, P.J.** and Moggach, A. 2004. *Freshwater pearl mussel survey of the Glen Beasdale candidate Special Area of Conservation.* SNH Commissioned Report.

- **Cosgrove, P.J.** 2004. *Freshwater pearl mussel survey of the Loch Stack Site of Special Scientific Interest.* SNH Commissioned Report.

- **Cosgrove, P.J.** 2003. *Freshwater pearl mussel survey of the Stanley Mills Weir, River Tay*. RWE Innogy Commissioned Report.

- Hastie, L.C., **Cosgrove, P.J.**, Farquhar, J.E. and Socrates, A. 2003. *Freshwater pearl mussel survey of the Rivers Naver-Mallart Special Area of Conservation.* SNH Commissioned Report.

- Hastie, L.C., **Cosgrove, P.J.**, Farquhar, J.E. and Socrates, A. 2003. *Freshwater pearl mussel survey of the River Oykel candidate Special Area of Conservation.* SNH Commissioned Report.

- Hastie, L.C. and **Cosgrove, P.J.** 2003. *Freshwater pearl mussel survey of the River Moriston candidate Special Area of Conservation.* SNH Commissioned Report.

- Hastie, L.C. and **Cosgrove, P.J.** 2003. *Freshwater pearl mussel survey of the River Tay system candidate Special Area of Conservation.* SNH Commissioned Report.

- **Cosgrove, P.J.**, Hastie, L.C. and Farquhar, J.E. 2003. *Freshwater pearl mussel survey of River Dee candidate Special Area of Conservation.* SNH Commissioned Report.

- **Cosgrove, P.**, Hastie, L. and. Watt, J. 2003. *Freshwater pearl mussel and otter survey and environmental assessment of proposed pipe construction and operations at Invercannie water treatment works, Banchory, River Dee, Aberdeenshire*. Scottish Water Commissioned Report.

- **Cosgrove, P.** and Farquhar, J. 2003. *Freshwater pearl mussel survey around proposed bank repair works on the Lummels Pool, at Aboyne Fishings, River Dee, Aberdeenshire*. Aboyne Water Fishings Commissioned Report.

- Laughton, R, **Cosgrove, P.J.** and Hastie, L.C. 2003. *The effect of Ranunculus removal on juvenile salmonids and Freshwater pearl mussels in the River Spey*. SNH Commissioned Report.

- **Cosgrove, P.** 2002. Freshwater pearl mussel survey for the A830 Arisaig to Loch Nan Uamh Road Development. SNH Commissioned Report.

- **Cosgrove, P.J.** and Hastie, L.C. 2002. *Freshwater pearl mussel survey of the Ahainn Dubh at Inverbain, Shieldaig, Highland.* Innogy Commissioned Report.

- Hastie, L.C. and **Cosgrove, P.J.** 2002. *Freshwater pearl mussel survey at Strachan, Water of Feuch, Aberdeenshire.* Scottish Water Commissioned Report.

- **Cosgrove, P.J**. and Hastie, L.C. 2002. *Freshwater pearl mussel survey and environmental assessment of a proposed outfall modification, Fochabers, River Spey, Morayshire.* Scottish Water Commissioned Report.

- **Cosgrove, P.J.** and Hastie, L.C. 2002. *Freshwater pearl mussel monitoring survey 2002 following river engineering work at Carron and Laggan fishings, River Spey, Morayshire.* SNH Commissioned Report.

- **Cosgrove, P.J.** and Hastie, L.C. 2002. *Freshwater pearl mussel survey of the River Tarff, Fort Augustus, Highland.* ASH Commissioned Report.

- **Cosgrove, P.**, Farquhar, J., Watt, J. and Birkeland, K. 2002. *Freshwater pearl mussel survey of the Ahainn na Coinnich, Highland.* ASH Commissioned Report.

- **Cosgrove, P.J.** 2002. *Freshwater pearl mussel survey of selected burns in Shetland*. Shetland Biological Records Centre Commissioned Report.

- Hastie, L.C. and **Cosgrove, P.J.** 2002. *Freshwater pearl mussel survey of the Douglas Water, Argyll.* Environmental Resources Management Commissioned Report.

- **Cosgrove, P**. and McKnight, A. 2001. *The Cairngorms Upland Grain Project*. A joint Cairngorms Local Biodiversity Action Plan and Cairngorms Farming and Wildlife Advisory Group report.

- **Cosgrove, P.** and Farquhar, J. 2001. *Freshwater pearl mussel survey of the River Moriston, Inchmore Fish Farm, Highland.* Marine Harvest Commissioned Report.

- Hastie, L.C. and **Cosgrove, P.J.** and Young, M.R. 2001. *Freshwater pearl mussel survey and environmental assessment at Aberlour and Craigellachie, River Spey Morayshire.* North of Scotland Water Authority (NoSWA) Commissioned Report.

- **Cosgrove, P.J.** 2001. *Freshwater pearl mussel survey of Stanley Mill race, adjacent to the River Tay, Perthshire.* Innogy Commissioned Report.

- **Cosgrove, P.J.**, Hastie, L.C. and Young, M.R. 2001. *Freshwater pearl mussel monitoring survey following river engineering work on the River Connon, Highland.* NoSWA Commissioned Report.

- **Cosgrove, P.J.** and Hastie, L.C. 2001. *Freshwater pearl mussel monitoring survey following river engineering work at the Carron and Laggan Fishings, River Spey, Moray*. SNH Commissioned Report.

- **Cosgrove, P.J.**, Hastie, L.C. and Farquhar, J.E. 2001. *Freshwater pearl mussel and river habitat survey of candidate Special Areas of Conservation: River Evelix, Badnaban Burn and Clashnessie Burn*. SNH Commissioned Report.

- **Cosgrove, P.J.**, Hastie, L.C. and Young, M.R. 2001. *National survey of the Freshwater pearl mussel – Phase II*. *Deepwater survey methodology*. SNH Commissioned Report.

- **Cosgrove, P.J.**, Hastie, L.C. and Young, M.R. 2000. *National survey of the Freshwater pearl mussel – Phase II*. SNH Commissioned Report.

- Hastie, L.C. and **Cosgrove, P.J.** 2000. *Environmental Impact Assessment of proposed river engineering works in the middle reaches of the River Spey*. SNH Commissioned Report.

- Hastie, L.C. and **Cosgrove, P.J.** 2000. *Freshwater pearl mussel survey of the River Dee near Lower Dess Mill, Kincardinshire O'Neil*. Morgan Fisheries Consultancy Commissioned Report.

- **Cosgrove, P.J.** and Hastie, L.C. 2000. *Freshwater pearl mussel* Margaritifera margaritifera *survey of the River X (confidential), Knoydart*. SNH Commissioned Report.

- **Cosgrove, P.J**. and Hastie, L.C. 2000. *Freshwater pearl mussel* Margaritifera margaritifera *survey of the Ardnamurchan burns.* SNH Commissioned Report.

- **Cosgrove, P.J.** 1999. *Beauly Firth Birds: a review report*. Hartley Anderson Ltd Commissioned Report.

- **Cosgrove, P.J.** and Farquhar, J.E. 1999. *Distribution and conservation status of the freshwater pearl mussel* Margaritifera margaritifera *in Lewis and Harris*. SNH Commissioned Report.

- **Cosgrove, P.J.** 1999. *Survey of the proposed River Moidart SAC for the presence of Freshwater Pearl Mussels* Margaritifera margaritifera. SNH Commissioned Report.

- **Cosgrove, P.J.** Young, M.R. and Hastie, L.C. 1999. *River Conon Freshwater Pearl Mussel monitoring programme*. NoSWA Commissioned Report.

- **Cosgrove, P.J.** 1999. *Survey of the proposed River Kerry SAC for the presence of Freshwater Pearl Mussels* Margaritifera margaritifera. SNH Commissioned Report.

- **Cosgrove, P.J.** Young, M.R. and Hastie, L.C. 1999. *The River Conon Freshwater Pearl Mussel translocation programme*. NoSWA Commissioned Report.

- **Cosgrove, P.J.** 1998. *Blackdog Environmentally Friendly Housing Environmental survey*. Aberdeenshire Council Commissioned Report.

- **Cosgrove, P.J.** and Young, M.R. 1998. *Survey of the River Conon for the presence of Freshwater Pearl Mussels (*Margaritifera margaritifera *Linn.)*. NoSWA Commissioned Report.

- **Cosgrove, P.J.** and Young, M.R. 1998. *Freshwater pearl mussel survey of the River Spey: Phase 1*. SNH Commissioned Report.

- **Cosgrove, P.J.** 1998. *Freshwater pearl mussel survey of the River Clunie*: Dee Salmon Fishery Board Commissioned Report.

- Cooksley, S.L. and **Cosgrove, P.J.** 1998. *Monitoring wood-ants in native pine woodland during regeneration*. SNH Commissioned Report.

- **Cosgrove, P.J.** and Young, M.R. 1998. *The status of the freshwater pearl mussel* Margaritifera margaritifera *in Scotland*. SNH Commissioned Report.

- Rae, S. and **Cosgrove, P.** 1997. *Botanical survey of upland areas around Loch Seaforth, North Harris: Phase II South Eisken.* SNH Commissioned Report.

- **Cosgrove, P.J.** 1997. *Distribution survey of Freshwater Pearl* Mussels Margaritifera margaritifera*: Observation records by Vice Counties in Scotland*. SNH Commissioned Report.

- Patterson, I.J., Kantolla, P.S., Oldfield, S. and **Cosgrove, P.J.** 1997. *Nesting distribution and nesting success of Eiders on Forvie National Nature Reserve*. SNH Commissioned Report.

- Patterson, I.J. and **Cosgrove, P.J.** 1997. *The Eider population of Forvie National Nature Reserve*. SNH Commissioned Report.

- Patterson, I.J. and **Cosgrove, P.J.** 1997. *Waders and waterfowl on the Ythan estuary 1996/97*. SNH Commissioned Report.

- Patterson, I.J. and **Cosgrove, P.J.** 1997. *Monitoring of a goose management scheme for the Strathbeg area.* SNH Commissioned Report.

- **Cosgrove, P.J.** 1997. *North Sea Bird Club Annual Report 1995/1996*, Aberdeen University.

- Lambin, X., Telfer, S., **Cosgrove, P.** and Alexander, G. 1996. *Survey of Water voles and American mink on the Rivers Don and Ythan*. SNH Commissioned Report.

- Patterson, I.J., **Cosgrove, P.J.** and Doyle, P. 1996. *Water quality and input of nutrients in winter by roosting birds at the Winter Loch, St Fergus, winter 1995/6*. St Fergus Dunes Management Committee Commissioned Report.

- **Cosgrove, P.J.** 1996. *Survey of piscivorous birds on the R. Deveron*. SNH Commissioned Report.

- **Cosgrove, P.** and Turner, R. 1995. *A review of the UK Government's commitments and responses to the Rio and Helsinki Biodiversity Forest Principles*, RSPB Commissioned Report.

- **Cosgrove, P.J.** and Doyle, P.A.T. 1995. *North Sea Bird Club Annual Report 1993/1994*, Aberdeen University.

- Harley, D. and **Cosgrove, P.** 1990. *Compendium of timber statistics*. RSPB Commissioned Report.

- **Cosgrove, P.**, Gordon, C., Bainbridge, I. and Turner, R. 1990. *Forestry consultations in England and Wales. A survey of County Councils and National Parks*. RSPB Commissioned Report.

POPULAR/MAINSTREAM WRITING:

- **Cosgrove, P.,** Shields, D. and Cosgrove, C. 2014. *Mollusc of the Glen*. British Wildlife 26:18-19.

- **Cosgrove, P.** Guest blog: *Tactics of the raptor haters*. Standing up for Nature. http://markavery.info/2014/11/12/guest-blog-peter-cosgrove

- **Cosgrove, P.**, Hastie, L. and Sime, I. 2012. *Wildlife crime and Scottish freshwater pearl mussels*. British Wildlife 24:1 pp 10-13.

- **Cosgrove, P.**, Amphlett, A., Elliott, A., Ellis, C., Emmett, E., Prescott, T. and Watson Featherstone, A. 2005*. Aspen: Britain's missing link with the boreal forest*. British Wildlife 17:2 pp 107-115.

- **Cosgrove, P.** and Field, B. 2005. *Home and Away: São Tomé and Principe, Gulf of Guinea Islands*. Birding World 18 (2) 81-82.

- **Cosgrove, P.** 2003. *Trends and change in Scottish freshwater pearl mussel populations*. Recorder News, Biological Recording in Scotland: 50, pp 8-9.

- *The Cairngorms Local Biodiversity Action Plan*. 2002. **Eds. Cosgrove, P.** and the Cairngorms Local Biodiversity Action Plan Steering Group. The Cairngorms Partnership.

- *The Biodiversity and management of Aspen woodlands.* 2002. **Eds. Cosgrove, P.** and Amphlett, A. The Cairngorms Partnership.

- **Cosgrove, P.** 2001. *Devils' island: illegal bird killing in Cyprus*. Birdwatch 106: pp 22-24.
- **Cosgrove, P.** 2001. *Bird killing in Cyprus*. Scottish Bird News 61: pp 4.
- **Cosgrove, P.**, Hastie, L. and Young, M. 2000. *Freshwater pearl mussels in peril*. British Wildlife 11:5 pp 340-347.
- **Cosgrove, P.** 1999. *Rat colonisation of Eynhallow, Orkney*. Orkney Field Club Bulletin 1999.
- **(Cosgrove, P).** 1999. *Caught in a trap: wildlife crime in Scotland*. The Angry Corrie: 41 pp 8.
- **Cosgrove, P.** 1999. *Red-flanked Bluetail at Newburgh*, North-east Scotland 1998. Birding Scotland 2:1 pp 36-38.
- Evans L.G.R. and **Cosgrove P.J.** 1997. *Turtle identification and sightings in British Waters*. Rare Birds 3:6 pp 268-269.
- Evans L.G.R. and **Cosgrove P.J.** 1997. *A Red-billed Starling in the North Sea- escape or vagrant?* Rare Birds 3:6 pp 270.
- **Cosgrove P.J.** 1997. *Fish-eating birds: a review*. Scottish Bird News: 44.
- **Cosgrove, P.J.** 1995-1998. Editor of 'The Fulmar: Bulletin of the North Sea Bird Club' Nos. 73-84.
- Jardine, D., **Cosgrove, P.**, Holmes, M. and Bankier, S. 1994. *Recoveries and controls from Siskins caught in Northumbria*. Northumbrian Birds 1993.

CURRICULUM VITAE
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RECENT CAREER SUMMARY

2015–present day	Principle Ecologist and Botanist with Alba Ecology.
2012 -2015	Senior Ecologist, Alba Ecology.
2010 -2012	Ecologist, Alba Ecology.
2008-2009	Post-doc Researcher, University of Aberdeen.
2007-2008	Biodiversity Officer, Environment Agency

EDUCATION

2003-2007	PhD. Biology and Environmental Science, University of Sussex.
2002-2003	MSc. Ecology, University of Aberdeen.
1998-2001	BSc. (Hons) Environmental Geoscience, University of Bristol.

PROFILE

Kate is a highly experienced ecologist with over fifteen years working in ecological research and habitat assessment. She is a particularly skilled botanist and respected habitat surveyor. She has contributed to and led on many large projects and has a strong proven track record of delivery in both the public and private sector, producing over 100 peer-reviewed scientific papers and commissioned reports.

Kate's main roles as a Principle Ecologist within Alba Ecology is carrying out habitats assessments for a range of projects and providing ecological advice particularly in relation to plants and habitats. Kate leads all the botanical based work such as Phase 1 Habitat, National Vegetation Classification (NVC), Groundwater Dependant Terrestrial Ecosystem (GWDTE) and floristic surveys for protected plants. In the last 10 years, she has successfully worked on numerous projects in the north of Scotland, and has got the vegetation and habitat element of ES's accepted on Mossy Hill Wind farm, Bhlaraidh Wind Farm, Stronelairg Wind Farm, Glencassley Wind Farm and Sallachy Wind Farm with others currently going through the planning/consents process (e.g. Coul Links Golf Course). Kate has written the Ecology ES chapters for Mossy Hill Wind Farm, Beaw Field Wind Farm and many that are currently actively in the planning process. Kate has experience of attending Public Inquiry as part of the planning process.

Kate is interested in invasive species management and led a recent successful efforts to remove non-native American Skunk Cabbage from a tributary of the River Spey Special Area of Conservation. Kate has surveyed for a range of non-native invasive species and has produced management plans to form the bases of irradiation programs.

RELEVANT EXPERIENCE

Habitats and Vegetation

Kate has carried out numerous Phase 1 Habitat, NVC and GWDTEs surveys in a wide range of habitats and vegetation types including uplands, montane area, sand dunes and grasslands. Kate co-ordinates the projects, carries out field work, writes the associated reports figure. Recent projects include the Distillery near Craggan, Mossy Hill Wind farm, Lairg Wind farm, Coul Links Golf Course, Viking Wind Farm, Bhlaraidh Wind Farm, Stronelairg Wind Farm, Glencassley Wind Farm and Sallachy Wind Farm, plus numerous smaller scale projects (single turbines, housing developments etc).

Ecological project co-ordination

Kate has led on the production of the Ecology elements of Environmental Statements for a number of large scale projects, including chapter writing, technical appendix writing and figure production. Recent projects include the Distillery near Craggan, Lairg Wind Farm, Coul Links Golf Course, Mossy Hill Wind Farm, Beaw Field Wind Farm with many still going through the planning process.

Kate also co-ordinates all habitat and vegetation projects, including managing field workers, writing report, meeting deadlines and providing advice.

Peatland Restoration

A particular strength is Kate's work on large-scale peatland restoration projects in relation to wind farm developments and the Forestry Commission land in the north and west of Scotland. This work has featured strongly in Habitat Management Plans we have developed for many of our recent clients.

GIS, Data Handling and Statistical Analysis

Kate is also our GIS specialist and statistics advisor. She is highly skilled in dealing with complex data sets. She has provided the Collision Risk Assessments (CRA) for numerous wind farm sites including Lairg Wind Farm, Blarghour Wind Farm and Mossy Hill Wind Farm. Kate performs analysis on our ecological data when required, such as modelling bird population dynamics using VORTEX.

Kate is proficient in using ArcGIS and QGIS. Her work involves creating, drawing and editing ecological data such as habitat polygons and flightlines as well as producing the maps and figures for ES submissions. Kate has a good working knowledge of statistical and data presentation packages such as Minitab, VORTEX and Simgmplot.

Species Surveys

Kate is experienced in undertaking surveys for a range of rare and/or protected species such as botanical surveys for rare species, freshwater pearl mussels, otters, water voles, red squirrels and badger. Kate has undertaken freshwater pearl mussel surveys in a range of rivers, including survey several Special Areas of Conservation (SACs) designated for freshwater pearl mussels.

RELEVANT SKILLS

Vascular Plants

- Excellent plant identification skills for plants found in grasslands, sand dunes and salt marshes and upland habitats including heaths, mires, flushes and montane habitats.

Non-native Invasive Species

- Excellent identification skills for non-native invasive plant species. Provides surveys for a range of non-native invasive species and produced management plans to form the bases of irradiation programs.

Non Vascular Plants

- Good bryophyte identification skills (attended bryophyte identification course, Royal Botanic Gardens, Edinburgh, and *Sphagnum* identification course).

Habitats and communities

- Highly experienced (>15 years) in Phase 1 Habitat and NVC surveying.
- Experienced (~10 years) in assessing potential groundwater dependant terrestrial ecosystems.

Mammals

- Experienced in following standard guidance and standard survey techniques for a range of mammal surveys and identifying mammal field signs for a range of species (e.g. water voles, otters, badgers, pine marten and red squirrel).

Freshwater Pearl Mussels

- Experienced in identification and following standard survey techniques at a range of rivers including several SAC designated for Freshwater pearl mussels.

Computer Skills

- Highly skilled user of PC desktop systems; using standard packages such as Windows Excel, Word, Powerpoint etc. Also skilled in GIS software using both ArcGIS and QGIS and statistical packages such as Minitab, VORTEX and Sigmaplot.

Presentation skills

- Presented scientific research at several conferences such as the British Ecological Society annual conference. Regularly presents information at project team meetings.
- Run a series of seminars at universities on a range of ecological subjects.

OTHER QUALIFICATIONS

Full driving licence. Member of Chartered Institute of Ecology and Environmental Management. Current First Aid Certificate. Safe Space Certificate.

PERSONAL INTERESTS AND HOBBIES

Hill walking. Mountain biking. Naturalist. Kate also volunteers through Girl-guiding as both a Brownies and Guide Unit Leader running weekly meetings, camps, holidays and activities for young girls and teenagers.

PUBLICATIONS

Massey, K., Cosgrove, P**.**, Massey, F., Jackson, D. and Chapman, M. 2016. Habitat characteristics of breeding Eurasian Whimbrel *Numenius phaeopus* on Mainland Shetland, Scotland, UK. *Bird Study* **63**: 500-508.

Massey, F.P. **Massey, K**., Ennos, A.R. and Hartley, S.E. 2009. Impacts of silica-based defences in grasses in the feeding preference of sheep. *Basic and Applied Ecology,* **10:** 622-630.

Massey, F.P., **Massey, K**., Press, M.C. and Hartley, S.E. 2006. Neighbourhood composition determines growth architecture and herbivory in tropical rain forest tree seedlings. *Journal of Ecology*. **94**: 646-655.

COMMISSIONED REPORTS

Cosgrove, P., **Massey, K.** Anderson, D., Shields, D. 2020. Cairngorms Crane Project: Feasibility Study for Crane Reintroduction. A commissioned report by Scotland: The Big Picture and the Cairngorms National Park Authority.

Massey, K. and Cosgrove, P. 2019. *Protected Terrestrial Mammal, Woodant and Rare Plant Survey Report for Proposed Glenmore Footpath*. Commissioned Report.

Massey, K. and Cosgrove, P. 2020. Freshwater pearl mussel survey of the Abhainn Bheag an Tunns, Argyll, 2020. Scottish Woodlands Commissioned Report.

Cosgrove, P., Shields, D., Anderson, D. and **Massey, K**. 2020. Understanding the impact of the 2018 drought on key freshwater pearl mussel populations in Scotland. SNH Research Report.

Cosgrove, P. and **Massey, K.** 2020. River Spey, Boat O'Brig freshwater pearl mussel translocation, 2020. Network Rail Commissioned Report.

Massey. K. and Shields. D. 2019. *Lairg II Wind Farm Ecology Environmental Statement*. Commissioned Report.

Massey, K. 2019. *Nethybridge Housing Phase 1 Habitat, NVC and GWDTE report*. Commissioned Report.

Massey. K. and Anderson. D. 2019. *Lairg II Wind Farm Ornithology Environmental Statement.* Commissioned Report.

Massey. K. and Anderson. D. 2019. *Lairg II Wind Farm Lairg Collision Risk Assessment. ES Technical Appendix.* Commissioned Report.

Massey. K. 2019. *Lairg II Wind Farm Natural Heritage Information Desk Study. ES Technical Appendix.* Commissioned Report.

Massey, K. and Cosgrove, P. 2019. *Lairg II Outline Habitat Management Plan. ES Technical Appendix.* Commissioned Report.

Massey. K. 2019. *Dunnottar Park, Stonehaven Invasive, Non-native Species Management Plan.* Commissioned Report.

Massey. K. 2019. *Dunnottar Park, Stonehaven Invasive, Non-native Species Survey Report*. Commissioned Report.

Cosgrove, P., Anderson, D., Shields, D. & **Massey, K**. 2019. *Freshwater Pearl Mussel Survey of Forestry and Land Scotland Badenoch and Strathspey Watercourses*. Forest and Land Scotland Commissioned Report.

Cosgrove, P., Anderson, D., Shields, D. and **Massey, K**. 2019. *Boat O'Brig Freshwater Pearl Mussel Survey, River Spey, 2019. C*ommissioned Report.

Cosgrove, P. and **Massey, K**. 2019. Freshwater Pearl Mussel Survey, Clashnessie Burn. Scottish Water Commissioned Report.

Massey. K. 2019. *Cromdale Housing Phase 1 Habitat, NVC and GWDTE report.* Commissioned Report.

Massey. K. 2019. *Distillery at Craggan Natural Heritage Desk Study Report*; ES Technical Appendix. Commissioned Report.

Cosgrove, P and **Massey, K.** 2019. *Distillery at Craggan Outline Habitat Management Plan*. ES Technical Appendix. Commissioned Report.

Massey, K and Cosgrove, P. 2019. *Distillery at Craggan Enviromental Statement - Ecology*. Commissioned Report.

Massey, K. 2019. *Phase 1 Habitat Survey and Groundwater Dependent Terrestrial Ecosystems Report for the proposed distillery at Craggan North of the A95 at Grantown on Spey.* ES Technical Appendix. Commissioned Report.

Massey. K and Shields, D. 2018. *Distillery at Craggan Phase 1 Habitat, NVC GWDTE Survey Report*. ES Technical Appendix. Commissioned Report.

Shields, D and **Massey, K.** 2018. *Lairg II Wind Farm Phase 1 Habitat, NVC and GWDTE report. ES Technical Appendix.* Commissioned Report.

Massey. K and Anderson. D. 2018. *Blarghour Wind Farm Collision Risk Assessment report*. ES Technical Appendix. Commissioned Report.

Massey, K. and Cosgrove, P. 2018. *Blarghour Wind Farm Environmental Statement - Ecology*. Commissioned Report.

Cosgrove, P. and **Massey, K.** 2018. *Blarghour Wind Farm Outline Habitat Management Plan*. ES Technical Appendix. Commissioned Report.

Massey, K., Anderson, D and Cosgrove, P. 2018. *Mossy Hill Bird Technical Report*. ES Technical Appendix. *Commissioned Report*.

Massey. K. 2018. *Mossy Hill Wind Farm Phase 1 Habitat, NVC and GWDTE report*. ES Technical Appendix. Commissioned Report.

Massey, K. and Cosgrove, P. 2018. *Mossy Hill Wind Farm Natural Heritage Desk Study*. ES. ES. Technical Appendix. Commissioned Report.

Massey. K. 2018. *Mossy Hill Wind Farm Collision Risk Assessment report*. ES Technical Appendix. Commissioned Report.

Massey, K. and Cosgrove, P. 2018. *Mossy Hill Wind Farm Environmental Statement*. *Commissioned Report*.

Cosgrove, P and **Massey, K**. 2018. *Mossy Hill Wind Farm Outline Habitat Management Plan.* ES Technical Appendix. Commissioned Report.

Massey, K. 2018. *Phase 1 Habitat Survey of LH Stainless, Towiemore*. Commissioned Report.

Massey, K. 2018. *River Fiddich Abstraction, Non-native Invasive Plant Species Survey 2018*. Commissioned Report.

Massey, K. 2018. *Collision Risk Model for Strathbeg Wind Farm*. Commissioned Report.

Shields, D. and **Massey, K**. 2018. Freshwater Pearl Mussel Survey of the River Dee by Ballater Bridge, Aberdeenshire. Aberdeenshire Council Commissioned Report.

Massey. K. 2017. *Blarghour Wind Farm Phase 1 Habitat, NVC and GWDTE report*. ES Technical Appendix. Commissioned Report.

Massey, K. and Cosgrove, P. 2017. *Lochaber Smelter Environmental Statement – Ecology Chapter*. Commissioned Report.

Massey, K and Cosgrove, P. 2017. *Phase 1 Habitat, Protected Terrestrial Mammal and Bat Roost Potential Surveys at Jacobite Cruises, Loch Ness*. Commissioned Report.

Shields, D. and **Massey, K**. 2017. *Phase 1 Habitat Survey of North Chesthill Hill Track*. Commissioned Report.

Massey, K, Shields, D, Potter, R and McMullen, A. 2017. *National Vegetation Classification Survey and Groundwater Dependant Terrestrial Ecosystem Report for Ourack Wind Farm*. Commissioned Report.

Massey, K. 2017. *Phase 1 Habitat, Protected Terrestrial Mammal and Bat Roost Potential Surveys at Proposed Car Park Extensions at Inverness Airport*. Commissioned Report.

Potter, R. and **Massey, K**. 2017. *National Vegetation Classification Survey Report for Camore.* Commissioned Report.

Massey, K. 2017. *Updated Phase 1 Habitat and Non-native Invasive Plant Species Survey of Carron Den, Stonehaven*. Commissioned Report.

Massey, K and Potter, R. 2016. *Phase 1 Habitat, NVC and GWDTE report for Coul Links*. Commissioned Report.

Massey, K. 2016**.** *Aerial Comparisons of Habitats at Coul Links between 1988, 2009 and 2016*. Commissioned Report.

Shields, D and **Massey K**. 2016. *Fonseca's Seed-fly Botanophila fonsecai Survey Report for Coul Links, Sutherland*. Commissioned Report.

Massey, K. and Cosgrove, P. 2016. *Coul Links Golf Course Environmental Statement – Ecology Chapter.* Commissioned Report.

Cosgrove, P. and **Massey, K**. 2016. *Beaw Field Wind Farm Environmental Statement – Ecology Chapter*. Peel Energy Ltd. Commissioned Report.

Massey. K. and Shields. D. 2016. *Beaw Field Wind Farm Phase 1, NVC and GWDTE report*. Commissioned Report.

Massey. K., Cosgrove, P. and Shields. D. 2016. *Beaw Field Wind Otter survey report*. Commissioned Report.

Massey, K. 2016. *Red-throated diver population modelling for Beaw Field Wind Farm*. Commissioned Report.

Potter, R. and **Massey, K**. 2016. *Phase 1 Habitat Survey Report for Brodie Castle.* Commissioned Report.

Massey. K. and Cosgrove. 2016. *Peatland Hag restoration at Glen Affric*. Commissioned Report.

Shields, D. and **Massey, K**. 2016. *Phase 1 Habitat Survey Report for Culcairn, Evanton, Ross and Cromarty*. Commissioned Report.

Shields, D and **Massey, K.** 2016. *Freshwater pearl mussel survey of the River Dee at Ballater Bridge, Aberdeenshire*. Commissioned Report.

Shields, D and **Massey, K**. 2015. *National Vegetation Classification Survey and Groundwater Dependant Terrestrial Ecosystem Report for a Wind Farm by Bettyhill*. Commissioned Report.

Massey, K. 2015. *Phase 1 Habitat and National Vegetation Classification Survey Report for Grantown-on-Spey Caravan Site*. Commissioned Report.

Shields, D and **Massey, K.** 2014. *Phase 1 Habitat and NVC Survey Report for Kergord access track, North Mainland, Shetland*. Commissioned Report.

Massey, K. 2014. *Preliminary National Vegetation Classification Report for the Proposed Access Track for Pogbie Wind Farm where it crosses the Linn Dean Scottish Wildlife Trust Reserve*. Commissioned Report.

Shields, D and **Massey, K.** 2014. *Protected Terrestrial Mammal Survey Report for Pogbie Wind Farm, East Lothian*. Commissioned Report.

Massey, K. 2014*. Amenity Grassland Project – Grass Species Identification Report*. Commissioned Report.

Shields, D and **Massey, K**. 2014. *Phase 1 Habitat, National Vegetation Classification and Groundwater Dependent Terrestrial Ecosystems Report for Loch Dubh, Lairg, Sutherland*. Commissioned Report.

Massey, K, and Cosgrove, P. 2014. Woodlands Ecological Environmental Statement Chapter. Commissioned Report.

Massey, K. 2014. *Natural Heritage Information Desk Study of Woodlands*, Easter Ross. ES Technical Appendix. Commissioned Report.

Cosgrove, P. and **Massey, K.** 2014. *Hartwood Wind Farm Environmental Statement.* ABO Wind Commissioned Report.

Massey, K. and Cosgrove, P. 2014. *Hartwood Wind Farm Outline Habitat Management Plan*. ABO Wind Commissioned Report.

Massey, K and Shields, D. 2014. *Breachen Court, Grantown on Spey Phase 1 Habitat & NVC Survey Report.* Commissioned Report.

Massey, K. 2014. *Phase 1 Habitat Survey and NVC Report, Branny, Invermark.* Commissioned Report.

Massey, K. 2014. *Phase 1 Habitat Survey and NVC Report, Dalbreck, Invermark*. Commissioned Report.

Massey, K. 2014. *Phase 1 Habitat Survey and NVC Report, Inchmundie,* Invermark. Commissioned Report.

Massey, K. 2014. *Otter and Water Vole Survey for Glenmore, Argyll.* Forestry Commission. Commissioned Report.

Massey, K. 2014. *Phase 1 Habitat and Protected Terrestrial Mammal Survey of Texas Instruments, Larkfield Industrial Estate, Greenock*. Commissioned Report.

Massey, K. 2014. *Natural Heritage Information Desk Study of Texas Instruments, Larkfield Industrial Estate, Greenock*. Commissioned Report.

Massey, K. 2014. *Phase 1 Habitat Survey and National Vegetation Classification Survey Report for Castle Fraser, Aberdeenshire*. Commissioned Report.

Massey, K. 2014. *Natural Heritage Information Desk Study of Corrybrough, Tomatin, Highland Region*. Commissioned Report.

Massey, K. 2014. *Phase 1 Habitat and Non-native Invasive Plant Species Survey of Carron Den, Stonehaven*. Commissioned Report.

Massey, K. 2014. Phase 1 Habitat Survey of Sillyflatt Farm, Inverbervie. Commissioned Report.

Massey, K., Massey, F.P. and Cosgrove, P. 2014. *Peatland Restoration Plan for North Nesting Pilot Study Area*. Commissioned Report.

Massey, K. 2013. *Woodlands Phase 1 and National Vegetation Classification Report*. ES Technical Appendix. Commissioned Report.

Massey, K. 2013. *Phase 1 Habitat Survey Report for Stemster, Caithness*. Commissioned Report.

Massey, K, 2012, *Stronelairg Phase 1 and National Vegetation Classification Report.* Commissioned report.

Cosgrove, P. and **Massey, K**. 2012. *Stronelairg Windfarm Environmental Statement – Ecology Chapter.* Commissioned Report.

Massey, K. 2012. *Bhlaraidh Phase 1 and National Vegetation Classification Report*. ES Technical Appendix. Commissioned Report.

Massey. K. 2012. *Phase 1 Habitat Survey and National Vegetation Classification Report – Levishie Wind Farm*. ES Technical Appendix. Commissioned Report.

Massey, K. 2012. *Balnacoil Natural Heritage Desk Study*. ES Technical Appendix. Commissioned Report.

Massey, K. 2012. *Balnacoil Phase 1 Habitat and NVC Survey Report. ES Technical Appendix*. Commissioned Report.

Massey, K. 2012. *Phase 1 Habitat and NVC Survey Report for Glencassley*. ES Technical Appendix Commissioned Report.

Massey, K, Massey, F.P. and Cosgrove. 2011. *A study to characterise breeding whimbrel habitat on Mainland Shetland: Field seasons 2010 and 2011*. Commissioned report.

Cosgrove, P. Doyle, P. and **Massey, K**. 2011. *Levishie Natural Heritage Desk Study*. ES Technical Appendix. Commissioned Report.

Massey, K., Wilson-Parr, R., Doyle, P. and Cosgrove, P. 2011. *Post-construction monitoring of birds at Slieve Rushen wind farm, Fermanagh: year 3 (2010)*. Commissioned Report.

Massey, K. 2011. *Earlswell Phase 1 Habitat Survey*. Commissioned Report.

Doyle, P. and **Massey, K**. 2011. *Earlswell Natural Heritage Desk Study*. Commissioned Report.

Massey, K., Massey, F.P. and Cosgrove, P. 2011. *A study to characterise breeding whimbrel habitat on Mainland Shetland: Field seasons 2010 and 2011*. Commissioned Report.

Massey, K. 2010. Phase 1 Ecological Survey of an Area Prior To Commercial Development in Portlethen, Aberdeenshire. Commissioned Report.

Massey, K. 2010. *Sallachy Phase 1 Habitat Survey and National Vegetation Classification Survey*. Commissioned Report.

Massey, K. 2010. *Sallachy Natural Heritage Desk Study*. Commissioned Report.

References available on request

Simon Waddell

Associate - Noise

Qualifications and Professional Memberships

- Environmental Geoscience BSc Hons.
- Acoustics and Noise Control PG Diploma
- Certification of Competence in Environmental Noise Measurement
- Member of Institute of Acoustics (MIOA)

Career Summary

Simon Waddell, BSc, MIOA is an experienced environmental consultant, with over 12 years of experience in environmental noise. A technical specialist in environmental noise, but with an appreciation of other environmental disciplines, Simon has extensive experience of noise assessment in accordance with various planning and permitting requirements across the UK, particularly in relation to power generation, energy storage, infrastructure, residential, industrial and waste-related developments.

Simon also has extensive international ESIA experience to both local and international standards, including IFC/World Bank. Experience includes the specification, commissioning and analysis of baseline monitoring campaigns and development of noise source inventories and computational models to international standards to determine potential environmental effects.

Selected Project Experience

UK Noise – Rockets and space

- SaxaVord Spaceport, EIA. Noise assessment of proposed spaceport on Unst, Shetland. Undertook baseline noise survey, predicted construction phase noise levels, liaised with rocket and aircraft noise specialist, interpreted predictions provided by specialist in the context of UK guidance, reported on findings. Spaceport planning application consented.
- SaxaVord Spaceport, AEE. Noise assessment of proposed spaceport on Unst, Shetland. Consulted with CAA, interpreted predictions provided by aircraft and rocket noise specialist in the context of new UK AEE guidance, reported on findings.
- Midlothian, Scotland. Noise assessment in support of proposed rocket engine testing facility. Baseline noise survey, agreement of approach with Environmental Health, prediction of operational noise levels, evaluation against agreed criteria.
- Midlothian, Scotland. Noise compliance monitoring to discharge planning conditions of rocket engine testing facility. Measurement of off-site noise levels at receptor locations, reported on findings. Planning condition discharged by Environmental Health.
- Cockenzie, East Lothian, Scotland. Noise and assessment as part of planning application for operation of proposed rocket engine testing facility within former power station coal storage area. Consulted with Environmental Health, undertook baseline noise survey, predicted operational noise levels via noise modelling, evaluated in accordance with BS4142 and appropriate guidance, attended community consultation events, specified appropriate mitigation, reported on findings.

- Port of Rosyth, Fife, Scotland. Measured noise levels during test firing of a rocket engine. Post-processed measured data to determine sound power level of test and characterise noise emissions associated with testing activities.

UK Noise – Land development

- Giants on the Quayside (Whey Aye Wheel), Newcastle-upon-Tyne, UK. Noise and vibration assessment of proposed observation wheel and associated entertainment facilities as part of EIA. Input to Scoping and consultation with Environmental Health, specified and oversaw baseline noise survey, analysed baseline data, predicted construction noise and vibration levels at sensitive receptors, predicted operational noise levels due to operation of wheel and associated facilities and from changes road traffic flows. Evaluated noise and vibration impact in accordance with BS5228, BS4142 and CRTN, specified appropriate mitigation, reported on findings.
- Whitekirk, East Lothian, UK. Assessment in support of EIA of proposed redevelopment of golf course to holiday lodges. Input to Scoping and consultation with Environmental Health, baseline noise survey, analysis of baseline data, review of baseline and projected traffic flow data, modelling of post development traffic noise in accordance with CRTN. Evaluated noise levels against BS8233 target noise levels, determined noise impacts in accordance with PAN1/2011, specified appropriate outline mitigation, reported on findings.
- Thistle Street NW Lane, Edinburgh, UK. Noise assessment of proposed hotel development within existing commercial building. Constructed detailed noise model of building, including proposed air handling plant, predicted noise levels at windows of neighbouring buildings, evaluation of plant noise against Noise Rating (NR) curves. Specified appropriate mitigation and reported on findings.

UK Noise – Manufacturing and waste

- Lochaber/Fort William, Highlands, Scotland. Noise assessment of proposed aluminum billet plant within Lochaber smelter complex. Consulted with SEPA, undertook baseline noise survey, predicted construction phase and operational phase noise levels. Evaluated predicted levels in accordance with BS5228 and BS4142, specified appropriate mitigation and reported on findings as a chapter within an EIA Report.
- Hillthorn Farm, Sunderland, England. Noise and vibration assessment of proposed business park adjacent to Nissan assembly plant. Consulted with Sunderland City Council, specified baseline monitoring campaign, predicted construction phase and operational phase noise levels, including noise from road traffic. Evaluated predicted levels in accordance with BS5228 and BS4142 and against DMRB criteria, specified appropriate mitigation and reported on findings as a chapter within an EIA Report.
- South Crosland Quarries, Huddersfield, UK. Noise assessments in support of planning applications and EIAs for quarrying and restoration of worked-out quarries using inert waste. Consulted with Environmental Health, specified and oversaw baseline surveys and noise and vibration source characterisation measurements. Predicted and evaluated operational noise and vibration levels. Specified appropriate mitigation and reported on findings.
- Tennents Wellpark Brewery, Glasgow, UK. Noise assessment to meet SEPA requirement for baseline monitoring before commissioning of new anaerobic digestion plant within existing brewery complex. Oversaw baseline noise survey, technical review of noise report.
- New distillery, Highlands, UK. Noise assessment as part of EIA for proposed whisky distillery near Grantown-on-Spey. Consulted with Environmental Health, oversaw baseline noise survey, reviewed available information and developed noise model of proposed distillery complex, evaluated noise from construction and operations phases in accordance with BS5228 and BS4142 respectively, specified appropriate mitigation, reported findings for ES.
- IAMP TWO, Sunderland, UK. Noise assessment as part of EIA for large-scale multi-unit manufacturing complex. Contributed to Scoping and undertook detailed consultation with Environmental Health. Undertook baseline noise survey, predicted noise levels during construction

and operation of the facility, and due to changes in road traffic flows. Vibration assessment considering vibration from piling and from road traffic.

- IAMP ONE, Sunderland, UK. Noise assessment as part of EIA for large-scale multi-unit manufacturing complex. Contributed to Scoping and undertook detailed consultation with EHO. Undertook baseline noise survey, predicted noise levels during construction and operation of the facility, and due to changes in road traffic flows. Specified appropriate mitigation and reported findings. Proposed development was consented and is under construction.
- Ardross Distillery, Highlands, UK. Noise assessment for proposed whisky distillery. Consulted with EHO, reviewed baseline noise data provided by others, reviewed available information and developed noise model of proposed distillery, operations phases in accordance BS4142, specified appropriate mitigation and reported findings.
- Jed Forest Distillery, Scottish Borders, UK. Noise assessment as part of EIA for two proposed whisky and gin distilleries near Jedburgh. Consulted with EHO at Scottish Borders Council, undertook baseline noise survey, reviewed available information and developed noise model of proposed distillery complex, evaluated noise from construction and operations phases in accordance with BS5228 and BS4142 respectively, specified appropriate mitigation, reported findings for ES.
- Buckie Maltings, Moray, UK. Noise assessment of new grain drying shed at maltings complex. Consulted with EHO, specified plan of study for baseline noise survey, reviewed available information and developed noise model of proposed facility, evaluated noise from operations phases in accordance with BS4142 respectively, specified appropriate mitigation, reported findings.

Employment History

- 2005 – 2006 – Mason Evans Partnership – Graduate Engineer
- 2007 – 2012 – Enviros/SKM Enviros/SKM – Consultant
- 2012 – 2016 – Golder Associates – Consultant
- 2016 – Present – ITPEnergised – Principal Consultant

ANNIE DANSKIN

ASSOCIATE – AIR QUALITY

QUALIFICATIONS & PROFESSIONAL MEMBERSHIPS

- BEng (Hons) Environmental Engineering
- Member Institution of Environmental Sciences
- Member Institute of Air Quality Management
- Member of Environmental Protection Scotland Expert Advisory Group on Air Quality

CAREER SUMMARY

Annie Danskin has 21 years of experience in the field of air quality consultancy and research, managing projects for and providing introductory and advanced training courses to many local authorities, regulatory authorities (EA, SEPA, HSE), industrial operators and academic institutions. She has prepared expert witness reports for public inquiries and presented at public meetings, conferences and exhibitions on numerous occasions.

Key projects include air quality impact assessments for EIAs, planning applications and PPC and Environmental Permits; Local Air Quality Management studies for Local Authorities; odour impact assessments and management plans; and assessment of accidental and emergency releases including fires and flares at offshore installations. She is an experienced project manager and is a specialist in atmospheric dispersion modelling, particularly using the full suite of ADMS models. Annie is a member of the Institution of Environmental Sciences and the Institute of Air Quality Management.

SELECTED PROJECT EXPERIENCE

INDUSTRIAL & MANUFACTURING

- Rocket Engine Testing Facility, Cockenzie – Client: Skyrora. Preparation of a dispersion modelling study to assess the potential short-term effects for local residents of exposure to carbon monoxide emissions from jet exhaust emissions during rocket launch events at a proposed rocket engine testing facility. Used the “puff” model to calculate peak exposure concentrations during the lifetime of the release and a total concentration dose experienced at each receptor for the duration of release. Launch events were simulated for a range of meteorological conditions.
- Coffee Roasting Factory, Dundee – Client: Aimers Coffee & Tea. Preparation of a detailed dispersion modelling study of emissions of odour, dust and oxides of nitrogen from a new coffee roasting factory in Dundee. Included analysis of a range of conditions dependent on the raw coffee bean source and the darkness of roasting. Included complex topography, sensitivity to building effects, time-varying emissions profiles and a range of operating scenarios and meteorological conditions. Involved extensive consultation Dundee City Council.
- Alloy Wheel Facility, Lochaber – Client: Liberty Lochaber Aluminium Ltd. Preparation of an EIA Report Air Quality Chapter submitted with the planning application. The Air Quality Impact Assessment (AQIA) included a detailed atmospheric dispersion modelling study to assess the potential impacts of emissions from a proposed new alloy wheel facility and adjacent biofuel generators at sensitive receptors for human health and ecology. Included complex topography, building effects, time-varying emissions profiles and a range of operating scenarios and meteorological conditions. Involved extensive consultation with SEPA, SNH and The Highland Council. Assessment included a Construction Phase Dust Risk Assessment.
- Rosebank and Islay Distilleries – Client: Blyth and Blyth. Technical advisor on stack height analysis, screening of boiler emissions, odour risk assessment and odour management plan.

- Expansion of Wood Pellet Manufacturing Facility, Girvan, South Ayrshire – Client: Land Energy. Project Manager to co-ordinate delivery of air quality, noise, ecology and landscape and visual impact assessments. Included liaison with SEPA and South Ayrshire Council environmental protection officers, site visits, detailed modelling of emissions from wood pellet manufacturing process and Biomass CHP exhaust gases. Complex building configurations and local topography were included in the study.
- Ambient Dust Monitoring at Scrap Metal Facility – Client: Dalton Metals Recycling. Undertaken to check compliance with IPC Permit conditions related to emissions from activities and processes within the site and the ambient concentrations at the site boundary and neighborhood sensitive receptors. Results submitted to SEPA with a dust management plan.
- Granton Distillery, Edinburgh - Client: Halewood International. Odour impact assessment for a proposed new gin distillery adjacent to existing residential receptors. Included dispersion modelling with ADMS-5, and recommended abatement technologies appropriate for the scale of the plant. Submitted with the planning application to City of Edinburgh Council.
- Town Hall Energy Centre, Crawley – Client: Westrock. Assessment of the potential impacts on existing and proposed future residential receptors of emissions from each of two development phases of an energy centre comprising gas boilers and CHP units. Submitted to the local authority with the planning application. Included an assessment of the potential impact mitigation provided by options for low-NO_x equipment.
- Sainsbury's CHP Plant, Dundee – Client: Sainsbury's. Assessment of the site suitability and potential impacts on local air quality from a proposed CHP plant, packaged back-up plant and associated substation do demonstrate no adverse impacts. Dispersion modelling using ADMS-5 included assessment for a range of stack heights.
- Glasgow Caledonian University CHP Plant – Client: GCU. Detailed atmospheric dispersion modelling assessment to assess the impact of the variable emissions profile from the GCU CHP plant on proposed and existing residential receptors at nearby development sites. Included complex topography, building effects and emissions from adjacent roads. Undertaken in order to discharge a planning condition imposed by Glasgow City Council
- PPC Permit Application for Enviroco at Albert Quay, Aberdeen. Project manager for the compilation of environmental assessments to support an application for a permit under the Pollution Prevention and Control (Scotland) Regulations 2000 (the PPC Regulations) for a Part A installation in the Waste Management Sector, administered by Enviroco at a site at Albert Quay, Aberdeen. The site is involved in the storage of hazardous waste received from offshore North Sea facilities pending transfer to a licenced disposal site, where it is processed in line with the PPC Regulations, where these are appropriate. The project included pre-application meetings with the Scottish Environment Protection Agency and submission of the final application.
- Environmental Permit Variation Application for Enviroco, Great Yarmouth. Project manager for the compilation of environmental assessments to support an application for a permit variation under the Environmental Permitting Regulations (England and Wales) 2010 for a Part A installation in the Waste Management Sector, administered by Enviroco in Great Yarmouth. The site was undergoing extensive expansion and introducing significant improvements for pollution prevention and control. The permit variation consolidated the previous permit, waste management licence and previous exemptions that applied to the site. The project included pre-application meetings with the Environment Agency and submission of the final application.

PROPERTY & URBAN REGENERATION

- Edinburgh Park Southern Phase, Residential-Led Mixed Use Development, Edinburgh – Client: Parabola Edinburgh LLP. Technical lead on an air quality impact assessment of a residential-led mixed-use development. Included dispersion modelling with ADMS-Roads to predict the potential effects of traffic-generated pollutants on air quality at existing and proposed receptors including a large number of projected cumulative impacts from allocated development sites included in the West Edinburgh Transport Appraisal (WETA). Additional assessment of impacts was undertaken

within two nearby AQMAs. A comprehensive six-month ambient air quality monitoring survey was also undertaken at locations around the proposed development boundary, and the data used to verify the dispersion model. The study also included an odour risk assessment due to the proximity of the proposed development to a poultry farm and included several odour sampling surveys in a variety of meteorological conditions and operational scenarios at the poultry farm.

- Johnnie Walker Experience, Edinburgh – Client: DIAGEO. Air quality impact assessment of a visitor experience development including the potential effects on local air quality of development-generated traffic, combustion source emissions and kitchen extraction systems at existing and proposed receptors including within the adjacent Edinburgh Central AQMA.
- Ratho Station Residential Development, Edinburgh – Client: Taylor Wimpey East of Scotland. Technical lead for an air quality impact assessment of a residential development for multiple iterations of site layout and road traffic scenarios. The air quality assessment included dispersion modelling with ADMS-Roads to predict the potential effects of traffic-generated pollutants on air quality at existing and proposed receptors including within the adjacent Glasgow Road AQMA. Included a Construction Phase Dust Risk Assessment.
- Crofthead, Bishopbriggs – Client: Mactaggart & Mickel Homes. Preparation of a detailed dispersion modelling study and report assessing the effects of changes in traffic flow on the local road network and the impacts for air quality, particularly within the Bishopbriggs AQMA. Assessment included a Construction Phase Dust Risk Assessment and site suitability assessment for residential use.
- Bishopsgate Office Redevelopment, London – Client: Estates Office Shoreditch. Technical Lead for air quality assessment for the partial demolition and redevelopment of commercial premises to mixed office and retail use. Included the impact of traffic and energy centre emissions on existing local receptors and proposed future occupants of the building. An Air Quality Neutral Assessment in accordance with London Council's Air Quality Guidance was included. Assessment included a Construction Phase Dust Risk Assessment.
- Kenmuir, Carmyle – Client: Arm Architects. Technical lead for an air quality impact assessment of a residential masterplan development and preparation of an EIA report chapter. The air quality assessment included dispersion modelling with ADMS-Roads to predict the potential effects of traffic-generated pollutants on air quality at existing and proposed receptors. Three site access routes were assessed and advice given to the design team regarding required distance of future residences from roadsides. Assessment included a Construction Phase Dust Risk Assessment and screening of the potential impacts at the development site from nearby industrial sources.
- Corton Village Development, Ayr – Client: Manse Investment. Technical lead for an air quality impact assessment of a residential/educational/commercial masterplan development and preparation of an EIA report chapter. The air quality assessment included dispersion modelling with ADMS-Roads and ADMS 5 to predict the potential effects of traffic-generated and energy centre-generated pollutants on air quality at existing and proposed receptors. The study included a large number of projected cumulative impacts from allocated development sites the Ayr/Prestwick area. Assessment included a Construction Phase Dust Risk Assessment.
- Retail Development, Cupar – Client: London and Scottish Investments Limited. Preparation of a detailed dispersion modelling study and report assessing the effects of changes in traffic flow and Drive-Thru queueing traffic on the local road network and the impacts for air quality, particularly within the Cupar Bonnygate AQMA.
- Cammo Fields Residential Development, Maybury Road, Edinburgh – Client Cala Homes. Technical lead for an air quality impact assessment of a residential development and preparation of an EIA report chapter. The air quality assessment included dispersion modelling with ADMS-Roads to predict the potential effects of traffic-generated pollutants on air quality at existing and proposed receptors including a large number of projected cumulative impacts from allocated development sites included in the West Edinburgh Transport Appraisal (WETA). Additional assessment of impacts was undertaken within a nearby AQMA. Supplementary reports including an assessment of the potential for odour impacts from a nearby composting facility

- Commercial Development, Chapelhall, North Lanarkshire – Client: Gray Planning. Preparation of a detailed dispersion modelling study and report assessing the effects of changes in traffic flow on the local road network and the impacts for air quality, particularly within the Chapelhall AQMA. Assessment included a Construction Phase Dust Risk Assessment.
- Gilston Farm, Polmont – Client: Acies Group. Management and technical delivery of an air quality impact assessment for a mixed residential and commercial development. The air quality assessment included dispersion modelling with ADMS-Roads to predict the potential effects of traffic-generated pollutants on air quality at existing and proposed receptors. An additional odour and dust risk assessment was undertaken to determine the potential for nuisance complaints from future residents due to the proximity to existing landfill and waste management sites. Mitigation measures were recommended where appropriate, to minimise the potential for adverse residual effects being experienced by sensitive receptors during the construction and operational phases of the proposed development.
- Clyde Waterfront & Renfrew Riverside and Glasgow Airport Improvement Area City Deals Projects- Client: Renfrewshire Council (2016-present). Senior team member to undertake air quality impact assessment of both schemes individually and assess the cumulative impact of both in conjunction with development projected to be facilitated by the Proposed Development. Including advanced dispersion modelling and GIS techniques and extensive data management. Preparation of material for public exhibitions and culminating in the production of three separate Environmental Statement Chapters on Air Quality with detailed technical appendices plus contributions to Climate Change chapters.
- A720 Sheriffhall Roundabout, Edinburgh – Client: Transport Scotland (2015). Senior team member to undertake DMRB Stage 2 Options Appraisal which involved a qualitative assessment of the various options based on the proximity to a range of identified sensitive receptors and the likely implications on traffic flows. Subsequent design and management of a baseline 6-month ambient air quality monitoring survey at 8 sensitive receptor locations and a detailed Stage 3 DMRB assessment of the preferred option, requiring detailed atmospheric dispersion modelling of road traffic emissions.

OIL & GAS

- Armada Kraken FPSO Vessel – Client: PI Ltd. Technical lead for assessment required to support an application to operate the vessel under Offshore Combustion Installations (Prevention and Control of Pollution) Regulations 2001. The purpose of the assessment was to predict pollutant concentrations of key substances at the nearest platforms within the North Sea, human receptors on the vessel and the nearest inhabited landfall point. The assessment considered the atmospheric emissions from the installation during normal gas and crude oil operations of the Steam Boiler Package (SBP) and the Power Generation Module (PGM).
- Montrose Alpha Offshore Installation – Client: PI Ltd. An assessment of atmospheric emissions from the existing installation and additional sources on a new bridge linked platform (BLP) adjacent to the Montrose platform, required to support an application to vary the PPC permit for the installation.
- Brent Removal and Dismantlement – Client: Shell (UK) Ltd. Management and technical delivery of Air Quality Environmental Statement chapter for the EIA to address the potential effects of the Brent Delta topside transfer to barge, inshore transit and onshore dismantlement project on air quality in Hartlepool.
- South Stream Russia to Bulgaria Pipeline. Member of project team that assessed the air quality impact of a proposed major gas pipeline between Russia and Bulgaria. The main focus of the assessment was the impact of construction phase emissions on sensitive receptors in close proximity to the landfall sections and pipeline corridor onshore. The assessment considered emissions from shipping, construction plant and road traffic within the affected areas.
- BAT Assessment of Odour Abatement Options and Odour Management Plan for PPC Compliance at Nigg Terminal. Review of potential odour emission sources on-site including jetty operations,

ship-to-ship transfer, crude oil reception and separation, ballast tanks, API separators, settlement tanks and lagoons and recommendations for priority control. The study included a BAT assessment of options for odour control and abatement and the development of new management procedures.

ONSHORE/OFFSHORE RENEWABLES

- Peaking Power Plants – Client: Forsa Energy. Technical advisor on detailed stack height analysis and dispersion modelling assessments of peaking power plants in Dundee and Greenock including assessment of Medium Combustion Plant Directive emissions limits. One site included consideration of the potential impacts of existing nearby wind turbine wakes on the dispersion of industrial emissions from new stacks.
- Gas-Fired Peaking Power Plant, Haydock – Client: LCFG Ltd. Assessment of the potential impacts on local air quality and in particular at a nearby Air Quality Management Area, of emissions from fourteen gas-fired engines. The assessment accounted for variable hours of operation and focused on the potential to exceed short-term air quality standards at sensitive receptors. The assessment also included stack height optimisation.
- Biomass Installation at Blackcraig Castle – Client: John Noel Thompson. Preparation of an air quality assessment to assess suitability of a proposed site for a wood fired biomass system.
- Biomass CHP Plant, Wellingborough – Client: Padd Energy. Technical lead on air quality assessment undertaken as part of an application for an Environmental Permit to the Environment Agency. Includes risk assessment, dispersion modelling, BAT assessment and the development of management plans to minimise emissions to atmosphere from the operation of the plant.
- River Tay District Heating Scheme – Client: Perth and Kinross Council – An assessment of the potential effects on local air quality of emissions of oxides of nitrogen (NO_x) from the use of gas-fired top-up boilers that are part of the scheme. Included an assessment of the potential net NO_x reduction in tonnes/annum across the City as public sector properties connected to the scheme.
- Raigmore Hospital, Inverness – Client: NHS Highland. Management and delivery of an atmospheric dispersion modelling study submitted with the planning application to Highland Council for the installation of two 1.7MW wood pellet boilers at Raigmore Hospital in Inverness. The study assessed the potential environmental impact and risk to human health of emissions from the existing multi-flue stack in a number of possible power generating scenarios at the hospital.

CORPORATE ADVISORY

- Review and Assessment of Air Quality for Local Authorities. Project Manager for a series of assessments for Scottish Local Authorities required as part of the Local Air Quality Management regime implemented under the Environment Act 1995. Included collation of emissions inventories including industrial, commercial, domestic and road traffic sources across the Council areas and within hotspots and Air Quality Management Areas (AQMAs); detailed dispersion modelling studies to determine source contributions and inform Action Plans for improvement; advise on air quality monitoring campaigns and preparation of annual reports.
- Assessing the Potential Air Quality Impact from Biomass Installations in the Planning Process, Workshop – Client Moray Council. Preparation and delivery of a half-day workshop for 4 personnel from the Moray Council Department of Public Health to assist the team in the assessment of planning applications for biomass installations within the Moray region with respect to local air quality impacts. Included practical exercises interpreting data supplied with the EPUK Biomass Boiler Information Request Form provided by applicants, and the use of spreadsheet screening assessment tools. Guidance was also given on when to ask applicants for more detailed assessments and how to consider cumulative impacts with other sources.

EMPLOYMENT HISTORY

- AECOM/URS – Principal Consultant - Responsible for business development in Scotland and providing training, mentoring, technical review and specialist advice on the effects of buildings and topography on atmospheric dispersion to the air quality consultancy teams located across the UK. Delivery of AQIAs for complex industrial sites and high profile developments including effects on human health and sensitive habitats and ecosystems at offshore and onshore locations.
- TSI Scotland – Air Quality Specialist - Primarily focused on the Environmental Consultancy part of the business but also provided support in the Energy business, undertaking energy audits and assessments for the Carbon Trust and developing and delivering energy awareness training programs for private and public sector clients.
- BMT Cordah – AQIAs for EIAs, planning applications and PPC permit applications for a wide range of property developers and industrial operators including companies from the oil and gas, power producing, waste management, renewables, chemical, cement and pulp and paper industries. Providing technical support and advice to UK Local Authorities on the regulatory regime of Local Air Quality Management (LAQM) and assisting them in fulfilling their obligations to review, assess and improve local air quality. Included preparation of review and assessment reports, compilation of emissions inventories including industrial, traffic and domestic sources, screening and detailed modelling studies and the development of Air Quality Action Plans (AQAP) for improvement.
- CERC - Major involvement in the development of the ADMS range of dispersion models including code testing, development of user guide documentation and completion of validation studies. Project manager on the development and delivery of introductory and advanced customised training courses in atmospheric physics and the use of dispersion models to individuals and audiences of up to 30 including personnel from industry, local authorities and regulatory agencies. Manager of the technical support helpdesk advising over 200 clients. Development of a database system for logging and responding to queries, and providing user-feedback to the model-development team in order to ensure continuous improvements to future versions of software. Consultancy services to a wide range of industrial clients from manufacturing, power producing, petrochemical and waste management industries, providing AQIAs and stack height analysis services to demonstrate compliance with environmental permit conditions or to accompany planning applications.

MarineSpace
Making Sense of the Marine Environment™

Curriculum Vitae

Ian Reach

Principal Marine Scientist

Email: Ian.reach2@marinespace.co.uk **Tel: 07867 432 444**

AREAS OF EXPERTISE

Ian has 28 years' experience as a marine ecologist and environmental auditor. Ian developed his marine ecological skills as part of JNCC's Marine Nature Conservation Review team and then in his role as Senior Marine Ecologist at Natural England. In this role Ian developed common standards monitoring, Natura 2000 marine SAC designations, and detailed knowledge of the legislative frameworks for UK waters; specialising in management advice to the marine aggregate and offshore renewables sectors. At MarineSpace, Ian has established himself as a leading marine environmental consultant delivering a range of projects. Ian can apply specialisms including marine ecology and nature conservation impact assessment, Expert Witness representation, and negotiation with Governmental and statutory bodies during licensing and HRA processes. He has a track record of HRA including plan-level, and strategic assessment for seabed user operations, allowing efficient and compliant delivery of assessments for operators and regulators alike. Ian is recognised as an international expert on *Sabellaria spinulosa* reefs and subtidal sandbank functionality and conservation.

KEY SKILLS

- Management and consenting advice of marine and coastal projects/developments;
- Strategic and Regional Environmental Assessment and Environmental Impact Assessment;
- Marine Protected Area advice/Habitats Regulations and Marine Conservation Zone Assessments;
- Production of adaptive environmental management plans, and mitigation and monitoring proposals;
- Managing compliance with permit conditions on behalf of clients;
- Strategic marine environmental research and assessment projects.

CAREER

2011 – Present:	MarineSpace Ltd, **Principal Marine Scientist**
2010 – 2011:	Natural England, **Principal Specialist Marine Ecology and Marine Operations**
2007 – 2010:	Natural England, **Senior Specialist Marine Ecology and Marine Aggregate Operations**
2006 – 2007:	Natural England, **Specialist Marine Operations – Offshore Wind**
2001 – 2006:	English Nature, **Specialist Marine Ecology and Marine Protected Area Officer**
1999 – 2001:	English Nature, **Wildlife Warden – Lundy Marine Nature Reserve**
1994 – 1997:	JNCC, **Marine Ecologist – Marine Nature Conservation Review**

QUALIFICATIONS/PROFESSIONAL AFFILIATIONS / POSITIONS

1993 BSc. (Hons) Marine Biology with Fish Biology, University of Plymouth, UK

Professional Member of the Marine Biological Association UK. Advisor to: ICES Working Group on Marine Systems; Pelagic Advisory Council; New York Energy Research and Development Authority Offshore Wind State of the Science Benthos and Birds Working Groups; U.S. Regional Wildlife Science Entity Bird and Bat, and Ecosystems Subcommittees; JNCC Offshore Wind Environmental Evidence Register Working Group.

SELECTED RECENT PROFESSIONAL EXPERIENCE

2022 - ongoing Skyrora XL LV – AEE, Syrora
Technical lead. Transboundary AEE Chapter.

2021 Astraius LV – MERA for AEE, Astraius/Prestwick Space Port
Technical lead. Transboundary MERA for AEE Chapter.

2021 Shetland Space Centre – AEE, SaxaVord
Technical lead. Transboundary AEE Chapter.

2021 Shetland Space Centre – AEE, SaxaVord
Technical lead. Review of the CAA AEE Regulations for client.

2020 - 2021 Shetland Space Centre – EIA, SaxaVord
Technical lead. Transboundary EIA Chapter.

2021 - ongoing 3 Array Assets, Ørsted
Technical lead. Environmental appraisal, HRA and MCZ Risk Assessments, Marine Licence applications for Array Cable Protection System stabilisation emergency work campaigns for 3 arrays/offshore wind farms.

2021 4 Array Assets, Ørsted
Technical lead. Environmental appraisal, HRA and MCZ Risk Assessments, Marine Licence applications for Array Cable Protection System stabilisation emergency work campaigns for 4 arrays/offshore wind farms.

2021 - ongoing Gas Pipeline Stabilisation and Decommission Programme, Perenco
Technical lead. Environmental appraisal, HRA and survey scope for all southern North Sea pipeline assets. Developing survey Sop's. Biogenic reef data interpretation and assessment. Liaison with SNCBs.

2020 - ongoing Round 4 Offshore Wind, Site Characterisation
Technical lead. Critical review of consenting risk associated with HRA issues for client.

2020 - ongoing Erebus Floating Offshore Windfarm – Environmental Statement, Blue Gem Wind
Technical Lead. HRA and EIA co-ordinator and lead assessor and QC.

2019 - ongoing Race Bank Wind Farm – Annual Monitoring Reporting, Ørsted
Technical Lead. Analysis of post-construction survey data, HRA compliance and innovative sandeel monitoring programme lead.

2019 - ongoing Lincs Wind Farm – Annex I reef habitat survey – Ørsted
Technical Lead. Analysis of acoustic data to identify Annex I *Sabellaria spinulosa* reef habitat within the wind farm array and Inner Dowsing, Race Bank and North Ridge SAC.

2019 – ongoing Morlais Tidal Array Demo – EIA, Mentor Môn
Technical lead. EIA chapters for assessment of tidal stream demonstration project. Benthic ecology, migratory fish baseline and assessment chapters. Advice concerning HRA issues.

2018 – ongoing Lincs Wind Farm, Transmission Capitol
Technical Lead. Information to identify consenting risk and inform HRA in support of export cable remediation O&M licence.

2014, 206, 2018 The Crown Estate Marine Mineral Licensing Round HRA, The Crown Estate
Technical Lead. Plan-level HRA in support of the last three marine aggregates licensing rounds.

2018 Race Bank Wind Farm – Annex I reef habitat survey – Ørsted
Technical lead. Design of subtidal drop-down video survey to identify Annex I *Sabellaria spinulosa* and cobble reef habitat along export cable route post-installation.

2018 Regional Cumulative Effect Assessments of Marine Aggregate Extraction Operations on Atlantic Herring Spawning Habitat and Sandeel Habitat, various Dredging Associations

Project Director and Technical Lead. Updated 2013 methodology to identify, map and assess herring and sandeel habitats and assessment of impacts from marine aggregate dredging for 4 strategic regions.

2017 – 2019 London Array Wind Farm, London Array Ltd
Technical Lead. HRA of cable remediation O&M licence/turbine replacement HRA / mitigation plan.

2017 – 2019 London Array Wind Farm, Blue Transmission London Array
Technical Lead. HRA in support of export cable remediation O&M licence.

2014 – 2015 Dogger Bank Creyke Beck Offshore Wind Farm Public Examination, Forewind Ltd
Expert Adviser. Benthic ecology and marine nature conservation support and HRA for Dogger Bank SCI. Support during examination, including expert witness client representation during public hearings.

2014 Atlantic Herring Spawning Habitat Strategic Assessment Workshop, European Dredging Association and International Council for the Exploration of the Sea (ICES)
Technical Expert. Led session at the ICES Working Group on Marine Systems (WGMARS) in Copenhagen, regarding innovative strategic methods of regional-scale Atlantic herring habitat classification.

2014 Race Bank Wind Farm – Annex I reef habitat survey – Centrica
Technical Expert. Design of subtidal drop-down video survey to identify and characterise Annex I *Sabellaria spinulosa* and cobble reef habitat along export cable route pre-installation.

2013 – 2014 Lincs Wind Farm, Centrica Renewables Energy Ltd / Lincs Wind Farm Ltd
Technical Expert. Developed innovative approach to HRA delivery for a 20 year O&M licence regarding HRA of jack-up rigs in a SAC. Adopted by MMO as a standard for efficient delivery of long-term O&M licenses.

SELECTED PUBLICATIONS

Contributing author to: Cook, A., K.A. Williams, E. Jenkins, J. Gulka, and J. Liner. 2021. Bird Workgroup Report for the State of the Science Workshop on Wildlife and Offshore Wind Energy 2020: Cumulative Impacts. Report to the New York State Energy Research and Development Authority (NYSERDA). Albany, NY. 37 pp. Available at https://www.nyetwg.com/2020-workgroups.

Contributing author to: Degraer, S., Z.L. Hutchison, C. LoBue, K.A. Williams, J. Gulka, and E. Jenkins. 2021. Benthos Workgroup Report for the State of the Science Workshop on Wildlife and Offshore Wind Energy 2020: Cumulative Impacts. Report to the New York State Energy Research and Development Authority (NYSERDA). Albany, NY. 45 pp. Available at http://www.nyetwg.com/2020-workgroups.

Reach I.S., 2016. *UK Aggregate Extraction and Atlantic Herring Spawning Habitat: Identification, Assessment, and Adaptive Environmental Management*. Proceedings of the ICES Annual Science Conference, Riga 2016.

Lloyd Jones D., Langman R., **Reach I.S.**, Gribble J., and Griffiths N., 2016. *Using Multibeam and Sidescan Sonar to Monitor Marine Aggregate Dredging*. In: Seafloor Mapping along Continental Shelves: Research and Techniques for Visualizing Benthic Environments. C.W. Finkl and C. Makowski (eds.), Coastal Research Library 13. Springer International Publishing, Switzerland.

Pastoors M., **Reach I.S.**, Worsøe Clausen L., Russell M., Wiseman A., Ohms V., Reedtz-Sparrevohn C., Strehlow H., Dankel D.J., and Goldsborough D., 2015. *Using a science-industry partnership to identify herring spawning locations in the North Sea*. Proceedings of the ICES Annual Science Conference, Copenhagen 2015.

Lloyd Jones D., Backstrom J., and **Reach I.S.**, 2014. *Regional Environmental Assessment of Marine Aggregate Dredging Effects: The UK Approach*. In: Environmental Management and Governance: Advances in Coastal and Marine Resources. C.W. Finkl and C. Makowski (eds.), Coastal Research Library 8. Springer International Publishing, Switzerland.

Reach I.S., Henson K., Golding T.J., Murphy K.J., Langman R.J., Coates A.S., Warner I.C., Hatton L., Wright, S., and Leake S., 2013. *Marine Aggregate Licence, Renewal and Application Areas: A Report to Inform an*

Appropriate Assessment (in combination), on the classified Red-throated Diver population of the Outer Thames Estuary Special Protection Area - Version 1.0. A Report produced for BMAPA to inform MMO.

Reach I.S., Latto P., Alexander D., Armstrong S., Backstrom J., Beagley E., Murphy K., Piper R., and Seiderer L.J., 2013. *Screening Spatial Interactions between Marine Aggregate Application Areas and Atlantic Herring Potential Spawning Areas.* A Method Statement produced for British Marine Aggregate Producers Association.

Reach I.S., Cooper W.S., Firth A.J., Langman R.J, Lloyd Jones D., Lowe S.A. and Warner I.C., 2012. *A Review of Marine Environmental Considerations associated with Concrete Gravity Base Foundations in Offshore Wind Developments*. A report for The Concrete Centre by Marine Space Limited. 160pp.

Limpenny D.S., Foster-Smith R.L., Edwards T.M., Hendrick V.J., Diesing M., Eggleton J.D., Meadows W.J., Crutchfield Z., Pfeifer S., and **Reach I.S.**, 2010. *Best methods for identifying and evaluating Sabellaria spinulosa and cobble reef*. Aggregate Levy Sustainability Fund Project MAL0008. Joint Nature Conservation Committee, Peterborough, 134 pp. ISBN: 978-0-907545-33-0.

Morris R.K.A., **Reach I.S.**, Duffy M.J., Collins T.S., and Leafe R.N., 2004. Forum: On the loss of saltmarshes in south-east England and the relationship with *Nereis diversicolor*. *Journal of Applied Ecology*, 41: pp. 787-791.

Reach I., 2002. The occurrence of the non-native brown alga *Sargassum muticum* and red alga *Asparagopsis armata* at Lundy. *Annual Report of the Lundy Field Society*, 51, 113-115.

Gavin Bollan

Technical Director

Qualifications and Professional Memberships

- BSc (Hons.) Environmental Science
- Chartered Environmentalist (CEnv)
- Chartered Scientist (CSci)
- Member of the Institution of Environmental Sciences (MIEnvSc)
- Fellow of the Institute of Air Quality Management (FIAQM)

Career Summary

Gavin has over 25 years of experience in the environment industry, more than 20 years of which has been in consulting. He has been active in Environmental and GHG Inventories and Permitting and industrial air pollution control and management in the UK since the 1990s. He has also been a practitioner and verifier of life cycle impact assessments at product and project level since 2011.

Gavin is an analytical chemist by training, having spent four years after graduation in industry as site environmental chemist, with responsibility for measuring emissions to air and water.

His work in consultancy was initially in air quality management, in the fields of industrial emissions, ambient air quality and occupational hygiene monitoring. Gavin has produced a suite of guidance for UK regulators in the UK on gaseous and particulate monitoring techniques which called on this direct experience.

In the 2000s he developed innovative major capital project carbon footprinting and lifecycle analysis services for Atkins, with a focus on transparency and traceability in source data, emission factors and calculation methodologies. He has also worked on some of the UK's largest infrastructure projects including major highway upgrades, high speed rail and the development of the London Olympic Park.

At ITPEnergised, Gavin is Technical Director with the Advisory Services business stream with responsibilities covering industrial air pollution permitting and pollution control issues, assisting clients with their obligations under the Industrial Emissions Directive and the latest iterations of Best Available Techniques for pollution control. He brings the benefit of long experience across multiple sectors in pollution control and especially greenhouse gas management to clients promoting clean and future energy projects. Since joining ITPEnergised in 2018 he has written several Environmental Statement / EIA Report climate chapters for transportation, industrial and commercial building developments, examining climate vulnerability and resilience, generating greenhouse gas inventories for project lifecycles and working with design teams on practical and measurable ways to reduce energy usage and GHG emissions. He is ITPEnergised's principal author of Major Accident and Disaster chapters for Environmental Statements, which calls on his extensive experience of industrial process operation and control.

Selected Project Experience

Climate Change Impact Assessment and Sustainability

- Climate Change (Resilience and GHG Emissions), various, England / Scotland, 2019-2022 chapters on several project including the Saxa Vord Space Centre, the Hillthorn Farm commercial development and the Alvance Aluminium Smelter extension. Analysis of future Met Office projections and assessment of project vulnerability. Development of GHG and energy inventories for critical review and development of mitigation strategies at construction and operational stages.
- Offshore Wind supply chain carbon strategy, Inch Cape, Scotland, 2021. Development of supply chain GHG emissions evaluation strategy and internal awareness presentation.
- Carbon analysis and energy efficiency optioneering, Trans Adriatic Pipeline (TAP), Greece and Albania, 2019-2020. Detailed analysis of fixed asset operating options to reduce GHG emissions and operating costs.
- Energy Statement and Project GHG Inventory, Ras al-Khair Industrial City, Royal Commission in Jubail, Saudi Arabia, 2011-2019. Thermal power and industrial emission inventory.

Major accidents and disasters

- Environmental Statement / EIA Report chapters, England / Scotland, 2019-2022. Qualitative environmental risk chapters for several project including the Saxa Vord Space Centre, the Hillthorn Farm commercial development and the Alvance Aluminium Smelter extension.

Renewable Energy Advisory

- Confidential green hydrogen development projects, Protium Green Solutions, England / Scotland / Wales, 2020 - date. Account Manager and Adviser on project facilitation and compliance, on several prospective renewably-powered electrolytic hydrogen production installations.
- Uskmouth Power Station Conversion, Wales, Simec Atlantis Energy, 2018-2021. Client's Agent, Simec Uskmouth Power. Embedded technical adviser in client's permitting and engineering teams for a former coal fired power station conversion in Wales
- Keadby Power Station, SSE Thermal, England, 2020. Carbon intensity evaluation for GHG abatement and alternative fuel scenarios.
- Low Carbon Infrastructure Transition Plan, Scottish Government, 2019 – date. Technical evaluation of Scottish Government grant applications for low carbon technology developments including water source heat pumps, green hydrogen and wind Power to X projects.
- Solar and Wind Energy Resource Assessments, Various Clients, Scotland and England, 2020-date. Project director and critical reviewer.
- Clean Development Mechanism Prefeasibility, Fadhili Gas Plant, Saudi Aramco, 2015. Review of planned activities with potential to generate carbon credits

Lifecycle Assessment

- Energy and Carbon Assessment, Thames Tideway Tunnel, 2011 – 2012. Tasks included a full lifecycle carbon model for the construction and operation of the tunnel, an Energy Statement to London Plan requirements and an options appraisal for renewable offsetting technologies.
- Full Multiparametric LCA, Sulzer Pumps, Germany 2011-2014 Cradle-to-grave assessments and voluntary disclosure report verification for industrial pumping products and construction products. Working in the capacity of official verifier for the International Environmental Performance Declaration consortium; developed assessment methodology, audit framework and reporting protocols. Desktop audit complemented by site visits in Germany and Switzerland.

Peter Dunmow BA(Hons) DipLA MA(Hons)

Chartered Landscape Architect

Qualifications

BA (Hons) Landscape Architecture, Greenwich University, 1991

Dip LA, Landscape Architecture, Greenwich University, 1993

MA (Hons) Landscape Architecture, Greenwich University, 1996

Affiliations

Chartered Member of the Landscape Institute

Fields of Competence

Peter has twenty five years of experience in Landscape Architecture and Urban Design, managing and working on a range of projects throughout the UK and overseas. His experience covers the full range of landscape consultancy services including landscape and visual impact assessments, comprehensive planning supporting statements and public inquiry evidence for a range of developments including wind farms and other renewable developments, overhead power lines, substation projects, biomass plants, business parks, housing, roads, quarry and mineral developments. Peter has prepared a range of townscape assessment work for a variety of new retail, commercial and residential developments as well as analysis and survey for urban renewal, regeneration and design studies. In addition, Peter complements these skills with considerable experience in masterplanning, detailed site planning and contract management.

Career History

HEPLA - Hermitage Environmental Planning and Landscape Architecture Limited

Director 2015

Enviros Consulting/ SKM Enviros/ Jacobs

Landscape Technical Lead 2005 – 2015

Farningham McCreadie Partnership

Principal Landscape Architect 1999 - 2005

Chris Blandford Associates, Sussex

1994 - 1999 Landscape Architect

British Waterways, Northamptonshire

Assistant Landscape Architect 1991 - 94

Technical Skills	Management Skills
• Expert Witness	• Organisation and Motivation
• Landscape and Visual Impact Assessment	• Team Management
• Environmental Impact Assessment	• Technical Leadership
• Masterplanning	• Commercial Focus
• Urban Design	• Market Adaption
• Townscape Studies and Assessments	• Project Management
• Landscape Design and Implementation	• Contract Management

Relevant Experience

Public Inquiries

- Pencloe Wind Farm Inquiry (2017) – Provision of support Inquiry Team on landscape and visual matters including preparation of an updated cumulative landscape and visual impact assessment, input to the Inquiry Report and Precognition, cross examination strategy. Appeal allowed. (North British Wind Energy/Invenergy)
- Fallago Rig Extension Inquiry (2017) –Preparation of Inquiry Report, Precognition and acted as Landscape Expert Witness at this wind farm Inquiry, held in the Scottish Borders. Appeal decision pending. (Scottish Borders Council)
- Kentish Flats Offshore Wind Farm Extension - Preparation of submissions to the Examination In Public (Vattenfall)
- Inverness Local Plan Inquiry – Preparation of a Statement of Evidence and accompanying documents in support of an allocation for residential development, including attendance and presentation of evidence at Inquiry. (William Gray Construction)
- Shawfair Local Plan Inquiry - Preparation of a Statement of Evidence including an independent Landscape and Visual Impact Assessment of the 'South East Wedge' area of Edinburgh for presentation at a Local Plan Inquiry with specific reference to housing land allocations. (Edmonstone Developments Ltd)
- Dungannon and South Tyrone Local Plan Inquiry - Preparation of Statements of Evidence including Landscape and Visual Impact Assessments of various subject lands for presentation at a Local Plan Inquiry with specific reference to housing/business land allocations. (Dungannon and South Tyrone Borough Council)
- Shawfair Local Plan Inquiry - Preparation of a Statement of Evidence including a supporting Landscape and Visual Impact Assessment for presentation at a Local Plan Inquiry with specific reference to housing land allocations. (Bett Homes Ltd)

Planning Appeals

- Dell Wind Farm – Preparation of landscape and visual aspects of the Statement of Appeal and associated appendices. (Coriolis Energy Limited)
- Article 33 Inquiry - Campbell College, Belfast - Preparation of Statements of Evidence in support of proposed residential developments including supporting Landscape and Visual Impact Assessments and full and detailed mitigation strategies for presentation at an Article 33 Planning Inquiry. (Campbell College Board of Governors)
- London Road, Kilmarnock - Preparation of a Townscape and Visual Impact Assessment in support of the conversion of a former nursing home, forming part of a written submission to the Scottish Executive, Planning and Conservation Area Consent Appeal . (Silverdale Developments Ltd)
- St. Patrick's Church, Cowgate — Preparation of Townscape and Visual Impact Assessment in support of a hotel development in the Edinburgh Old Town Conservation Area forming part of a written submission to the Scottish Executive, Planning and Conservation Area Consent Appeal.
- Straid Road, Ballycastle – Preparation of statement of evidence and documents in support of a small residential development, including attendance and participation in an informal hearing. (Private Client)

Presentations, Consultation and Lecturing

- Delivery of lecture to the MSc / Diploma Postgraduate Course in EIA – Landscape and Visual impact Assessment in EIA, Scottish Rural College. (2020)
- All Energy Conference Paper, Aberdeen, June 2013 – 'Cumulative Assessment – Visualisation Techniques'. Peter set out a review current best practice in the use of graphics to support the cumulative assessment of wind farms.
- Renewables UK Conference Paper, Glasgow, November 2010 – 'Views from the Front: Residential Visual Amenity and Settings Assessment'. Peter set out a user friendly guide to the evolving methodologies for the presentation of robust assessments.
- Provision of EIA module lecturing to the MSc/PG Dip in Ecological Economics – Introduction to Landscape and Visual impact Assessment lecturing role with the Scottish Agricultural College. (2009-2011)
- Scottish Government Planning Advice - Enviros Consulting Ltd MacRoberts LLP were appointed by the Scottish Government to provide support and advice including landscape advice to planning authorities on the preparation of their supplementary planning guidance (SPG) for wind farms from the period between March 2008 and March 2009. Details at www.spgadvice.co.uk. (Scottish Government)
- British Wind Energy Association - Enviros Consulting Ltd were appointed by BWEA to undertake a review of Draft Supplementary Planning Guidance (SPG) Wind Energy in Northern Ireland's Landscapes, prepared on behalf of the Department of the Environment NI by Julie Martin Associates. This review was prepared to assist BWEA in drawing up a formal response to the Draft SPG. (BWEA)

Landscape and Visual Impact Assessments

A wide experience on a very wide range of assessment work including Environmental Impact Assessment, and Landscape and Visual Impact Assessment for over 20 onshore and offshore wind farms. LVIA experience includes preparation of comprehensive planning supporting statements and public Inquiry evidence for a range of developments including business parks, housing, roads, quarry and mineral developments.

Renewables Experience

- Pencloe Wind Farm, New Cumnock, East Ayrshire – review of Landscape and Visual Impact Assessment for a tip height extension, Section 36c application.
- Yell Wind Farm, Yell, Shetland - Landscape and Visual Impact Assessment for a proposed 32 turbine, Section 36 application. Engagement with Shetland Island Council and SNH at an early stage to agree parameters and sensitivities associated with the proposal. Detailed design optimisation process to achieve a careful landscape fit. Element Power Ltd / energy Isles
- Bilbo Solar Farm, Crimmond, Aberdeenshire – Landscape and Visual Impact Assessment for a proposed 44.5 Ha solar array (Green Energy International)
- Patrickston Solar Farm, Kippen, Stirlingshire– Landscape and Visual Impact Assessment for a proposed 17.4 Ha solar array (Green Energy International)
- Greystone Knowe Wind Farm – Feasibility Study for a proposed 12 turbine wind farm in the Moorfoot Hills (Coriolis Energy Limited)
- Ulzieside Wind Farm, Dumfries and Galloway – Preparation of supplementary environmental information, including a comprehensive cumulative landscape impact assessment, to refresh an existing planning application following resolution of aviation constraints. NBW Wind Energy Ltd

- Bettyhill Farm Extension, Sutherland – Preliminary feasibility and design advice followed by ongoing Landscape and Visual Impact Assessment for a proposed c.7 turbine extension. NBW Wind Energy/ Invenergy
- Turnalt Wind Farm, Argyll and Bute – Preliminary feasibility and design advice for a proposed wind farm site near Ardfern in mid Argyll. Coriolis Energy Limited
- Tidal Stream Array, Anglesey – site search for onshore cable land fall and sub station, for a proposed tidal stream array, to minimise landscape and visual effects. Anglesey Marine Energy, Morlais
- Blar Gavary Farm, near Bonar Bridge, Highlands – Baseline Landscape and Visual Impact Assessment for a proposed 10 turbine development. Eneco
- New Wind Farm Proposal, Powys – Preliminary feasibility and design advice for a non-TAN8 site in the Cambrian Mountains. Infinis
- Margree Wind Farm, Dumfries and Galloway – Preparation of supplementary environmental information to refresh an existing planning application following resolution of aviation constraints. NBW Wind Energy Ltd
- Starryshaw Wind Farm, Shotts, North Lanarkshire – Post application supplementary environmental information and consultation. Willowind
- Blairadam Wind Farm, Fife – Post application consultation. Partnership for Renewables
- Pencloe Wind Farm, New Cumnock, East Ayrshire - Landscape and Visual Impact Assessment for a proposed 19 turbine, Section 36 application. Engagement with East Ayrshire Council and SNH at an early stage to agree parameters and sensitivities associated with the proposal. Detailed design optimisation process to achieve a careful landscape fit. NBW Wind Energy Ltd
- Cummings Hill, nr. Jedburgh, Scottish Borders - Landscape and Visual Impact Assessment for a proposed 7 turbine development. Early stage submission of representations with regard to designation of Special Landscape Areas. Design optimisation process to balance production capacity and sensitive landscape receptors. Infinis
- Dell Wind Farm north of the Glendoe Hydro project, Highland - Ongoing Landscape and Visual Impact Assessment for a proposed 18 turbine wind farm, Section 36 application. Detailed design optimisation to eliminate effects on Castle Urquhart. Completion of challenging and remote site work. Coriolis
- Balunton Wind Farm near Bargrennan, Dumfries and Galloway - Ongoing Landscape and Visual Impact Assessment for a proposed 9 turbine application. The project became viable following a successful representation to the Dumfries and Galloway Interim Planning Policy for Renewables, arguing that the site was appropriate to be included as an unconstrained area of search. NBW Wind Energy Ltd.
- Kentish Flats Offshore Wind Farm Extension – Preparation of a landscape, seascape and visual impact assessment for 17 turbine extension to an existing offshore wind farm. Key tasks included seascape characterisation of the study area and advice on design optimisation. (Vattenfall)
- Blyth Offshore Demonstrator Project – Landscape Technical Lead for the now consented NaREC 15 turbine offshore test array. Key tasks include working within a ‘Rochdale envelope’ project description to identify the maximum scale of development with the least environmental harm and consultation with the MMO. (NaREC)
- Tullo Wind Farm Extension, Aberdeenshire - Landscape and Visual Impact Assessment for a proposed 5 turbine extension to an existing wind farm, near Stonehaven.
- Seagen Sea Skerries Tidal Stream Array, Anglesey – Technical review of Landscape and Visual Impact Assessment for the proposed turbine array. (MCT Ltd)

- Belmore Wind Farm – Settings assessment of Scheduled Ancient Monument sites prepared as an addendum to a EIA for a proposed wind farm in Northern Ireland. (Airtricity)
- Park Head Wind Farm – Landscape and Visual Impact Assessment for a proposed 9 turbine wind farm in Castle Morpeth District, Northumberland. (Renewable Energy Systems)
- Butterwell Wind Farm, Northumberland – Preparation of a detailed Landscape and Visual Impact Assessment for a 9no. turbine wind farm, including cumulative assessment of 7 adjacent sites. (Renewable Energy Systems)
- Tallentire Wind Farm, Cumbria –Baseline Landscape and Visual Impact Assessment for a 9no. turbine wind farm. (Renewable Energy Systems)
- Goonhilly Wind Farm – Landscape and Visual Impact Assessment for a proposed wind farm on the site of Goonhilly Downs Earth Station Site. (British Telecom/PMSS)
- Yelvertoft Wind Farm – Landscape and Visual Impact Assessment for a proposed wind farm close the M1 motorway in Northamptonshire. (Your Energy Ltd)
- Crockandun Wind Farm - Landscape and Visual Impact Assessment for a proposed wind farm on Slieve Gallion near Draperstown. (SWS Energy)
- Craignagapple Wind Farm - Landscape and Visual Impact Assessment for a proposed wind farm east of Strabane within the western extent of the Sperrin Mountains. (SWS Energy)
- Heysham Wind Turbine – Preparation of a Landscape and visual impact Assessment of a proposed large single wind turbine to the east of Heysham. (British Telecom)
- Tormywheel Wind Farm, Fauldhouse – Preparation of a comprehensive landscape strategy to provide mitigation to a proposed development of 14no. wind turbines. (PI Renewables)
- Perth and Kinross Wind Farm Policy – Preparation of representations to the Perth and Kinross Structure Plan on of behalf of the Scottish Renewables Forum as part of an objection to strategic wind farm planning policy in the region. (Scottish Renewables Forum)
- Slievekirk Wind Farm – Landscape and Visual Impact Assessment for an overhead pole mounted grid connection for a new wind farm in Northern Ireland. (Airtricity)
- Durran Mains – Feasibility and design work associated with a proposed borrow pit for a wind farm in Caithness. (DP Energy)
- Scottish Wind Farm Site Search – Support to RES in their prospecting for new Scottish Wind Farm sites. Advice focussed on a review of Landscape Character Types and their capacity for wind farm development. (RES)
- South and East of England Site Search – Services to RWE NPower in the preparation of sieve maping in GIS, followed by the identification and ranking of search areas. (RWE Npower)
- Numerous Planning Policy Representations on behalf of Wind Farm developers. (Wind Prospect, North British Wind Ltd, Infinis)
- Dunduff Quarry Wind Farm - Preparation of a landscape appraisal to inform the potential planning of a new small scale wind farm adjacent to an existing quarry development. (Patersons of Greenoakhill)
- Tesco CHP Plant Goole – Landscape and Visual Impact Assessment for a proposed Combined Heat and Power Plant at the Tesco distribution warehouse near Goole, East Riding of Yorkshire. (Tesco)
- Tesco CHP Plant Livingston – Landscape and Visual Impact Assessment for a proposed Combined Heat and Power Plant at the Tesco distribution warehouse in Livingston, West Lothian. (Tesco)

Environmental Impact Assessment

- Wavegarden, Ratho – Preparation of scoping correspondence with City of Edinburgh Council, including preliminary Zone of Theoretical Visibility plans to confirm that Landscape and Visual matters could be scoped out of the EIA process – (Tartan Leisure)
- Trengothal Radio Station, Land's End, Cornwall – Landscape and Visual Impact Assessment for a proposed large new satellite dish antenna at the Trengothal Radio Station site, including the preparation of indicative photomontages. The site is located in close proximity to sensitive Cornwall AONB. (BT/Avanti)
- Peffermill Sports Complex and Athletes Village – Landscape and Visual Impact Assessment for the proposed re-development of the Peffermill Sports Complex and associated Athletes Village, Peffermill, Edinburgh (Edinburgh University)
- Bangour Village – Landscape and Visual Impact Assessment for a residential development within the former Bangour Village Hospital site (Ambassador Group)
- Mixed Use Development Comprising Film & TV Studio Including Backlot Complex, Mixed Use Employment Uses, Straiton, Midlothian – Preparation of a comprehensive landscape and visual impact assessment for 36 Ha site to the south of Edinburgh. (Pentland Film Studios Ltd)
- Dolphingston, East Lothian – Preparation of a comprehensive landscape and visual impact assessment for a proposed new 8.72 Ha residential development to the south-west of Prestonpans. (Hallam Land)
- Orchardfield, East Linton, East Lothian – Preparation of a comprehensive landscape and visual impact assessment for a proposed new 6.32 Ha residential development, including indicative wireframe visualisations. (Stewart Milne Homes Ltd)
- Millerhill Zero Waste Facility. LVIA for a new large scale waste facility at Millerhill, Edinburgh. (Midlothian Council)
- Garreg Lwyd Hill Wind Farm, Wales - Preparation of a Landscape and Visual Impact Assessment and as part of an Environmental Impact Assessment for a new overhead power line connecting from the substation in the middle of the Proposal site at Tre-foel over a course of 39km south to just beyond Kington in Herefordshire. (RES)
- Robin House Children's Hospice, Balloch - Landscape and Visual Impact Assessment Children's Hospice Association Scotland's second children's hospice for Scotland, Robin House in Balloch near Loch Lomond, open to children with life-limiting / terminal conditions and their families. Significantly the LVIA was carried out in the context of the newly formed Loch Lomond and the Trossachs National Park. Despite the design having been commended by bodies such as The Royal Fine Arts Commission, the new Park Authority's Planning advisor recommended the project for refusal on site and policy issues. Permission was granted at committee following completion of the LVIA.
- Global Point International Business Park, Belfast – Preparation of a Landscape and Visual Impact Assessment and Concept Design Statement as part of an Environmental Impact Assessment for a new 200 acre Business Park. (Invest Northern Ireland/Pro Logis)
- Castlecourt, Belfast – Preparation of a Townscape and Visual Impact Assessment as part of an Environmental Impact Assessment for a 500,000 ft² extension to city centre shopping mall. (Westfield Shopping)
- Dunadry, Nr. Antrim – Preparation of a Landscape and Visual Impact Assessment and Concept Design Statement as part of an Environmental Impact Assessment for a new garden village settlement. (Lagan Developments)

- Mullingar Business Park, County Westmeath, Eire – Preparation of a Landscape and Visual Impact Assessment as part of an Environmental Impact Assessment for a new 70 acre business park. (IDA)
- Ballyoan, Londonderry – Preparation of a Landscape and Visual Impact Assessment and as part of an Environmental Impact Assessment for a 95 acre settlement expansion. (Various)
- 'K' Village, Kendal - Detailed townscape assessment forming part of an Environmental Impact Assessment for the redevelopment of a former shoe factory as a factory outlet centre. (Guinea Group)

Quarry Related Experience

- Willington Sand and Gravel Pit Extension, Trent Valley, Derbyshire – Landscape and Visual Impact Assessment and mitigation strategy for the proposed quarry extension. (Cemex)
- Swinton Quarter Craft Stone Quarry, Swinton, Scottish Borders – Landscape and Visual Impact Assessment and mitigation strategy for the proposed re-opening of a small stone quarry in the Scottish Borders. (Hutton Stone)
- Comrie Colliery Reclamation Scheme, Comrie Open Cast Site, Oakley, Fife – Restoration planting strategy for the re-formed earthworks associated with this former open cast coal mine.
- Borrow Pits, Burn of Whilk Wind Farm, Caithness – Quarry phasing design and mitigation strategy for the proposed re-opening of a small hard rock quarry.
- Tarfhaugh Sand Pit, West Linton, Scottish Borders – Preparation of draft quarry development proposals as part of feasibility study for the potential opening of a sand and gravel quarry on the site of a glacial kame feature near West Linton.
- Durran Mains – Feasibility and design work associated with a proposed borrow pit for a wind farm in Caithness. (DP Energy)
- East Garnock, Quarry Design and Restoration - Lead design and planning of a 120Ha quarry proposal for a site in North Ayrshire. The design proposals include progressive restoration of the 7 million tonne extraction phased over 20 years. Restoration is focussed on the creation of extensive areas of new wetland habitat and tidal lagoons. (NPL Estates)
- Levenseat Quarry Extension, Fauldhouse, West Lothian – Preparation of full and detailed Landscape and Visual Impact Assessment in support of an application for a 12Ha extension to an existing sand and gravel quarry. (WBB Minerals)
- Levenseat Quarry Re-Phasing – Preparation of a presentation to illustrate proposals for an application to vary a Planning Consent. The presentation prepared in Powerpoint included the design of the proposed quarry phasing over a 20 year period alongside an accompanying landscape mitigation strategy. (WBB Minerals)
- Edston Quarry, Peebles – Preparation of a Landscape and Visual Impact Assessment (LVIA) in support an application to re-open a small hard rock quarry. The assessment included proposals for mitigation and quarry phasing.
- Craigiehill Quarry, Edinburgh - Dormant hard rock quarry. Landscape and Visual Impact Assessment (LVIA) as part of an EIA and Restoration Strategy for a change of use from a quarry to a recycling facility. (Tarmac)
- Beltmoss Quarry, Kilsyth, North Lanarkshire - Hard rock quarry. LVIA as part of an EIA and Restoration Strategy for an extension to an existing quarry. Followed by Determination of Conditions Application in respect of Conditions appended to Planning Permission. (Patersons of Greenoakhill)

- Cruicks Quarry, Inverkeithing, Fife - Hard rock quarry making aggregates. LVIA followed by Determination of Conditions Application in respect of Conditions appended to Planning Permission. Contract Administration of initial phase of the restoration planting works. Subsequent preparation of detailed restoration proposals to support an application for quarry deepening. (Tarmac)
- Cotside Quarry, Carnoustie, Angus - Sand and gravel quarry. LVIA and Restoration Strategy as part of an Environmental Impact Assessment for an extension to the existing quarry. Followed by Determination of Conditions Application in respect of Conditions appended to subsequent Planning Permission.
- Cunmont Quarry, Dundee, Angus - Hard rock quarry LVIA as part of EIA and Restoration Strategy for an extension to an existing quarry. Followed by Determination of Conditions Application in respect of Conditions appended to Planning Permission. (Ennstone Thistle)
- Boyne Bay, Portsoy, Aberdeenshire - Limestone quarry. Preparation of a Restoration Strategy as part of an application to modernise working conditions and a Planning Application for a quarry extension. (Boyne Bay Lime Company)
- Lough Fea, Draperstown, County Antrim, Northern Ireland - Sand and gravel quarry LVIA as part of an EIA and Restoration Strategy for a new sand and gravel quarry. (FP McCann)
- Altnamuskin Quarry, County Tyrone, Northern Ireland - Sand and gravel quarry. Preparation of a Restoration Strategy as part of a Determination of Conditions Application to the Planning Permission. (Mullin and Sons)

Masterplanning

- Bangour Village Hospital, West Lothian – Preparation of the Landscape Masterplan for the conversion of the former hospital site in a housing led masterplan. Ambassador Group Ltd.
- Winning entry for the Moorside Earthworks Competition in the west of Cumbria. The earthworks will form the setting to Europe's largest nuclear new build power station site at Moorside, planned by NuGen. http://moorside.landscapeinstitute.org/
- Preparation of a Concept Master Plan of Belad Al-Husayneya, Mecca, Saudi Arabia – Preparation of a concept masterplan and early stage design principles for a new suburban extension to the Holy City of Mecca. The preliminary concept design was developed from initial masterplan baseline studies, through a series of design options, followed by the adoption a final concept masterplan. (Al Waqif Family/Khatib and Alami)
- Raith Estate, Kirkcaldy West - Preparation of Concept Masterplan and detailed supporting statement as part of representation to the FIFEPlan Local Development Plan. (Raith Estates)
- Ardeer Peninsula, North Ayrshire - Masterplan led regeneration strategy for a 100 Hectare site to deliver of a mix of suitable and sustainable end uses. A series of Masterplan options have been prepared for the heavily constrained and contaminated site which are subject to an ongoing SEA process. Enviros have coordinated Stakeholder consultation and a series of public exhibitions which have led to the selection of a preferred Masterplan option.
- Tamfourhill, Falkirk – Preparation of a Concept Masterplan to guide Falkirk Council in planning the redevelopment of contaminated lands adjacent to the Union Canal. The proposals considered the integration of the Falkirk Wheel Visitor Centre, the Antonine Wall and the redevelopment proposals beside the canal including: residential; business; and commercial boat services/canal basins. (Falkirk Council)
- Former Woodilee Hospital, Lenzie - Masterplan led regeneration of a former hospital site for a new village development at Woodilee, Lenzie. The detailed site planning of the

village was designed in accordance with the 'home zones' principle and included the formation of a market street as the core to the proposed development.

- Dunadry Garden Village, Nr. Antrim – Preparation of a Concept Master plan, as part of an Outline Planning Application, for an innovative garden village of potential regional significance. The new village proposals include a mixed use development of approx. 1500 houses arranged around a central core, including parkland, local services, community facilities and a small business park. (Lagan Developments)
- Global Point International Business Park – Preparation of a detailed Master plan, as part of an Outline Planning Application, in support of a new 200 acre business park on the edge of Belfast. The development proposals consist of 1.45millon ft2 of business floor space set within a high quality landscape that includes linear parks, formal recreational facilities, a 'village centre,' and structural woodlands. Following on from the master planning stage a design brief was developed to provide a coherent and practical framework for the future development of the business park. (Invest Northern Ireland/Pro Logis)
- Middlefield, Falkirk – Preparation of a Concept Master plan in support of a proposed mixed use Business Park at Middlefield, Falkirk. The masterplan was accompanied by a design guide for the long term sustainable development of the site. (Callendar Estate)
- Dundee Western Villages – Master planning for a new village development to the west of Dundee. The detailed site planning of the village was designed in accordance with the 'home zones' principle and included the formation of a market street as the core to the proposed development. The proposed development has received detailed planning consent. (Bett Homes)
- Collinswell Park, Burntisland – Master planning for the development of a new residential development on the site of a former Aluminium Works. The scheme is centred on a new public park which was carefully designed to accommodate flood waters from the Kirkton Burn. (Collinswell Land)
- Blair's College Aberdeen - Preparation of Concept Masterplan for the re-development of a seminary college near Banchory. The proposals include a luxury hotel and signature golf course and golf related facilities, integrated with the development of 280 residential units. (Muir Group)
- Land at East Haddington – Preparation of a Concept Masterplan for a proposed settlement expansion and golf course extension to the existing Amisfield Golf Course on lands to the east of the village of Haddington in East Lothian. (Bryant Homes)
- Longniddry, East Lothian – Preparation of a Concept Masterplan for the expansion of an existing settlement incorporating a new golf course and country Club. (Bryant Homes)

Major Infrastructure Projects

- Jubilee River (Maidenhead, Windsor and Eton Flood Alleviation Scheme) - Design and implementation of 11.5km of new river channel to alleviate flooding along the River Thames, including Environmental Management throughout the contract period. (Environment Agency)
- M25 Widening - Comprehensive scheme design for proposed Motorway widening between Junctions 12-15 including comprehensive landscape and visual impact assessments and mitigation design. (Highways Agency)
- A1M Alconbury to Peterborough - Design and implementation of highway upgrade and widening including Environmental Management throughout the contract period. (Highways Agency)

Infrastructure Projects

- EE Mobile Phone Mast Roll Out – Preparation of landscape and environmental planning services to support the implementation of emergency mast sites throughout Scotland.

- Finnieston substation, Glasgow - Preparation of detailed landscape mitigation proposals for the city centre development (Scottish Power, 2011)
- Kentish Flats Offshore Wind Farm Extension - Preparation of a landscape, seascape and visual impact assessment for 17 turbine extension to an existing offshore wind farm. The work included the assessment of the cable landfall, transition pit and options for routeing of the underground cable corridor over a 2km route from Whitstable to the onshore grid station. Support given on this NSIP through EIP process (Vattenfall ,2011).
- Proposed Substation, Swansea North - LVIA for a proposed 400kV substation near at Swansea North. The scheme has successfully been granted planning permission (National Grid plc, 2010)
- Blyth Offshore Demonstration Project - Confirmation of preferred route corridor for connection of a 1.5km underground HVDC route for the 275 kV export cables from the cable landfall and transition pit to the Blyth substation (formerly Blyth Power Station) owned by National Grid. Included extensive consultation and negotiation with Natural England (NAREC, 2011)
- Slievekirk Wind Farm - Landscape and Visual Impact Assessment for an overhead pole mounted grid connection for a new wind farm in Northern Ireland. (Airtricity, 2010)
- Garreg Lwyd Hill Wind Farm, Wales - Preparation of a Landscape and Visual Impact Assessment and as part of an Environmental Impact Assessment for a new overhead power line connecting from the substation in the middle of the Proposal site at Tre-foel over a course of 39km south to just beyond Kington in Herefordshire. (RES, 2010)

Townscape Studies and Assessments

Experience with a range of urban assessment work for a variety of new retail, commercial and residential development, covering a wide range of townscape analysis and surveys for urban renewal, regeneration and design studies.

- Iona Street – Preparation of verified visualisations to support a proposed residential development in Edinburgh (Manson Architects)
- Bonnington Road Lane – Preparation of verified visualisations to support a proposed residential development in Edinburgh (JM Architects)
- Jeffrey Street - Preparation of Townscape and Visual Impact Assessment and verified visualisations to support a proposed hotel extension development in Edinburgh (CFP Architects)
- Calton Hill, City Observatory Project – Townscape and Visual Impact Assessment for the proposed refurbishment and re-development of the City Observatory Compound. Key issues included consideration of the effects of a proposed new ‘Salon’ housing a restaurant, designed to reflect the adjacent neoclassical architecture, on the city skyline, the Edinburgh World Heritage Site and associated conservation designations.
- Royal Edinburgh Hospital (REH) Edinburgh - Townscape and Visual Assessment (TVA) for the proposed redevelopment of existing hospital complex in south Edinburgh suburbs to modernise and improve facilities, while retaining the key parkland edges and other important townscape/ landscape features and minimising effects on patients and surrounding residents. Hub South-east Scotland
- Port of Leith Redevelopment - Responsible for townscape and visual impact assessment and advice and guidance on the overall project design optimisation for the proposed redevelopment and extension of the Port of Leith, Edinburgh. Within this complex environment close to conservation areas, listed buildings and extensive areas of residential development key services included negotiation on the scope of the assessment with Statutory Consultees. 2012 – Ongoing. Scottish Enterprise / Forth Ports

- Audley Square, Mayfair – Preparation of a Townscape and Visual Impact Assessment as part of an Environmental Impact Assessment for a new hotel and apartment complex within the heart of Mayfair. The proposals for the eight storey building were developed with Foster and Partners. Architects. (Hedleigh (Mayfair) Ltd)
- Royal Shakespeare Theatre, Stratford Upon Avon – Detailed Townscape and Visual Impact Assessment forming part of an Environmental Impact Assessment for the redevelopment of the existing Royal Shakespeare Theatre. (Royal Shakespeare Company Ltd)
- Woodside Quarry, Horsforth, Leeds – Preparation of a Townscape and Visual Impact Assessment as part of an Environmental Impact Assessment for a mixed use development within the context of a former sandstone quarry within suburban Leeds. The proposals include a mix of residential and commercial uses including a small community hub centred around a high quality public realm. (Burford Group Ltd)
- Gallowgate, Newcastle Upon Tyne - Preparation of a Townscape and Visual Impact Assessment, including a night time lighting impact assessment as part of an Environmental Impact Assessment for a mixed use development on the former Tyne Brewery site. The proposals included: a hotel; offices; student halls of residence; and a residential accommodation, located within five separate buildings. (Storeys SSP/Downing)
- St. Andrews Greenbelt Study.
- South East Wedge, Edinburgh, Green Belt Study.
- Donaghadee – Preparation of a Town Strategy presenting an overview of the area's key characteristics, needs, issues and priorities, including a literature review, local survey/public consultation and report. (Ards Borough Council)
- Glengormley and Ballyclare – Town centre re-generation studies. (Newtownabbey Borough Council)
- Lee Valley Regeneration Study – Preparation of a regeneration strategy and associated environmental enhancements for the River Lee. (London Borough of Hackney)

Landscape Design and Implementation

- Nationwide House, Croft Campus, Swindon – Lead design consultant for major projects at Nationwide Building Society's Headquarters in Swindon, associated with the development of the Headquarters Campus for the Nationwide Building Society. These have included: the design and implementation of a new Decked Car Park and associated roof garden; major campus wide environmental enhancements; and, the construction of a new system of site access and circulation. All projects have included liaison with an extended project team, detailed contract management and inspection within the context of an extremely busy campus environment used by 3000 employees. (Nationwide Building Society)
- West Mill Road, Colinton, Edinburgh – Preparation of detailed hard and soft landscape proposals for a new residential development to discharge Planning Conditions, followed by the implementation of the scheme on site. (Applecross Properties Ltd)
- New Baptist Church, Moira, Northern Ireland – Preparation of detailed hard and soft landscape proposals for a new church to discharge Planning Conditions, followed by the implementation of the scheme on site.
- Eastfieldburn, Cambuslang – Preparation of detailed hard and soft landscape proposals for the restoration of a disused mine. Specifically, the proposals included the formulation of strategy to eradicate a Japanese knotweed infestation.
- 23a Northumberland St, Edinburgh – Preparation of detailed hard and soft landscape proposals associated with a domestic extension and new garden, followed by the implementation of the scheme on site.

- Cruicks Quarry, Inverkeithing – Preparation of detailed quarry restoration planting proposals to discharge Planning Conditions followed by on site implementation, contract management and inspection and ongoing maintenance.
- Altonhill, Kilmarnock – Preparation of detailed soft landscape proposals associated with a new residential development, initially to discharge Planning Conditions, followed by on site implementation, contract management and inspection and ongoing maintenance.
- Swanley Town Centre - Detailed design and implementation of town centre environmental enhancements. (Swanley Borough Council)
- Kuwait Oil Sector Complex - Preparation of detailed proposals for the design of a new flag ship development in Kuwait City. (Kuwaiti Ministry of Oil)

Urban Design

- Bells Mills, Dean Village, Edinburgh – Site planning and preparation of hard and soft landscape proposals as part of a Planning Application for 24no. apartments within 4no. 3-4 storey blocks for a vacant overgrown site adjacent to the Water of Leith. The scheme was successfully taken to appeal following a deemed refusal and is currently being worked up in detail for implementation. (Bishop Loch/BUREDI)
- Belford Lodge, Dean Village, Edinburgh – Similar scale and form of flatted apartment development for a nearby site beside the Water of Leith. The approved scheme is now also being worked up in detail for implementation. (Gregor Properties)
- Donaghadee – Preparation of a Town Strategy presenting an overview of the area's key characteristics, needs, issues and priorities, including a literature review, local survey/public consultation and report. (Ards Borough Council)
- Royal Quay, Harefield – Detailed planning application for a new residential development within the context of a Conservation Area, including hard and soft landscape proposals. (Ravenblack Developments)
- Gravesend – Detailed planning application for a new flatted apartment development overlooking the River Thames in Kent. The waterfront scheme includes the formation of a new riverside walkway focussed on a redeveloped pier and restaurant. (Ravenblack Developments)
- Ards Shopping Centre, Newtownards – Detailed hard and soft landscape design for the proposed re-development of a shopping centre. The extended development includes the creation of significant areas of formal and informal public open space, new squares, plazas and a water garden. A proposal for an extended earthwork feature forms the gateway to the development itself, Newtownards and the county of Ards and North Down. (Private Client)

Historic Garden Restoration Design

- Houghton Park - Preparation of detailed Restoration Management Plan for a Grade 1 registered park funded by English Heritage to improve the legibility of the landscape for visitors, re-create lost parkland and restore key relationships between the park and surrounding buildings. (Lord Cholmondeley)
- Regency Parks Brighton - Preparation of detailed proposals for the restoration of the existing dilapidated parks within Brighton. (Brighton and Hove Borough Council)
- Norfolk Square, Brighton - Site planning through to on site implementation for the restoration of Norfolk Square, Brighton. (Brighton and Hove Council)

Other Interests

- World travel, walking and mountaineering, climbing, ski-touring, cycling, vegetable growing, cooking, river and sea-kayaking, art.

Ruth Fain

Associate Director – Environmental Planning and Advisory

Qualifications and Professional Memberships

- MGeol (Hons) Environmental Geology
- Chartered Scientist (CSci)
- Member of the Institute of Environmental Sciences (MIEnvSc)
- Member of the Institute for Air Quality Management (MIAQM)
- NEBOSH General Certificate in Occupational Health and Safety (Distinction)

Career Summary

Ruth is a Chartered Scientist and Member of the Institute of Air Quality Management with over 18 years' experience in managing and delivering environmental impact assessment (EIA) and compliance projects, with a focus on renewable energy and industrial developments. She is an experienced client and project manager and is a specialist in development consenting.

In addition to her Project Management skills, Ruth is a technical expert in air quality and odour and is experienced in all aspects of environmental regulation and management. She utilises this operational knowledge in her EIA project management, bringing a whole project approach to the planning and design stages.

Ruth is knowledgeable in the latest UK EIA Regulations and their implementation, best available techniques, and conversant in international best practice guidance and standards for ESIAs issued by the International Finance Corporation and World Bank Group. She has experience of Development Consent Order applications and experience of working with all stakeholder groups associated with planning and consenting.

Selected Project Experience

Environmental Impact Assessment

- SaxaVord Spaceport, Unst - Assessment of Environmental Effects (AEE) and reporting to the Civil Aviation Authority as part of the Spaceport Operator License Application under the Space Act 2018. Management and reporting of AEE focusing on operation effects of launching small satellites from the three vertical launchpads on Unst.
- Shetland Space Centre - SaxaVord Spaceport, Unst - Management and reporting of EIA as part of major planning application for a vertical launch space port and associated infrastructure at Lamba Ness. Assessment over three years with particular focus on marine and transboundary effects, minimisation of impact on scheduled monuments and assessment and mitigation of effects on a diverse bird and animal population.
- Alvance British Aluminium – Billet and Casting Facility, Fort William - Management of EIA for 12,254 m2 billet casting facility. Works included multi-discipline EIA, flood risk management, draingage strategy design and peat management planning.

- Sembcorp - Combined Cycle Power Plant, Teesside. Air Quality, Noise and Greenhouse gas assessment works to support DCO variation required by design change to alternative technology.
- Legal & General - Hillthorn Business Park, Sunderland**.** Management and delivery of EIA technical input for a large industrial business park.
- Giants on the Quayside, World Wheel Company, Newcastle - Management and delivery of technical input to planning and EIA process including production of Environmental Statement for £100M urban regeneration project in Newcastle, comprising Europe's largest observation wheel and associated entertainment developments.
- International Advanced Manufacturing Park, Sunderland - Assessment and delivery of air quality input into Environmental Statement and Non-Technical Summary for Phase 1 and 2 of an advanced manufacturing park, including DCO process at phase 2.
- Forsa Energy - Air Quality Impact Assessment and delivery of air quality input into Environmental Statement and Non-Technical Summary for a proposed peaking power plant site with approximate output of 19.9 MWe and located in an area with particularly onerous council requirements.
- Distilleries – Management of development EIA for proposed distilleries including Glenmorangie, Glenrothes and a new distillery in Jedburgh. Assessment included multi-disciplinary assessment of construction and operational effects in accordance with appropriate standards.
- Mining Development, Gabon - Air quality monitoring (in-field) and EIA assessment to support a World Bank standard environmental and social impact assessment for the construction and operational phase of a mine in Gabon, Africa.
- Kosovo Motorway, Kosovo Ministry of Transport - World Bank standard environmental and social impact assessment for the construction and operational phase of the Kosovo Motorway Project. Assessment of impacts on air quality of a 102 km dual carriageway road scheme.

Associated Projects

- Locate Solar – Development and utilisation of a bespoke methodology with Lichfields for assessing site suitability for solar development.
- Confidential Client, South east England - feasibility assessment of developing ground mounted solar installations including identification of potential sites and grid and wider environmental constraints assessment.
- Project technical and development support, confidential thermal and fuel cell hydrogen installations, Protium Green Solutions, UK
- Bruichladdich – Project Hyladdie, Islay. Technical input into BEIS Green Distilleries funded feasibility study on incorporating innovative hydrogen combustion technology into an existing distillery.
- Permitting and Industrial Pollution Control
    - PPC / EP permit application, variations and surrenders - Project management and delivery of PPC/ EP permit applications, variations and surrenders for clients in the Manufacturing, Power, Oil and Gas and Waste sectors including Nestlé, Refresco, British Nuclear Group, Egdon Resources, National Oilwell Varco, AES Kilroot, Biffa, Shanks Waste Solutions, Princes, Thomas Hardy Brewery and Premier Foods. Support during negotiations with regulatory authorities, coordination of specialist studies and ongoing compliance and stakeholder engagement work.
    - Nestlé UK – Long term regulatory compliance support to various UK Sites including emissions dispersion modelling, odour impact assessment, Best Available Technique (BAT) assessment, cost benefit analysis and general EP compliance support during planning, permitting and divestiture stages of operation. Various sites across the UK. Regularly liaising between site contacts, regulators, client and external legal advisors and client commercial/PR teams regarding issues of nuisance, civil claims, EP permit breaches and transactional risk management.

- BAT Assessment - Assessment of particulate abatement plant for emissions from gas and coal fired boilers and other site process emissions for confidential manufacturing client. In addition to planning and permitting requirements, the investigation was submitted as a case study to an Environment Agency large combustion plant (LCP) BAT reference document working party.

- Air Quality and Odour Assessment and Modelling
  - Co-author: "Guidance on the Assessment of Odour for Planning", Institute of Air Quality Management.
  - Odour Dispersion Modelling, Impact and BAT Assessments – odour impact assessment, BAT assessment and cost benefit analysis for planning, permitting and due diligence stages of operation for clients in the waste and manufacturing sectors. Regularly working with client legal and commercial teams regarding issues of statutory and private nuisance and operational risk management.
  - AERMOD and ADMS dispersion modelling and assessment of emissions from various manufacturing, waste and power facilities. Site impact assessment (base case) and investigation into modelled impact of operational improvement scenarios, including varying stack designs, locations and heights and BAT assessment of various abatement technologies.

Blue Ridge Research and Consulting, LLC

Shetland Space Centre Launch Vehicle Operations Data Call

November 25, 2020

Prepared for:
Scott Hammond
Shetland Space Centre
Shetland, Scotland
Scott.Hammond@ShetlandSpaceCentre.com

Blue Ridge Research and Consulting, LLC
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Asheville, NC 28801
(p) 828-252-2209
(f) 831-603-8321
BlueRidgeResearch.com

CAGE Code:	4JAW9
TIN:	20-4555864
DUNS No.:	784-426-954
NAICS 541330:	Small Business
OCI:	None
Validity:	120 days

1 Qualifications

The following sections provide an overview of our team as well as the qualification and experience of the key personnel related to the proposed effort.

1.1 Blue Ridge Research and Consulting, LLC

29 N Market St, Suite 700, Asheville, NC 28801
Contact: *Michael James*
Phone: *828.252.2209*
Website: *BlueRidgeResearch.com*

BRRC is an acoustical engineering consultancy focused on critical noise and vibration challenges for aerospace, aviation, and Department of Defense projects. With experience from 250+ civilian and military noise studies, BRRC's team of exceptional acoustical engineers are trusted advisors to public, private, and academic clients around the world. BRRC's expertise comprises measurement, modeling, and analysis of outdoor acoustics and sonic booms with a broad range of applications, including airports, spaceports, highways, railways, industrial plants, outdoor warning siren systems, and natural soundscapes.

BRRC's modeling capabilities enable the company to address unique conditions and impacts, and BRRC has developed specialized visualization tools to relate that information to decision makers and the public. BRRC's modeling experience ranges from military noise and sonic boom models including NoiseMap, MR_NMap, SARNAM, BNoise, PCBoom, and BoomMap to publicly available models such as AEDT and TNM. BRRC also has advanced in-house modeling capabilities with BRRC noise models such as The Launch Vehicle Acoustic Simulation Model (RUMBLE), flight safety models, and flight optimization models.

BRRC's noise source and propagation measurement experience is extensive, encompassing aircraft (subsonic and supersonic), rockets, helicopters, weapon systems, UAVs, sirens, and soundscapes. BRRC has significant experience in test plan development, pretest coordination, site selection, measurement setup, test execution, data analysis, and test documentation. BRRC personnel have provided their expertise for the development of numerous standardized testing and data analysis protocols. Our team has led the development of state-of-the-art customized measurement systems, which range in complexity from self-contained, three-channel systems to measurement arrays requiring 350+ data channels.

BRRC has the expertise to address complex environmental noise modeling and measurement challenges that require interdisciplinary teams and unique acoustical knowledge.

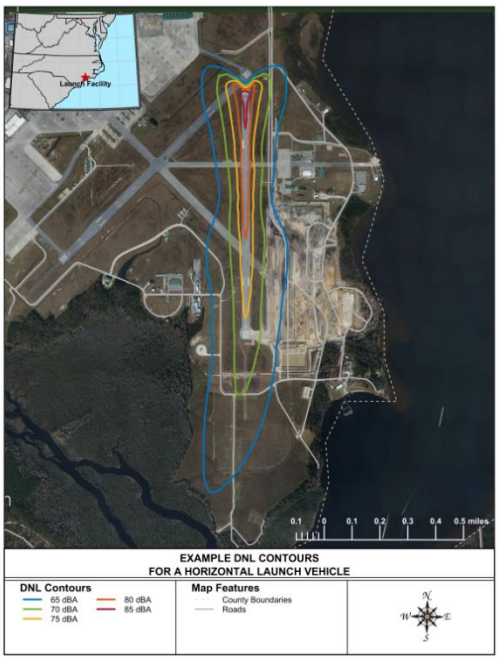
1.2 Related Projects

LAUNCH VEHICLE ENVIRONMENTAL NOISE STUDIES
Various Primes *Date: 2010 to Present*

BRRC has provided noise analyses as the prime launch vehicle noise consultant in over twenty-five rocket noise environmental studies. The noise effects on the local communities and environment were evaluated based on the FAA Order 1050.1F, Environmental Impacts: Policies and Procedures, on a cumulative basis in terms of human annoyance, measured by DNL. The launch vehicle propulsion noise analyses, performed using RUMBLE, were often supplemented with single-event metrics for hearing conservation and structural damage criteria. In addition to the propulsion noise, the sonic boom analyses were performed using PCBoom, which calculates the magnitude and location of sonic boom overpressures on the ground from supersonic flight. Sonic boom impacts from launch and reentry were evaluated on a single-event basis for hearing conservation and structural damage criteria.

BRRC's commercial space launch vehicle noise study experience includes:

- EA for ABL Space Systems VAFB Launch Site (2020);
- EA for Relativity Space's Terran 1 Launch Vehicle Operations at VAFB Site B330 (2020);
- EA for Relativity Space's Terran 1 Launch Vehicle Operations at CCAFS CX-16 (2019-2020);
- EA for United Launch Alliance's Vandenberg AFB Vulcan Centaur Launch Site (2019-2020);
- EA for SpaceX's Starship Landings at LZ-4, Vandenberg AFB (2019);
- EA for Firefly's Vandenberg Orbital Launch Site (2019);
- EA for Firefly's Cape Canaveral AFS Orbital Launch Site (2019);
- EA for SpinLaunch's Kinetic Launcher System at Spaceport America (2019);
- EA for Blue Origin's Vandenberg AFB Orbital Launch Site (2019);
- EA for United Launch Alliance's Cape Canaveral AFS Vulcan Centaur Launch Site (2019);
- Space Florida's Landing Site Operators License for the Shuttle Landing Facility (2018-Present);
- EA for Canso, Nova Scotia, Canada Launch Site (2017-Present);
- EA for NASA Kennedy Space Center, LC-48 (2017);
- Space Florida's Launch Site Operators License for the Shuttle Landing Facility (2017-2018);
- EIS for Spaceport Camden (Submitted, 2016-2017);
- EA for Blue Origin Cape Canaveral AFS LC-36 Launch Site (2016);
- EA for Cecil Spaceport (Submitted, 2015-2017);
- Site-wide PEIS for expanding operations at NASA Wallops Flight Facility (2014-2016);
- EA for Hawaii Air and Space Port (Submitted, 2014-Present);
- EA for Titusville Spaceport (Submitted, 2014-Present);
- EIS for Shiloh Launch Complex (Submitted, 2013-2014);
- EA for Issuing an Experimental Permit to SpaceX for Operation of the DragonFly Vehicle at the McGregor Test Site (2013-2014);
- Preliminary Site Evaluation for Space Florida's Shiloh Launch Facility (2013);
- EIS for SpaceX Texas Launch Site (2012-2014);
- Site-wide PEIS for expanding operations at Wallops Flight Facility (2012-2013);
- EA for Midland International Airport and Space Port (2012-2014);
- PEIS for Wallops Flight Facility (2010).


Launch Facility
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EXAMPLE DNL CONTOURS
FOR A HORIZONTAL LAUNCH VEHICLE
DNL Contours
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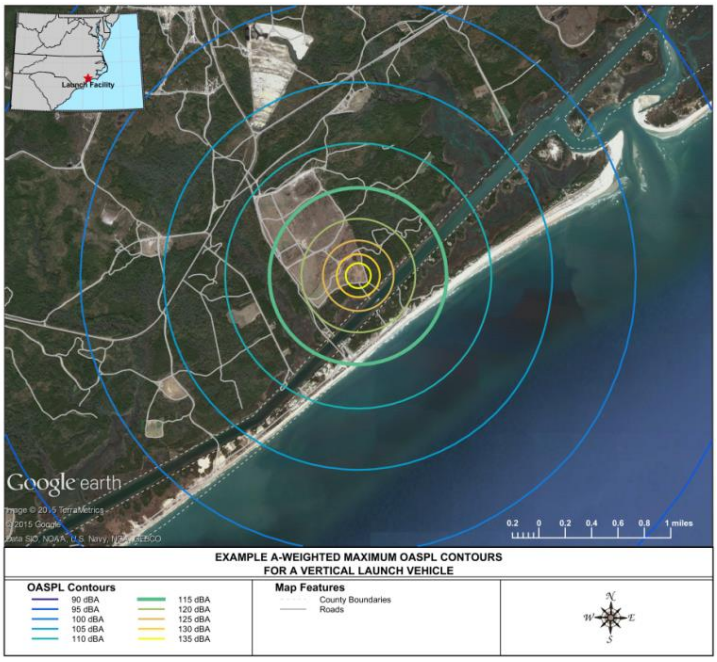
70 dBA
75 dBA
80 dBA
85 dBA
Map Features
County Boundaries
Roads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EXAMPLE A-WEIGHTED MAXIMUM OASPL CONTOURS
FOR A VERTICAL LAUNCH VEHICLE
OASPL Contours
90 dBA
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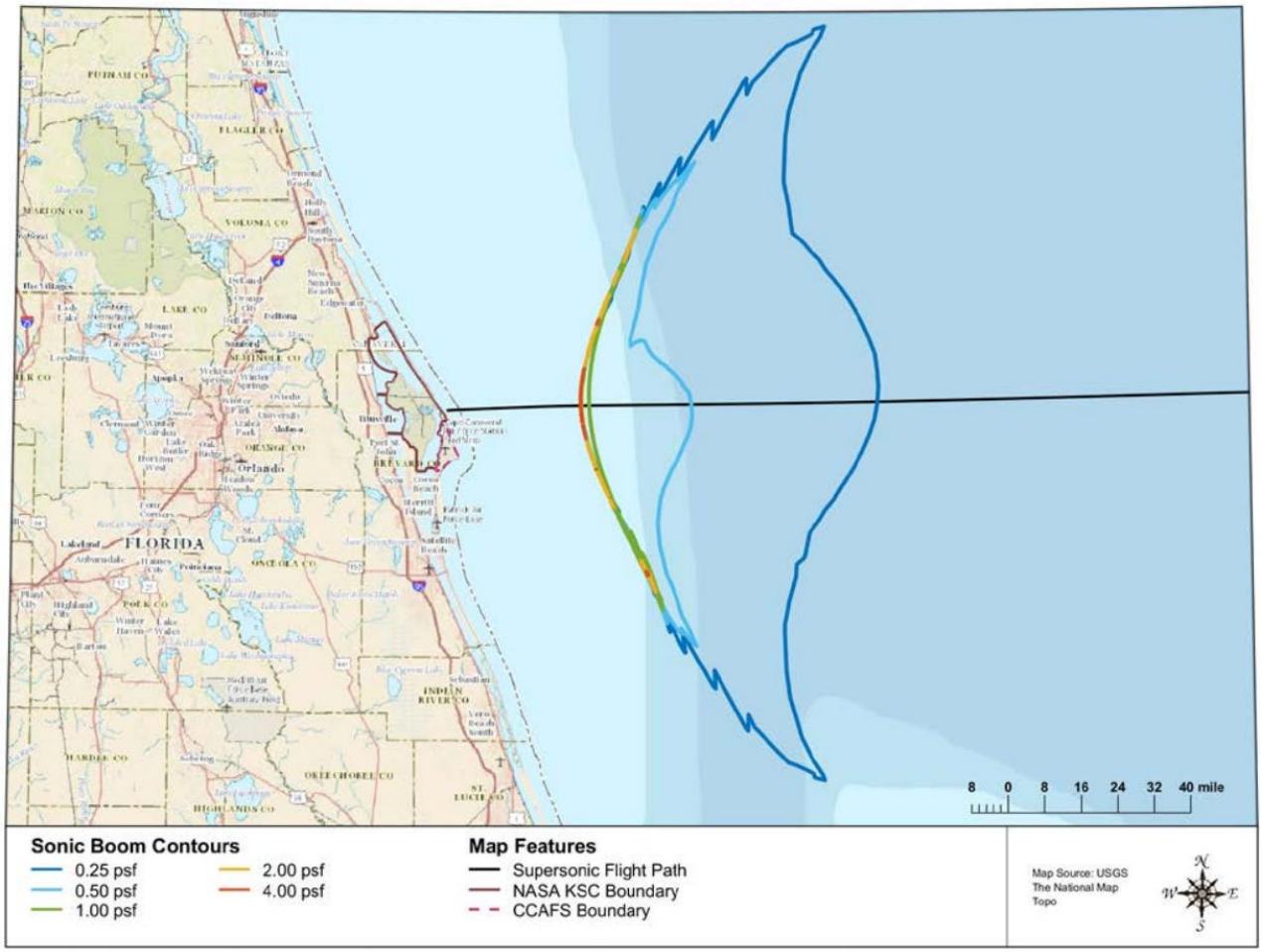
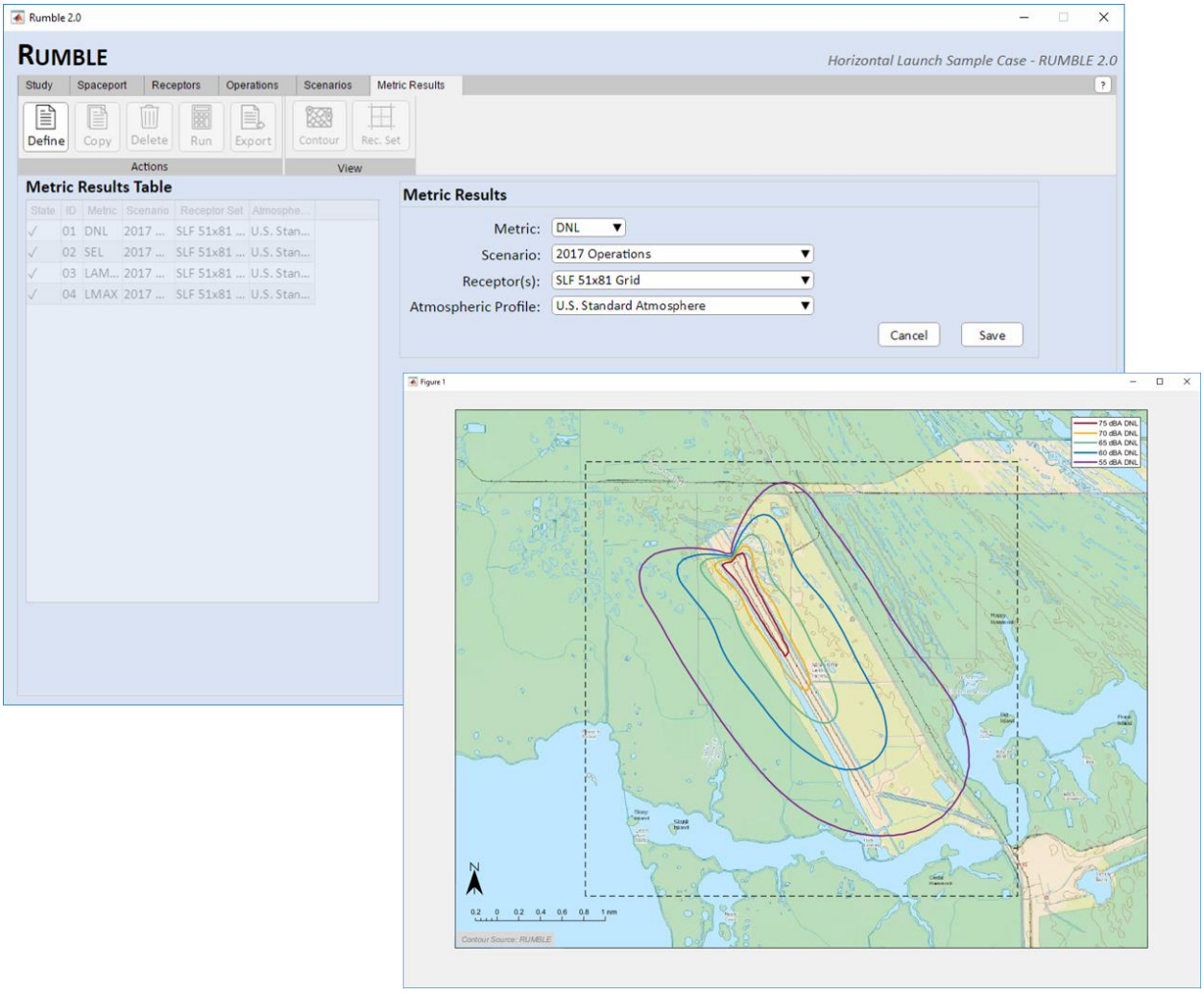
135 dBA
Map Features
County Boundaries
Roads


FLORIDA
Orlando
8 0 8 16 24 32 40 mile
Sonic Boom Contours
0.25 psf
0.50 psf
1.00 psf
2.00 psf
4.00 psf
Map Features
Supersonic Flight Path
NASA KSC Boundary
CCAFS Boundary
Map Source: USGS
The National Map
Topo

ACRP 02-66: Commercial Space Vehicle Noise Model Development for AEDT Integration

National Academies of Science *Date: 2015 to 2017*

BRRC's Launch Vehicle Acoustic Simulation Model, RUMBLE, was selected for ACRP Project 02-66. RUMBLE provides an efficient noise prediction model that produces accurate output relevant to environmental analysis of commercial space operations and airport/space launch site facilities. The RUMBLE modeling methodology reflects the best available science and practices, and has been reviewed and accepted by FAA AEE for use in over ten commercial space studies. RUMBLE includes an updateable database of essential input parameters that compiles the available spacecraft airframe and engine data pertaining to commercial space launch operations for actively licensed launch sites and vehicles. The model's input parameters and user-interface were specifically designed to maintain a level of consistency with the AEDT modeling platform to ensure smooth future integration. A user manual and example cases will highlight the model's features and provide potential users with a better understanding of the model's operation and capabilities. This effort has resulted in improved performance and efficiency of RUMBLE with the goal of making the tool accessible to a larger community of users.



ACRP 02-81: Commercial Space Operations Noise and Sonic Boom Measurements

National Academies of Science *Date: 2017 to 2020*

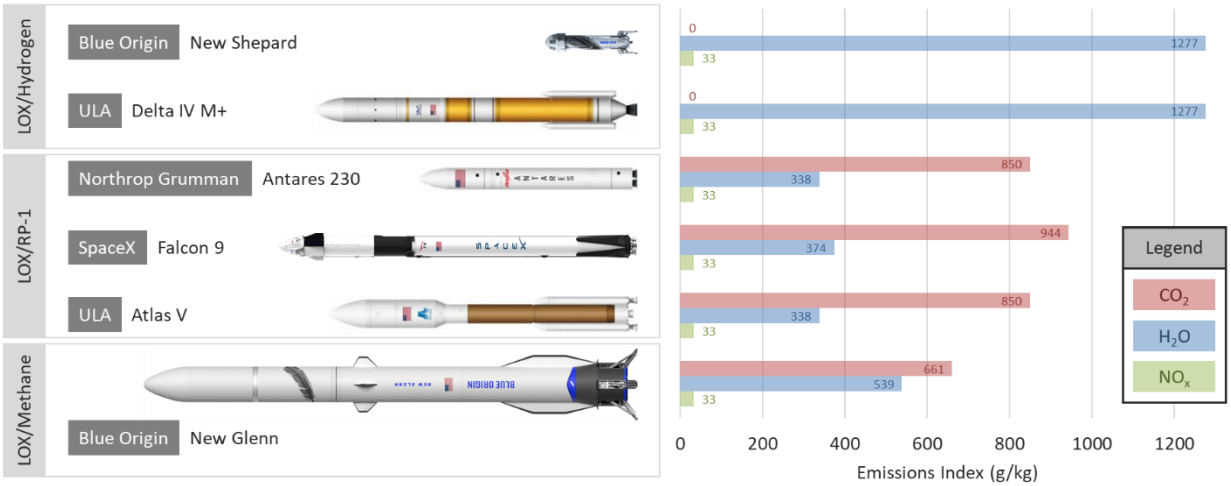
BRRC conducted a measurement campaign to obtain high-fidelity rocket propulsion noise and sonic boom signatures from a diverse set of commercial space vehicle operations under Airport Cooperative Research Program (ACRP) Project 02-81. The campaign included acoustic measurements of launch operations for the SpaceX Falcon Heavy and Falcon 9, ULA Delta IV Heavy, and Northup Grumman Innovation Systems Antares 230, as well as return-to-landing operations for the Falcon Heavy side boosters. BRRC deployed custom-built multiple-channel ground recording systems at a range of locations to measure detailed time histories of the rocket propulsion noise and sonic boom signatures. BRRC compiled the results into a database of rocket propulsion noise and sonic boom measurements that will serve as model source characteristics for the purpose of facilitating community noise model development and validation. Additionally, as part of the project objectives, BRRC developed a comprehensive community noise measurement protocol for commercial space operations propulsion noise and sonic booms that is intended to standardize the methodology for acquiring future measurements.



ACRP 02-85: COMMERCIAL SPACE VEHICLE EMISSIONS MODEL

National Academies of Sciences *Date: 2018 to Present*

BRRC developed a commercial space vehicle emissions model, which uses emissions indices to estimate the total quantities of the various pollutants emitted by space vehicles. A review of existing literature relevant to commercial space vehicle emissions informed the model development by identifying existing data and methodologies. The emissions model was integrated into BRRC's Launch Vehicle Acoustic Simulation Model, RUMBLE, providing the first user-friendly tool of its kind to enable practitioners to make accurate commercial space vehicle emissions and noise predictions for environmental documents. RUMBLE uses internal databases of engine performance data and emissions indices to allow users to easily estimate emissions for existing and emerging commercial space vehicles. A companion user guide describes the model's inputs and outputs as well as a technical review of the numerical codes and first-order approximations used to develop the databases and model methodology. Since AEDT is the standard model for estimating airport-related emissions, BRRC designed the commercial space vehicle emissions model with the intent to be integrated with AEDT. Additionally, BRRC prepared an integration plan, which describes the software and user interface modifications required to achieve a seamless integration of the commercial space vehicle emissions model with AEDT.



1.3 Key Personnel

Michael James, *Chief Engineer*

Mr. Michael James' areas of expertise include applied research, measurement, and analysis of atmospheric acoustics and technical management of consulting studies focused on military and community noise. Mr. James' research focus is developing innovative measurement, signal processing, and modeling techniques to characterize and map the noise emitted from complex noise sources. He has performed over 50 large-scale sound and vibration measurements for military and civilian aviation, rockets, weaponry, and blast noise to develop reference noise data and advanced propagation algorithms.

He has been the principal investigator for a diverse set of rocket environmental noise and launch load prediction studies. These studies have included propulsion and sonic boom noise analysis for static, launch and landing operations of both vertical and horizontal launch vehicles. Mr. James has been the principal investigator in the development of multiple rocket noise models including The Launch Vehicle Acoustic Simulation Model, RUMBLE. These advances have led to improvements in both near-field noise modeling used to predict vibroacoustic loading on space vehicles and far-field noise modeling to predict community impact.

Mr. James, as a member of working groups, has coauthored two American National Standards Institute standards (S12.75, S12.76) on aircraft noise source characterization. Mr. James has been instrumental in developing complete measurement systems, including portable sonic boom and noise measurement systems, an energy-based acoustic measurement system for rocket noise, a near-field acoustic holography system for jet plume characterization, and the Aero-Acoustic Research Complex for aircraft source noise characterization in White Sands, NM.

Prior to the founding of BRRC, Mr. James worked for Wyle Laboratories, where he conducted aviation research for the DoD and provided technical management for airport noise studies. His MS research at Virginia Tech's Vibration and Acoustic Laboratory included designing and testing passive and active turbofan engine noise reduction and control technologies for the NASA Langley Acoustics Research Group.

1.4 Abbreviated Curricula Vitae

MICHAEL JAMES, M.S.
Chief Engineer

PRINCIPAL DUTIES AND RESPONSIBILITIES

Conceives, directs and conducts applied research and consulting studies on high-amplitude noise sources and their effects on communities and the environment.

PROFESSIONAL EXPERIENCE

Blue Ridge Research and Consulting, Asheville, NC **2006 – Present**
Chief Engineer

- Founding member of BRRC. Responsible for developing innovative measurement, analysis, and modeling techniques to characterize and map the noise emitted from rocket engines/motors and jets (co-author of over 100 technical papers and reports).
- PI for over twenty-five rocket environmental noise studies consisting of propulsion noise and sonic boom impact analysis for projects involving a diverse collection of vertical and horizontal launches vehicles. Led the development of BRRC's Launch Vehicle Acoustic Simulation Model, RUMBLE.
- PI for three Airport Cooperative Research Program (ACRP) projects designed to develop commercial space noise (Project 02-66) and emission (Project 02-85) modeling tools, and conduct a measurement campaign to gather launch vehicle noise and sonic boom data (Project 02-81).
- Performed over fifty large-scale sound and vibration measurements for military and civilian aviation, rockets, sonic boom, weaponry, and blast noise to develop reference noise data and validate models. Extensive experience in sound and vibration measurements, data acquisition, signal processing, data analysis, and software development.
- Co-Authored two ANSI standards on "Methods for the Measurement of Noise Emissions from High Performance Military Jet Aircraft (ANSI S12.75)" and "Methods for Measurement of Supersonic Jet Noise from Uninstalled Military Aircraft Engines (ANSI S12.76 (Draft))." Provided technical expertise, including jet noise measurement procedures, signal processing, data acquisition systems, testing logistics and error / variability analysis.
- Co-PI of a NASA SBIR to develop an acoustic energy-based probe to facilitate greater understanding of the noise generation characteristics of rocket engine/motors. Performed multiple static fire measurements to evaluate the probes, producing significant advances in the characterization of the rocket acoustic source sound levels, directivity, and spatial extent.
- Co-PI of an Air Force SBIR to develop a near-field acoustic holography measurement system to characterize and map the noise emitted from jet engines. The system produced the first 3D holographic representation of the sound radiation from a military jet aircraft (F-22).

Wyle Acoustics Group, Arlington, VA **2002 – 2006**
Senior Engineer

- Researched and developed innovative measurement procedures and propagation models for the new generation of fighter aircraft with different engine geometries and thrust vectoring. Performed measurement of F/A-18E and F-22 to examine nonlinear propagation characteristics.
- Performed airport Master Plan and FAR Part 150 aviation noise studies. Developed advanced analysis and processing tools for community noise exposure, radar data, model validation, and soundscape studies.

EDUCATION

M.S., Mechanical Engineering, Virginia Tech	2003
B.S., Mechanical Engineering, Virginia Tech	2000

Appendix 1.2 EIA Report Schedule of Environmental Commitments

Table 18.1 Schedule of Environmental Commitments

Subject Area	Commitment	Timing
Proposed Development		
CEMP	All construction works will be subject to a Construction Environmental Management Plan (CEMP) to minimise environmental impacts during this phase of the Proposed Development. The CEMP will contain, as a minimum, the following management plans: ➢ Pollution Prevention Management Plan ➢ Emergency Response and Flood Risk Management Plan; ➢ Biosecurity Management Plan; ➢ Construction Noise Management Plan; ➢ Dust and Air Quality Management Plan; ➢ Construction Waste Management Plan; ➢ Water Quality and Pollution Management Plan; ➢ Peat Management Plan; ➢ Habitat Management Plan; ➢ Protected Species Management Plan; ➢ Construction Traffic Management Plan; and, ➢ Archaeological Management Plan. An outline CEMP, for information at the planning stage, is included in Volume IV as Technical Appendix 3.1. On appointment of the Principal Contractor, the outline CEMP will be reviewed, updated and submitted to Shetlands Islands Council for agreement prior to any construction activities commencing at the Proposed Development.	Pre-construction and construction
Pollution Prevention Strategy	Prior to commencement of construction activities, a pollution prevention strategy, contained within a CEMP, will be agreed with SEPA to ensure that appropriate measures are put in place to protect watercourses and the surrounding environment.	Pre-construction and construction

	High standards of health and safety will be established and maintained at all times. All activities will be undertaken in a manner compliant with applicable health and safety legislation and with relevant good practice, as defined under applicable statutory requirements and codes of practice and guidance.	
OEMP	All operational works will be subject to an Operational Environmental Management Plan (OEMP) to minimise environmental impacts during this phase of the Proposed Development. An outline OEMP, for information at the planning stage, is included in Volume IV as Technical Appendix 3.2. On receipt of planning permission, the Applicant will work with relevant Launch Service Providers to review and update the OEMP and submit to Shetlands Islands Council for agreement prior to operational activities commencing at the Proposed Development.	Pre-operation and operation
DEMP	During decommissioning of the Proposed Development, the Applicant will produce, and adhere to, a Decommissioning Environmental Management Plan. The DEMP shall be developed in accordance with current legislation and guidance at the time of decommissioning.	Pre-decommissioning
Landscape and Visual		
Visual impact	The design of the Proposed Development has evolved as part of an iterative process which has aimed to provide an optimal design in environmental, as well as technical and economic terms and, landscape and visual mitigation measures have been a central consideration in the design process. The proposed design layout has been developed to minimise the effect on the surrounding landscape and visual resource. The layout design has therefore evolved with the intention of presenting a simple, well balanced image of the Proposed Development in the majority of views.	Pre-construction
	Reflecting the expansive nature of the site and the surrounding topography, each of the buildings to be located on the proposed Launch Site has been designed with simple forms, reflecting the characteristic scattering of barns in the landscape, helping the structures to integrate with the surrounding landscape. The clusters of new buildings at Lamba Ness will be given unity by use of similar recessive colour themes and palettes that draw upon colours seen in buildings across Unst and natural colours occurring within the local Unst landscape. To assist in breaking up the elevations, the buildings will be finished with a coloured horizontal cladding, transitioning from a dark red at ground level to light grey blending with the sky above.	Pre-construction
	The adjustment of site levels and earth working will be minimised where possible with the use of bunds, cuttings and embankments also minimised. Changes in level will be carefully reprofiled where possible to tie in with the natural flow of the landscape. Sharp, angular transitions in earthworks will be avoided where possible. The exception to this will be the formation of earth sheltered berms at the launch pads which will necessarily have steep profiles.	Pre-construction
	Sections of drystone walling which are in the way of the works will be re-positioned and rebuilt on new alignments where possible, tying in with the local network of field boundaries.	Site restoration

	Disturbed ground and areas of earthworks will be re seeded with seed of local and native provenance, to restore the semi-natural coastal grasslands. As appropriate, more sheltered areas may be left to natural regeneration and exposed areas restored with retained turves cut from the site.	Site restoration
	The use of lighting at the Proposed Development will be minimised, with cut off lighting used where possible to reduce lighting overspill and glare. Unnecessary lighting will not be introduced and only task specific lighting will be used. Flood lighting will be used at the launch pads in the few days preceding a launch, to illuminate the launch vehicle, with cowls used to prevent unnecessary overspill and glare.	Operation
Ornithology and Ecology		
Breeding Birds Protection Plan	The Applicant will develop a detailed Breeding Birds Protection Plan to be informed by, and updated annually through, targeted breeding bird surveys. The Applicant will engage an experienced ornithologist to undertake a series of repeat ornithological surveys to update the baseline information as required.	Pre-construction & Operation
Construction Work and Vegetation Removal	An experienced ornithologist will be employed on-site in an ECoW capacity during the pre-construction and construction phases. Wherever possible, all vegetation clearance will occur outside the breeding season (i.e. between September – March inclusive), to ensure that no active nests are damaged or destroyed by the proposed works. This includes any areas of vegetation removed for infrastructure.	Construction
Habitats Disturbance	Avoidance of unnecessary disturbance to habitats by minimising the extent of ground clearance and other construction practices as far as practicable. ➢ Reinstatement of habitats (e.g. preserving the topsoil from the habitat that is lost and laying it over the top of the areas to be reinstated). Micro-siting e.g. avoiding sensitive habitats. This will necessarily be carried out on the ground under supervision by the ECoW.	Construction
Species Licensing	Where planned activities may result in potential disturbance which would likely be considered unlawful under the 1981 Wildlife and Countryside Act and the 2004 Nature Conservation (Scotland) Act unless they were licensed, appropriate licenses will be acquired.	Construction
Habitats Management	Implementation of an Outline Habitat Management Plan to deliver the following aims: ➢ Enhance habitats for species of importance present on, or linked to, the study area.	Construction, Operation

	➢ Restore important habitats and associated species. ➢ Create a wildlife watching hide. ➢ Peatland restoration. ➢ Create native riparian broadleaf tree/scrub cover. ➢ Coastal grassland habitat management. ➢ Creation of artificial otter holts. Three of the above aims are focussed on breeding Schedule 1 bird species. Two of these objectives target mitigation for species likely to be adversely affected by the Proposed Development. One is better described as enhancement, as the objective is for a species where no adverse or likely significant effects are predicted.	
Cultural Heritage and Archaeology		
Archaeological Programme of Works at the proposed Launch Site	An Archaeological Programme of works including Historic Building Recording, Peat Coring, a Strip, Map and Record Exercise and an Archaeological Watching Brief will be undertaken to mitigate direct impacts of the proposed Launch Site on archaeological remains. Where required, assets will be demarcated and/or construction works and plant movements will be monitored to avoid inadvertent damage to assets and features outwith the development footprint. All works will be overseen by an Archaeological Clerk of Works.	Pre-construction; Construction
Archaeological Watching Brief at Northdale Road	An Archaeological Watching Brief will be undertaken on ground-breaking works associated with the construction of the New Section of Access Road at Northdale. The aim of this will be to identify and assess the significance of any archaeological remains that may be present and, where these cannot be preserved in situ, to ensure they are preserved by record.	Construction
Archaeological Watching Brief at the proposed LRCC	An Archaeological Watching Brief will be undertaken on any ground-breaking works associated with the adaptation of the existing building on site for use as the LRCC. The aim of this will be to identify and assess the significance of any archaeological remains that may be present and, where these cannot be preserved in situ, to ensure they are preserved by record.	Construction
Vibration Monitoring	Vibration monitoring will be undertaken on archaeological Sites 96, 98, 99 and 111 in the vicinity of Launch Pad 3 and Site 85 in the vicinity of Launch Pad 2 and Site 90 between Launch Pads 2 and 3 during the operation phase. Furthermore, baseline data will be gathered prior to launches commencing on Site and monitoring will initially take place during launches to ensure that there is no damage to structures as a result of the operation of the Proposed Development. A programme of regular monitoring will be established thereafter and be dependent upon the results of initial monitoring. Where monitoring identifies the potential for structural damage, HES and the Shetland Regional	Operation

	Archaeologist will be informed immediately and further mitigation strategies will be discussed, agreed and implemented to prevent damage to any affected structures.	
Traffic and Transport		
Construction Traffic Management Plan (CTMP)	Review, update and adherence to the CTMP detailing mitigation measures deemed necessary to offset the temporary adverse effects of construction vehicles and including agreed operational times and haulage routes to the satisfaction of Shetland Islands Council. The CTMP is included in, and will be implemented through, the Construction Environmental Management Plan (Volume IV Technical Appendix 3.1).	Construction
Operational Traffic Management	The primary mitigation for the operational phase will be the proposed New Section of Access Road at Northdale which will remove the need for vehicles accessing the proposed Launch Site to travel through Saxa Vord. Site entrance roads will be well maintained and monitored during the operational life of the development. Regular maintenance will be undertaken to keep the site access track drainage systems fully operational, the road surface in good condition, and to ensure there are no adverse issues affecting the public road network. Staff travel within the launch cycle will be managed using two private coaches to significantly reduce vehicle traffic. In addition, any visitors to the Proposed Development will be picked up and transported by the Applicant's electric vehicles to minimise traffic movements and reduce greenhouse gas emissions. Spectators will be controlled by a Spectator Traffic Management Plan (STMP) which will be agreed with Shetland Islands Council in advance of the first launch.	Operation
Noise and Vibration		
CEMP	A Construction Environmental Management Plan (CEMP) will be produced and implemented to minimise unnecessary disruption associated with construction works. The CEMP will provide contact details for the contractor undertaking the works, name the personnel responsible for communication with residents, and set out a complaints procedure such that noise complaints are handled appropriately. Where reasonably practicable, quiet working methods will be employed, including the use of the most suitable plant, reasonable hours of work for noisy operations, and economy and speed of operations. Where possible, given ferry timetables, deliveries to site by heavy goods vehicle (HGV) will be scheduled to minimise disruption during sensitive times.	Construction

	Plant will be switched off when not in use, and unavoidably noisy works will, if required, be screened to reduce noise propagation towards neighbouring properties.	
General Noise Management	➢ Fixed plant will be specified such that it meets appropriate noise limits at noise sensitive receptors; ➢ Where necessary, attenuation such as acoustic enclosures will be specified to enable noise limits to be met; ➢ Where possible, noisy items of plant will be situated such that project infrastructure provides screening (e.g. fans and air handling plant will be situated on the opposite side of buildings from the closest noise sensitive receptors); and, ➢ The Applicant will seek to minimise additional vehicle journeys by providing local accommodation for site workers.	Operation
Community Engagement Protocols	No mitigation is possible to reduce instantaneous noise levels associated with launches. However, the following community engagement protocols will be followed to seek to minimise the potential for annoyance: ➢ Although predicted noise levels inside the closest dwellings will be substantially below the level at which discomfort or hearing damage would occur, the timing of launches will be advertised well in advance, in local media and online, such that local residents can avoid launch noise if they choose. Residents wanting to minimise their noise exposure may then choose to remain indoors when the launch is scheduled; and, ➢ The Applicant will engage with the local community to support local jobs and increase employment, increase tourism to the area and connect with local schools and colleges to aid teaching of science and technology subjects. Further details of proposed community engagement and expected local benefits are provided in Chapter 14 Socio-Economics of this EIA Report.	Operation
Air Quality		
CEMP and CTMP	Mitigation measures during construction will comprise implementation of a Construction Environmental Management Plan (CEMP) and a Construction Traffic Management Plan (CTMP) in relation to staff movements to and from the site. The measures recommended for inclusion in the CEMP with respect to mitigating against potential dust nuisance and human health impacts are outlined in Volume IV Technical Appendix 11.1.	Construction

Operational Controls	Improvements to the existing public road network and the construction of the New Section of Access Road at Northdale will mitigate against potential congestion pinch points that can lead to an increase in vehicle emissions due to reduced speed and stop-start behaviour. A Staff Travel Plan will promote car sharing. Staff travelling to the Proposed Development will be collected by coach from the ferry terminals thereby avoiding the generation of additional traffic numbers. The Applicant will use electric vehicles to collect and transport visitors to and around the Proposed Development. A Spectator Traffic Management Plan (STMP) has been developed to avoid congestion and encourage sustainable transport choices and is described in more detail in Chapter 9 Traffic and Transport of this EIA Report. The STMP will mitigate against the generation of air pollution from vehicles. Generators proposed for the LSPF will be compliant with EU Stage IIIa emissions limits (FG Wilson, 2020), and all other generators across the proposed Launch Site will be fuel optimised to minimise NOx emissions. Generator stack heights will be designed to ensure compliance with the Chimney Height Memorandum as defined in the 1956 Clean Air Act and to ensure effective dispersion and avoidance of potential downwash effects. The Applicant intends to secure a permanent three phase power supply for the proposed Launch Site, enabling the number of diesel generators to be reduced significantly to two standby generators and two mobile generators supplying the deluge pump systems used during launch events.	Operation
Geology, Hydrology and Hydrogeology		
CEMP	Mitigation measures during construction will comprise pre-construction site investigation works, and implementation of a Construction Environmental Management Plan (CEMP) relating to construction works at the proposed Launch Site, New Section of Access Road and LRCC. Pre-construction site investigation works will be undertaken to further characterise ground conditions, inform detailed foundation and infrastructure design, and refine proposed construction environmental management measures. The CEMP will include: ➢ a detailed breakdown of the phasing of construction activities; ➢ a pollution risk assessment of the site and the proposed activities; ➢ identification of all Controlled Waters that may be affected by the works and temporary discharge points to the on-site drainage ditches and the marine environment;	Construction

	➢ planning and design of dewatering activities to minimise the local drawdown of perched groundwater in peatland habitat, and maintain the hydrology of identified sensitive habitats; ➢ planning and design of appropriate pollution control measures during earthworks and construction; ➢ details of appropriate fuel and chemical storage measures, including storage of such materials in suitably designated areas with impermeable bunding/containers, maintaining oil booms and absorbent pads within all work areas, keeping spill kits in all vehicles to enable a rapid and effective response to any accidental spillage or discharge, and training all construction staff in the effective use of this equipment; ➢ management of the pollution control system, including dewatering of excavations away from drainage ditches and the marine environment; ➢ contingency planning and emergency procedures; and, ➢ on-going monitoring of construction procedures to ensure management of risk is maintained.	
Peat	To minimise environmental effects as far as is reasonably practical, the following additional mitigation measures will be undertaken during construction and operation of the Proposed Development: ➢ Excavated peat will be re-used on-site as far as is reasonably practicable and to provide suitable restoration, landscaping and localised habitat enhancement at identified disturbed/degraded areas of peat on-site without adversely affecting the Scheduled Monument designation or sensitive ornithological or ecological receptors, as set out in AECOM's Outline Peat Management Plan (AECOM, 2020) (included as Appendix 12.4), and discussed in Appendix 6.3: Outline Habitat Management Plan (HMP). ➢ However, it has not been possible to identify on-site areas suitable for habitat restoration/enhancement in this manner, and large enough to re-use the predicted volume of excavated peat, without potentially having a detrimental impact on the site's Scheduled Monument designation or ornithological/ecological receptors. As discussed in the Outline HMP, identified areas of degraded blanket bog habitat in the local area (off-site to the west and/or south-west) will therefore be subject to habitat restoration using excavated peat from the development which cannot be appropriately re-used on-site. This will include deposition of excavated peat (avoiding areas of established vegetation), hag re-profiling, erosion gully blocking and other actions (refer to Appendix 6.3 for further detail). A monitoring programme will be	Construction

	agreed to review the effectiveness of the HMP and agree any further work or modification. The HMP will be agreed with NatureScot (previously SNH), SEPA and Shetland Islands Council prior to construction, and will be implemented during the operation of the Proposed Development. ➢ Through the on-site and off-site re-use and restoration, all excavated peat will be used without the requirement for any disposal of excavated peat. This therefore mitigates the effect of peat excavation (although recognising that habitat restoration will take time and will require monitoring as noted above). ➢ The above-noted habitat restoration works will also likely result in beneficial, though not material, hydrological effects on watercourses local to the agreed HMP area. ➢ A programme of surface water monitoring in the Burn of Norwick, upstream and downstream of the proposed New Section of Access Road, will be devised and implemented prior to and during construction. This will ensure that any impact on water quality in the Burn of Norwick can be identified, and extra measures introduced to address the cause of such impact. ➢ The area of geological interest along the cliffs in the south of the proposed Launch Site (designated as a GCR) will be appropriately demarcated on site during construction, and site operatives will be informed of the geological interest to ensure that construction works do not directly impact on this area.	
Drainage	A detailed drainage strategy will be implemented. The AECOM Drainage Strategy report and associated drawings provided with Chapter 12 of this EIA Report, set out full details of the proposed arrangements for the management of drainage throughout the Proposed Development areas.	Operation
Marine and Transboundary Effects		
Launch Exclusion Zone and Protocol – Orbital Launches	The Federal Aviation Administration (FAA) methodology will be applied to define an exclusion zone. This will apply to sea and air. Using FAA defined exclusion zones ensures a precautionary approach, as these are larger than UK exclusion zones. The direction from land will vary with the launch azimuth, with bearings currently projected to range from 330 to 030 True. The exclusion zone will span between the aforementioned bearings and extend outwards from the Launch Site to at least 3.3 nautical miles. Once an exclusion zone has been identified, the area will be registered on Marine Charts and will be activated via a Notice to Mariners. An exclusion zone is not anticipated to be required for the stages and fairings. For these, a Notice to Mariners will be published, with the exact areas dependent upon individual launches/rockets.	Operation

Launch Protocol – Sub-orbital Launches	In order to avoid Sullum Voe and Shetland airspace, stratospheric weather balloon launches will not take place if the weather conditions and modelling outputs predict the balloon will travel south-west and potentially land on any of the Shetland Islands or in the nearshore areas. This also minimises and essentially eliminates any risk to nearshore receptors, such as ports and harbours, areas of dense shipping activity, and breeding seabird species that utilise Shetland's beaches and cliffs. Sounding rockets will use the FAA defined exclusion zone approach described above. Operational areas (nearshore of the rocket launch and the calculated drop zone) will be clearly marked and promulgated through Notice to Mariners if required by the Maritime and Coastguard Agency. If the zones are expected to be active for extended time periods, consultation with the UK Hydrographic Office will determine whether the zones need to be marked on Admiralty paper and electronic charts. Prior to launch, a Notice to Mariners will be published, and NAVTEX warnings and Sécurité messages will be broadcast over Very High Frequency (VHF) radio. This will ensure that other maritime users are aware of the launch and recovery operations and will assist in the implementation of temporary exclusion zones. In addition, continuous monitoring of AIS and radar will be carried out from land to ensure navigational safety at all times in the indicative impact zone. NAVTEX warnings will be provided at least five days in advance of launches. The recovery/patrol vessel will be present in the calculated drop zone throughout the launch of the sub-orbital (stratospheric weather balloon or single stage rocket). The vessel will monitor launches and the trajectory of the sub-orbital payload, receiving continuous real-time updates from land and the GPS receiver and tracker on the payload. The payload will also be monitoring visually, from land and from the vessel, using observers with binoculars. This will enable the recovery/patrol vessel to inform nearby and approaching vessels of the impending payload drop and recovery. In order to increase visibility, the Applicant will ensure that payloads are marked with bright yellow tape/paint and will affix a flashing beacon light.	Operation
Socio-economic Effects		
Stakeholder Framework Analysis (LaunchUK, Open University)	No mitigation is applicable to this chapter as the effects were all assessed as beneficial. However, the Applicant is committed to further study of the socio-economic effects of the Proposed Development as part of its preparations for operation. The Applicant has partnered with the Open University to research development of socio-economic opportunities arising from the Proposed Development beyond the usual indicators.	Pre-operation, Operation

	The Open University study will develop a stakeholder analysis framework to assess the socio-economic benefits of the Proposed Development as part of the Launch UK spaceflight programme. It is recognised that space ports can involve highly sensitive, rural areas, and consultations for stakeholder input analysis regarding socio-economic benefit assessments must be carefully planned (and tailored to the specific locale) in collaboration with local partners. Working with the Applicant, the Open University team will determine the stakeholders involved in the space port and define the most appropriate consultation and analytical process, thus enabling the Open University's socio-economic benefits evaluation framework to be applied. The focus of the framework is on determining the less tangible socio-economic benefits that arise from such activities, beyond the traditional financial analyses performed to date.	
Climate Change		
Climate Effects / Resilience	A range of standard mitigation measures will be implemented to lessen the impact of potentially significant climate effects on the Proposed Development: ➢ Dust is likely to be generated during the construction phase and the magnitude will be exacerbated by hot and dry weather conditions, hence a Construction Dust Assessment has been carried out to determine the impact magnitude and sensitivity of receptors and to propose targeted mitigation recommendations. ➢ The launch vehicles (LVs) and Launch Service Provider (LSP) personnel will be protected from lightning strikes by a lightning protection mast which will function to dissipate lightning surges. ➢ Lamba Ness has localised areas at risk from pluvial surface water flooding, meaning the site is vulnerable to heavy rainfall. Within the proposed Launch Site there are small unnamed natural streams and watercourses, and drainage ditches have been cut in the flatter areas to aid drainage into these natural streams. A comprehensive drainage system will be implemented to mitigate flood risk during the construction and operation of the Proposed Development. ➢ Site activities during the construction and operational phases will be suspended during extreme weather events to mitigate against health and safety risks for site personnel and potential damage to structures and equipment. ➢ Construction and site personnel must be provided with appropriate personal protective equipment (PPE) to mitigate against the health and safety risks posed by extreme weather. For example, eyewear to mitigate against the health effects of dust mobilisation in high winds. ➢ Deluge pumps will be installed as a fire protection measure.	Construction, Operation

Greenhouse Gas (GHG) Emissions	IEMA best practice guidance considers all GHG emissions to be significant due to their contribution towards climate change. The following measures will be applied to reduce resulting GHG emissions: ➢ A Construction Environmental Management Plan (CEMP) will be compiled in advance of the construction work. This will define mitigation measures to be incorporated into the construction process, including reducing emissions related to the embodied carbon of construction materials and minimising emissions associated with construction equipment and transport. An outline CEMP is included as Technical Appendix 3.1. ➢ The Applicant is seeking to maximise the local economic impact of the Proposed Development whilst simultaneously reducing the GHG emissions by sourcing goods and services from local suppliers where possible. This measure will reduce GHG emissions resulting from the transportation of personnel and goods in the construction and operational phases. For example, stone, the construction material required in the highest quantity, is proposed to be sourced from a quarry on Unst located only 4.5 miles away from the Proposed Development. ➢ A Peat Management Plan has been developed to prevent any extracted peat from drying and degrading before re-use and hence emissions due to breakdown of organic matter from the extracted peat are expected to be minimal. Pre-construction site investigation works will be carried out and a conservation management plan will be developed. Implementation of the conservation management plan will offset any loss of habitat by improving the condition of damaged peatland off-site and provide an improvement in comparison to the current baseline. The restoration of peat off-site proposed as part of the Outline Habitats Management Plan (OHMP) will result in net carbon sequestration.	Construction
Major Accidents and Disasters		
Safety case and risk assessment	Mitigation measures will be informed by the outcome of the emerging requirements of UKSA licensing guidance on safety case and risk assessment work required at the proposed Launch Site. Standard mitigation will also include the following: ➢ Development of a management system and operating procedures; ➢ Maximising separation distance between launch vehicles and site operatives during testing and launch events; ➢ Minimal storage of reagents on site in favour of ”just-in-time” delivery; and,	Operation

	➢ Bunded tanker transfer locations during launch vehicle fuelling. Inherent safe operating practices are required under UKSA licensing requirements. Other than where fluid bunding and transfer arrangements are noted, the mitigation of other accidents and disasters will be managed through parallel risk and hazard management processes under UKSA licensing.	
Defence, Aviation and Telecommunications		
Defence	There will be no permanent structures above 15.2 metres in height nor any overhead power lines, in line with Ministry of Defence (MOD) requirements. The launch vehicles (LVs) themselves will potentially exceed this height when erected for launch. However, the MOD will be notified of all launch events which, in any case, represent only a temporary activity of short duration.	Operation
Aviation	The Proposed Development requires a Change of Airspace Use to be approved by the CAA, as a volume of airspace between the proposed Launch Site and orbit is required to be vacant before, during and after launches. This is a multistage process which is progressing as the detailed design of the Proposed Development emerges. Necessary design principles and industry consultations have taken place and the CAA has approved the application's progression to Stage 2 of the seven-stage decision and validation process, which is currently ongoing. The CAA will seek to minimise risks from the Proposed Development to all other airspace users.	Operation

Appendix 1.3 Planning Consent 2021/005/PPF

SHETLAND ISLANDS COUNCIL

Town and Country Planning (Scotland) Acts
Town and Country Planning (General Permitted Development) (Scotland) Orders

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With reference to the application for **Planning Permission** (described below) under the above Acts and Orders, the Shetland Islands Council in exercise of these powers hereby **GRANT Planning Permission** for the development, in accordance with the particulars given in, and the plans accompanying the application as are identified; subject to the condition(s) specified below.

Applicant Name and Address
Shetland Space Centre Limited
Moray Park
Seafield Avenue
Grantown-on-Spey
UK
PH26 3JF

Agent Name and Address
Alan Farningham
Farningham Planning Ltd
The Bourse
47 Timber Bush
Leith
Edinburgh
UK
EH6 6QH

Reference Number: 2021/005/PPF

Vertical launch space port including launch pad complex, satellite tracking station, assembly and integration hangar buildings, with associated security fencing, access, servicing and infrastructure, : Land at Lamba Ness, Unst, Shetland

IMPORTANT INFORMATION

If you are aggrieved by any of the conditions on the grant of planning permission made by the planning authority, you may appeal to the Scottish Ministers under section 47 of the Town and Country Planning (Scotland) Act 1997 within 3 months from the date of this notice. The notice of appeal should be addressed to Planning and Environmental Appeals Division, Scottish Government, Ground Floor, Hadrian House, Callendar Business Park, Callendar Road, Falkirk FK1 1XR. They will provide you with the necessary forms, or alternatively they can be found on the Scottish Government's website, www.scotland.gov.uk. Appeals can also be submitted electronically using the Online Appeal and Application system, ePlanning, the address for which is: www.eplanning.scotland.gov.uk.

If permission to develop land is refused or granted subject to conditions, whether by the planning authority or by the Scottish ministers, and the owner of the land claims that the land has become incapable of reasonably beneficial use in its existing state and cannot be rendered capable of reasonably beneficial use by the carrying out of any development which has been or would be permitted, the owner of the land may serve on the planning authority a purchase notice requiring the purchase of the owner of the land's interest in the land in accordance with Part 5 of the Town and Country Planning (Scotland) Act 1997.

The applicant, or a third party with sufficient interest, may also petition the Court of Session for judicial review of the decision of the planning authority within three months beginning with the date of this notice. Further information on Judicial Review, including how to raise an action, can be found on the website of the Scottish Courts Service, Petition Department, Court of Session, Parliament House, Parliament Square, Edinburgh, EH1 1RQ at www.scotcourts.gov.uk or through the Citizens Advice Bureau at www.citizensadvice.org.uk.

Environmental Impact Assessment
Regulation 3 of the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017, 'the EIA Regulations', prohibits the granting of planning permission for EIA development unless an environmental impact assessment has been carried out and that the environmental information has been taken into account when undertaking an assessment of the development proposal.

The application has been subject to Environmental Impact Assessment under the terms of the EIA Regulations and the applicant has submitted an Environmental Impact Assessment Report (EIAR), which was followed by an EIAR Addendum which was submitted to seek primarily to address an objection to the proposal lodged by Historic Environment Scotland, by revising the proposed site layout for the launch site through adjustment of some of the site infrastructure. The EIAR Addendum also included further clarification and information on the site selection process, and confirmed a specific mitigation of a no-launch period identified as required through the initial consultation responses received to the application. The environmental information contained within the EIAR and EIAR Addendum, and the comments made on the application by consultees, and representations made by members of the public following advertisement of the application in The Shetland Times and The Edinburgh Gazette on 25 January 2021, followed by The Shetland Times on 29 October 2021 and The Edinburgh Gazette on 17 December 2021, carried out in accordance with the requirements of the Town and Country Planning (Development Management Procedure) (Scotland) Regulations 2013, 'the 2013 Regulations', and the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017, 'the 2017 Regulations', have been taken into account in coming to this decision.

The results of the consultation responses gathered pursuant to the EIA Regulations are set out below:

- Scottish Natural Heritage (SNH) – SNH are content that the proposal can be progressed with appropriate mitigation. It has concluded that the integrity of the Hermaness, Saxa Vord and Valla Field Special Protection Area (SPA), protected for its breeding seabird colony, breeding red-throated diver and a number of breeding seabird species, will not be adversely affected provided no launches or static tests are carried out between mid-May and the end of June, to avoid disturbing birds during the critical incubation and early brooding period. They also identified that mitigation measures identified in the EIAR will reduce to some extent the impact on otters, a European Protected Species, and any licence required from them would be granted.
- Scottish Water – No objection.
- Scottish Environment Protection Agency (SEPA) – SEPA ask that planning conditions relating to: a) appropriate mechanisms to ensure off-site habitat restoration will take place as per the finalised Habitat Restoration Plan; b) the submission of a detailed Peat Management Plan (PMP) and Habitat Management Plan (HMP); and c) a surface water management plan are applied/secured otherwise its representation is to be considered as an objection.
- Historic Environment Scotland (HES) – HES advises that taking all the information provided into account for its historic environment interests, it does not object to the planning application.
- Scottish Ministers – No comments specific to the detail of the submission received. In response to the planning authority having notified the Scottish Ministers of the proposal by virtue of a Direction that came into force in June 2020, because it is for space port related development that had come into the planning system, the Scottish Ministers issued "The Town and Country Planning (Notification of Spaceport and Ancillary Development at Unst) (Shetland islands Council) Direction 2021". Having been notified subsequently that the Council was minded to grant planning permission for the development the subject of the application, the Scottish Ministers on 25 March 2022 gave notice that it was not Scottish Ministers' intention to intervene in the application by either issuing a direction restricting the granting of planning permission or by calling in the application for their own determination.
- Unst Community Council - Concluded there were no grounds for objecting to the grant of planning permission.
- Health and Safety Executive – No comments to make.
- Ministry of Defence – Identifies that whilst the physical structures are unlikely to have any significant impact on the operation of Air Defence Radar (ADR), the proposed use has the potential to have an effect on ADR sensors. To address this it requests a condition is applied to any permission issued requiring the submission and approval of a liaison protocol outlining arrangements to ensure that it is made aware of proposed launches (including amendments), and provide for a means of cancellation/postponement of launches if required.
- National Air Traffic Services – Has no safeguarding objection to the proposal.
- Public representations analysed and taken account of.

The Council is satisfied that the requirements of the EIA Regulations have been met.
An Environmental Impact Assessment Report (EIAR) followed then by an EIAR Addendum have been submitted along with the application proposal. The EIAR has considered:

- Site Selection, Design Iteration and Alternatives
- Landscape, Seascape and Visual Impact
- Ornithology
- Ecology and Biodiversity
- Cultural Heritage and Archaeology
- Traffic and Transport
- Noise and Vibration
- Air Quality
- Geology, Hydrology and Hydrogeology

- Marine and Transboundary Effects
- Socio-economic Effects
- Climate Change
- Major Accidents and Disasters
- Aviation and Telecommunications
- Environmental Commitments; and
- Residual Effects.

The EIAR Addendum submitted revised the proposed site layout through adjustment of some of the site infrastructure, and provides further clarification and information on the site section process as well as confirming a specific mitigation of a no-launch period. The environmental information as contained within the EIAR and EIAR Addendum, and as otherwise presented as additional information, and the comments made on the application by the consultees, and representations received following advertisement of the application, have been considered, fully and carefully, and taken into account. It is concluded that the proposed development will not give rise to any significant or unacceptable environmental effects, subject to appropriate mitigation measures being implemented to ameliorate effects. The proposal incorporates the necessary environmental design and mitigation measures to minimise adverse environmental impacts. These include measures to address impacts generally, and also specifically upon: the landscape seascape and visual effects; ornithology; ecology and biodiversity; cultural heritage and archaeology; traffic and transportation; noise and vibration; air quality; geology, hydrology and hydrogeology; the marine environment; climate change; and defence, aviation and telecommunications activities. These and other measures to mitigate/monitor impacts can be secured by means of appropriate controlling planning conditions to ensure that there are no unacceptable adverse impacts arising, either as a result of construction related activities, or during the period the site is operational as a vertical launch space port Where consultees have proposed conditions to mitigate/monitor impacts these have been included as conditions. In the absence of any unacceptable or significant environmental impacts the proposal is acceptable in EIA terms, and subject to compliance with the stated planning conditions, it is considered that the proposed development is acceptable in terms of safeguarding cultural heritage and archaeology; protected species and habitats; landscape and visual; noise; air quality; and peat interests. It is therefore concluded that, on balance, the proposed development accords with the aims and objectives of the adopted Shetland Local Development Plan 2014. The Council is satisfied that there are no material considerations that indicate otherwise.

The Council's assessment of the information presented within the EIA Report and the EIAR Addendum and the other environmental information in relation to the development, and material representations which resulted from the public notification and consultation process carried out in accordance with the 2013 Regulations and 2017 Regulations, together with the Council's reasoned conclusion on the significant effects of the development on the environment are contained within the Report of Handling for the planning application dated 28 February 2022 required under the 2013 Regulations.

The Council is satisfied that this reasoned conclusion is still up to date.

The Council is further satisfied that the significant effects can be addressed by way of mitigation. A detailed description of the proposed mitigation is contained within the chapters of the EIA Report identified above and the Report of Handling dated 28 February 2022, with the latter including any necessary additional mitigations that may have been identified.

The Council has incorporated the requirement for adherence to a schedule of mitigation within the conditions of this permission. Requirements for monitoring measures have been identified and are detailed within the conditions of this permission, and include ones specifically relating to: peat re-use/reinstatement areas (on-site and off-site); the condition of the Scheduled

Monument; ornithological interests; noise and vibration monitoring during the operation and ongoing servicing of the site; and the performance of a Visitor and Spectator Management Plan.

All documents can be viewed online at https://www.shetland.gov.uk/ and searching using the case reference number.

Reasons for Council's decision:

The proposed development would deliver the UK Vertical Launch Pathfinder project - the first ever vertical small satellite orbital launch from UK soil in 2022. It has been stated by both the UK and Scottish Governments to be of National Strategic Importance serving as a catalyst for the growth of the UK's Vertical Spaceflight Programme.

As with all planning applications, the benefits of the proposed development must be weighed against potential disbenefits and then considered in the round, taking account of the relevant Development Plan policies and other material considerations.

Overall, the proposals have attracted more letters of support than objection. While Unst Community Council declined to state either support or opposition, it confirms that a significant majority of the local community is supportive of the project.

Statutory consultee comments have been comprehensively addressed in the Report of Handling and their requests to mitigate and/or monitor identified impacts have been included in the proposed suite of planning conditions. Provided all approved mitigation measures as set out in the EIA Report and the EIA Addendum are implemented, and subject to compliance with the stated planning conditions, it is considered that the proposed development is acceptable in terms of safeguarding cultural heritage and archaeology; protected species and habitats; landscape and visual; noise; air quality; and peat interests. It is therefore concluded that, on balance, the proposed development accords with the aims and objectives of the adopted Shetland Local Development Plan 2014.

In addition to regulation under planning and environmental legislation, the construction and operation of the proposed development, including all safety measures, will be controlled through separate licencing agreements granted by other authorities including the UK Space Agency, the Civil Aviation Authority, Marine Scotland, NatureScot and SEPA.

<u>Variation of Application</u>
A variation to the application was made in accordance with section 32A of the Town and Country Planning (Scotland) Act 1997 (as amended). The variation arose from changes to the site layout, to reduce the impact of the proposal on specific features of the Scheduled Monument while having regard to other identified on-site constraints in respect of protected species (otter) habitats and peat. The changes included an amendment to the location of the western Administration and Assembly Buildings and a movement of the TEL Hangar building from a position at the Garths further to the south and west, to a position to the south of the site access road being proposed. Specifically: the car park was moved from the south to the west of the Administration building; an area of hardstanding to the north of the assembly area was moved east; the road and future west Assembly buildings have been moved as a block east; and the TEL Hangar building was moved to the south of the existing site access road. These amendements were accepted as they did not result in a substantial change to the description of the development being proposed.

Details of Approved Plans and Drawings:

- Site Boundary Plan Drawing No. 60617516-ACM-XX-00-DR-CE-0092
  Received. 06.01.2021
- Wall Details Drawing No. 60617516-ACM-XX-00-DR-CE-0091
  Received. 06.01.2021
- General Arrangement Drawing No. 60617516-ACM-XX-00-DR-CE-0088 Rev. A
  Received. 06.01.2021
- Access Road Layout Drawing No. 60617516-ACM-XX-00-DR-CE-0082 Rev. B
  Received. 06.01.2021
- Access Road Layout Drawing No. 60617516-ACM-XX-00-DR-CE-0083 Rev. B
  Received. 06.01.2021
- Access Road Layout Drawing No. 60617516-ACM-XX-00-DR-CE-0084
  Received. 06.01.2021
- Access Road Layout Drawing No. 60617516-ACM-XX-00-DR-CE-0086 Rev. A
  Received. 06.01.2021
- Storage Area Drawing No. 60617516-ACM-XX-00-DR-CE-0079
  Received. 06.01.2021
- Access & Carparking General Arrangement Drawing No. 60617516-ACM-XX-00-DR-CE-0077 Rev. A
  Received. 06.01.2021
- General Arrangement Drawing No. 60617516-ACM-XX-00-DR-CE-0073
  Received. 06.01.2021
- General Arrangement Drawing No. 60617516-ACM-XX-00-DR-CE-0074 Rev. A
  Received. 06.01.2021
- General Arrangement Drawing No. 60617516-ACM-XX-00-DR-CE-0068 Rev. C
  Received. 06.01.2021
- Drainage Strategy Drawing No. 60617516-ACM-XX-00-DR-CE-0054 Rev. B
  Received. 06.01.2021
- Drainage Strategy Drawing No. 60617516-ACM-XX-00-DR-CE-0072 Rev. A
  Received. 06.01.2021
- Drainage Strategy Drawing No. 60617516-ACM-XX-00-DR-CE-0060 Rev. C
  Received. 06.01.2021
- Drainage Details Drawing No. 60617516-ACM-XX-00-DR-CE-0065 Rev. A
  Received. 06.01.2021
- Road Levels Drawing No. 60617516-ACM-XX-00-DR-CE-0048 Rev. C
  Received. 06.01.2021
- Road Levels Drawing No. 60617516-ACM-XX-00-DR-CE-0061 Rev. B
  Received. 06.01.2021
- Section Plan Drawing No. 60617516-ACM-XX-00-DR-CE-0032 Rev. E
  Received. 06.01.2021
- Section Plan Drawing No. 60617516-ACM-XX-00-DR-CE-0051 Rev. D
  Received. 06.01.2021
- Section Plan Drawing No. 60617516-ACM-XX-00-DR-CE-0029 Rev. E
  Received. 06.01.2021
- Section Plan Drawing No. 60617516-ACM-XX-00-DR-CE-0047 Rev. F
  Received. 06.01.2021
- Fence Details Drawing No. 60617516-ACM-XX-00-DR-CE-0039 Rev. B
  Received. 06.01.2021
- Fence Details Drawing No. 60617516-ACM-XX-00-DR-CE-0038 Rev. B
  Received. 06.01.2021
- Proposed Elevations Drawing No. 60617516-ACM-08.-XX-DR-AR-03801 Rev. A
  Received. 14.01.2021

- Proposed Roof Plan Drawing No. 60617516-ACM-08-R1-DR-AR-01803 Rev. A Received. 14.01.2021
- Proposed Ground Floor Plan Drawing No. 60617516-ACM-08-GF-DR-AR-01801 Rev. A Received. 14.01.2021
- Proposed First Floor Plan Drawing No. 60617516-ACM-08-01-DR-AR-01802 Rev. A Received. 14.01.2021
- Proposed Plan & Elevations Drawing No. 60617516-ACM-09-XX-DR-AR-01901 Rev. A Received. 14.01.2021
- Proposed Plan & Elevations Drawing No. 60617516-ACM-05-ZZ-DR-AR-01501 Rev. B Received. 14.01.2021
- Proposed Plan & Elevations Drawing No. SSC-ACM-04-ZZ-DR-AR-01401 Rev. B Received. 14.01.2021
- Proposed Elevations Drawing No. 60617516-ACM-03-XX-DR-AR-03301 Rev. B Received. 14.01.2021
- Proposed Roof Plan Drawing No. 60617516-ACM-03-R1-DR-AR-01303 Rev. B Received. 14.01.2021
- Proposed Floor Plan Drawing No. 60617516-ACM-03-GF-DR-AR-01301 Rev. B Received. 14.01.2021
- Proposed First Floor Plan Drawing No. 60617516-ACM-03-01-DR-AR-01302 Rev. B Received. 14.01.2021
- Proposed Floor Plan and Roof Plan Drawing No. 60617516-ACM-02-ZZ-DR-AR-01201 Rev. B
  Received. 14.01.2021
- Proposed Elevations Drawing No. 60617516-ACM-02-XX-DR-AR-03201 Rev. B Received. 14.01.2021
- Proposed Elevations Drawing No. 60617516-ACM-01-XX-DR-AR-03101 Rev. C Received. 14.01.2021
- Proposed Floor Plan and Roof Plan Drawing No. 60617516-ACM-01-ZZ-DR-AR-01101 Rev. C
  Received. 14.01.2021
- Proposed Plan & Elevations Drawing No. 60617516-ACM-07-XX-DR-AR-01701 Rev. B Received. 14.01.2021
- Technical Details Drawing No. 60617516-ACM-XX-00-DR-CE-0098
  Received. 01.02.2021
- Outdoor Access Plan Drawing No. LP-001-SAXA v1.0
  Received. 25.10.2021
- Indicative Restoration Plan Drawing No. Figure 1 - Offsite Indicative Peatland Restoration Areas Received. 09.02.2022
- Access Road Layout Drawing No. 60617516-ACM-XX-00-DR-CE-0085 Rev. D Received. 25.02.2022
- Access Road Layout Drawing No. 60617516-ACM-XX-00-DR-CE-0087 Rev. C Received. 25.02.2022
- Storage Area Drawing No. 60617516-ACM-XX-00-DR-CE-0078 Rev. D Received. 25.02.2022
- Storage Area Drawing No. 60617516-ACM-XX-00-DR-CE-0079 Rev. A Received. 25.02.2022
- Drainage Strategy Drawing No. 60617516-ACM-XX-00-DR-CE-0057 Rev. E Received. 25.02.2022
- Construction Details Drawing No. 60617516-ACM-XX-00-DR-CE-0156 Rev. - Received. 25.02.2022
- Proposed Elevations Drawing No. 60617546-ACM-06-XX-DR-AR-03602 Rev. D Received. 25.02.2022
- Proposed Elevations Drawing No. 60617546-ACM-06-XX-DR-AR-03601 Rev. D Received. 25.02.2022

- Proposed Roof Plan Drawing No. 60617546-ACM-06-R1-DR-AR-01603 Rev. E Received. 25.02.2022
- Proposed Floor Plan Drawing No. 60617546-ACM-06-GF-DR-AR-01601 Rev. D Received. 25.02.2022
- Proposed Mid Floor Plan Drawing No. 60617546-ACM-06-01-DR-AR-01602 Rev. D Received. 25.02.2022
- Proposed Site Plan Drawing No. 60617516-ACM-XX-00-DR-CE-0037 Rev. U Received. 25.02.2022
- Proposed Plan & Elevations Drawing No. 60617516-ACM-XX-00-DR-CE-0019 Rev. F Received 25.02.2022
- Drainage Strategy Drawing No. 60617516-ACM-XX-00-DR-CE-0056 Rev. E Received. 25.02.2022

Conditions:

(1) The development hereby permitted shall not be carried out other than wholly in accordance with the above plans and details (as may be amended and/or expanded upon by a listed document following afterward) unless previously approved in writing by the Planning Authority:

Reason: For the avoidance of doubt as to what is being authorised by this permission.

(2) The development hereby permitted shall be carried out following as a minimum the 'Schedule of Environmental Commitments' included as Table 18.1 to Chapter 18 of the EIA Report submitted with the planning application.

Reason: To ensure compliance with the environmental mitigation and management measures associated with the development and in the interests of safeguarding the environment in compliance with Shetland Local Development Plan (2014) Policies.

Notice of Initiation of Development

(3) The developer shall submit a written 'Notice of Initiation of Development' to the Planning Authority at least 7 days prior to the intended date of commencement of development. Such a notice shall:

(a) include the full name and address of the person intending to carry out the development;

(b) state if that person is the owner of the land to which the development relates and if that person is not the owner provide the full name and address of the owner;

(c) where a person is, or is to be, appointed to oversee the carrying out of the development on site, include the name of that person and details of how that person may be contacted; and

(d) include the date of issue and reference number of the notice of the decision to grant planning permission for such development.

Reason: To ensure that the developer has complied with the pre-commencement conditions applying to the consent, and that the development is carried out in accordance with the approved documents, in compliance with Section 27A of The Town and Country Planning (Scotland) Act 1997 (as amended).

Planning Monitor Officer

(4) No development shall commence unless and until the Planning Authority has approved in writing the terms of appointment by the developer of a suitably qualified environmental consultant to assist the Planning Authority in monitoring compliance with the terms of the planning permission and conditions attached to it (a Planning Monitoring Officer, "PMO"). The terms of appointment shall:

(a) impose a duty to monitor compliance with the terms of the planning permission and conditions attached to it;

(b) require the PMO to submit a bi-monthly report to the Planning Authority summarising works undertaken on site; and

(c) require the PMO to report to the Planning Authority any incidences of non-compliance with the terms of the planning permission and conditions attached to it at the earliest practical opportunity.

The PMO shall be appointed on the approved terms throughout the period from Commencement of Development to completion of post-construction restoration works.

Reason: To enable the Development to be suitably monitored to ensure compliance with the permission issued.

Ecological Clerk of Works

(5) No development shall commence unless and until the terms of appointment of an independent Ecological Clerk of Works (ECoW) by the developer have been submitted to and approved in writing by the Planning Authority.

For the avoidance of doubt, the ECoW shall be appointed as a minimum for the period from the commencement of development to the time of the development's construction in accordance with the approved plans and details to completion, and their remit shall, in addition to any functions approved in writing by the Planning Authority shall:

- Provide training to the developer and contractors on their responsibilities to ensure that works are carried out in strict accordance with environmental protection requirements;
- Monitor compliance with all environmental and nature conservation mitigation works and working practices approved under this permission;
- Advise the developer on adequate protection for environmental and nature conservation interests within, and adjacent to, the application site;
- Direct the placement of development (including any micro-siting, if permitted by the terms of this permission) and the avoidance of sensitive features; and

o Immediately inform the site foreman or equivalent named person with legal responsibility to be able to halt works on a development site where, in their opinion, activities witnessed to be taking place give rise to environmental considerations that warrant such action.

The ECoW shall be appointed on the approved terms throughout the period from Commencement of Development, throughout any period of construction activity and during any period of post-construction restoration and aftercare phases of the development.

The developer shall ensure that the ECoW is present during excavations, ground investigations and construction works and is permitted to survey areas to be subject to excavation and construction prior to and during work on the site. If any species of flora or fauna considered to be of significant value are identified, then the ECoW shall design appropriate bespoke mitigation measures to minimise impacts to the feature, and the developer shall thereafter implement them in full.

Reason: To secure the effective monitoring and compliance with the environmental mitigation and management measures associated with the development and in the interests of safeguarding the environment in compliance with Shetland Local Development Plan (2014) Policies GP2, NH1, NH2, NH3, NH5 and NH7.

Archaeological Clerk of Works

(6) No development shall commence unless and until the terms of appointment of an independent Archaeological Clerk of Works (ACoW) by the developer have been submitted to and approved in writing by the Planning Authority following consultation with the Shetland Regional Archaeologist. The scope of the ACoW's appointment shall include:

(a) Advising the developer on the best protection of archaeological interests on the site;

(b) Checking for new assets/features of archaeological interest for which additional mitigation may be required, and liaising with the Shetland Regional Archaeologist to achieve this;

(c) Monitoring compliance with the requirements of the programme of archaeological works approved under the Archaeological Management Plan approved as part of the approved Construction Environment Management Plan (CEMP), including mitigations, reinstatement and restoration measures;

(d) Approving in writing any micro-siting under the vertical launch space port's approved site layout, including fencing, infrastructure and tracks; and

(e) Require the ACoW to report to the developer's nominated construction project manager and to the Planning Authority any incidences of non-compliance with the approved programme of archaeological works at the earliest practical opportunity.

For the avoidance of doubt, the ACoW shall be appointed on the approved terms from commencement, throughout any period of construction activity and throughout any period of post-construction restoration works.

Reason: To ensure the protection or recording of archaeological features within the development site in compliance with Shetland Local Development Plan (2014) Policies HE1 and HE4.

Construction Environment Management Plan

(7) No development shall commence unless and until a Detailed Construction Environment Management Plan (CEMP) containing details of all on-site construction works, reinstatement, drainage and mitigation, together with details of their timetabling and phasing (with reference to the approved Overall Phasing Plan Drawing No. 60617516-ACM-XX-00-DR-CE-0156 has been submitted to and approved in writing by the Planning Authority following consultation with SEPA.

The CEMP shall define good practice as well as specific actions required to implement mitigation and monitoring requirements as identified in the EIA Report relating to the development hereby permitted, during the planning application process and/or as are identified by other licensing or consenting processes.

The CEMP will address all phases of the construction phase development and shall incorporate the following:

a) Pollution Prevention Management Plan;
b) Emergency Response and Flood Risk Management Plan;
c) Biosecurity Management Plan;
d) Construction Noise Management Plan;
e) Dust and Air Quality Management Plan;
f) Construction Waste Management Plan;
g) Water Quality and Pollution Management Plan;
h) Peat Management Plan;
i) Habitat Management Plan;
j) Breeding Birds Protection Plan
k) Otter Protection Plan;
l) Construction Traffic Management Plan; and
m) Archaeological Management Plan.

Thereafter all work in connection with the development shall be carried out in accordance with the approved CEMP unless otherwise approved in writing by the Planning Authority.

Reason: For the avoidance of doubt as to what is being authorised by this permission and to ensure that the impacts of the development during the construction phase are identified, controlled and minimised and that the mitigation measures contained in the EIA Report accompanying the application (or as otherwise agreed), are fully implemented to reduce environmental impacts on protected species and their habitats and to safeguard the amenity of the locale and

public safety in compliance with Shetland Local Development Plan (2014) Policies GP1, GP2, GP3, WD1, WD3, NH2, NH3, NH4, NH5, NH6, NH7, TRANS3 and W5.

Peat Management Plan

(8) No development shall commence unless and until a detailed Peat Management Plan (PMP) has been submitted to and approved in writing by the Planning Authority following consultation with SEPA and NatureScot. The PMP shall provide details of the following:

(a) Finalised volumes, depth and location of any peat to be disturbed;

(b) A method statement for peat stripping, temporary storage and stockpiling within the site during the construction period including details of the timing of operations, location, volumes, construction methods and management of any peat storage areas;

(c) Details of the proposed re-use of the peat within the site including a plan showing volumes, location and usage (which shall be consistent with any Scheduled Monument Consent granted by Historic Environment Scotland), providing estimated maximum and minimum heights for the placement of excavated peat, along with details of the phasing and timing of construction works restoration;

(d) Details of the proposed post-reinstatement landform to make clear how the placement of the excavated peat will be done and include tapering the thickness of the deposited reinstated peat to create a smooth transition to the existing ground surface, avoiding creating a bare "cliff face" in a sudden step change of surface level, and details showing the post-reinstatement topography.

(e) Details of the disposal of any peat proposed off-site, including confirmation of locations at Loomer Shun shown on approved Drawing 'Indicative Restoration Plan Drawing No. Figure 1 -Offsite Indicative Peatland Restoration Areas', volumes and detailed disposal proposals that account for ornithological interests and features important to the Loomer Shun location;

(f) In the case of the area of land at Ritten Hamar shown on approved Drawing 'Indicative Restoration Plan Drawing No. Figure 1 -Offsite Indicative Peatland Restoration Areas', details of consideration of the means by which the area is to be accessed and of a peat slide risk assessment undertaken to ensure the potential impact of restoration works proposed to take place there is understood and will not give rise to peat slides or bog bursts;

(g) Details of the monitoring of reinstated areas; and

(h) Information on environmental checks and audits to be undertaken during and post-construction including frequency and means of reporting to the Planning Authority.

The PMP must be submitted a minimum of two months prior to commencement of development on site (the PMP Notice Requirement). Notwithstanding the foregoing, the Planning Authority (in its sole discretion) may shorten or waive the PMP Notice Requirement where the developer is otherwise able to satisfy the Planning Authority in terms of the requirements of this condition prior to commencement of development on site.

Unless otherwise agreed in advance in writing by the Planning Authority, the approved PMP shall be implemented in full and shall remain operative for the lifetime of the development or such other period as may be agreed as part of the PMP.

Reason: In order to minimise and off-set disturbance of peat and ensure the appropriate re-use and management of peat on the site, in compliance with Shetland Local Development Plan (2014) Policies GP1, GP2, GP3 and NH5.

Habitat Management Plan

(9) No development shall commence unless and until:

(a) a detailed Habitat Management Plan (HMP) has been submitted to and approved in writing by the Planning Authority following consultation with NatureScot and SEPA, which shall include off-site peat restoration works at the areas of land known as Loomer Shun, Skaw Paet Hoose, and Ritten Hamar shown on approved Drawing 'Indicative Restoration Plan Drawing No. Figure 1 -Offsite Indicative Peatland Restoration Areas'; and

(b) the developer has provided to the Planning Authority evidence that formal agreements which commit the owners of the land, the subject of the proposed off-site habitat restoration works, including those required at the areas of land known as Loomer Shun, Skaw Paet Hoose, and Ritten Hamar shown on approved Drawing 'Indicative Restoration Plan Drawing No. Figure 1 -Offsite Indicative Peatland Restoration Areas', in terms acceptable to the Planning Authority which secure the protection of the habitat restoration in perpetuity (or an agreed long term period the Planning Authority otherwise agrees to in writing following consultation with SEPA and NatureScot), have been entered into.

The HMP must be submitted a minimum of two months prior to commencement of development on site (the HMP Notice Requirement). Notwithstanding the foregoing, the Planning Authority (in its sole discretion) may shorten or waive the HMP Notice Requirement where the developer is otherwise able to satisfy the Planning Authority in terms of the requirements of this condition prior to commencement of development on site.

The HMP shall include details of the off-site restoration works to take place at the areas of land known as Loomer Shun, Skaw Paet Hoose, and Ritten Hamar shown on approved Drawing 'Indicative Restoration Plan Drawing No. Figure 1 -Offsite Indicative Peatland Restoration Areas', and the measures to avoid disturbance to breeding birds and their young on or in the vicinity of each.

In relation to the off-site restoration works to take place at the areas of land known as Loomer Shun, Skaw Paet Hoose, and Ritten Hamar shown on approved Drawing 'Indicative Restoration Plan Drawing No. Figure 1 - Offsite Indicative Peatland Restoration Areas', the HMP shall also include the following information:

i) the volume of excavated catotelm and acrotelm that will be re-used at the off-site location at Loomer Shun, with illustration of how it will be used, e.g., if in-filling the trenches made by peat cutting then provide information on the dimensions of the trench and the volume of catotelm and acrotelm that will be placed.
ii) The area of each site undergoing restoration, with detail of the baseline condition and target restoration condition of each restoration location.
iii) Estimates of the reduction in greenhouse gas emission rate (in tonnes CO2 equivalents per year) that are expected to be achieved by the proposed restoration works at each site should be provided. This may be estimated as a function of the expected change in peatland condition category due to the restoration work and the surface area of the peatland that where that improvement is expected, in conjunction with the emission factors for peat condition categories (in tonnes CO2 equivalents per hectare per year). The peat condition emission factors applied in the UK Greenhouse Gas Emissions Inventory are presented in Implementation of an Emissions Inventory for UK Peatlands, Table 4.1, page 43.
iv) Details of how the cessation of peat cutting will be ensured in perpetuity, not only within the proposed lifetime of the development.
v) Confirmation of the replacement shelter for the sheep that must be provided on Loomer Shun and how the restored areas will be protected in perpetuity/long-term from grazing on all three sites.

The HMP shall also set out the proposed habitat management of the development site during the period of construction, operation, decommissioning, restoration and aftercare of the land, and shall provide for the maintenance, monitoring and restoration of the habitat on site, and for reporting on progress and for review of the HMP.

Unless otherwise agreed in advance in writing by the Planning Authority, the approved HMP and any revisions to it agreed to by the Planning Authority following review of the operation and effectiveness of the HMP, shall be implemented in full.

Reason: In the interests of good land management and to safeguard protected species and their habitats in compliance with Shetland Local Development Plan (2014) Policies GP1, GP2, GP3, NH1, NH2, NH3 and NH5.

Archaeological Management Plan

(10) No development shall commence unless and until a detailed Archaeological Management Plan (AMP) and Written Scheme of Investigation (WSI), which identifies a phased programme and method of archaeological work, has been submitted to and approved in writing by the Planning Authority, following consultation with the Shetland Regional Archaeologist. The AMP shall provide for a suitable mitigation strategy arising from archaeological investigations that take place under the approved WSI, which should themselves take place before the site is occupied

and shall confirm that reasonable access to the site may be given to the Shetland Regional Archaeologist at all times. The AMP shall also provide for Historic Building Recording and Post Excavation Research Design for the analysis, publication and dissemination of results and archive deposition within an agreed timescale.

Reason: In line with HEPS 1 - 4, 6; SPP 137-139; 145; 150-151; PAN 2/2011 20 - 22; 25-27; and in compliance with Shetland Local Development Plan (2014) Policies HE 1 and HE 4.

Scheduled Monument Condition Survey and Monitoring

(11) No development shall commence unless and until:

(a) both a condition survey of the Scheduled Monument on the development site has been carried out, and a scheme detailing monitoring of the condition of the Scheduled Monument during the operational phase of the development have been submitted to the Planning Authority and been accepted by it in writing following consultation with the Shetland Regional Archaeologist and Historic Environment Scotland.
(b) a scheme of vibration monitoring to take place during the operational phase of the development has been submitted to and agreed in writing by the Planning Authority

Reason: To ensure that the developer meets their obligation to minimise impacts on the archaeological resource and to provide the developer with the opportunity to make a positive impact on the survival and understanding of the archaeological resource, and in compliance with Shetland Local Development Plan (2014) Policies HE 1 and HE 4.

Conservation Management Plan

(12) Prior to the development site becoming an operational vertical launch space port, the developer shall submit to the Planning Authority for its approval in writing before the first launch takes place, a Conservation Management Plan (as committed to in Chapter 8 paras 8.9.3 and 8.9.5 of the EIA Report submitted in support of the planning application). The Conservation Management Plan shall identify future conservation needs based on the approved Scheduled Monument Condition Survey, and the review of works required during the operational phase of the development based on condition monitoring, to ensure the condition of the Scheduled Monument does not deteriorate below the standard identified in the approved Scheduled Monument Condition Survey. The Conservation Management Plan shall not preclude works that might improve on the condition of the Scheduled Monument recorded in the approved Scheduled Monument Condition Survey

Thereafter the Conservation Management Plan shall be implemented in its entirety subject to all consenting requirements having been met.

Reason: To ensure the protection of historical features within the development site in compliance with Shetland Local Development Plan (2014) Policy HE1.

Surface Water Drainage Plan

(13) No development shall commence unless and until a Surface Water Drainage Plan (SWDP) detailing the proposed surface water disposal methods has been submitted to and approved in writing by the Planning Authority. Details of the scheme shall be supported by:

a) Details of existing and proposed site levels, including a measured sectional drawing, showing the proposed SuDS treatment train to be provided;

b) Details of proposed SUDs drainage, designed following Ciria C753 "The SUDs Manual" guidance including calculations to show that attenuation of flows to greenfield rates for rainfall events of up to a 1 in 10 year return period will be achieved, and an assessment of how the proposals will meet the required water quality treatment standards;

c) Details of how any sustainable drainage scheme is to be maintained.

d) Confirmation that: i) deluge water from the launch pads, if used during a launch, will be collected to a tank and removed off-site for treatment; ii) in the event of fire, then fire-fighting water will be collected to the same storage tanks as the deluge water and tankered off-site for treatment; and iii) if there is no fire-fighting water requirement from a launch/test the slab will be washed down after the launch/test to remove any residual contamination (drainage collected to the same storage tanks) before normal surface water drainage routes are opened.

Reason: To ensure the provision of adequate surface water drainage as insufficient information has been submitted with the application in order to satisfy the Planning Authority that the development will not result in flooding, or be liable to flooding, and to ensure that no works are undertaken which have an adverse impact on any neighbouring properties or landownership in compliance with Shetland Local Development Plan (2014) Policies GP2 and WD3.

Site Waste Management Plan

(14) No development shall commence unless and until a Site Waste Management Plan (SWMP) dealing with all aspects of waste produced during the construction and decommissioning/reinstatement phases of the development (other than peat) and the operational phase of the development (other than peat), including details of: briefing of all contractors and personnel on the presence of Japanese Knotweed in the area identified at Section 7.5.25 of the EIA Report submitted in support of the planning application, and the need to apply relevant biosecurity best practice measures to avoid the spread of the species; and dealing with its appropriate eradication.

Reason: To ensure that the impacts of the development during the construction phase are identified, controlled and minimised and to safeguard the amenity of the

locale in compliance with Shetland Local Development Plan (2014) Policies GP2 and W5.

Bird Breeding Season

(15) Notwithstanding the approved plans, no launches or static tests are to be carried out at the development site between mid-May and the end of June to avoid disturbing birds during the critical incubation and early brooding period.

Reason: To ensure there is no adverse affect on the integrity of the Hermaness, Saxa Vord and Valla Field Special Protection Area through effect on its qualifying features, in compliance with Shetland Local Development Plan (2014) Policies NH1 and NH2.

Breeding Birds Protection Plan

(16) No development shall commence unless and until a Breeding Birds Protection Plan (BBPP) has been submitted to, and approved in writing by, the Planning Authority following consultation with NatureScot. The BBPP, as well as providing for ornithological monitoring in both the pre-construction and construction phases of the development, should include the following:

(a) Launch specific monitoring to be carried out before, during and after rocket launches to record short term bird behavioural responses;
(b) Longer term monitoring to evaluate any impacts on productivity and populations status;
(c) A feedback and review mechanism so that significant adverse impacts detected through monitoring can be addressed by implementing additional mitigation measures;
(d) The criteria for identifying levels of adverse impacts to trigger changes; and
(e) The production of monitoring reports, together with the frequencies of their production and review, and by who, for the consideration of amendments to the operations taking place at the development site.

Construction and any other operational works at the site shall progress in accordance with any mitigation measures contained within the approved BBPP and the timescales contained therein until the development hereby permitted is decommissioned.

Reason: In the interests of the protection of protected bird species and in compliance with Policies NH2 and NH3 of the Shetland Local Development Plan (2014).

Otter Protection Plan

(17) No development shall commence unless and until:

(a) i) a pre-construction otter survey is conducted and a report produced; ii) based on the results from the pre-construction otter survey apply for an otter licence, if necessary, from NatureScot; and

iii) until such otter licence (if necessary) is issued, not carry out any works on any otter holts.; and

(b) an Otter Protection Plan (OPP) has been submitted to and approved in writing by the Planning Authority following consultation with NatureScot, which shall provide for a programme of future monitoring for otters on the site to allow the adaptation of management under the approved OPP as may be agreed to in writing by the Planning Authority.

The approved OPP shall be complied with during the carrying out and operation of the development hereby permitted.

Reason: As there is evidence of the presence of otters (a European Protected Species) on and around the development site, and it has been determined by NatureScot that an otter licence may be required to ensure that disturbance of otters in the vicinity of the development site will not be detrimental to the maintenance of the population at a favourable conservation status in their natural range, in compliance with Shetland Local Development Plan (2014) Policy NH2.

Reason: To ensure that any otters or their holts are protected in compliance with Shetland Local Development Plan (2014) Policy NH2.

Construction Traffic Management Plan

(18) No development shall commence unless and until:

(a) a full site specific Construction Traffic Management Plan (CTMP) containing details of all elements of traffic and transport during the construction phase of the development (including programming and timescales as well as predicted HGV movement volumes and patterns and routes, including to off-site peat restoration areas) in conjunction with details of mitigation measures proposed to ameliorate effects on existing uses, and off-site improvement works to the public road network required for the development site to be accessed satisfactorily (including programming and timescales), has been submitted to and approved in writing by the Planning Authority following consultation with the Roads Authority.

(b) evidence of an agreement between the Council and the developer has been provided to the Planning Authority with regards to costs of any repairs required due to use of public roads within Unst by construction traffic generated by the development of the site hereby permitted.

The CTMP shall define good practice as well as specific actions required to implement mitigation and monitoring requirements as identified in the EIA Report, the planning process and/or other licensing or consenting processes.

Thereafter, all work in connection with the development shall be carried out in accordance with the approved CTMP unless otherwise approved in writing by the Planning Authority following consultation with the Roads Authority.

Reason: For the avoidance of doubt as to what is being authorised by this permission and to ensure that the traffic impacts of the development during the construction phase are identified, controlled and minimised and that the mitigation measures contained in the EIA Report accompanying the application (or as otherwise agreed), are fully implemented in the interests of safeguarding local amenity and public safety in compliance with Shetland Local Development Plan (2014) Policies GP2, GP3 and TRANS3.

Operational Environmental Management Plan

(19) Prior to the development site becoming an operational vertical launch space port, the developer shall submit to the Planning Authority for its approval in writing before the first launch takes place, a detailed Operational Environmental Management Plan (OEMP) based on the outline OEMP provided in the EIA Report submitted in support of the planning application following review. The OEMP shall provide for a scheme of noise and vibration monitoring and include the routes to be taken on the public road network by vehicles associated with the operation and ongoing servicing of facilities at the development site.

Reason: In the interests of safeguarding local amenity and public safety in compliance with Shetland Local Development Plan (2014) Policies GP2, GP3 and TRANS3.

Operational Management Plan

(20) Prior to the development site becoming an operational vertical launch space port, the developer shall submit to the Planning Authority for its approval in writing before the first launch takes place, a detailed Operational Management Plan (OMP). The OMP shall detail how the space port is to be operated. It shall include the proposed mitigation measures and actions to be taken should an unexpected event or aeronautical incident occur. The OMP shall include an Emergency Response Plan and shall also have regard to possible adverse effects from such events and incidents on the Scheduled Monument and include a liaison protocol to be followed by the developer involving the Planning Authority and Historic Environment Scotland in such a circumstance.

Reason: In the interests of the protection of the historic environment features on the development site, and to ensure acceptable health and safety standards or levels are not compromised, in compliance with Shetland Local Development Plan (2014). Policies HE1 and GP2.

Ministry of Defence Launch Liaison

(21) The development hereby approved shall not be brought into use for the launching of rockets until such time as a launch liaison protocol that outlines liaison arrangements to be followed to ensure that the Ministry of Defence (MOD) is made aware of proposed launches, and any amendments to those arranged launches, has been submitted to and approved in writing by the Planning Authority following consultation with the MOD. The protocol shall also provide for the means of cancellation/postponement of launches if required. Thereafter launch operations at

the site shall take place strictly in accordance with the launch liaison details approved under this condition's terms.

Reason: The proposed use of the development site for the launching of rockets has the potential to have an effect on Air Defence Radar (ADR), and the protocol will address this, in compliance with Shetland Local Development Plan (2014) Policy GP2.

Visitor and Spectator Management Plan

(22) No launch events shall take place at the development site until a Visitor and Spectator Management Plan (VSMP), which shall include a Launch Day Traffic Management Plan, has been submitted to and approved in writing by the Planning Authority following consultation with the Roads Authority and the Shetland Islands Council's Transport Services. The plan shall detail the visitor management interventions proposed depending on the particular launch parameters, and account for events that otherwise take place on the isles of Yell and Unst, and provide for monitoring, review and updating of the VSMP with the agreement of the Planning Authority.

Reason: To ensure the site is operated having regard to legal protections surrounding access rights, and to ensure that the impacts of increased visitor numbers and the site's operational requirements do not give rise to unacceptable impacts on the wider community within Unst in particular. In compliance with Shetland Local Development Plan (2014) Policies GP2, TRANS2, TRANS3 and ED2.

Wildlife Hide

(23) Details of the design, construction materials, and external colours and finishes of the wildlife hide shown on the approved plans, along with details of the access path to it, shall be submitted to and approved in writing by the Planning Authority before its construction takes place. Its design shall be DDA compliant. Before it is brought into use the wildlife hide shall be provided with 2 no. disabled parking spaces to a standard and design agreed to in writing by the Planning Authority beforehand following consultation with the Roads Authority.

Reason: In compliance with Shetland local Development Plan (2014) Policies GP2, GP3 and TRANS3.

Hangar Buildings

(24) Details of the design, construction materials, and external colours and finishes of the hangar buildings shown on the approved plans shall be submitted to and approved in writing by the Planning Authority before their construction takes place.

Reason: In compliance with Shetland local Development Plan (2014) Policies GP2 and GP3.

Fencing

(25) Details of the colour of fencing to be erected on and around the site approved under the terms of this permission shall be submitted to and approved in writing by the Planning Authority before their erection takes place.

Reason: In compliance with Shetland local Development Plan (2014) Policies GP2 and GP3.

Lighting

(26) A lighting strategy for the development site when operational as a vertical launch space port shall be submitted to the Planning Authority for approval in writing and implemented before the first launch takes place. Phasing of the introduction of lighting to the site shall be allowed under the lighting strategy.

Reason: In compliance with Shetland local Development Plan (2014) Policies GP2 and GP3.

Interpretation (Heritage) Strategy

(27) Within 6 months of the notice of commencement of development having been given to the Planning Authority, the developer shall submit to the Planning Authority for approval in writing, following consultation with the Shetland Regional Archaeologist and Historic Environment Scotland, an Interpretation (Heritage) Strategy, the aim of which shall be to enhance understanding, appreciation and experience of the historic interest of RAF Skaw and Inner Skaw and also other archaeological assets and features on the site. The Strategy shall also confirm the availability of public access.

Reason: To ensure good use of resources within the development site in compliance with Shetland Local Development Plan (2014) Policies GP3 and HE1.

Access Management Plan

(28) Prior to the development site becoming an operational vertical launch space port, the developer shall submit to the Planning Authority for its approval in writing before the first launch takes place, a detailed Access Management Plan (AMP) based on the approved Outdoor Access Plan. The AMP shall fully assess the effects on outdoor access of the proposed development and detail the access arrangements that will exist whilst the launch site is operational along with the mitigations proposed for the loss of unrestricted access to parts of the development site.

Reason: In the interests of safeguarding local amenity and public safety in compliance with Shetland Local Development Plan (2014) Policies GP2 and GP3.

Decommissioning

(29) Should the site cease to be operational as a vertical launch space port for a continuous period exceeding two years, the development shall be decommissioned, the site restored and aftercare undertaken in accordance with plans and a

Decommissioning Environmental Management Plan (DEMP) developed in accordance with legislation and guidance existing at the time, to a timescale agreed in writing in advance with the Planning Authority (in consultation with NatureScot, Historic Environment Scotland and SEPA).

Thereafter, the development shall be decommissioned, the site reinstated and restored and aftercare undertaken, in accordance with the approved plans and DEMP, unless otherwise agreed in writing in advance with the Planning Authority in consultation with NatureScot, Historic Environment Scotland and SEPA.

Reason: To ensure that the site is reinstated and restored in an environmentally acceptable manner in compliance with Shetland Local Development Plan (2014) Policies GP1, GP2 and GP3.

Notes to Applicant:

Commencement of Development
The development hereby permitted must be commenced within 3 years of the date of this permission in order to comply with Section 58 of the Town and Country Planning (Scotland) Act 1997, as amended by Section 20 of the Planning etc (Scotland) Act 2006.

Building Warrant
You are advised to contact the Building Standards Service on 01595 744293 to discuss any building warrant requirements for your development.

Ministry of Defence (MOD) has requested that the following are noted:

1: Launch Vehicle operation should only take place where requisite notice has been given to the appropriate agencies and organisations to minimise the risks for other air/maritime users. It is anticipated that Notice to Airmen (NOTAMs), Notice to Mariners (NMs) or similar will be issued prior to any launch and these notices will contain sufficient information to ensure air and maritime users can operate safely during the preparation, launch and removal of infrastructure and support structures.

2: In order to address MOD concerns and provide an appropriately detailed liaison protocol, it is strongly recommended that the applicant and/or site operator (as appropriate) attend a meeting with MOD. It is envisaged that participants would cooperate to produce a documented way forward setting out standard agreed details that could be included in submissions intended to discharge the relevant planning condition. The MOD would welcome this engagement.

Works Licence
Should any part of the finalised drainage arrangements extend below the level of Mean High Water Springs (MHWS) a works licence under the Zetland County Council Act 1974 from the Shetland Islands Council may be required. Please contact Marine Planning, Shetland Islands Council, 8 North Ness Business Park, Lerwick, Shetland, ZE1 0LZ Tel: 01595 744293

Road Construction Consent

The Shetland Islands Council Roads Service has advised that Road Construction Consent (RCC) will be required for all works to, or impacting on, PROW13 which crosses Lamba Ness. Any parts of the new internal site road that the public may be directed down (as an alternative to using the existing route) will also need to be covered by an RCC. Existing retained sections of the PROW may also need to be upgraded under the RCC. The RCC process is separate to the planning process. You are advised to contact Road Services prior to the commencement of any development: Roads Services, SIC Department of Infrastructure Services, Gremista, Lerwick, ZE1 0PX. Tel: 01595 744866.

Road Opening Permit

The Shetland Islands Council Roads Service has advised that the length of access that crosses the public road verge shall be constructed to its satisfaction. A Road Opening Permit must be obtained from the Roads Service prior to carrying out any works to form an access onto the public road. You are advised to contact Road Services prior to the commencement of any development: Roads Services, SIC Department of Infrastructure Services, Gremista, Lerwick, ZE1 0PX. Tel: 01595 744866.

SEPA

Pollution Prevention and Control (PPC permitting)

SEPA noted reference to a number of generators and power sources on the site. If any of these are greater than 1MW net rated thermal input, the applicant may have to apply to SEPA for a permit under the Pollution Prevention and Control (Scotland) Regulations. Further information is on SEPA's website at Medium combustion plant | Scottish Environment Protection Agency (SEPA) and you can contact the SEPA Waste Industry team via wasteandindustry@sepa.org.uk for further advice.
Proposed crushing or screening will also require a permit under these regulations.

Waste management

Management of surplus peat or soils may require an exemption under The Waste Management Licensing (Scotland) Regulations 2011.

Impacts on the water environment

Authorisation is required under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) to carry out engineering works in or in the vicinity of inland surface waters (other than groundwater) or wetlands, for abstractions and for discharges.
A construction site licence will be required for management of surface water run-off from the construction site. See SEPA's Sector Specific Guidance: Construction Sites (WAT-SG75) for details.
While it will not be directly regulated by SEPA as it does not have a discharge, SEPA do not consider the proposal in section 12.7.13 of the EIA Report to use a foul storage tank during operation of the site a sustainable solution and would recommend consideration of an alternative option.
Please see the CAR Practical Guide for further advice and contact the SEPA local office via NHNI@sepa.org.uk to discuss any of the above aspects of CAR licencing. SEPA would also be happy to provide further advice on the pre-construction site investigation works and would wish to discuss with the applicant whether there exist any licensing implications for using the existing Fuel Storage Area at Baltasound Airfield, which does not form part of this planning application.

Wildlife and Countryside Act 1981
The developer is reminded of the duties imposed by the Wildlife and Countryside Act 1981 in relation to breeding birds.

Notice of completion of development
As soon as practicable after the development is complete, the person who completes the development is obliged by section 27B of the Town and Country Planning (Scotland) Act 1997 (as amended) to give the Planning Authority written notice of that position.

30 March 2022

Executive Manager - Planning

Appendix 2 -

Appendix 3.1 Outline Operational Environmental Management Plan

Shetland Space Centre

Outline Operational Environmental Management Plan

Client:	Shetland Space Centre Limited
Project/Proposal No:	3148
Version:	1.0
Date:	2021-01-04

Document Information

Project Name:	Shetland Space Centre
Document Title:	Outline Operational Environmental Management Plan
Client Name:	Shetland Space Centre Limited
Client Contact:	Scott Hammond
Client Address:	Saxa Vord Resort Haroldswick, Unst, Shetland, Scotland, ZE2 9TJ
Document Status:	Final for Issue
Author:	E Stella
Reviewed:	R Fain
Approved:	G M Bollan
Date:	2021-01-04
Version:	1.0
Project/Proposal Number:	3148
ITPEnergised Office:	4th Floor, Centrum House, 108-114 Dundas Street, Edinburgh, EH3 5DQ

Revision History

Version	Date	Authored	Reviewed	Approved	Notes
1.0	2021-01-04	E Stella	R Fain	G M Bollan	Client Issue

Contents

1. Introduction

1.1 Overview

This Outline Operational Environmental Management Plan (OOEMP) refers to the operation of the proposed development, a vertical launch spaceport, by Shetland Space Centre Limited (hereafter referred to as 'the Applicant').

The proposed development will be operated by the Applicant and used to launch small satellites into either polar or sun-synchronous, low-earth orbits.

The Proposed Development comprises the following principal elements which are the subject of three separate planning applications:

- Proposed Launch Site – a launch area at Lamba Ness comprising three launch pads, a satellite tracking station, launch vehicle integration buildings, roadways (largely re-using existing roads), fuel storage and ancillary infrastructure;
- Proposed Launch and Range Control Centre (LRCC) at Saxa Vord;
- Proposed New Section of Access Road – a short stretch of new road at Northdale; and,
- Reuse of the existing Fuel Storage Area at Baltasound Airfield. (An integral part of the proposal; however, this does not form part of any one of the submitted planning applications as formal planning permission is not required for this element).

The OEMP is the environmental management tool for the operation of the proposed development.

The OEMP will be updated and finalised post consent in line with any relevant planning condition and in agreement with Shetland Islands Council, NatureScot and Scottish Environment Protection Agency (SEPA).

1.2 Scope and Objectives

The final OEMP will be a key document assisting the Applicant in complying with set planning conditions. The OEMP will be a live document, updated as required throughout the planning and operational process.

The purpose of this OOEMP is to provide an overview of potential environmental impacts of the proposed development, during its operational phase, and describe the management and mitigation measures to protect the environment and sensitive receptors, both on- and off-site, and minimise potential adverse impacts on the environment that will then be revised and updated as required and included in the final OEMP.

The objectives of this OOEMP are to provide:

- an overview of the proposed development operations;
- guidance on compliance with relevant environmental legislation and the Applicant's policies in the operational phase;
- a means of implementing appropriate mitigation measures for the key environmental issues (refer to supplementary Environmental Management Plans in Appendix 2);
- a working environmental management tool to follow during the operation phase of the Space Centre;
- definition of roles and responsibilities of the operational team;
- a guide for the interaction with relevant government authorities and other relevant stakeholders, including the community during the operational phase of the proposed development; and

- a basis for monitoring, reporting and maintaining compliance with regulatory requirements for the proposed development;

This OOEMP is a live document. The management strategies and control measures detailed within this document and the supplementary Environmental Management Plans will be reviewed and updated, where necessary, to reflect changes introduced by the Applicant's operational team, site specific outcomes, non-conformances and recommendations arising out of inspections, meetings and audits.

1.3 Supporting Environmental Management Plans

A series of environmental management plans will be developed to support the OEMP following receipt of planning permission. Plans which will be included in the final version of the OEMP include:

- Visitor Management Strategy
- Operational Habitats Management Plan
- Operational Health and Safety Plan
- Operational Emergency Response Plan
- Operational Waste Management Plan

2. Statutory and Policy Considerations

The Applicant is committed to complying with all of its legal obligations and other voluntary commitments. Compliance with applicable regulatory requirements concerning the operations of the Space Centre will be achieved through:

- identifying and accessing legal and other requirements which are directly applicable to the organisation;
- consulting and involving relevant government agencies;
- internally communicating relevant information regarding legal and other requirements;
- regularly auditing, reviewing and upgrading systems, management plans and supporting documentation; and
- providing relevant training.

2.1 Legal and Other Requirements

A considerable quantity of environmental legislation applies to the operational stage of the proposed development. The expectation is that all relevant legislation, including requirements for licences, permits and / or consents shall be identified.

For each significant environmental aspect, the relevant applicable environmental legislation and regulations will be identified from, but not limited to, the list provided below:

- Town and Country Planning Act (Scotland) 1997 as amended by The Planning etc. (Scotland) Act 2006;
- The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017;
- Marine (Scotland) Act 2010;
- Civil Aviation Act 2012;
- The Environmental Authorisations (Scotland) Regulations 2018;
- Anti-Pollution Works (Scotland) Regulations 2003;
- Control of Substances Hazardous to Health (COSHH) Regulations 2002 (and amended 2003, 2004);
- The Waste (Scotland) Regulations 2011; and
- The Space Industry Act 2018.

The list of relevant legislation and its applicability to the proposed development will be reviewed and updated following receipt of planning permission.

2.2 Environmental Approvals

A list of required permits will be completed following receipt of permit to change airspace use from the Civil Aviation Authority, but is likely to include:

- Spaceport license – UK Space Agency (UKSA)
- Relevant Health and Safety permits
- OFCOM license
- Airspace change - CAA regulatory authority
- Maritime licenses - Marine Scotland

2.3 Management System

This section will be completed with relevant information from the Shetland Space Centre integrated management system once the system has been finalised.

2.4 Environmental Policies

This section will be completed with relevant information from the Shetland Space Centre integrated management system once the system has been finalised.

2.5 Operational Efficiency

This section will be completed with relevant information from the Shetland Space Centre integrated management system once the system has been finalised.

3. Proposed Development Operations

3.1 Site Setting

The proposed development is situated on Unst, Shetland, the most northerly of the Shetland Islands.

The proposed Launch Site is centred on reference point 466500 E, 1215500 N and occupies an area of approximately 80.8 hectares (ha). It comprises three launch pads, a satellite tracking station, launch vehicle integration buildings, roadways (largely re-using existing roads), fuel storage and ancillary infrastructure a vertical launch spaceport including a launch pad complex, mobile tracking stations and assembly/integration hangar buildings with associated security fencing, access and servicing.

The proposed LRCC is located approximately 2.4 km southwest of the proposed Launch Site, at the southwest of the Saxa Vord resort complex. The proposed LRCC site is currently occupied by a former brewery building, which is proposed to be repurposed to form the LRCC.

The proposed 510 m New Section of Access Road is located between two existing roads, across ground which rises up from the valley for the Burn of Norwick and runs southwest to northeast. The proposed New Section of Access Road is located approximately 1.6 km southwest of the proposed Launch Site.

3.2 Description

The proposed development comprises the construction of the following buildings and infrastructure, the impact of which have been considered in this CEMP:

- Launch Pad Complex: located on the Lamba Ness peninsula and comprising three launch sites, each incorporating a launch pad, ground services storage and control, lightning protection masts, liquid and compressed gas storage and water deluge tanks for launch operations;
- Satellite Tracking Station: an area of hardstanding housing satellite tracking and telemetry devices located on the Lamba Ness peninsula;
- Launch Site Processing Facility (LSPF) hangar buildings (two): located on the Lamba Ness peninsula, a building where the LVs are assembled and the payload (the satellites) integrated into the LVs;
- Administration Building, Pyrotechnics Store, and Hazardous Materials Store located adjacent to the LSPF on the Lamba Ness peninsula;
- Integration Hangar/TEL building: located on the Lamba Ness peninsula, a forward position building close to the launch pads housing the transporter erector launcher (TEL) and where the final integration activities take place as required;
- Support Infrastructure: located on the Lamba Ness peninsula including access, an internal track system and a series of small temporary buildings and a construction compound;
- Gate House, including a tourist information area, located on the Lamba Ness peninsula;
- Wildlife Hide: located on the Lamba Ness peninsula;
- Launch and Range Control Centre (LRCC): redevelopment of the former Valhalla brewery building at Saxa Vord to provide a facility where launch and range control activities will take place;
- New Section of Access Road: construction of a new section of access road at Northdale; and,

- Reuse of the existing Fuel Storage Area at Baltasound Airfield.

The proposed layout of the Launch Site is included as Appendix 1.

3.3 Operations Overview

The proposed development will be operated by the Applicant to launch small satellites into either polar or sun-synchronous, low-earth orbits. Polar orbit means that the trajectory of the satellite is over both the North and South poles. Sun-synchronous orbits are also polar, or nearly polar, but ahead of the sunrise, allowing a satellite's solar panels to function continuously. Launches will take place in a northerly direction over the sea. The design of the proposed development allows for launches by multiple launch service providers (LSPs) using a range of different rocket (launch vehicle - LV) types.

For safety reasons, rockets are not permitted to fly over inhabited areas and so the proposed development has a significant advantage over other sites considered as launches from Lamba Ness will avoid both the oil fields to the west and east of Shetland and void the Faroe Islands to the north-west.

Also, transatlantic air traffic over Unst is minimal, which means that there will be little or no need for in-flight re-routing and there are no Royal Navy or RAF training ranges nearby.

The SSC operational phase will commence with the delivery to the launch site of the following components:

- LVs
- Payloads
- Propellent and commodities

It will then continue into the assembly of LVs and loading with payloads; subsequently the LV will be transferred to the launch pad where it will be fuelled and prepared for the launch. The last operation includes the launch of the LV, including the payload, into orbit.

The integration of the LV and the payload will be manged by the LSP. The LSP will also manage the launch campaigns with the assistance of the Applicant's Launch Safety Officer (LSO). The LSO will be responsible for the operation of the site and managing range safety.

The duration of each launch campaign is expected to run for around four weeks, starting with delivery of the LV and ending with successful launch and facility clean down.

3.4 Representative Launch Operating Scenario

The proposed development is a facility which allows for launch operations by multiple LSPs using different LVs. For the purposes of the OOEMP, a representative launch operating scenario has been defined.

As described above, the operational phase will comprise: delivery of LVs, payloads, fuel and commodities to the proposed Launch Site; assembly of LV and integration of payload(s), transfer of the LV to the relevant launch pad, fuelling and preparation of the LV for launch at the launch pad, and the launch of the LV into a high inclination orbit, including polar and sun-synchronous orbits.

To achieve the launch of the satellites into the required orbits, the proposed trajectories of the LVs will be to the North.

3.4.1 Launch Exclusion Zone (LEZ)

In order to guarantee public safety, measures to control the launch exclusion zone (LEZ) will be implemented at specific periods of the launch campaigns, like at the run-up to and during launch. The LEZ will include an area around the launch pad and a downrange overflight exclusion zone.

In addition to the LEZ, downrange sea and air space exclusion zones will also be activated.

3.4.2 Launch Campaign

Each launch period will run for approximately four weeks, beginning with the delivery of the LV and payload to the site and ending with successful launch and deployment of the payload in orbit and clean-down of the facility. The key steps in a representative normal launch campaign are set out below.

It is anticipated there will be up to 30 launches per calendar year. Launches require specific conditions to allow them to succeed, therefore it is possible there could be night-time launches. It is expected that the number of launches will be lower in the first year, gradually increasing up to 30 launches per year.

3.4.3 LV Assembly

The LV and payload will be delivered to the proposed Launch Site separately by the LSP for assembly, integration and testing. It is anticipated that the LV and payload elements will be delivered to the proposed Launch Site by road in 40 foot road containers or vans. The LV integration process involves the assembly of the LV stages and the emplacement of payload into the fairing; and will be undertaken under controlled conditions within the Launch Site Processing Facility (LSPF).

3.4.4 Launch Site Operation

Once the LVs are integrated with payloads, they will be transported in a horizontal position from the LSPF to the relevant launch pad using the transporter erector launcher (TEL), normally between 24 hours and six hours before launch. Once in position on the launch pad, the LV will be raised to a vertical orientation using the TEL and connected to the launch pad electrical, fuel and communications systems through umbilical cables. This is expected to be completed approximately three hours before launch.

Once the LV is in a vertical position on the launch pad and prior to fuels being loaded, the LV tanks and overground fuel lines will be preconditioned using liquid nitrogen evaporation. Pressurant loading will then commence followed by loading of the fuels. Loading will be automated and controlled from the LRCC.

A ‘wet dress rehearsal’ may be carried out before launch. This will involve loading the LV with the fuels to function test the LV systems and then subsequently unloading the fuels. The fuels and liquid oxygen (LOX) will be returned to their relevant tanks, and any residual LOX will be released safely into the atmosphere. Once this has been successfully undertaken, the LV will be re-loaded with fuels prior to launch.

LEZ restrictions will be in place from the point the LV is brought to the launch pad with the intention to launch. All site personnel will move back beyond the LEZ for launch a few hours prior to the scheduled launch. Activation of the LEZ and the length of time when restrictions will prevail will be kept to the absolute minimum necessary.

3.4.5 Fuel Transportation

Fuel will be stored at the fuel depot at Baltasound, 10.5 km south from the proposed Launch Site. Fuel will be transported to the proposed Launch Site in ISO road containers when required. A delivery holding area will be located at the proposed Launch Site entrance, and containers held here before being taken to the respective launch pad. At the launch pad the containers are stored in the designated protected areas as shown on Drawings 3.5, 3.6 and 3.7.

Large volume fuel and gas containers will remain on their trailers for fuelling and de-fuelling. Fuel and gases will be piped to the LV above ground and in a below ground trench over the launch pad.

Small volumes of fuels and oils in containers will be off-loaded to the ground within the control areas of the launch pads to facilitate electrical and mechanical support during launches. These will be stored in accordance with best practice procedures, including being kept within a designated storage site in appropriate impermeable bunded containers/areas.

3.4.6 Countdown

The LV will be fuelled from approximately two hours before launch until approximately ten minutes before launch. During this time, the required airspace and sea space management and monitoring procedures will be activated to ensure the range safety compliance of the launch.

Approximately two minutes before launch, the LV will transition to its internal power source and continue to perform an autonomous series of preparatory configurations and status checks.

Approximately 20 seconds before launch the hold-down mechanism will be armed, and launch command control relinquished to the LV. First Stage ignition will occur at approximately two seconds before launch.

3.4.7 Launch, Ascent and Payload Deployment

The LV will lift off from the launch pad following the ignition of the First Stage engines. A few minutes after launch, First Stage engine cut-off will occur, followed shortly by First Stage separation and Second Stage engine ignition. The First Stage will fall back to earth within a previously identified 'impact zone'. The Payload Fairing will separate shortly after Second Stage engine ignition. Second Stage engine cut off will occur several minutes after ignition, followed shortly afterwards by deployment of the payload. The Payload Fairing will separate shortly after Second Stage engine ignition. Second Stage engine cut off will occur several minutes after ignition, followed shortly afterwards by deployment of the payload.

The number of impact zones arising from a launch will depend on the number of stages in the LV, which may be one or two, and whether or not Stages/Fairings break up on re-entry. It is broadly anticipated that Stage 1 will remain intact upon returning to Earth, whereas the fairing will break-up. Taking into account the impact zone for the payload fairing, up to three impact zones are expected per launch (Stage 1, Stage 2 and the payload fairing). The impact zones are expected to occur at a minimum distance of 200 km from the proposed Launch Site, and up to a maximum distance of 1,100 km. The indicative locations of impact zones have been provided by the LSPs and assessed in Chapter 13. The impact zone(s) will be subject to Notice to Airmen and Mariners to warn third parties to remain clear.

3.4.8 Clean-down

The clean-down operation will start following the launch operation: the launch pad facilities would be cleaned down and commodities replenished for the next launch operation.

3.4.9 Launch Scrub Scenario

A launch scrub scenario occurs when there may be a requirement to reschedule a planned launch, for example if the weather conditions are not suitable. An on-pad scrub scenario can happen up to the point of engine ignition. In such situations it is usually the case that the LV can be re-used for a subsequent launch.

In this scenario, the LV would be de-fuelled by returning the fuel and LOX to their respective tanks and discharging any residual LOX to the atmosphere. The LV would then be returned to the horizontal position and transported back to the LSPF if required.

3.4.10 Abnormal Launch Scenario

An abnormal launch operating scenario is one where the launch operation does not proceed to plan (excluding the representative scrub operating scenario outlined above). Abnormal launch operating scenarios could occur on the launch pad before lift-off (e.g. a fire) or could occur in the air after lift-off (e.g. the LV deviating from the planned trajectory).

3.5 General Considerations

3.5.1 Access Controls

The Applicant will display signage to advise visitors and the general public that relevant areas of the proposed Launch Site are private and not for public use.

Additional signage across the proposed Launch Site will include:

- Directional and speed limit signs for vehicles; and,
- Adequate signage to satisfy work health and safety requirements.

Security will be maintained by fences with gates locked outside of operating hours. Fences will be inspected routinely for signs of damage and/or intruder entry.

3.5.2 Plant and Equipment Maintenance

All plant and equipment installed or used within the proposed development will be operated and maintained in accordance with Planning Conditions and requirements. This includes all processing infrastructure and pollution control equipment.

3.5.3 Fire Prevention

If an on-site fire occurs, all necessary measures to extinguish associated fires will be implemented immediately. Adequate fire prevention resources have been put in place, and all personnel are able to access fire-fighting equipment and manage fire outbreaks at any location at the proposed Launch Site in accordance with the guidance provided in the draft Emergency Response Plan (to be included in Appendix 2 on revision and update of the OOEMP).

3.5.4 Dangerous Goods Storage (TBC once CAA licence is obtained)

Fuels and gases will not be permanently stored at the proposed Launch Site, rather they will be brought to the launch pads from external storage, via road haulage, as required.

Large volume fuel and gas containers will remain on their trailers for fuelling and de-fuelling. Small volumes of fuels and oils in containers will be off-loaded to the ground within the control areas of the launch pads, to facilitate electrical and mechanical support during launches. These will be stored in accordance with best practice procedures, including being kept within a designated storage site in appropriate impermeable bunded containers/areas.

All other fuels or flammable solvents for general operational use will be appropriately stored in a secure and well-ventilated area in accordance with the planning conditions and COSHH requirements. This storage is located on unfilled land, and all flammable liquids stored within a bund of 110% capacity of the volume of those flammable liquids so that any release of raw or burning fuel do not cause a fire in the filled waste or impact on surface water. A Hazardous Substances and Dangerous Goods Register will be developed to record chemicals used at the proposed development.

3.5.5 Litter Control

Litter control will be carried out in accordance with the Waste Management Plan (to be included in Appendix 2 on revision and update of the OOEMP).

3.6 Key Environmental Issues and Management Measures

An assessment of the proposed development operational activities has identified the following potential environmental impacts:

- **Water:** The water deluge system may absorb small amounts of contaminants during the launch process. There is potential for accidental release of contaminated deluge water or fire water to be released.
- **Air:** During the operational phase potential impacts could arise from road traffic accessing the site and from the release of air pollutant emissions during the launch activities.
- **Noise:** Noise sources during the operational phase will include noise associated with launch vehicle propulsion systems during take-off and operational traffic.
- **Light:** It is expected that appropriate external lighting would be required at the launch pad and possibly other areas of the site to allow for night-time working during launch campaigns.

Further information on these key issues and appropriate management measures to be implemented are detailed below:

3.6.1 Water

When no launch activities are in operation, the penstock valve on the launch pit will be maintained open such that rainwater run-off from the launch pit will discharge into a filter trench prior to sea outfall.

Launch pad fuel storage areas, which will store mainly RP-1 Kerosene, will have a contained concrete surface with run-off into channels which will discharge into a full-retention alarmed interceptor, before discharging into either a filter drain or drainage ditch. The interceptor will be appropriately sized to accommodate a tanker cell burst.

Drainage from roofs (other than the Gatehouse and Integration Building), roads, hardstanding area and the satellite tracking area concrete pads will discharge into filter trench systems to provide Sustainable Drainage Systems (SuDS) treatment, prior to discharging into the existing ditch drainage system or newly created ditches to tie into the existing sea outfalls.

3.6.2 Air

Improvements to the existing public road network and the construction of the New Section of Access Road at Northdale will mitigate against congestion pinch points that can lead to an increase in vehicle emissions due to reduced speed and stop-start behaviour.

A staff travel plan will seek to maximise car sharing. Staff travelling to the proposed development will be collected by coach from the ferry terminals avoiding the generation of additional traffic numbers.

The Applicant intend to use electric vehicles to collect and transport visitors to and around the proposed development.

A Spectator Traffic Management Plan (STMP) will be developed to avoid congestion and encourage sustainable transport choices.

Generators proposed for the LSPF will be compliant with EU Stage IIIa emissions limits (FG Wilson, 2020), and all other generators across the proposed Launch Site will be fuel optimised to minimise NOx emissions. Generator stack heights will be designed to ensure compliance with the Chimney Height Memorandum as defined in the 1956 Clean Air Act and to ensure effective dispersion and avoidance of potential downwash effects.

In future, the Applicant intends to secure a permanent three phase power supply for the proposed Launch Site, enabling the number of diesel generators to be reduced significantly to two standby generators and two mobile generators supplying the deluge pump systems used during launch events.

3.6.3 Noise

No mitigation is possible to reduce instantaneous noise levels associated with launches; however, the following community engagement protocols will be followed to seek to minimise the potential for annoyance:

- The timing of launches will be advertised well in advance, in local media and online, such that local residents can avoid launch noise if they choose. Although predicted noise levels inside the closest dwellings will be substantially below the level at which discomfort or hearing damage would occur, so residents wanting to minimise their noise exposure may then choose to remain indoors when the launch is scheduled.
- Suggestions for appropriate community liaison are provided below:
    - Establish Liaison Group Forum;
    - Project update newsletter;
    - Media, website update, social media;
    - Briefings with site neighbours, landowners, community representatives, interest groups and other key stakeholders as identified;
    - Produce leaflet detailing upcoming activities;

- Send letters to stakeholders likely to be immediately affected;
- Hold public open days / exhibitions;
- Manage community helpline and general email contact;
- Attend parish and town community council meetings quarterly; and
- Manage complaints procedure.

3.6.4 Light

At night and during periods of darkness, directional security lighting will be used. Lighting will be selected and sited so as to minimise visual intrusion to local communities, whilst maintaining the safe and efficient operation of the proposed development.

Lighting design will comply with the requirements of the Environmental Protection Act (UK Government, 1990). As well as implementing relevant measures set out in the Guidance Notes for the Reduction of Obtrusive Light GN01:2011 (Institute of Lighting Professions, 2011) and SEPA guidance on Controlling Light Pollution and Reducing Lighting Energy Consumption (SEPA, 2007). Measures to reduce the impacts of artificial lighting include:

- Unnecessary lighting will be avoided and, following completion of the task, lighting will be switched off and/or removed. All lighting will be switched off during daylight hours;
- All lighting will be designed to avoid visual intrusion and/or light spillage. Lighting will be positioned and directed to avoid nuisance to residents and wildlife and/or causing distractions to drivers on adjacent roads. Lighting will also avoid spillage onto neighbouring habitats; and
- Where mobile lighting relies on portable diesel generators for power, the containment of the diesel will be monitored to check for leaks and spills. Spill kits will be made available and staff provided appropriate training.

4. Implementation of the OEMP

4.1 Structure, Roles and Responsibility

4.1.1 Roles and Responsibilities

All staff will be made aware of the manner in which the site is to be operated and managed, to ensure compliance with the OEMP. A summary of the authorities and environmental responsibilities of key personnel for the operation of the proposed development is outlined below:

4.1.1.1 Launch Site Manager

- Ensure that the site complies with relevant licenses, acts and regulations;
- Approve and implement the OEMP;
- Allocate resources to handle environmental issues;
- Authorize and confirm the implementation of mitigation measures;
- Ensure any subcontractors comply with requirements;
- Review the OEMP and associated documentation, as required;

4.1.1.2 Environmental Officer or Site nominee

- Undertake and/or co-ordinate environmental monitoring requirements specified within the OEMP;
- Ensure that environmental records and files are maintained;
- Identify non-conformances and notify the Launch Site Manager;
- Ensure that environmental non-conformances are recorded and actioned;
- Review and updates the OEMP and associated documentation, as required;
- Collate and maintain records of complaints and respond accordingly.

4.1.1.3 Subcontractors

- Comply with all legal and contractual requirements;
- Comply with management / supervisory directions; and
- Participate in induction and training as directed.

4.1.1.4 All Personnel

- Comply with the relevant Acts, Regulations and Standards;
- Comply with Applicant policies and procedures;
- Promptly report any non-conformances and/or environmental incidents to management; and
- Undergo induction and training in environmental awareness as required.

4.2 Training

All employees and subcontractors (as necessary) will receive suitable environmental training, to ensure they are aware of their responsibilities and are competent to carry out their work. Training will be provided during site inductions and on an ongoing basis as required. All inductions and ongoing training shall be recorded. Training will include the following areas:

- SSC environmental and sustainability policy;
- OEMP and related documents;

- Significant risks, environmental aspects, impacts and controls;
- Emergency procedure and response; and
- Understanding legal obligations.

4.3 Communication and Consultation

The Applicant is committed to meaningful stakeholder engagement and will work in collaboration with relevant consultees and the local community to resolve any issues that impact local environmental amenity as a result of operation of the proposed development.

4.3.1 Government Bodies

The following government agencies will be consulted with in relation to the operations of the proposed development and the requirements of this OEMP:

- UK Civil Aviation Authority;
- Shetland Islands Council;
- SEPA;
- NatureScot;
- Historic Environment Scotland; and
- Marine Scotland.

4.3.2 Community

The Applicant will ensure that the local community is kept informed of the progress of the project in a pro-active and responsive manner. This will be by way of local newsletters, leaflets, newspaper advertisements, and community notice boards to include information such as:

- Operating hours;
- Contact details (telephone number);
- Launch campaign timings and any major changes to program; and
- Any major proposed works which may impact the community.

The Applicant will also prepare and circulate an annual community newsletter providing an overview of operations at the proposed development.

Key objectives of the community consultation program include:

- To understand any concerns of local community groups;
- Community consultation activities including:
    - a dedicated SSC webpage, offering general information; and
    - a community telephone line to provide a central point of contact for community enquiries;

4.3.3 Complaints Handling

Close liaison will be maintained between residences near the proposed Launch Site to provide effective feedback in regard to perceived problems.

A community telephone line and or email contact will be used to receive public feedback, including complaints.

Complaints or adverse reports received from any external source will be recorded and the Launch Site Manager and/or Environmental Officer will be notified for response. Records of all complaints will be kept for at least four years after the complaint was made.

All received public complaints (either written or verbal) will be documented to record the:

- Nature and extent of the complaint;
- Method by which the complaint was made;
- Name and address of the person lodging the complaint;
- Details of all related factors including location, dates, frequency, duration, site conditions and effects of the complaint; and
- Action taken to address the complaint including follow up contact with the complainant.

The Launch Site Manager and/or Environmental Officer will record the details of all complaints received in an up-to-date log-book to ensure that a response is provided to the complainant within 24 hours or as soon as practicable.

The Launch Site Manager, or their nominee, shall investigate and determine appropriate corrective/preventive actions to be taken to address all complaints. The complainant will be informed in writing of the results of the investigation and action to be taken to rectify or address the matter(s). Where no action is taken the reasons why are to be recorded.

Corrective actions may involve supplementary monitoring to identify the source of the non-conformance, and/or may involve modification of operational techniques to avoid any recurrence or minimise its adverse effects.

4.4 Incident and Emergency Response

A key objective of this OEMP is to identify potential risks, and to develop, and maintain measures to manage them.

The Applicant 's approach to incident and emergency response management includes:

- Risk Analysis - The identification of hazards and risks that could impact the community, environmental and operational implications.
- Prevention – The planning and documentation of prevention and mitigation activities for all major hazards, and allocation of responsibility for their implementation.
- Preparedness – The development, implementation and review of specific incident management plans and processes to manage identified risks, the training of staff, and establishment of facilities to ensure the Applicant can respond effectively to any incident.
- Response – The issue of warnings and establishment of processes for effective notification of incidents, and mobilisation of resources to combat the incident or threat.
- Recovery – The return to normal operations, management of debriefs, and implementation of lessons learnt from the response process.

The following priorities will be adopted when dealing with an incident / crisis:

- Protection of human life and welfare;
- Protection of the environment; and
- Protection of the Applicant's assets.

Potential threats to the environment or public health that may arise in relation to the operation of the proposed Launch Site:

- fire;
- deflagration of flammables;
- overflow / spillage;

- structural damage;
- power or other utility failure;
- natural disaster;
- surface water contamination, and;
- traffic accident.

4.4.1 Emergency Response Management

The Applicant will operate an Emergency Response Plan (to be included in Appendix 2) whenever an incident, emergency or crisis could lead to public health, safety or environmental issues.

5. Monitoring and Review of the OEMP

5.1 Monitoring and Reporting

Regular environmental inspections will be undertaken to ensure that environmental controls have been implemented, meet specification, and are being maintained in accordance with the current legislations as summarised in Table 5.1 below.

Table 5.1 SSC Environmental Testing and Inspection schedule

Plant/Process/Substance	Type	Frequency	Responsibility
TBC			

At completion of each inspection, any corrective actions required will be recorded and managed in a timely manner (Table 5.2).

Table 5.2 Correction Action Timetable

Priority	Action	Timeframe
Low	May not require immediate action. Monitor situation and schedule control action	Action typically required within 15 to 29 days
Medium	Control actions as soon as possible	Action typically required within 7 to 14 days
High	Significant and immediate control	Action typically required within 1-7 days

Compliance with all environmental regulatory criteria is a priority for the Applicant. Specific compliance obligations will be detailed and controlled in the supporting Environmental Management Plans to be included in Appendix 2 this OEMP. Environmental non-compliances will be managed on a case-by case basis depending on the severity of the incident as described in Table 5.3. Appropriate response process will be developed and included in the final OEMP.

Table 5.3 Incident Categories

Incident Category	Descriptor
Category 1	Major, serious, persistent and/or extensive impact or effect on the environment, people and/or property
Category 2	Significant impact or effect on the environment, people and/or property
Category 3	Minor or minimal impact or effect on the environment, people and/or property
Category 4	Substantiated incident with no impact - No measurable adverse impacts.

5.1.1 Environmental Audits

Audits will be undertaken on a regular basis to ensure that the Applicant meets compliance objectives, as well as to support continuous improvement. The audits will:

- assess the effectiveness of the OEMP in meeting operational policies and legislative and industry standards;
- determine whether the measures and/or corrective actions carried out conform to the objectives of the OEMP;
- assess the adequacy of implemented controls to minimise high risk environmental issues or operational activities; and
- identify areas for continuous improvement.

Audit reports will be maintained to enable non-conformances and opportunities for improvement identified to be recorded, reported and responded to.

5.2 Management Review

Management reviews of the OEMP will be scheduled annually to assess the continuing suitability, adequacy and effectiveness of the measures implemented.

The inputs to the management review process shall include (but not be limited to):

- audit findings; and
- incident management and investigation of non-conformance events, incidents, near misses and management of all complaints received.

The output from the management review shall include any decisions and actions related to:

- possible changes to the management plans, procedures, practices, objectives and targets associated with the environmental management of the proposed development;
- improvement of the effectiveness of the management system and its processes; and
- resource needs.

5.3 Environmental Monitoring Program

The implementation of monitoring requirements will be the responsibility of the Launch Site Manager or nominee.

Relevant monitoring requirements will be established on revision of the OOEMP and included as Appendix 3.

All sampling strategies and protocols undertaken as part of the monitoring program will be conducted in line with industry best practices. Monitoring will be performed by the Environmental Manager or other relevant party in accordance with the requirements set out in this OEMP and supporting EMPs.

Where monitoring and measuring devices are used, these will be calibrated in accordance with the manufacturer's recommendations. Records of calibration will be maintained, and the calibration status of the device will be clearly communicated.

Appendix 1 Launch Site Layout

Project Management Initials: Designer: MMcF Checked: DR Approved: DR ISO A0 841mm x 1189mm

PUBLIC ROAD
EXISTING STONE WALL
OVERHEAD ELECTRIC LINE
AREA OF WET GROUND / PEAT BOG
EXISTING TRACK TO BE USED FOR GENERAL SITE ACCESS
SITE ENTRANCE
GATE HOUSE
STORAGE AREA
LAUNCH PAD ACCESS ROAD FOLLOWS ROUTE OF EXISTING TRACK.
EXISTING DITCH
SATELLITE TRACKING AREAS
LAUNCH SITE 1
LAUNCH SITE 2
CONTRACTORS COMPOUND
TEL BUILDING AREA
LAUNCH SITE 3
WILDLIFE HIDE
TRACK TO WILDLIFE HIDE
TEMPORARY ROAD TO CONTRACTORS COMPOUND DURING PHASE 1
EP
1:8 SLOPE
1:6 SLOPE
ASSEMBLY & STORAGE AREAS (2 No. SHOWN).
61m x 28m INTEGRATION HANGAR WITHIN 115m x 50m COMPOUND AREA.
61m x 28m INTEGRATION HANGAR WITHIN COMPOUND TO INCLUDE STORAGE AREAS, PARKING, etc.
Lamba Ness
Nor Wick
N
0m 100m 200m
SCALE 1:2500

Last saved by: DAVID.RENNIE(2020-12-17) Last Plotted: 2020-12-17
Filename: \\EU.AECOMNET.COM\EMIA\UK\IUKED11\JOBS\PR-448651_SSC_ENVIRONMENTAL_STUDY\900_CAD_GIS\910_CAD\DCUB\ITP DRAWING 3.2 - 60617516-ACM-XX-00-DR-CE-0037_V2.DWG

AECOM

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Notes
- PLANNING APPLICATION SITE BOUNDARY
- PROPOSED 2.44m HIGH SITE BOUNDARY FENCE
- PROPOSED 2.4m HIGH COMPOUND \ LAUNCH PAD SECURITY FENCE

Key Plan

Purpose Of Issue
FOR PLANNING

Project Number
60617516

Sheet Title
PROPOSED LAUNCH SITE LAYOUT

Sheet Number
Drawing 3.2

Scale: 1:2500@A0 **Rev:**

Appendix 2 Supporting Environmental Management Plans

(To be included on revision)

Appendix 3 Environmental Monitoring Program

(To be included on revision)

Appendix 4 -

Appendix 5.1 Breeding Bird Survey report

Appendix 5.1 Shetland Space Centre Breeding Bird Survey Non-confidential version

Alba Ecology Ltd.

2020

Registered Office: Coilintra House, High Street, Grantown on Spey, Moray PH26 3EN Tel: 01479 870238. *enquires@albaecology.co.uk*

Introduction

A proposal for a satellite launch facility has been made by the Applicant in north Unst, Shetland - known as the 'Shetland Space Centre' (SSC). As part of this proposal, Alba Ecology Ltd. was commissioned in 2017 to conduct breeding bird surveys targeted around the proposed planning application boundary on Unst. The proposed development involves the following three elements:

- Proposed Launch Site – a launch area at Lamba Ness comprising three launch pads, a satellite tracking station, launch vehicle integration buildings, roadways (largely re-using existing roads), fuel storage and ancillary infrastructure;
- Proposed Launch and Range Control Centre (LRCC) at Saxa Vord; and
- Proposed New Section of Access Road – a short stretch of new road at Northdale.

Aim

To inform the proposed development in Unst, Shetland a breeding bird survey with four main stages was undertaken.

- Survey site selection;
- Survey methodology agreed with Scottish Natural Heritage (SNH, now NatureScot);
- Breeding bird surveys of potentially affected areas; and
- Breeding bird survey report.

Survey methodology consultation

On 06/02/18 SNH was approached and consulted on the scope and scale of ecological and ornithological surveys to support a planning application for a satellite launch site at Lamba Ness, Unst by Alan Farningham of Farningham Planning Ltd. Jonathan Swale of SNH responded on 16/02/18 stating that "*Our advice on the survey work proposed by Alba Ecology and on the scope of any environmental impact assessment is set out below. As we don't yet have full details of the proposed development and operation, this is offered on the basis of the information provided to date and without prejudice to further consideration when more details become available*".

Jonathan Swale reported that *"the environmental assessment should consider the impacts on breeding birds of operation of the launch site, as well as its construction, so surveys should cover the area likely to be affected. Rocket launches could cause disturbance over a large area, but without information on the expected noise levels we aren't able to advise on the likely extent of disturbance nor on the area that should be surveyed to carry out the impact assessment. It may be necessary to assess possible impacts on seabirds within Hermaness, Saxa Vord and Valla Field SPA but this will not require additional survey work as we have recent data that can be used".*

Consideration of whimbrels within the Hill of Colvadale and Sobul SSSI was also recommended for potential works near that designated site. However, this area did not

feature in the planning application boundary and so is not reported on. SNH advised that the cliffs around Lamba Ness were likely to support nesting fulmar, shag, black guillemot and possibly gulls and that these species should therefore be surveyed too.

Methods

Survey site selection

Assessing the potential effects of disturbance on bird species is a complex issue which varies depending on the type of disturbance (e.g. routine/predictable verses unusual/unexpected), topography, vegetation and the behaviour/tolerance of the bird species and even different individuals within species. Therefore, identifying a one-size-fits-all Study Area over which all potentially affected breeding bird species could be surveyed is challenging. Consequently, this was considered in a number of different ways, which are outlined below.

In Scotland, all wild birds are legally protected, but some species are considered more sensitive to human disturbance than others and they are specially protected under European, UK and Scottish legislation. Disturbance can have adverse effects on birds' breeding success, e.g. through chilling, overheating and desiccation of eggs or chicks and starvation of chicks and ultimately the abandonment of a territory. Therefore, the distance over which disturbance might potentially occur was considered particularly important when determining the breeding bird Study Area.

Very little work has taken place on the impact of disturbance on most of the species potentially present within habitats on north Unst. However, for two of these species, some guidance has been published on the distances at which they are likely to be affected by disturbance. In Ruddock and Whitfield (2007), 80% of expert opinions estimated static disturbance occurred at 500-750 m for nesting and chick-rearing red-throated divers and expert opinion suggested 'safe working distances' could exceed 500m. Ruddock and Whitfield (2007) suggested that breeding red-throated divers are sensitive to human activity, visual disturbance and sudden noise events over relatively large distances (up to 500m). Evidence from Viking Wind Farm studies in Shetland indicated that some individuals (perhaps habituated) appear to tolerate moderate levels of disturbance in some situations. The size of waterbodies also has an impact; breeding birds are more easily disturbed and fly from smaller nesting lochans (where they presumably feel more vulnerable) than larger nesting lochs, where they have the ability to swim away, without taking flight.

Similarly, breeding merlins are considered sensitive to human activity, visual disturbance and sudden noise events over large distances (up to 500 m) (Ruddock and Whitfield 2007) particularly prior to egg laying and during incubation in Shetland (the late Mark Chapman, *pers comm.*). However, individual merlins appear to tolerate moderate levels of disturbance in some situations. For example, merlins appear to be able to nest relatively close to public roads in Shetland, where regular (predictable) disturbance occurs.

Based on Ruddock and Whitfield (2007), there is some evidence and expert opinion that sudden noise events up to 500-75 0m away from two potentially affected species could be detrimental. Based on this, it might have been possible to recommend a 1 km survey buffer

around the launch facilities. However, none of the potentially affected target species had been monitored in relation to sudden, relatively short-duration loud noise events of the magnitude of a satellite launch. Furthermore, at the time of Pre-app scoping (2018) and determination of the ornithological Study Area, there was no information on predicted noise levels available. Consequently, this 1 km survey buffer was not considered an adequate basis on which determine the size of the breeding bird Study Area.

EIA best practice guidance (and the EIA Regulations) requires consideration of worse-case and best-case scenarios and the subsequent reporting of *likely* effects. There is no standard guidance on potential disturbance (and so survey) distances for satellite launch facilities compared to other large-scale developments e.g. wind farms. At the time of pre-app scoping, it was not possible, based on previous experience or published information, to determine what *likely* might be in the context of this development and so a precautionary approach to determining the size of the Study Area was considered and adopted.

During pre-app scoping, there was no planning application boundary, only an indicative boundary area. As a result, an arbitrary, but very large precautionary Study Area, was selected for breeding bird surveys. According to expert opinion (Ruddock and Whitfield, 2007), the greatest distance any UK species was predicted to be affected by human induced disturbance was 1.5-2 km (for breeding golden eagle – which does not occur on Unst). Given the lack of any empirical evidence or guidance, it was decided that doubling the greatest possible disturbance distance for any UK breeding bird, i.e. a 4 km buffer from the proposed launch facility, was a legitimate precautionary basis on which to proceed with breeding bird surveys. Consequently, the size of the breeding bird Study Area (EIA Report Drawing 6.1) was much larger than the final planning application boundary area and it was centred on indicative launch site locations provided by the Applicant during Pre-app scoping discussions in 2018.

Breeding bird survey methodology

Reconnaissance

A preliminary site visit by Dr Peter Cosgrove in late autumn 2017 determined that the proposed development area was predominantly open coastal/upland habitat characterised by peatland, grassland, cliffs and plus some old military buildings.

The principal land use of the Study Area was sheep grazing through crofting and common grazings. There was potential for several specially protected bird species to be present so breeding bird surveys were conducted under a SNH Schedule 1 licence.

Photo 1. Typical view of the satellite launch facility part of Study Area, taken from Ward of Norwick, overlooking Swartling and Inner Skaw east towards The Garths and Lamba Ness.

Moorland breeding bird surveys

The modified Brown and Shepherd (1993) Moorland Breeding Bird survey is the standard survey technique for moorland/upland breeding birds (Gilbert *et al*., 1998) and is described in the SNH online guidance (e.g. SNH 2005; and subsequent updates). The Brown and Shepherd methodology is based on a constant search method involving spending 25 minutes in each 500 m × 50 0m quadrant, within the study area. This equates to spending 100 minutes for every km^2. Each quadrant was walked to ensure that all parts were approached to within 100m. At regular intervals, the surveyor paused, scanned the area for species and listened out for calls and songs. All registrations were marked on a 1:25,000 scale map using British Trust for Ornithology symbols with a note of the species activity. The main habitat was defined as open moorland so this survey technique was used across all parts of the Study Area. However, there were some wetter/marshy areas in the Study Area which were observed from the nearest edge.

Population estimates of birds in the Study Area were derived by comparing the summary maps for each of the breeding survey visits. Registrations/territories plotted during each period were considered to be separate from one another if more than approximately 500m apart for larger species, 300 m in the case of smaller species. If there was any doubt about whether more than one pair of birds was present in an area, the surveyor would sit quietly nearby and observe the behaviour, gender and number of birds present as per Brown and Shepherd's 1993 survey methodology. When compiling figures of breeding birds, the approximate central location of all registrations recorded from different visits is used to identify a notional territory centre (the species 'dot' on the relevant figure) where a nest was not discovered. Surveys were undertaken in 2018 and 2019 as per consultation agreement with SNH.

Breeding raptor surveys

SNH provides clear guidance in relation to raptor sensitivities and survey effort (2005; and subsequent updates). The only regularly occurring and widespread breeding raptor in Shetland is merlin, although both kestrel and peregrine are occasionally recorded breeding in Shetland and in 2018-2019 sparrowhawk was recorded breeding in Shetland for the first time (Shetland Bird Club, 2020). Breeding raptor surveys were undertaken to determine the location of any breeding merlins within the Study Area using standardised merlin survey methods (e.g. as per Hardey *et al*., 2013). These surveys also covered potential breeding habitats of kestrel and peregrine, were they to be present. Surveys were undertaken in 2018 and 2019 as per agreement with SNH.

Breeding red-throated diver surveys

Searches were made for breeding red-throated divers within the Study Area. Following SNH guidance, searches for nesting red-throated divers were undertaken on all potentially suitable waterbodies within the Study Area. The waterbodies were visited at least twice during the breeding season if nothing was present. However, if the water body was occupied, sites were revisited later in the breeding season to determine nest locations and breeding success. Surveys were undertaken in 2018 and 2019 as per agreement with SNH.

Black guillemot

Black guillemots breed on the coast, preferentially near shallow water and their nests are typically in natural holes, crevices, caves and boulder beaches (Gilbert *et al*., 1998). Black guillemots usually nest in pairs or in small groups scattered along the coast and so surveys should therefore aim to cover sections of coastline rather than discrete 'colonies'. The standard survey methodology for this species highlights that '*nest-sites are difficult to count with any accuracy because of their scattered distribution and inaccessibility. Carefully timed counts of individual adults provide the most accurate* [survey] *method*' (Gilbert *et al*., 1998).

The black guillemot survey methodology requires two survey visits a week or more apart, preferably during the first three weeks of April, although counts later in April or early May also acceptable (Gilbert *et al*., 1998). Two survey visits were undertaken in April 2018 and 2019 (as per agreement with SNH). The surveys were conducted from first light until particular defined cliff reaches were surveyed, during suitable, calm and clear weather conditions (as per Gilbert *et al*., 1998).

The surveyor was specifically required to make a note of any substantial cliff reaches where land-based surveys were not possible due inaccessibility or health and safety considerations. As it turned out, most of the potentially suitable black guillemot breeding habitat could be surveyed from land (which SNH advised would likely be the case) and so surveys proceeded on that basis. The surveyor, who was familiar with the Study Area, moved along the coast counting all black guillemots on the sea, within about 300 m of the shore and any that were on land. Repeat counts were also undertaken in the afternoon for some reaches for comparative purposes.

Cliff nesting seabirds

Other cliff nesting seabirds were potentially present and required survey: fulmar, shag, guillemot, razorbill, puffin and possibly gulls. The standard method for surveying cliff nesting seabirds requires the number of individual adult birds per visit recorded (also known as max number of Apparently Occupied Nests (AON) from any one visit), which can be summed, and a mean produced over different survey visits undertaken. The standard survey guidance recommends between two to five survey visits. Given the nature of the Study Area, with no low tide beach below the steep cliffs, boat-based counts were undertaken between the eastern edge of the Hermaness, Saxa Vord and Valla Field SPA (approximately Virdik) and The Nev (southeast of Hill of Clibberswick), as per agreement with SNH. No climbing down a cliff to count breeding birds was undertaken.

Puffins are difficult to census due to their use of burrows, often in inaccessible locations. The most reliable way they are monitored is by long-term monitoring of Apparently Occupied Burrows (AOB) from sample areas, rarely possible in Shetland due to the steep and inaccessible nature of the terrain (Mitchell *et al.,* 20014). When these burrows cannot be accessed, as was the case within the Study Area, the standard survey methodology is to count individual birds on land, which provides a rough estimate of numbers present. However, in Shetland such previous counts have taken place at the same time as the optimal count for other cliff nesting seabirds in June, when it is known that non breeders also attend colonies and so can inflate numbers of presumed breeders present (Owen *et al.,* 2018).

The razorbill, guillemot and shag standard survey methods recommend surveys in the first three weeks of June in north of Scotland in ‘normal years’ (June or July for gannets, June for fulmar, early-mid June for kittiwake). Consequently, boat-based surveys were scheduled for the first three weeks of June given the main species likely to be present on the cliffs (and well-spaced across these 3 weeks). The two main sources of seabird survey guidance were followed: Gilbert *et al*., (1998) and JNCC Seabird Monitoring Handbook (Walsh *et al*., 2011).

Following this best practice guidance, the following measures were undertaken:

- Suitable health and safety measures were enacted, and the boat was operated by an experienced and trained skipper and life jackets were worn at all times.
- The boat was manoeuvred a suitable distance offshore for surveying to ensure that count position was not close enough to disturb the cliff nesting seabirds.
- For ease of counting, each area of cliff was defined into distinct units for monitoring and recording purposes. These were marked on a map to aid recording purposes.
- Counts were undertaken during the day between 0900 and 1600.
- Counts were replicated, by two highly experienced ornithological surveyors (David Cooper and Brydon Thomason) at the same time.
- The first and third boat-based trips were counted from south to north and the second from north to south in an attempt to reduce any potential 'time of day' bias.
- Foggy and/or wet and windy conditions were avoided. Surveys were planned for, and undertaken on, calm days with good visibility.
- Any parts of the cliff survey area that were not visible for survey were noted.

Further methodological detail on how each seabird species was counted is provided within the JNCC Seabird Monitoring Handbook (Walsh *et al*., 2011). These survey methods and proposed personnel were discussed and agreed with Glenn Tyler at SNH (in a phone call on 24/05/18). Glen Tyler agreed that this approach was suitable and that three-separate boat-based surveys spread across the first three weeks of June during suitable weather conditions was standard and '*sounded ideal*', given the information available at the time. Surveys were undertaken in 2018 as per agreement with SNH.

During data sharing with SNH in 2020 it became apparent that existing bird data for the SPA did not exist for the whole Hermaness, Saxa Vord and Valla Field SPA area. The SPA extends to Virdik but only the marine extension – it does not include the cliffs, which is the only section SNH monitors. Consequently, a gap in cliff nesting seabird data for the area between Virdik and Ura was identified. Fortuitously, this data gap was identified in May 2020, allowing boat-based seabird surveys to be organised for the relevant section of cliff in June 2020, which also coincided with the relaxation of COVID-19 restrictions for outdoor work. The same surveyors who undertook the 2018 boat-based seabird surveys conducted three boat-based seabird surveys between Virdik and Ura in June 2020.

Results

The Study Area was surveyed under SNH Schedule 1 licence for breeding birds in 2018 and 2019 by David Cooper. David Cooper and Brydon Thomason undertook boat-based seabird counts in 2018 and 2020. In 2020 David Cooper surveyed the Application Boundary during the breeding season to inform summer survey visits by SSC staff and other non-ornithological surveyors e.g. archaeologists. Both David Cooper and Brydon Thomason are highly experienced and locally based ornithologists and used the relevant standard breeding bird survey methods during suitable weather conditions.

A total of 135 bird species were recorded in the Study Area during 2018 and 2019 breeding bird surveys. For full list of species recorded, see Appendix 1 to this report; this report focusses on potential target species requiring consideration in the context of the proposed development.

Target species are considered individually below:

Whooper swan *Cygnus cygnus*

Amber List, Schedule 1, Annex 1 species. No evidence of breeding in the Study Area.

A single adult was seen in flight, flying east over Millfield on 21st April 2018. No whooper swans were recorded during 2019 surveys.

Barnacle goose *Branta leucopsis*

Amber List, Annex 1 species. No evidence of breeding in the Study Area.

A flock of five were seen at Lamba Ness on 7th May 2018. A flock of ten were seen in flight, flying northwest over Saxa Vord hill on the 10th May 2018. A singleton was seen at Lamba

Ness on the 9th June 2018. A pair was seen at Hill of Clibberswick and Millfield on the 9th June 2018 but on no other dates. No Barnacle geese were recorded during 2019 surveys.

Long-tailed duck *Clangula hyemalis*

Schedule 1 species. No evidence of breeding in the Study Area.

A single drake in summer plumage was seen at Skaw throughout June 2018. No records of long-tailed duck during 2019 surveys. In all but three years since 1970, the species has been recorded into at least June in Shetland. In many years, occasional singletons have been seen in July and August, but there has never been any suggestion of breeding (Pennington *et al*., 2004).

Quail *Coturnix coturnix*

Amber List, Schedule 1 species. Evidence of potential breeding in the Study Area.

No birds heard or seen in 2018. Two records of singing birds heard on territory during June 2019, but not further evidence of potential breeding was recorded.

Red-throated diver *Gavia stellata*

Amber List, Schedule 1, Annex 1 species. Evidence of multiple pairs breeding in the Study Area.

Two breeding attempts in the Study Area in 2018 and 2019 (EIA Report Confidential Drawing 1).

Numerous encounters were logged across the whole site including at Lamba Ness, Norwick and Skaw, involving display flights and typical noisy aerial territorial disputes seen throughout both summer breeding seasons.

Black-throated diver *Gavia arctica*

Amber List, Annex 1 species. No evidence of breeding in the Study Area.

A single adult in summer plumage was seen at Lamba Ness and Norwick on the 1st June 2018. No records of black-throated diver were recorded during 2019 surveys.

Great northern diver *Gavia immer*

Amber List, Annex 1 species. No evidence of breeding in the Study Area.

Numerous encounters logged on the sea in 2018 including at Lamba Ness, Norwick and Skaw spanning the months April to June, with a maximum of three individuals together seen at Lamba Ness in April. A lone individual was seen in Norwick in June in summer plumage.

Great northern divers were recorded each month between April and July in Norwick Bay in 2019.

Black guillemot *Ceppus grylle*

Two black guillemot surveys were undertaken in both 2018 and 2019. In 2018, the first was on 10-12th April 2018 and the second on 18-20th April 2018. In 2019, the first was on 11-13th April and the second on 28-30th April 2019. The locations of black guillemots are presented in EIA Report Drawing 6.3. The maximum count in 2018 was 84 black guillemots with 101 individuals in 2019.

Cliff nesting seabirds

The summary results in Table 1 refer to three boat-based counts undertaken on 13th, 17th and 29th of June 2018. These surveys covered the coast/cliffs from Virdik, east and southwards down to The Nev (southeast of Hill of Clibberswick). EIA Report Drawings 6.4-6.9 present individual seabird counts in relation to the distance from proposed launch sites.

Table 1. Boat-based seabird cliff counts, Virdik to The Nev, Northeast Unst, June 2018

Species	AON 13/06/18	AON 17/06/18	AON 29/06/18
Shag *Phalacrocorax aristotelis*	55	42	42
Fulmar *Fulmarus glacialis*	3,460	3,895	4,330
Kittiwake *Rissa tridactyla*	53	55	55
Great black-backed gull *Larus marinus*	2	1	1
Guillemot *Uria aalge**	48	80	62
Razorbill *Alca torda**	6	11	8
Puffin *Fratercula arctica**	18	49	41

*Total number of individual adults on land recorded – not AON.

The summary results in Table 2 refer to three boat-based counts undertaken on 10th, 13th and 24th June 2020. These surveys covered the coast/cliffs from Virdik, west to Ura (immediately south of The Noup).

Table 2. Boat-based seabird cliff counts, Virdik to Ura, Northeast Unst, June 2020

Species	AON 10/06/20	AON 13/06/20	AON 24/06/20
Shag	22	25	26
Fulmar	2,495	2,601	2,657
Kittiwake	0	0	0
Great black-backed gull	5	6	6
Herring gull *Larus argentatus*	5	5	4
Guillemot*	9	17	20
Razorbill*	2	4	0
Puffin*	76	37	38

*Total number of individual adults on land recorded – not AON.

Black kite *Milvus migrans*

Annex 1 species. No evidence of breeding in the Study Area.

No records of black kite during 2018 surveys. Single record of a black kite in April 2019 at Battles Kirk, Northwick.

White-tailed eagle *Haliaeetus albicilla*

Red List, Schedule 1 species. No evidence of breeding in the Study Area.

No records of white-tailed eagle during 2018 surveys. Two records of a single individual in May 2019 in Norwick and Ward of Norwick.

Marsh harrier *Circus aeruginosus*

Amber List, Annex 1 species. No evidence of breeding in the Study Area.

A single immature male was seen at Norwick on the 24th April 2018. Three records of marsh harrier in April 2019 in Skaw, with a single female recorded in June 2019 at Northdale.

Merlin *Falco columbarius*

Amber List, Schedule 1, Annex 1 species. Evidence of breeding probably near to the Study Area.

One nearby successful breeding attempt in 2018. A brood of three fledged recorded around Northdale. Despite searching, no merlin nest was recorded within the Study Area and it is not known where the fledged brood came from.

One nearby successful breeding attempt in 2019. A female with fledged juveniles was recorded between Skaw and Inner Skaw. Despite searching, no merlin nest was recorded within the Study Area and it is not known where the fledged brood came from.

Peregrine *Falco peregrinus*

Schedule 1, Annex 1 species. No evidence of breeding in the Study Area.

A single female was seen at Hill of Clibberswick, Norwick and Swartling on 25th May 2018. A total of three single individuals were recorded during 2019 breeding season surveys between months of April and June in Skaw and Ward of Norwick.

Crane *Grus grus*

Amber List, Annex 1 species. No evidence of breeding in the Study Area.

A single individual was seen at Feall on the 20th April 2018 and in flight over Millfield on the 21st April 2018. No records of common crane during 2019 surveys.

Ringed plover *Charadrius hiaticula*

Red List species. Evidence of multiple pairs breeding in the Study Area.

Nine breeding pairs were recorded in 2018 and ten breeding pairs recorded in 2019 (EIA Report Drawing 6.10). Most of the pairs were found at Skaw, Lamba Ness and Norwick.

Golden plover *Pluvialis apricaria*

Amber List, Annex 1 species. Evidence of multiple pairs breeding in the Study Area.

Seven breeding pairs were recorded in 2018 and 13 pairs in 2019 in the Study Area (EIA Report Drawing 6.12). Breeding pairs were distributed throughout the Study Area including at Saxa Vord, Sothers Field, Northdale, Housi Field, Hill of Clibberswick and Swartling.

Whimbrel *Numenius phaeopus*

Red List, Schedule 1 species. Evidence of multiple pairs breeding in the Study Area.

There were five breeding territories in 2018 and four in 2019 (EIA Report Confidential Drawing 2).

Curlew *Numenius arquata*

Red List species. Evidence of multiple pairs breeding in the Study Area.

There were circa.16 breeding territories in 2018 and circa 13 in 2019 (EIA Report Drawing 6.14). Given the distances breeding curlews can move, it is possible that some territories have been double-counted and without colour ringing it is not possible to be certain. Nevertheless, in areas where multiple territories have been plotted close together e.g. Norwick Meadows, there was direct evidence of multiple pairs being present within a relatively small area.

Dunlin *Calidris alpine*

Amber List, Annex 1 race (*C. a. schinzii*). Evidence of breeding in the Study Area.

Five breeding territories were recorded in 2018 and four breeding territories recorded in 2019 (EIA Report Drawing 6.16). Breeding territories were located in areas including Saxa Vord hill, Southers Field, Skaw, Lamba Ness and Housi Field.

Black-tailed godwit *Limosa limosa*

Red List, Schedule 1 species. No evidence of breeding in the Study Area.

A single individual was recorded in suitable breeding habitat, but no evidence of breeding was recorded.

Greenshank *Tringa nebularia*

Amber List, Schedule 1 species. No evidence of breeding in the Study Area.

A single individual was seen along the coast at Wick of Skaw in June 2019. No records of greenshank during 2018 surveys.

Wood sandpiper *Tringa glareola*

Amber List, Annex 1 species. No evidence of breeding in the Study Area.

A single individual was seen at Millfield on the 30th July 2018. No records of wood sandpiper during 2019 surveys.

Arctic skua *Stercorarius parasiticus*

Red List species. Evidence of multiple pairs breeding in the Study Area.

Five pairs of arctic skua recorded breeding in the Study Area in 2018 and 2019 (EIA Report Drawing 6.19). Pairs occupied territories both years in areas including Hill of Clibberswick, Ward of Norwick and Inner Skaw.

Great skua *Stercorarius skua*

Amber List. Highly variable numbers of great skua were recorded during surveys breeding in the Study Area, reflecting the social nature of this species.

Large numbers of non-breeding great skua can hold territory in apparently suitable breeding habitats, making accurate estimates of actual number breeding difficult and with a high degree of uncertainty. It is considered that the number of breeding pairs within the Study Area is likely to be in the low tens, with breeding birds mainly concentrated over 3 km away from the nearest launch pad (EIA Report Drawing 6.21). Great skua numbers were concentrated around Saxa Vord hill e.g. with minimum 17 nests recorded in June 2018 and groups of presumed non-breeders numbering up to 90 individuals. Additionally, within the 3 km to 4 km buffer, smaller numbers of great skua were recorded at Sothers Field and Housi Field.

Sandwich tern *Sterna sandvicensis*

Amber List, Annex 1 species. No evidence of breeding in the Study Area.

A single individual was seen offshore at both Norwick and Skaw on five dates from the 31st March 2018 until the 16th July 2018. No records of sandwich tern during 2019 surveys.

Common tern *Sterna hirundo*

Amber List, Annex 1 species. No evidence of breeding in the Study Area.

The first returning individual was noted at Norwick on the 8th May 2018. Whilst there were then multiple sightings typically of single individuals at Haroldswick and Norwick throughout the summer breeding was never proven. In 2019, individuals were recorded in Wick of Skaw in May and July, but breeding was never proven.

Arctic tern *Sterna paradisaea*

Amber List, Annex 1 species. Multiple pairs breeding in the Study Area.

Several small breeding colonies were present within the Study Area (EIA Report Drawing 6.18) with one pair on Hill of Clibberswick in 2018, two pairs in 2018 and three pairs in 2019 on Norwick beach and six pairs in 2018 and ten pairs in 2019 at Skaw.

Red-backed shrike *Lanius collurio*

Red List, Schedule 1, Annex 1 species. No evidence of breeding in the Study Area.

A female was present at Haroldswick on 26th May 2018. A male was present at Inner Skaw and Swartling on 28th and 29th May 2018. A pair were present (the male was singing) at Northdale for a few days from the 28th May 2018. Three records of red-backed shrike were recorded in 2019, a female in May at Clibberswick, a female in June at Inner Skaw and two females in Northdale in June.

Black redstart *Phoenicurus ochruros*

Schedule 1 species. No evidence of breeding in the Study Area.

Single record of a black redstart at Saxa Vord in April 2019. No records of black redstart during 2019 surveys.

Bluethroat *Luscinia svecica*

Annex 1 species. No evidence of breeding in the Study Area.

A single male was singing at Millfield on 11-12th May 2018 and a single was recorded in May 2019. A single male was present at Valyie and Norwick beach on the 14-15th May 2018.

DISCUSSION

Scottish Planning Policy requires that the presence (or potential presence) of legally protected bird species such as Schedule 1 and Annex 1 species is factored into the planning and design of development proposals, and that any impacts on such protected species are fully considered prior to the determination of planning applications.

There is direct evidence from the Study Area of potentially sensitive and specially protected target bird species breeding within, and adjacent to, the proposed planning application boundary (Table 3) and so these need to be considered further in relation to the proposed development.

Table 3. Regularly recorded, potentially sensitive and specially protected breeding birds (2018-2020) within 4 km of SSC launch sites (approximately between Ura and The Nev).

Species	Within 0.5km of launch sites	0.5-1km of launch sites	1-2km of launch sites	2-3km of launch sites	3-4km of launch sites
Red-throated diver pairs	2018 = 0 2019 = 0	2018 = 0 2019 = 0	2018 = 0 2019 = 0	2018 = 1 2019 = 0	2018 = 1 2019 = 2
Black guillemot individuals	2018 = 14 2019 = 13	2018 = 8 2019 = 12	2018 = 27 2019 = 25	2018 = 25 2019 = 26	2018 = 10 2019 = 25
Puffin individuals	2018 = 2	2018 = 6	2018 = 27	2018 & 2020 = 23	2018 & 2020 = 67*
Guillemot individuals	2018 = 0	2018 = 0	2018 = 27	2018 & 2020 = 20	2018 & 2020 = 53*
Razorbill individuals	2018 = 0	2018 = 0	2018 = 0	2018 & 2020 = 2	2018 & 2020 = 13*
Shag AON	2018 = 1	2018 = 0	2018 = 5	2018 & 2020 = 24	2018 & 2020 = 51*
Kittiwake AON	2018 = 0	2018 = 0	2018 = 50	2018 & 2020 = 0	2018 & 2020 = 5*
Great black-backed gull AON	2018 = 0	2018 = 0	2018 = 2	2018 & 2020 = 2	2018 & 2020 = 3*
Herring gull AON	2018 = 0	2018 = 0	2018 = 0	2018 & 2020 = 2	2018 & 2020 = 3*
Fulmar AON	2018 = 430	2018 = 740	2018 = 1,465	2018 & 2020 = 2,645	2018 & 2020 = 1,707*
Ringed plover pairs	2018 = 3 2019 = 3	2018 = 0 2019 = 0	2018 = 4 2019 = 5	2018 = 2 2019 = 1	2018 = 0 2019 = 1
Golden plover pairs	2018 = 0 2019 = 1	2018 = 0 2019 = 0	2018 = 2 2019 = 3	2018 = 1 2019 = 5	2018 = 4 2019 = 4
Whimbrel pairs	2018 = 1 2019 = 1	2018 = 1 2019 = 1	2018 = 1 2019 = 1	2018 = 2 2019 = 1	2018 = 0 2019 = 0
Curlew pairs	2018 = 0 2019 = 1	2018 = 0 2019 = 0	2018 = 3 2019 = 2	2018 = 5 2019 = 5	2018 = 8 2019 = 5
Dunlin pairs	2018 = 0 2019 = 1	2018 = 0 2019 = 0	2018 = 2 2019 = 2	2018 = 1 2019 = 0	2018 = 2 2019 = 1
Red-necked phalarope nests	2018 = 0 2019 = 0	2018 = 0 2019 = 0	2018 = 1 2019 = 1	2018 = 0 2019 = 0	2018 = 0 2019 = 0
Arctic skua pairs	2018 = 0 2019 = 0	2018 = 1 2019 = 1	2018 = 1 2019 = 2	2018 = 3 2019 = 2	2018 = 0 2019 = 0
Arctic tern pairs	2018 = 0 2019 = 0	2018 = 0 2019 = 0	2018 = 8 2019 = 13	2018 = 1 2019 = 0	2018 = 0 2019 = 0

*Does not include a very small part of the SPA i.e. from Ura northwards to the Luig, the ca. 4km Study Area boundary.

Note, the individual cliff nesting seabirds recorded between Ura and The Nev are considered 'wider countryside species' and not part of the nearby SPA.

Without doubt, potentially sensitive and specially protected breeding birds could be adversely affected by the proposed satellite launch facility and so a Breeding Birds Protection Plan will be required to be implemented. At the time of writing this report (July 2020) there was no information on likely noise levels from the launch facility. Consideration

of potential impacts of satellite launches will be considered within the Environmental Impact Assessment Report (EIA Report). In the meantime, all bird figures/drawings produced have 0.5km, 1 km, 2 km, 3 km and 4 km buffers illustrated to help estimate distances from the proposed launch facilities.

The magnitude of potential effects from the proposed Saxa Vord and Northdale road extension areas is considered likely to be typical of any standard type of construction development and will be considered as such within the EIA Report.

REFERENCES

Gilbert, G., Gibbons, D.W. and Evans, J. 1998. Bird Monitoring Methods: a manual of techniques for key UK species. RSPB, Sandy.

Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. and Thompson, D. 2006 (2nd Edition 2009; 3rd Edition 2013). Raptors, a field guide to survey and monitoring. The Stationery Office, Edinburgh.

Mitchell, I.P., Newton, S.F., Ratcliffe, N. and Dunn, T.E. 2004. Seabird populations of Britain and Ireland. Poyser.

Owen, E., Prince, O., Cachia-Zammit, C., Cartwright, R., Coledale, T., Elliot, S., Haddon, S., Longmore, G., Swale, J., West, F. and Hughes, R., 2018. Counts of Puffins in Shetland suggest an apparent decline in numbers. Scottish Birds 38: 223-231.

Pennington, M., Osborn, K., Harvey, P., Riddington, R., Okill, D., Ellis, P and Heubeck, M. 2004. The Birds of Shetland. Helm, London.

Ruddock, M. and Whitfield, D.P. 2007. A review of disturbance distances in selected bird species. A report from Natural Research (Projects) Ltd to SNH.

Shetland Bird Club. May 2020. Newsletter 188.

SNH. 2005 (amended 2010 and subsequently). Survey Methods for Use in Assessing the Impacts of Onshore Windfarms on Bird Communities

Walsh, P.M., Halley, D.J., Harris, M.P., del Nevo, A., Sim, I.M.W. and Tasker, M.L. 1995 (reprinted 2011). Seabird monitoring handbook for Britain and Ireland. Published by JNCC / RSPB / ITE / Seabird Group, Peterborough.

APPENDIX 1 – BIRD SPECIES RECORDED IN SCC STUDY AREA APRIL-JULY 2018/19

1. Mute swan, *Cygnus olor*
2. Whooper swan, *Cygnus cygnus*
3. Pink-footed goose, *Anser brachyrhynchus*
4. White-fronted goose, *Anser albifrons*
5. Greylag goose, *Anser anser*
6. Canada goose, *Branta canadensis*
7. Barnacle goose, *Branta leucopsis*

8. Shelduck, *Tadorna tadorna*
9. Wigeon, *Anas penelope*
10. Teal, *Anas crecca*
11. Green-winged teal, *Anas carolinensis*
12. Mallard, *Anas platyrhynchos*
13. Pintail, *Anas acuta*
14. Shoveler, *Anas clypeata*
15. Eider, *Somateria mollissima*
16. Long-tailed duck, *Clangula hyemalis*
17. Common scoter, *Melanitta nigra*
18. Red-breasted merganser, *Mergus serrator*
19. Goosander, *Mergus merganser*
20. Red grouse, *Lagopus lagopus*
21. Quail, *Coturnix coturnix*
22. White-billed diver, *Gavia adamsii*
23. Red-throated diver, *Gavia stellata*
24. Black-throated diver, *Gavia arctica*
25. Great Northern diver, *Gavia immer*
26. Slavonian grebe *Podiceps auritus*
27. Fulmar, *Fulmarus glacialis*
28. Manx shearwater, *Puffinus puffinus*
29. Shag, *Phalacrocorax aristotelis*
30. Grey heron, *Ardea cinerea*
31. Black kite*, Milvus migrans*
32. White-tailed eagle, *Haliaeetus albicilla*
33. Marsh harrier*, Circus aeruginosus*
34. Hen harrier, *Circus cyaneus*
35. Sparrowhawk, *Accipiter nisus*
36. Osprey*, Pandion haliaetus*
37. Kestrel, *Falco tinnunculus*
38. Merlin*, Falco columbarius*
39. Peregrine, *Falco peregrinus*
40. Water rail*, Rallus aquaticus*
41. Moorhen*, Gallinula chloropus*
42. Coot*, Fulica atra*
43. Crane, *Grus grus*
44. Oystercatcher, *Haematopus ostralegus*
45. Ringed plover, *Charadrius hiaticula*
46. Golden plover, *Pluvialis apricaria*
47. Lapwing, *Vanellus vanellus*
48. Knot *Calidris canutus*
49. Sanderling, *Calidris alba*
50. Dunlin, *Calidris alpine*
51. Jack snipe, *Lymnocryptes minimus*
52. Snipe, *Gallinago gallinago*
53. Woodcock, *Scolopax rusticola*
54. Black-tailed godwit, *Limosa limosa*
55. Whimbrel, *Numenius phaeopus*
56. Curlew, *Numenius arquata*
57. Redshank*, Tringa tetanus*
58. Greenshank, *Tringa nebularia*

59. Green sandpiper, *Tringa ochropus*
60. Wood sandpiper, *Tringa glareola*
61. Common sandpiper, *Actitis hypoleucos*
62. Turnstone, *Arenaria interpres*
63. Arctic skua, *Stercorarius parasiticus*
64. Long-tailed skua, *Stercorarius longicaudus*
65. Great skua, *Stercorarius skua*
66. Black-headed gull, *Chroicocephalus ridibundus*
67. Common gull, *Larus canus*
68. Lesser black-backed gull, *Larus fuscus*
69. Herring gull, *Larus argentatus*
70. Great black-backed gull, *Larus marinus*
71. Kittiwake, *Rissa tridactyla*
72. Sandwich tern, *Sterna sandvicensis*
73. Arctic tern, *Sterna paradisaea*
74. Common tern, *Sterna hirundo*
75. Guillemot, *Uria aalge*
76. Razorbill, *Alca torda*
77. Black guillemot, *Cepphus grille*
78. Puffin, *Fratercula arctica*
79. Rock dove, *Columba livia*
80. Woodpigeon, *Columba palumbus*
81. Collared dove, *Streptopelia decaocto*
82. Long-eared owl, *Asio otus*
83. Short-eared owl, *Asio flammeus*
84. Skylark, *Alauda arvensis*
85. Shore lark, *Eremophila alpestris*
86. Sand martin, *Riparia riparia*
87. Swallow, *Hirundo rustica*
88. House martin, *Delichon urbicum*
89. Meadow pipit, *Anthus pratensis*
90. Rock pipit, *Anthus petrosus*
91. Grey wagtail, *Motacilla cinerea*
92. Pied/white wagtail, *Motacilla alba*
93. Robin, *Erithacus rubecula*
94. Wren, *Troglodytes troglodytes*
95. Dunnock, *Prunella modularis*
96. Bluethroat, *Luscinia svecica*
97. Black redstart, *Phoenicurus ochruros*
98. Redstart, *Phoenicurus phoenicurus*
99. Whinchat, *Saxicola rubetra*
100. Stonechat, *Saxicola torquatus*
101. Wheatear, *Oenanthe Oenanthe*
102. Ring ouzel, *Turdus torquatus*
103. Blackbird, *Turdus merula*
104. Fieldfare, *Turdis pilaris*
105. Song thrush, *Turdus philomelos*
106. Redwing, *Turdus iliacus*
107. Sedge warbler, *Acrocephalus schoenobaenus*
108. Marsh warbler, *Acrocephalus palustris*
109. Icterine warbler, *Hippolais icterina*

110. Blackcap, *Sylvia atricapilla*
111. Garden warbler, *Sylvia borin*
112. Lesser whitethroat, *Sylvia curruca*
113. Whitethroat, *Sylvia communis*
114. Greenish warbler, *Phylloscopus trochiloides*
115. Chiffchaff, *Phylloscopus collybita*
116. Willow warbler, *Phylloscopus trochilus*
117. Goldcrest, *Regulus regulus*
118. Spotted flycatcher, *Muscicapa striata*
119. Pied flycatcher, *Ficedula hypoleuca*
120. Red-backed shrike, *Lanius collurio*
121. Jackdaw, *Corvus monedula*
122. Rook *Corvus frugilegus*
123. Hooded crow, *Corvus cornix*
124. Raven, *Corvus corax*
125. Starling, *Sturnus vulgaris*
126. House sparrow, *Passer domesticus*
127. Tree sparrow, *Passer montanus*
128. Chaffinch, *Fringilla coelebs*
129. Brambling, *Fringilla montifringilla*
130. Twite, *Linaria flavirostris*
131. Common rosefinch, *Carpodacus erythrinus*
132. Lapland bunting, *Calcarius lapponicus*
133. Snow bunting, *Plectrophenax nivalis*
134. Black-headed bunting, *Emberiza melanocephala*
135. A confidential Schedule 1 species

Appendix 5.2 Background Literature Review

Appendix 5.2 Background Literature Review of Potential Noise Impacts on Birds for the Shetland Space Centre

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Background literature review of potential noise impacts on birds for the Shetland Space Centre

Can loud noises from rocket launches kill birds? There is no evidence found from the published literature, with lots of photos demonstrating that the noise from much larger rockets than those proposed at the Shetland Space Centre has not instantly killed the birds in the pictures (note a very small number of birds have been killed during launches due to direct collision with the rocket). Two examples of typical launch photos from on-line are provided below.

There are two components to noise, frequency measured in Hertz (Hz) and loudness measured in decibels (dB). The decibel scale is logarithmic, so the difference between the noise at 90dB is ten times that of 80dB, and 100dB is 100 times louder than 80dB.

The general structure of birds' ears shows little variation between species (Encyclopaedia Britannica, 2020). Birds hearing is sensitive, with birds able to detect shorter and lower sounds than humans. The hearing range of a typical bird is between 100Hz to 8-10kHz, sensitivity at 0-10dB, hearing best between 1-4kHz (Beason, 2004) with some species hearing range extending up to 12kHZ (Cotanche, 2008). For comparison, human hearing range is typically between 20 to 20kHz. Data on hearing range is available for one of the species of interest to the proposed development; puffin (*Fratercula arctica*) which has a hearing range 500Hz to 8kHz (Mooney *et al.* 2019). As rockets launch noise is concentrated in the low to mid frequencies (Lubert, 2017), well within both puffin and a typical birds' hearing range, it is fair to conclude that rocket/satellite launch noise frequencies will be audible to all species potentially impacted by the proposed Shetland Space Centre (SSC) development.

Noise in general has been shown to impact on wildlife populations, reducing biodiversity including birds, causing for example stress and affecting productivity and immune function (Wolfenden, 2017). Additionally, proximity to infrastructure (and perhaps associated noise) has been shown to reduce breeding productivity in some species; for example, red-necked phalarope (*Phalaropus lobatus*) breeding in Alaska (Liebezeit *et al.* 2009). Response to noise will depend on how far away an animal is from the noise source, as noise attenuates (i.e. reduces) over distance (Bowles, 1995).

Much of the literature available on noise has studied the effect of chronic noise on bird populations. Chronic and frequent noise interferes with an organism's ability to detect important sound (Francis & Barber, 2013) and has been demonstrated to reduce reproductive success in for example great tit (*Parus major*), a common woodland species (Halfwerk *et al.* 2011). In addition to a reduction in reproductive success, long term exposure to road traffic noise can cause oxidative stress. In nestling tree swallow (*Tachycineta bicolor*)

oxidative stress is associated with ageing and an increased risk of disease, thus both the increased oxidative stress and smaller nestling size from road noise demonstrates the potential for exposure to loud noise to result in long term impacts for an individual which may ultimately be seen at a population level (Injaian *et al.* 2018). Behaviour may be adapted to offset the effects of chronic noise, for example, chiffchaff (*Phylloscopus collybita*) reduce the frequency of their song in response to chronic airport noise (Wolfenden *et al*. 2019) to facilitate communication.

Although the impacts of chronic noise are relatively well studied, chronic noise studies may be of limited relevance in considering the impact of much louder impulsive occasional noise (a short duration noise event that occurs over a range of frequencies) experienced during rocket/satellite launches. Loud noise events are often reacted to as a threat by birds (Francis & Barber, 2013), causing them to alter behaviour in response. As such impulsive events by their nature are infrequent, and so habituation to these events is considered less likely.

Impacts of impulsive noise can be divided into lethal, sub-lethal and trivial/non-existent effects. Lethal effects may occur when a loud noise results in mortality, for example if the startled 'flight' response to a stimulus leads to a collision with a nearby object. Increased noise intensity will increase the severity of the likely response (Francis and Barber, 2013). Dependant young are more likely than adults to suffer lethal effects through exposure, interruption in provision of care or, in extreme cases, being knocked out the nest during a parent's startled/frightened reaction. 'Flight' responses causing startled animals to alter their behaviour including fleeing is similar to, for example, an organism's response to a predation risk event. Most noise startle events will not result in mortality to adults, but instead sub-lethal effects may possibly be observed e.g. by reducing fecundity or increasing stress. Sub-lethal effects of loud noises additionally could involve temporary damage to the birds' hearing structure, however, birds unlike humans are able to regenerate damaged auditory hair cells. Physical trauma to the ear is more commonly the result of impulse noise rather than continuous noise as continuous noise loud enough to cause permanent damage is rarer than similarly loud impulsive noise (Larkin *et al*. 1996). The noise level that causes damage and the extent of damage varies depending on the species of bird (Beason, 2004).

Birds, unlike in humans, are able to regenerate damaged auditory (cochlear) hair cells and so any damage to auditory hair cells is potentially reversible. Hair cells are regenerated following a process called apoptosis, which is programmed cell death in response to inhospitable environments. Cells adjacent to those undergoing apoptosis are able to produce new hair cells within a matter of days through both direct trans-differentiation and mitotic regeneration (Cotanche, 2008) to replace those dying cells. This process of regeneration takes approximately two months to complete depending on the extent of the damage (Bowles, 1995). Given that the proposed schedule of SSC satellite launches are at least monthly throughout the year, were significant damage to occur to a birds' hearing, then insufficient time would likely occur between launches to allow for full repair/recovery between launches.

This literature review aims to look at how impulsive noise (from various sources including aircraft, fireworks, military ranges and rocket launches) impacts on both bird populations and individual behaviour and breeding success in order to help assess the potential noise impacts of the proposed SSC. To do this, the review has attempted to focus on identifying impulsive noise studies for the species of interest on Unst and with the ornithological study area. A variety of freely available data bases were searched including ResearchGate and Google Scholar. References considered included both peer-reviewed published scientific papers and grey literature reports. However, relevant literature was at best limited and so a wider literature search was conducted looking at other species including where possible analogous birds to those present in the SSC ornithological study area.

Helicopter and aircraft noise including military (Jet flyover at 100ft – ~103dB)

Aircraft movements have been shown to alter time-activity budgets of various species of waterfowl as a result of alert responses and increased locomotion in response to noise stimulus (Pepper *et al.* 2003). In response to sudden onset high amplitude noise from military jets (>100dB), harlequin ducks (*Histrionicus histrionicus*) decreased courtship for 1.5 hours and increased agnostic interactions for 2 hours following noise despite direct behavioural responses (head up, startle – flushing, agitated, diving) at the time of the flyovers generally lasting under a minute (Gougie & Jones, 2004).

A study on peregrine falcons (*Falco peregrinus*) found low military jet training had no impact on breeding success rates (Roby *et al*. 2002). However, this study highlighted that impacts of noise on a species may differ between sex; a reduction in male attendance at eyrie's with high jet activity was observed, albeit compensated for by increased female attendance. It was speculated that resultant changes to the female's time budgets may have long term implications for individual fitness. Elsewhere, a study on Wilson's plover (*Charadrius wilsonia*) reported military flights increased birds alertness and scanning behaviour, but with no evidence of effect on heart rate or incubation, or direct evidence of this behavioural response reducing reproductive success (Derose-Wilson *et al.* 2015).

Arctic tern (*Sterna paradisaea*) incubating behaviour is impacted by both fixed-wing aircraft and helicopters, with helicopters causing more disturbance to birds than fixed-wing aircraft, however human presence had a larger effect than aircraft disturbance (reviewed in Manci *et al*. 1988).

Sound levels are important in the determination of whether or not a species is going to respond to a noise stimulus; a small proportion of a colony (<20%) of crested terns (*Sterna bergii*) nesting on the Australian great barrier reef exhibited behaviour indicating that they were preparing to fly away (or actually flying away) in response to aircraft noises when louder than 85dB (Brown, 1990). Such 'upflights' lead to an increase in predation risk of young or eggs, exposure of eggs/chicks to temperature extremes in addition to the energetic cost of the flight to the adult bird.

Not all studies report a reaction to aircraft noise; a study exploring the possibility that increased air traffic associated with oilfields off north-east Scotland was impacting breeding seabirds recorded the reactions of a mixed colony of fulmars (*Fulmarus glacialis*), shags (*Phalacrocorax aristotelis*), herring gulls (*Larus argentatus*), kittiwakes (*Rissa tridactyla*), common guillemot (*Uria aalge*), razorbills (*Alca torda*) and puffins on the Buchan cliffs in relation to aircraft flying within 100m of breeding cliffs. Virtually no behavioural reaction was reported as a result of the flyovers to within 100m of the colony conducted during early egg laying and early nestling periods (Dunnet, 1977). Most of these species are present in, and therefore directly relevant to, the SSC ornithological study area.

The apparent lack of behavioural changes does not necessarily mean there was no impact on fitness; studies of heart rate response to visitor disturbance on kittiwakes and shags (i.e. study not specifically looking at noise) found increased heart-rates of up to 50% with individuals showing extreme variation following disturbance (Beale, 2007); such increases in heart-rate may have implications for energy budgets and thus individual fitness. However, it is worth noting that increased heart rates and stress from, for example, being trapped and handled by licensed bird ringers is not generally considered important in terms of individual (or population level) energy budgets and fitness for most species of birds.

Drawing firm conclusions from one study e.g. the lack of an impact recorded in Dunnet's 1977 north-east Scotland study may not always be replicated elsewhere because individuals from the same species can vary in terms of responses. A recent study on airplane

disturbance in California on common murres (aka common guillemot) found that 57% of aeroplane flyovers resulted reactions including head bobbing and flushing (Rojek *et al.* 2007). Guillemots found helicopter flyovers significantly more disturbing with 83% of flyovers resulting in observable disturbance in the same study, despite aircraft being louder, leading to lost eggs and chicks. Extensive head bobbing occasionally resulted in the loss of eggs or chicks, but most egg/chick lost were dislodged during flushing. Reactions to flyovers were dependant on the time of year with guillemots more prone to flushing in the pre-egg and early egg-laying periods than after egg-laying is well underway (Rojek *et al.* 2007). It is worth noting that such egg losses may have been focussed on those nest sites close to cliff edges in sub-optimal locations which may have failed naturally regardless. In other words, such egg losses may not have been additive.

There are several studies on raptor responses to disturbance/noise events. For example, Grubb *et al.* (2010) investigated the response of incubating golden eagles (considered by expert opinion to be the most sensitive UK bird species to disturbance; Ruddock & Whitfield, 2007) to heli-skiing and military helicopters in northern Utah, USA. They watched 303 helicopter passes between 0–3,000m (horizontal distance) in 22 nesting territories and found no effect on early courtship, nest repair or subsequent nesting success. No response occurred in 66% of passes and incubating birds watched helicopters in 30% of observations. Whilst this and other raptor studies are in themselves interesting, their relevance to the situation on Unst is unclear.

The literature does not show any significant difference between bird responses when considering the height of the passing over event; perhaps because substantial adverse responses are so rarely recorded. Elsewhere, helicopters are considered to have more impact on birds than fixed-wing aircraft (despite aircraft being louder), however, it is unclear as to what aspect of the noise is most disturbing to birds (Bowles, 1995), but perhaps due to the slower nature of helicopter flight. Curlew (*Numenius arquata*) roosting on grassland fields are sensitive to helicopter overflights at less than 200m overhead (Smit & Visser, 1993).

Sudden blasts including fireworks & military shooting ranges (fireworks ~ 145dB)

A study of northern cardinal (*Cardinalis cardinalis*), a north American songbird, breeding on military bases (thus exposed to noise disturbance including firing guns, artillery, and ordinance) found no evidence for decreased offspring provisioning or reproduction success between areas of high military activity (tenfold difference on disturbance) and areas elsewhere with lower military activity (Barron *et al.* 2012). Cardinal abundance was not formally tested but was considered similar between high and low disturbance areas. No efforts were made to quantify the levels of noise exposure, thus both sites may have had the same maximum dB levels, just less frequent loud noises in the low activity area, therefore, it's possible that both high and low activity sites were considered equally disturbed to cardinals - the study would have benefited from a non-military control site. The same study provided evidence that the presence of the military activity suppressed crow activity with use of low activity areas five times that of high activity areas (Barron *et al.* 2012) demonstrating that not all species are equally affected by disturbance.

Golden plover (*Pluvialis apricaria*), a species present in the SSC study area, breeding on Otterburn firing range in England increased from 25 pairs in 1994 to 34 pairs in 1998 despite noise disturbance (Forsdyke, 2004). Despite the increase in breeding numbers, individual golden plover displayed adverse behavioural responses: "*a flock of approximately 50 (non-breeding) golden plover were startled into flight approximately 1,000m ahead of the launcher*

and exhibited a pattern of irregular flight movements characteristic of predator evasion" in response to missile launches (Forsdyke, 2004).

Occasionally, fleeing behaviour following loud noise exposure can result in breeding failure. For example, adult prairie falcons (*Falco mexicanus*) fleeing nests in response to loud noise (construction blasting) caused some eggs to be knocked from the nest (as reviewed in Larkin *et al.* 1996).

Mass mortality events associated with fireworks have been reported, for example, an estimated 5,000 passerines including European starlings (*Sturnus vulgaris*), common grackles (*Quiscalus quiscula*), red-winged blackbirds (*Agelaius phoeniceus*) and brown-headed cowbirds (*Molothrus ater*) fell to the ground in a 30 minute period in a square mile area in Bebe, Arkansas on one winters' day. Testing conducted by the National Wildlife Health Centre concluded the birds died after suffering from 'blunt-force trauma' following being flushed from roost sites by professional grade (i.e. loud) fireworks and crashing into objects including trees and buildings (National Geographic, 2011).

This phenomenon of being flushed from roost sites following fireworks has also been reported elsewhere, e.g. in Poland where a study of roosting magpies (*Pica pica*) throughout winter found a marked reduction in the numbers roosting following nearby use of fireworks; 30 individuals roosting on New Year's Eve reduced to 5 the day following the fireworks (Karolewski *et al.* 2014). Although no direct mortality was reported, the loud noise impacted the bird's choice on returning to the area over a temporal scale beyond 24 hours, suggests a possibility of breeding territory abandonment in response to sufficiently loud noise impulsive.

Although most of the above cases relate to passerines, this phenomenon of loud bangs from fireworks causing disturbance has also been reported for some waterbirds (Shamoun-Baranes *et al.* 2011) and auks (Weigand & McChesney, 2008). Monitoring by U.S. Fish and Wildlife Service and the Bureau of Land Management of pelagic cormorants (*Phalacrocorax pelagicus*), pigeon guillemots (*Cepphus columba*), western gulls (*Larus occidentalis*), black oystercatchers (*Haematopus bachmani*) and Brandt's cormorants (*Phalacrocorax penicillatus*) nests on costal rocks in California found some nests were abandoned, following a nearby fireworks display (Weigand & McChesney, 2008).

Non-breeding curlew on the Humber estuary in England at a high tide roost changed behaviour (alertness etc.) in response to an experimental blast noise but not taking flight at noise levels of approx. 72dB, taking off but returned quickly at noise levels of approx. 76dB, taking off and leaving the area at values of 80dB (Wright *et al.* 2010). High levels of individual variation were observed in responses to the airhorn blast noise stimulus. Golden plover appear more sensitive than curlew to the airhorn blasts, changing behaviour (alertness etc.) but not taking flight at noise levels of approx. 69dB, taking off but returning quickly at noise levels of approx. 74dB and taking off and leaving the area at values of 80dB (Wright *et al.* 2010). Note these wader responses were measured outwith the breeding season, thus perhaps the birds were not as invested in the location as they would be if on their breeding territory. Breeding birds have been shown to be tolerant of much louder blasts e.g. an experimental 138dB trial blast on Christmas Island in the vicinity of red-footed boobies (*Sula sula*) (a species similar to gannet) recorded no behavioural response other than an increase in the apparent vigilance of chicks (Environment Australia, 2000). This blast was carried out as part of and EIA for a proposed rocket launch facility.

Space centres and birds

Space centres can hold good breeding populations of birds, many of them declining species and conservation priorities. For example, the land immediately adjacent to the Kennedy Space Centre in Floirida, USA, is home to large breeding populations of wetland/wading birds (Smith & Breininger, 1995), despite being exposed to irregular loud impulsive noise events.

Populations of certain species of birds are considered problematic at the Kennedy Space Centre; following a bird strike (by a vulture) damaging a launching shuttle's external tank after liftoff, NASA implemented a policy of removing roadkill on the infrastructure leading towards the space center in order to reduce the numbers of vultures in the area (Schlierf *et al.* 2007). Monitoring of reproductive success rates of endangered Florida scrub jay (*Aphelocoma coerulescens*) breeding near launch pads found comparable success to those further away (Breininger *et al*. 1994). An Environmental Assessment for heavy launch vehicle programs from a space launch complex at East Vandenberg Air Force Base, California reviewed the literature on the impact of noise on western snowy plover (*Charadrius nivosus nivosus*) (a similar species to ringed plover). It concluded wintering western snowy plover during Titan IV launches (130dBA) did not exhibit any adverse reactions to the launch, and monitoring during the breeding season recorded no injury or mortality to adults, young, or eggs following smaller launches and concluded behaviour was not adversely affected by launch noise or vibrations (Space Exploration Technologies, 2011). However, impacts of rocket launch noise have been demonstrated for some species; a launch in California in July 1997 resulted in losses of least tern (*Sternula antillarum*) eggs and chicks including 4-5 nests on eggs and one nest containing two chicks breeding within 650m of the launch site (Schultz, 1997). The severe disturbance of the launch combined with predation attempts by owls likely contributed to the observed early seasonal departure from the site by the remaining adult least terns.

SSC noise and birds

Taking into account evidence from the literature above, it is apparent that loud infrequent noise associated with rocket launches could be expected to impact on birds in the vicinity of the proposed development. Less clear, are the ecological effects and consequences of the short duration loud disturbance impacts on birds. Birds closer to the launches are predicted to be at higher risk of noise impact. Depending on how far away individuals are from the noise, the birds can be expected to either not react (best-case scenario), freeze, and/or become agitated or flee and die (worse-case). The short-term loud noises experienced during a rocket launch could potentially result in either or both physiological and behavioural changes in those individuals experiencing the noise. However, most studies consider potential impacts and do not show or demonstrate long-term population level effects or consequences.

Changes in behaviour may lead to longer term impacts on the local population (although this is rarely, if ever, empirically demonstrated in published studies) if breeding failure or a reduction in success occurs. Behavioural responses are expected to vary according to species, and even within a species. For example. individual variation in response to human disturbance has been documented in red-throated divers (*Gavia stellata*) (Bundy, 1976), a species present in the SSC ornithological study area. The infrequent nature of the event should reduce the potential magnitude of the impacts, conversely, the irregularity of the noise might prevent the birds from becoming habituated to the disturbance.

The impact of noise disturbance has potential to negatively impact breeding attempts. The following impacts on breeding birds may occur; reduced suitability of breeding habitat in vicinity of the launch facility, deterring birds from settling to breed and increased risk of breeding attempt abandonment (temporarily or permanently) through startle events. Such startle events causing parents to flee may result in increased predation risk in nests temporarily unattended, crushing or dislodgement to both eggs or nestlings, loss of eggs/chicks following exposure to adverse weather, reduced numbers of young fledging or reduced quality (e.g. weight) of young fledging impacting on post fledging survival. The time period for which these affects may occur will be dependent on the breeding phenology of each species in relation to the time of satellite launches, with impacts during egg-laying and incubation likely to be more severe than during chick rearing, when adult parents have developed familial bonds with their offspring. Although empirical data to back this up is limited, the available literature suggests noise impacts may be greatest during the early breeding season when parental investment in the breeding attempt is low.

The loud noise from the launch itself is not expected to directly result in hatching failure through mechanical damage to eggs, an experiment carried out on 20 hen and 20 quail eggs exposed to a loud noise peaking at over 170bD showed no physical damage/cracking (Bowles *et al.* 1991). Additionally, the same experiment found no significant difference in hatching success rate or weights compared to control eggs. Hatch weights have been demonstrated to be important to whimbrel (*Numenius phaeopus*) breeding on Shetland where heavier brood weight was found to be associated with the proportion of the brood surviving to fledging during two breeding seasons (Grant, 1991). Although there is no direct evidence of mechanical damage to eggs due to loud noise, the absence of research regarding the effect of exposure to loud noises on developing embryos hearing has been highlighted (Larkin *et al.* 1996).

Rocket launches in Scottish Special Protection Areas (SPA)

The following two locations are operational military sites in Scotland where live fire exercises have taken place for decades. Both locations lie within and adjacent to internationally important designated sites for birds that are also present within the SSC ornithological study area.

Hebrides Range (Benbecula)

South Uist missile range (also known as Hebrides Range) lies on the northwest part of the island of South Uist, together with its local radar tracking station, immediately to the south of the island of Benbecula. According to Jimmy Slaughter (Operations Support – Ground, Shetland Space Centre and a former Artillery Officer, who has fired at Hebrides Range), "*the MOD fire Rapier missiles at the Hebrides ranges on Benbecula and also the HVM (High Velocity Missile) system has been fired there in the past. The Navy do test fire some of their air defence missiles, but these will be fired from the sea. The RAF also test fire over the sea: they fire the Meteor (which is fired from the Typhoon) and ASRAAM (an air-to-air missile) nearby. The range is in use roughly 35 weeks of the year*". The use of the Hebrides Ranges appears to have risen recently, in terms of the number of different types of missiles launched (https://www.pressandjournal.co.uk/fp/news/1634218/natos-growing-use-of-island-missile-testing-range-revealed/). Data released to the Press and Journal in 2019 shows that 12 different types of missile were used at the facility in 2017/18. The Hebrides Range includes part of the South Uist Machair and Lochs SPA, a 5,027ha designated site for birds.

According to SNH SiteLink (accessed August 2020) "*South Uist Machair and Lochs SPA is a complex site along the west coast of South Uist. The west coast of South Uist is of outstanding importance for its transition of habitats from the acidic moorland to the*

calcareous coastal plain, and for the transition from freshwater habitats to saltwater habitats. This complex includes outstanding examples of (moving seawards), relict woodland, moorland and blanket bog, large oligotrophic lochs, acidic blacklands, wet and dry machair with eutrophic machair lochs, freshwater marsh, saltmarsh, coastal dunes and sandy and rocky shores. These areas are of outstanding importance for their populations of wintering and breeding waterfowl and for their breeding population of corncrakes associated with traditional crofting practices".

"South Uist Machair and Lochs SPA qualifies under Article 4.1 by regularly supporting populations of European importance of the Annex 1 species: corncrake (1992 to 1994, 20 calling males, 4% of the GB population); little tern (1986 to 1990, 31 pairs, 1% of the GB population) and dunlin (1995, 357 pairs, 4% of the GB population).

"South Uist Machair and Lochs SPA further qualifies under Article 4.2 by regularly supporting populations of European importance of the migratory species: ringed plover (1995, 393 pairs, 3% of the Europe/Northern Africa biogeographic population; and, during 1993/94 and 1994/95, up to 490 wintering individuals, 1% of the same biogeographic population); redshank (2007, 379 pairs, 1.3% of the Eastern Atlantic biogeographic population); oystercatcher (2007, 629 pairs, 0.2% of the Europe & Northern/Western Africa biogeographic population, and selected as one of the most suitable sites for oystercatcher in GB with 0.6% of the GB population) and sanderling (2004, 667 wintering individuals, 0.6% of the Eastern Atlantic/Western & Southern Africa biogeographic population, and selected as one of the most suitable sites for sanderling in GB with 4% of the GB population)".

According to SNH SiteLink, aside from land acquisition for a 0.2ha area called Stilligarry, there are no management agreements for this site, which presumably means that the military activity undertaken (rocket launches, live fire etc.) within the SPA is not seen as threat to the designated site bird species or site integrity. Dunlin and ringed plover are both present within the SSC ornithological study area.

Cape Wrath (Sutherland)

According to Jimmy Slaughter (Operations Support – Ground, Shetland Space Centre and a former Artillery Officer, who has fired at Cape Wrath) "*Naval and Artillery live firing does take place there as well as mortar fire from time to time too. All ammunition natures (high explosives, smoke and illumination) are fired. An Garbh-eilean (Garvie Island), just off the coast, also gets a fair share of high explosives courtesy of numerous NATO air forces, including our own. In addition, small arms firing takes place at Cape Wrath*". Firing takes place during the bird breeding season (https://www.gov.uk/government/publications/scotland-firing-times; accessed August 2020). "*The RAF drop 1,000lbs bombs on to Garvie Island*", which is within the Cape Wrath SPA, a 6,737ha site (although the island itself is within the SPA, it appears excluded from the designated site map).

According to SNH SiteLink (accessed August 2020) "*Cape Wrath SPA covers two stretches of Torridonian sandstone and Lewisian gneiss cliff around Cape Wrath headland in north west Scotland. These cliffs support large colonies of breeding seabirds. The boundary of the SPA overlaps with the boundary of Cape Wrath SSSI, and the seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface*".

"*Cape Wrath SPA qualifies under Article 4.2 by regularly supporting in excess of 20,000 individual seabirds. It regularly supports 50,000 seabirds including nationally important populations of the following species: kittiwake (9,700 pairs, 2% of the GB population), common guillemot (13,700 individuals, 1% of the GB population), razorbill (1,800 individuals,*

1% of the GB population), puffin (5,900 pairs, 1.3% of the GB population) and fulmar (2,300 pairs, 0.4% of the GB population)".

According to SNH SiteLink, there are no management agreements for this site, which presumably means that the military activity undertaken (rocket launches, live fire, including bombing etc.) within the SPA is not seen as threat to the designated site bird species or site integrity. Kittiwake, common guillemot, razorbill, puffin and fulmar are all present within the SSC ornithological study area.

REFERENCES

Barron, D. G., Brawn, J. D., Butler, L. K., Romero L. M. & Weatherhead, P. J. 2012. *Effects of Military Activity on Breeding Birds*. The Journal of Wildlife Management, 76, 911-918.

Beale, C. M. 2007. *The Behavioral Ecology of Disturbance Responses*. International Journal of Comparative Psychology, 20, 111-120.

Beason, R. C. 2004. *What Can Birds Hear?* USDA National Wildlife Research Center – Staff Publications. 78. (https://digitalcommons.unl.edu/icwdm_usdanwrc/78).

Bowles, A. E., Aubrey, F. T. & Jehl, J. R. 1991. *The effect of high amplitude impulsive noise on hatching success - a reanalysis of the Sooty Tern Incident. Noise and Sonic Boom Impact Technology Program*, Report #HSD-TP-91-0006 (https://apps.dtic.mil/dtic/tr/fulltext/u2/a234766.pdf).

Bowles, A. E. 1995. Chapter 8 - Responses of Wildlife to Noise. In "*Wildlife and Recreationists – coexistence through management and research*", Island Press (ISBN-13: 978-1559632577).

Breininger, D. R., Barkaszi, M. J. O., Smith, R. B. Oddy, D. M. & Provancha, J. A. 1994. *Endangered and potentially endangered wildlife on John F. Kennedy Space Center and faunal integrity as a goal for maintaining biological diversity*. NASA Technical Memorandum 109204.

Brown, A. L. 1990. *Measuring the effect of aircraft noise on birds*. Environment International, 16, 587–592.

Bundy, G. 1976. *Breeding Red-throated Divers in Shetland*. British Birds, 71, 199-208.

Canso Spaceport Facility. 2019. *Canso Spaceport Facility Project | Environmental Assessment* | Nova Scotia Environment https://www.novascotia.ca/nse/ea/canso-spaceport-facility.

Cotanche, D. A. 2008 *Genetic and pharmacological intervention for treatment/prevention of hearing loss*. Journal of Communication Disorders, 41, 421–433.

Derose-Wilson, A., Fraser, J. D., Karpanty, S. M. & Hillman, M. D. 2015. *Effects of overflights on incubating Wilson's plover behavior and heart rate.* The Journal of Wildlife Management. 79, 1246–1254.

Dunnet, G. M. 1977. *Observation on the effects of low-flying aircraft at seabird colonies on the coast of Aberdeenshire, Scotland*. Biological Conservation 12, 55-63.

Encyclopedia Britanica 2020. https://www.britannica.com/science/sound-reception/Hearing-in-birds (accessed 06/08/2020).

Environment Australia. 2000. *Environment Assessment Report - Proposal to construct and operate a satellite launching facility on Christmas Island*. (http://www.ga.gov.au/webtemp/image_cache/GA20982.pdf).

Francis, C. D. & Barber, J. R. 2013. *A framework for understanding noise impacts on wildlife: an urgent conservation priority*. Frontiers in Ecology and the Environment, 11, 305–13.

Forsdyke, M. R. 2004. *Assessment of Noise Effects on Sensitive Animal Communities*. PhD thesis. The Open University.

Gougie, R. I. & Jones, I. L. 2004. *Dose-response relationships of harlequin duck behaviour to noise from low-level military jet over-flights in central Labrador*. Environmental Conservation, 31, 289–298.

Grant, M. C. 1991. *Relationships between egg size, chick size at hatching, and chick survival in the Whimbrel* Numenius phaeopus. Ibis, 133, 127-133.

Grubb, T.G., Delaney, D.K., Bowerman, W.W. & Wierda, M.R. 2010. *Golden eagle indifference to heli-skiing and military helicopters in northern Utah*. Journal of Wildlife Management 74(6): 1275–1285.

Halfwerk, W., Holleman, L. J. M., Lessells, C. M. & Slabbekoorn, H. 2011. *Negative impact of traffic noise on avian reproductive success*. Journal of Applied Ecology, 48, 210–219.

Injaian, A. S., Taff, C. C. & Patricelli, G. L. 2018. *Experimental anthropogenic noise impacts avian parental behaviour, nestling growth and nestling oxidative stress*. Animal Behaviour, 136, 31–39.

National Geographic. 2011. *Why are birds falling from the sky?* https://www.nationalgeographic.com/news/2011/1/110106-birds-falling-from-sky-bird-deaths-arkansas-science/ (accessed 16/07/20).

Karolewski, K., Bocheński, M., Ciebiera, O., Markulak, D. & Jerzak, L. 2014. *New Year's Eve fireworks impact on the number of magpies on the roosting place*. International Study of Sparrows, 38, 27-29.

Larkin, R. P., Pater, L. L. & Tazik, D. J. 1996. *Effects of Military Noise on Wildlife: A Literature Review*. Lab US Army Corps of Engineers Construction Engineering Research, Report No, USACERL-TR-96/21.

Liebezeit, J. R., Kendall, S. J., Brown, S., Johnson, C. B., Martin, P., McDonald, T. L., Payer, D. C., Rea, C. L., Streever, B., Wildman, A. M. & Zack, S. 2009. *Influence of human development and predators on nest survival of tundra birds, Arctic Coastal Plain, Alaska.* Ecological Applications, 19, 1628–1644.

Lubert, C. P. 2017. *Sixty years of launch vehicle acoustic*. Conference proceedings of 174th Meeting of the Acoustical Society of America.

Mooney, T. A., Smith, A., Hansen, K. A., Larsen, O. N., Wahlberg, M. & Rasmussen, M. 2019. *Birds of a feather: Hearing and potential noise impacts in puffins (*Fratercula arctica*).* Conference Proceedings - 5th International Conference on the Effects of Noise on Aquatic Life.

Pepper, C., Nascarella, M. & Kendall, R. 2003. *A Review of the Effects of Aircraft Noise on Wildlife and Humans, Current Control Mechanisms, and the Need for Further Study*. Environmental management, 32, 418-432.

Roby, D.D., Murphy S.M., Ritchie, R.J., Smith, M.D., Palmer, A.G., Nordermeyer-Elmore, D.L., Pruitt, E. & Kull, J.C. 2002. *The effects of noise on birds of prey. A study of Peregrine falcons Falco peregrinus in Alaska.* United States Air Force Academy.

Rojek, N.A., Parker, M.W., Carter, H.R. & McChesney, G.J. 2007. *Aircraft and vessel disturbances to Common Murres* Uria aalge *at breeding colonies in central California, 1997–1999*. Marine Ornithology, 35, 61–69.

Ruddock, M. & Whitfield, D.P. 2007. *A review of disturbance distances in selected bird species*. A report from Natural Research (Projects) Ltd to SNH.

Schlierf, R., Hight, R., Payne, S., Shaffer, J., Missimer, B. & Willis, C. 2007. *Kennedy Space Center (KSC) Launch Pad Avian Abatement Efforts Including Related KSC Road Kill Reduction Effort*. Proceedings of the 2007 International Conference on Ecology and Transportation (ICOET 2007) 42 – 55.

Schultz, S. J. 1997. *Californian Least Tern Monitoring Report for the July 9, 1997.* SLC-2 Delta Space Vehicle Launch, Vandenberg Air Force Base.

Shamoun-Baranes, J., Dokter, A., van Gasteren, H., Loon, E., Leijnse, H. & Bouten, W. 2011. *Birds flee en mass from New Year's Eve fireworks*. Behavioural Ecology, 22, 1173-1177.

Smit, C. J., & Visser, G. J. M. 1993. *Effects of disturbance on shorebirds: A summary of existing knowledge from the Dutch Wadden Sea and delta area*. Wader Study Group Bulletin, 68, 6-19.

Smith, R. B. & Breininger, D. R. 1995. *Wading Bird Populations of the Kennedy Space Center*. Bulletin of Marine Science, 57, 230-236.

Space Exploration Technologies. 2011. *Final Environmental Assessment Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from Space Launch Complex 4 East Vandenberg Air Force Base California.*

Weigand, JF; and McChesney, GJ. 2008. *Seabird and marine mammal monitoring and response to a fireworks display at Gualala Point Island, California, Sonoma County, May to August 2007*. Unpublished report, USDI Bureau of Land Management, California State Office, Sacramento, CA; and USDI Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, CA.

Wolfenden, A. 2017. *The effects of aircraft noise on avian communities and communication*. PhD Thesis, Manchester Metropolitan University.

Wolfenden, A. D., Slabbekoorn, H., Kluk, K & de Kort, S. R. 2019. *Aircraft sound exposure leads to song frequency decline and elevated aggression in wild chiffchaffs*. Journal of Animal Ecology, 88, 1720-1731.

Wright, M. D., Goodman, P. & Cameron, T. C. 2010. *Exploring behavioural responses of shorebirds to impulsive noise.* Wildfowl, 60, 150–167.

Appendix 5.3 Detailed Habitat Management Plan

SaxaVord Spaceport:
Detailed Habitat Management Plan Part I
Non-confidential elements

Alba Ecology Ltd.

Loomer Shun peatland restoration area

February 2022

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Introduction

Unst Space Port Ltd., is committed to establishing, implementing and funding an agreed Habitat Management Plan (HMP) for the lifetime of the proposed SaxaVord Spaceport (formerly called Shetland Space Centre). The detailed HMP has been prepared to set out how the Applicant will enhance ecological interests through the construction and operation of SaxaVord Spaceport and is based on the Outline Habitat Management Plan (OHMP) which was prepared and submitted to Shetland Island Council (SIC) as part of the Environmental Impact Assessment Report (EIAR) in 2021.

Whilst priority biodiversity has been the main focus of the HMP actions, they also afford substantial opportunities for tie-ins with carbon offsetting, wildlife-related tourism and local community enjoyment of nature.

SaxaVord Spaceport provides the basic infrastructure for space vehicle launches which may in the future conceivably develop and evolve with emerging technologies and commercial demands. Although the development does not have a pre-determined operational lifespan, it is anticipated to be operational for at least 30 years. When decommissioning of the SaxaVord Spaceport eventually takes place, a separate Decommissioning Management Plan will be prepared (using current best practice at that time) that will commit SaxaVord Spaceport to ensure that the decommissioning works can be completed so as to continue to deliver the objectives of the approved HMP.

Having considered the potential and likely impacts and effects of the proposal, we believe this HMP provides sufficient ecological benefits to offset adverse ecological impacts for a potential development of this nature and scale and that it provides additional wide-ranging ecological enhancements that supports relevant policy objective e.g. SPP and NPF4.

The SaxaVord Spaceport has promoted the inclusion of a planning condition that will secure the development and implementation of the HMP and ensure its full and effective delivery.

Aims and Objectives

The HMP has the following overall aims:

- Aim 1: To enhance habitats for species of importance present on, or linked to, the Study Area (as defined in the EIAR).
- Aim 2: Restore important habitats and associated species.

These aims were given an objective in the OHMP which were:

- Objective 1: Create a wildlife watching hide on Lamba Ness.
- Objective 2: Peatland restoration.
- Objective 3: Create native riparian broadleaf tree/scrub cover.
- Objective 4: Coastal grassland habitat management.

All potential HMP management areas have been surveyed and assessed for suitability and to ensure that any existing important biodiversity is protected and considered when developing and implementing the approved HMP. Most HMP works will be undertaken between September and late March (inclusive) to prevent the possibility of disturbing nesting birds. However, if works do take place outside this period, then measures will be put in place to ensure no significant disturbance of sensitive/legally protected species occurs.

Objective 1. Create a wildlife watching hide on Lamba Ness

Current situation

The eastern most tip of Lamba Ness has long been recognised as one of the best locations in Shetland to watch seabirds and cetaceans. During informal discussions with local birdwatchers and whale watchers a concern was raised that access to the favoured tip of Lamba Ness might be curtailed by the development of SaxaVord Spaceport. The existing and best wildlife watching location is at HP 67502 15654 and is very exposed to the elements, with the only shelter (which is partial) provided by one of the existing old RAF buildings, which itself would be within the SaxaVord Spaceport fenced off area and so not utilisable in the future.

The suggestion was made by local birdwatchers that a purpose built wildlife watching hide, with guaranteed access (except around launch days) would allay such fears and be a welcome addition to facilities on Unst. The proposed hide location needs to be as close to the edge of the rocky area identified below as possible and would be partly on the rocky projection and the also party on the grass (Photo 1). The arrows marked on the following series of photos show the indicative direction looking out of the hide.

Wildlife hides in the wrong place or facing in the wrong direction are not usable and a wasted opportunity. Based on hundreds of hours of bird and whale observations, the hide must be at this precise location (HP 67502 15654) and face the direction illustrated on photos for it to work observationally. There are no worthwhile alternative locations due to the greater height of the cliffs, access, direction/angle of the sun and geographical position of all other potential locations. Currently, whale watchers and bird watchers sit on the grassy step (broadly where the base of the arrow marked in Photo 3 is) and look out to sea. Most seabirds pass this point very closely and bypass the other areas in and around Lamba Ness. The whales and dolphins tend to congregate in the zone of water mixing ca. 300m off this location, although killer whales/orcas are usually much closer in, hunting seals along the shoreline.

Photo 1. View onto downslope proposed hide location, 2020.

Photo 2. Angled view from south looking onto proposed hide location, 2020.

The hide location is regularly used by local residents and visitors for bird and whale watching currently. The shelter afforded by a hide in this windswept and exposed location means it would be well used and very likely to become a valued community and tourist facility. Given visiting groups of up to 12 people would likely use the sea-watching hide, it should aim to be able to accommodate ca. 12-15 people.

Photo 3. Angled view from north onto proposed hide location, 2020.

Photo 4. Reverse view from proposed hide location, looking back inland towards existing old RAF buildings, 2020.

Delivery

The provision of a wildlife hide along with a footpath/track have been included in the design layout (Figure 1).

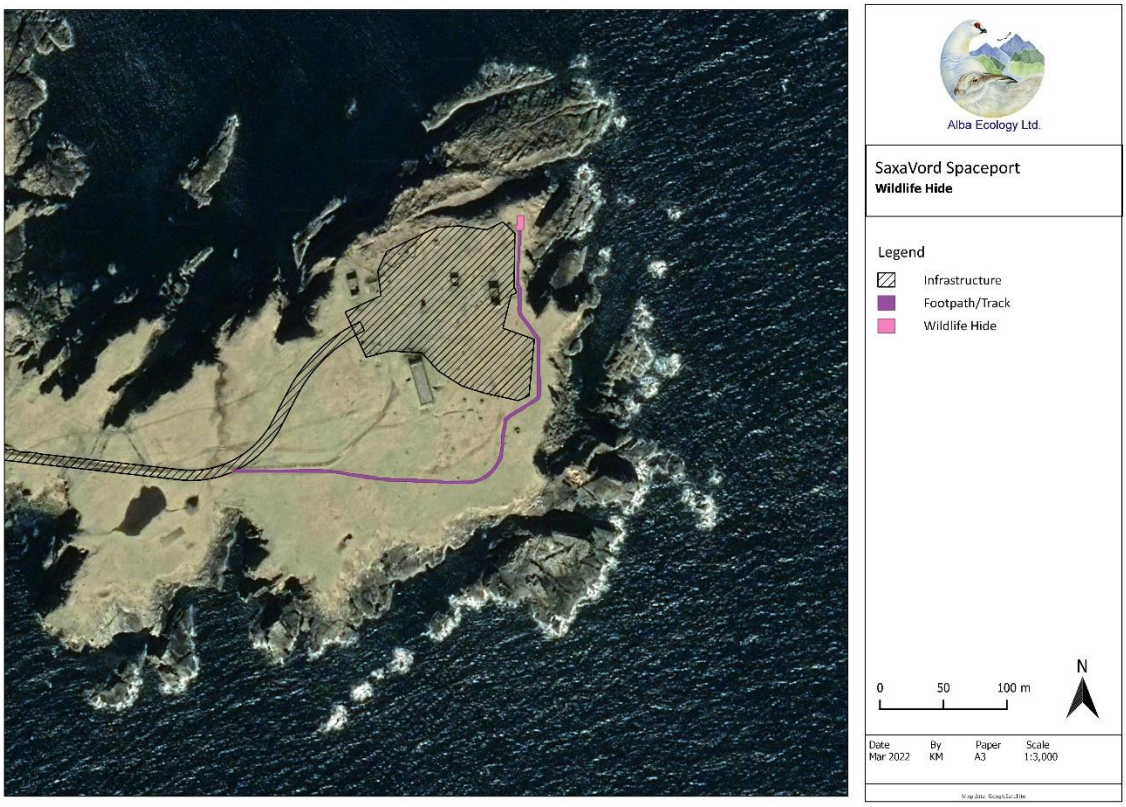


Figure 1: Location of Wildlife Hide on Lamba Ness

The location of the proposed wildlife hide is on land managed by SaxaVord Spaceport and so the work will be guaranteed to be taken forward. The Applicant has been willing, and continues to be open to potential community ownership of the wildlife hide whilst contributing to an

annual maintenance budget for hide repairs and improvements. A footpath along the edge of the Saxa Vord Spaceport boundary fence will provide access from the public road (Figure 1).

Ideally, a wildlife hide should enable easy and ample viewing for seated observers using both binoculars and telescopes not looking through glass. Designs of sea-watching hides are varied, but whatever design is used, it needs to be robust to withstand the autumn and winter storms on Unst. Typical 'standard' wooden bird hides would not be suitable as they would likely be damaged or destroyed during storms. Consequently, some sort of stone structure will probably be necessary. Detailed plans of a sea-watching hide recently constructed at Flamborough Head, Yorkshire can be viewed here. A few more sea-watching hide designs can be viewed here. The stone-built wildlife hide at Whitburn, County Durham was purpose built in 1990 and has withstood the tests of time and weather since then.

In summer 2022, SaxaVord Spaceport will consult with local stakeholders e.g. Unst resident birders and whale watchers and agree a suitable design for the wildlife hide, after which, the hide will be built as soon as suitable materials are available in 2022.

Objective 2. Peatland restoration

Areas of blanket bog within north Unst have historically been subject to peat cutting and other pressures such as grazing by sheep combined with extreme weather. This has led to a noticeable deterioration in the condition of the blanket bog habitat, with erosion features and impacts of drainage on the blanket bog reducing its ability to support species of conservation importance such as red-throated diver.

The OHMP identified peatland restoration as a key objective. In the intervening time between the OHMP being written and consent being granted the location and type of peatland restoration has been amended. In February 2022 an outline of proposed peatland restoration plan was provided in a confidential document entitled "*A Summary Report Outlining Peatland Restoration Proposals for Unst Space Port*".

Three indicative peatland restoration areas were identified in north Unst (Figure 2). Loomer Shun was identified as suitable for peatland restoration and peat re-use from the construction of the Saxa Vord Spaceport. Peat re-use is considered in more detail in the Peat Management Plan (PMP). Skaw Paet Hoose and Ritten Hamar were both sites identified for peatland restoration (without peat re-use from the construction of the SaxaVord Spaceport).

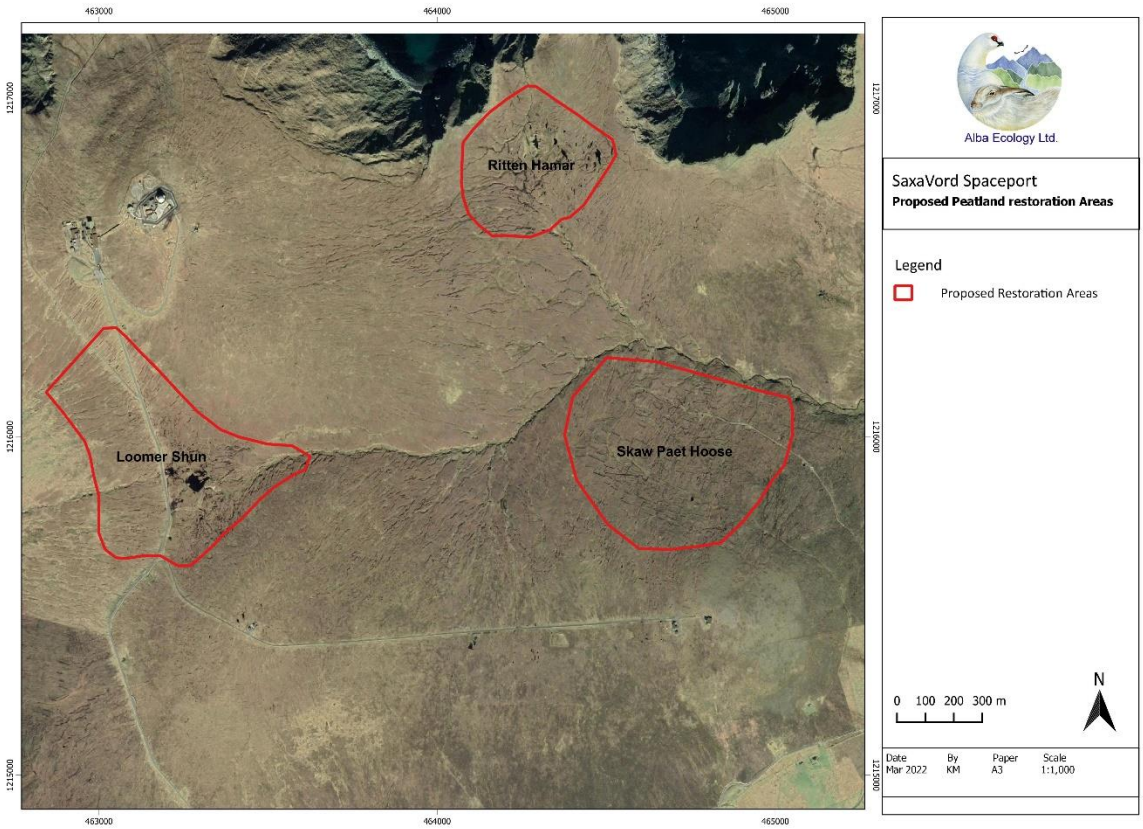


Figure 2: Indicative Peatland Restoration Areas

Current situation – Loomer Shun

The area that is termed 'Loomer Shun' in Figure 2 is a ca. 20.7ha area between the hills of Saxa Vord and Sothers Field. It is made up of modified bog habitat which has been widely cut for peat, both historically and more recently. The recently cut peat had bare peat faces are

ca.1m-1.5m in height with fresh exposed peat on the face and for ca. 1m on the cut base. Where the peat had been historically cut there was evidence of further wind and rain erosion resulting in undercuts with dry vegetation overhanging the cuttings. Sheep clearly use the cuttings as shelter during inclement weather and whilst doing so have caused erosion locally around the lochan area. Further down the hillslope, to the east, the bog vegetation appeared to have a more naturally eroded pattern from wind and rain action likely exacerbated from sheep. As detailed in the OHMP, the lochan at Loomer Shun is considered to be at risk of being lost through water drainage.

Photo 5: Loomer Shun, peat cut and eroded to mineral soil in the foreground. Older peat cuttings and erosion in the background.

Baseline conditions – Loomer Shun

A site visit and Peatland Condition Assessment (PCA) was undertaken at Loomer Shun in February 2022.

PCA surveys are a standardised, if basic, method for assessing the condition of peatland habitats. The PCA bases the condition of blanket bog on indicators such as bog-moss cover, extent of bare peat and evidence of management activities such as grazing, peat cutting and burning (Peatland Action, 2016). The PCA recognises four categories of peatland condition:

1. Near-Natural - peat forming bog-mosses dominant, with no recent fires, little or no grazing pressure and little or no bare peat, heather is not dominant.
2. Modified – bare peat is in small patches, fires may be recent, grazing impacts are evident, bog-mosses are absent or rate, extensive cover of heather or purple moor-grass.
3. Drained – within 30m either side of an artificial drain or a revegetated hagg or gully system.
4. Actively Eroding – actively eroding hagg/gully system, extensive continuous bare peat surfaces.

Figure 3 provides an indicative PCA map (based on a site visit and aerial photos). All of the peatland was classified as Modified and Drained, largely through peat cutting but also through some more natural erosion features, likely from a combination of sheep and wind and rain

action. There were areas that were actively eroding and this included the cut faces and erosion feature faces which had exposed peat.

The total length of peat cuttings at Loomer Shun (based on aerial photos) was estimated to be ca. 3.2km[1].

The total length of erosion features at Loomer Shun (based on aerial photos) was estimated to be ca. 0.8km.

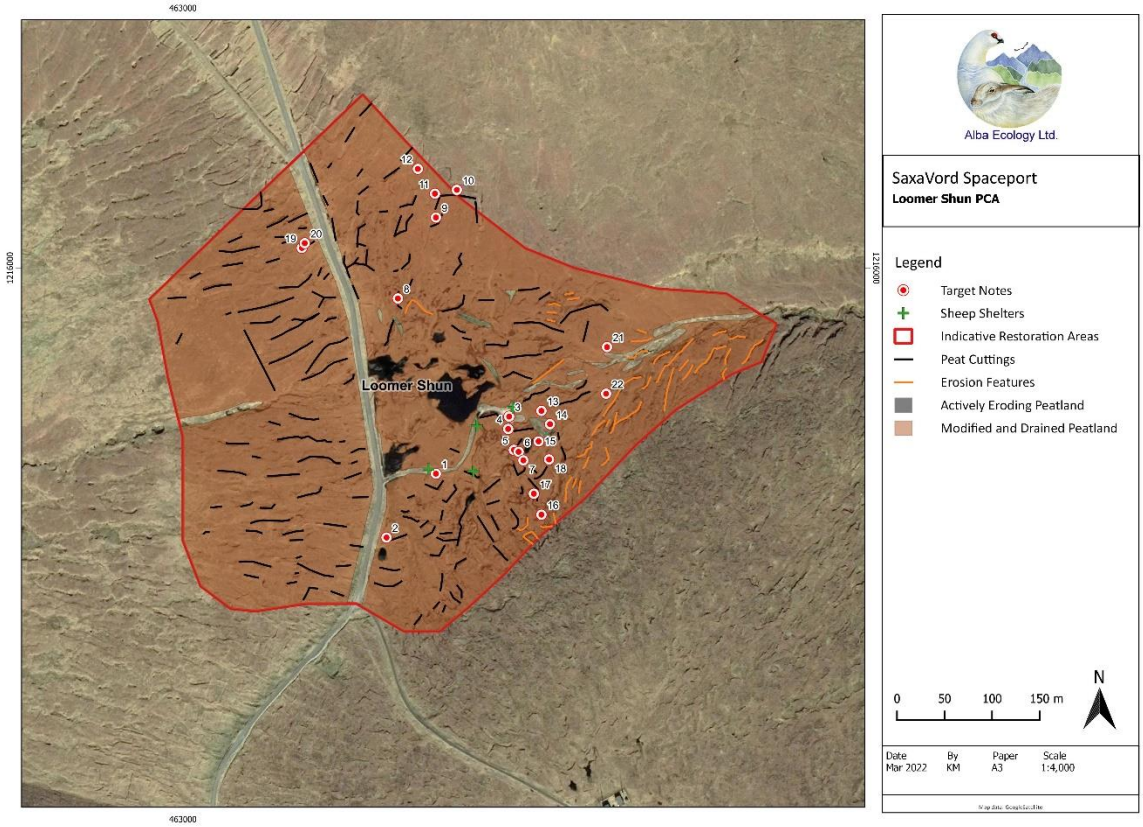


Figure 3: PCA and Target Note locations for Loomer Shun

There were three key habitat types mosaiced within the peatland at Loomer Shun;

- Modified and drained bog at the original bog surface;
- Modified bog that had revegetated at the base of the cut surface where the remaining peat was >0.5m; and
- Acid grassland/wet heath vegetation that had revegetated at the base of the cut surface where the peaty soils peat was <0.5m.

The modified bog at the original bog surface was usually dry, with heather and crowberry common with common cottongrass and species such as glittering wood moss. Patches of bog-

[1] Note that these metrics and locations shown in Figure 3 are based on aerial images, viewed between 1:2,000 and 1:4,000 and have not been fully ground truthed. It is possible some 'peat cuttings' are actually 'erosion features' and visa versa. Lengths are estimates only.

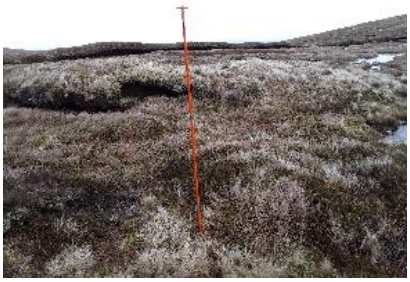
moss were occasional. This was the original surface, where peat has been cut away, leaving exposed drying and eroding edges or in some places more natural forms of erosion were present. It was hydrologically disconnected from other section of bog habitat, due to the peat cutting; this results in a form of dry heath vegetation forming over the deep peat.

The modified bog that had revegetated at the base of the cut surface where the remaining peat was >0.5m was generally damper underfoot than the original bog surface vegetation. Common cottongrass was the dominant vascular plant, but there was also heather and hare's-tail cottongrass. Bog-mosses were frequent and included red bog-moss and papillose bog-moss.

The acid grassland/wet heath vegetation that had revegetated at the base of the cut surface where the peaty soils peat was <0.5m was generally dominated by either mat grass or heather with common cottongrass, depending on the thickness of the peaty substate. In some places these areas went down to mineral soils.

Table 1 provides details of the baseline through a series of Target Notes of the peatland habitats at Loomer Shun. The locations of the Target Notes are shown in Figure 3.

TG	Grid	Note	Photo
1	HP 63266 15784	Recent peat cutting area, which was ca. 15m x 15m in size. The cut face was ca. 1m high. There was ca. 0.3m of soil below the cut surface which had revegetation to form wet heath with abundant bog-moss. It is considered that this is suitable for infilling with peat. The level of revegetation, post peat cutting, demonstrates that the bog will likely recover from restoration and the current sheep densities have not prevented the natural revegetation of these areas.	 
2	HP 63214 15717	Peat cutting is common in this area. This old cutting was well vegetated. It was ca. 0.5m high. Bog mosses were present at the base of cuttings.	

TG	Grid	Note	Photo
3	HP 63343 15844	In the central area, where the vehicle track ends, the peat had been historically cut leaving shallow soils (0-0.5m deep) with acid grassland, wet heath or bare mineral soils/bedrock. There was remanent dry bog surrounding this area demonstrating where the original bog surface would have been. The cut faces were ca. 1m-2m high and actively eroding.	 
4	HP 63342 15831	Recently cut peat. The cut face was ca. 0.5m-1m deep. Potential area for filling with peat from construction. There were shallow soils at the cut surface which had revegetated with acid grassland and wet heath. The surrounding, original bog has been drained from the cut feature. There was heather, common cottongrass and crowberry with occasional patches of bog-mosses present in this area.	 

TG	Grid	Note	Photo
5	HP 63348 15809	Although much of this area is not the original bog surface, some pools were formed within the cut surface. This wet area was ca. 0.5m deep. There were cutting features ca 1.5m high around this feature, showing where the peat had been historically removed. The regenerating vegetation on the cut surface demonstrates the potential for bog vegetation to re-establish successfully.	 
6	HP 63353 15807	Ca. 10m x 10m patch of bare peat. Eroded to mineral soil at the lower end, and 5m deep at the top end. The bare exposed peat was actively eroding.	
7	HP 63358 15798	Views of peat cuttings across Loomer Shun. The cuttings in the distance look appropriate for infilling. The surface vegetation will be lifted up first, suitable peat added and then the surface will be laid back down. The PMP provides more information for this peat re-sue.	 

TG	Grid	Note	Photo
8	HP 63226 15968	This area had old cuttings. The cut faces of the cutting had eroding edges giving a more 'natural' look. Between these peat cuttings there was deep peat (ca. 1.5m deep), with bog-moss rich vegetation. These areas would be suitable for reprofiling, to prevent drying and hydrologically link the bog.	 
9	HP 63266 16053	This old peat cutting was ca. 1m in height. There was deep peat (ca. 1m) below the cut surface, which had revegetated with some small hummocks of bog-moss.	
10	HP 63288 16082	Deep peat underlies the cut surface vegetation. The remaining peat was ca. 1m deep and there were wet areas. The cuttings were ca. 1m deep. This demonstrates that the bog vegetation will establish successfully after restoration.	
11	HP 63265 16078	View across Loomer Shun.	

TG	Grid	Note	Photo
12	HP 63247 16104	This recent peat cutting was ca. 1.5m deep and ca. 10m long. There was 0.5m of peat at the cut surface. The cut surface had revegetated with acid grassland and wet heath.	
13	HP 63377 15850	There was a large bowl-shaped historic cutting area which was ca. 30m x 50m in size. The cut faces were ca. 1m-2m in height reaching to the original bog. The cut surface had ca. 0.5-0.6m deep peaty soils which was revegetated. Suitable for infilling.	
14	HP 63386 15836	There were occasional pools with feathery bog-moss in them. However, this one was only ca. 0.5-0.6m deep.	
15	HP 63374 15818	Here the peat cutting went down to mineral soil. This was within the main bowl-shaped historic peat cutting. The original bog surface was ca. 2m higher. Suitable for infilling.	

TG	Grid	Note	Photo
16	HP 63377 15741	Peat cutting. Generally shallow soil at base of cutting, cut faces ca. 1m in height.	 
17	HP 63369 15763	Infilling would be suitable in all this modified bog habitat.	
18	HP 63385 15799	This area was clearly modified through peat cutting and subsequent drying of the original bog surface. Common cottongrass, heather and crowberry were the most common species with patches of flat-topped bog-moss. There was ca. 1m of peat below the cut surface, which was in generally good condition, demonstrating that the bog vegetation would recover successfully after restoration.	
19	HP 63125 16021	There were number of old peat cuttings on this side of the road. There was ca. 1m of peat below the cut surface, which was well vegetated. The cuttings were ca. 1m high with the original bog surface lined with heather demonstrating an associated drying effect of the cutting.	

TG	Grid	Note	Photo
20	HP 63128 16026	There were peat cuttings along the road for ca. 400m and ca. 50m wide from the road. The cuttings were regularly cut to ca. 1m–1.5m. The remaining cut surface was well vegetated, demonstrating a high chance of successful restoration. There was ca. 1.2m peat below the cut surface.	 
21	HP 63446 15917	There were what appeared to be 'natural' erosion features at this location. They were ca. 1m-2m in height. There was bare exposed, eroding peat of the hagg face. Suitable for reprofiling.	 
22	HP 63445 15868	There was a ca. 2m high erosion feature at this location with exposed peat actively eroding.	

Table 1: Target notes for Loomer Shun

Delivery – Loomer Shun

There is suitability at Loomer Shun for careful and sensitive peatland restoration, including around the main lochan (as detailed in the OHMP) and more widely, particularly in the areas of current and historic peat cutting. This peatland restoration would include effectively re-using peat extracted from the construction of SaxaVord Spaceport.

In addition to plugging the outflow areas of the main lochan to prevent water draining away, two main peatland restoration techniques will be suitable at Loomer Shun:

i. Infilling the peat cut areas with peat from the construction of SaxaVord Spaceport; and
ii. Reprofiling of cut peat edges.

Best practice techniques for peatland restoration techniques have been developing rapidly, therefore discussions with an experienced peatland restoration team is recommended prior to restoration work commencing. The peatland restoration techniques of infilling and reprofiling were discussed in detail on-site and off-site with local crofters at Loomer Shun. At least one of the local crofters (contact details available upon request) has completed practical peatland restoration work across Viking Wind Farm for the last 1.5 years using the best practice peatland restoration techniques discussed and he considered the proposed methods to be appropriate and suitable for Loomer Shun.

Loomer Shun is considered suitable for peat re-use from the construction of SaxaVord Spaceport for both ecological and practical reasons. There is a public road which provides access from the construction area to the Loomer Shun peatland restoration area ensuring that peat can be quickly and effectively moved without the need for road construction. The peatland restoration which re-uses the peat from construction of SaxaVord Spaceport is detailed further in the PMP.

Infilling: The vegetation on the historically cut bog surface would be carefully stripped ensuring there was sufficient material to retain roots. Peat won from the construction of SaxaVord Spaceport would be used to infill the cutting, raising the level of cutting back to the height of the original bog surface and meeting the height of the surrounding bog. The stripped vegetation would then be carefully placed back on top of the peat. In some areas careful contouring will be required to ensure levels meet the surrounding surfaces. This infilling technique would be particularly suitable where peat has been cut/eroded to the underlying mineral soil layer. Also, this technique would lend itself to historically cut areas where the remaining vegetation and peaty soils/peat depths were relatively shallow.

Photo 6: Recent peat cutting at Loomer Shun suitable for infilling.

Photo 7: A view of historic peat cuttings at Loomer Shun suitable for infilling.

Reprofiling: The edges of historical peat cuttings and erosion features can be reprofiled. Reprofiling is a mechanism for lowering the gradient of the hagg or cut face, and covering the bare peat of the hagg or cut face with vegetation, stretched from nearby existing vegetation (i.e. using the vegetation on adjacent bog at the top of the hagg/cutting and stretching this over the hagg/cutting face). Appendix 1 provides some details on best practice peatland restoration techniques including reprofiling.

Photo 8: A peat cut area at Loomer Shun with deep peat remaining and bog vegetation established. Suitable for reprofiling or infilling.

These peatland restoration techniques will deliver a series of ecological benefits to the Loomer Shun area. They will: halt the current erosion on bare peat faces through wind and rain erosion; halt the bare peat faces losing mass through microbial decomposition; and reduce drying out of the remnant adjacent blanket bog. This will stop the Loomer Shun area from being an atmospheric carbon source. Furthermore, these restoration techniques will wet-up and hydrologically link the existing bog vegetation, which is currently fragmented, and allow a more natural surface pattern and hydrology to develop. In turn, this will benefit the species that rely on wet bog vegetation such as craneflies and other insects, which further benefit associated bird species. This hydrologically linked wet bog will likely deliver additional carbon sequestration as the bog-mosses and bog vegetation form peat over a wider area, locking carbon into the peatland habitat. Hence, the Loomer Shun area would be transformed from being a source of carbon, to potentially an area with widespread carbon sequestration (i.e. a carbon sink).

The crofters (who we understand hold the peat cutting rights to this area) have agreed to a permanent cessation of peat cutting at Loomer Shun. This secures the long-term effectiveness of restoring the peat and blanket bog in this currently degraded area.

The crofters currently have a low level of sheep grazing across Loomer Shun and the wider hill area (estimated at about one ewe per ha by the crofters in 2022). Current grazing levels are not having a noticeable detrimental impact on the wider bog vegetation. For example, there was no evidence of sheep causing or widening bare peat areas and there was wide-scale evidence of the blanket bog restoring itself within the historical peat cuttings. Current sheep impacts are limited to around the lochan and locally at the edges of the peat cutting faces.

Peat cutting removes the bog surface and leaves bare peat. However, much of Loomer Shun, which has clearly been peat cut for generations, was revegetated demonstrating that the current grazing conditions are suitable for revegetation. This was particularly evident where deep peat remained in the cut areas and blanket bog vegetation had re-established and included a variety of bog-moss species. Therefore, it is considered unnecessary to further reduce sheep numbers, although a written commitment to not increase sheep numbers from current base-line levels would ensure the maintenance of low levels of grazing.

Sheep clearly use the erosion/cutting features as shelter in the not inconsiderable winds, particularly around the lochan. Therefore, ensuring shelter for sheep present at Loomer Shun would be essential. This could be achieved by carefully contouring some of the erosion features to be vegetated but still provide shelter, alternatively, or in combination, it could be achieved by providing man-made shelters. Manmade sheep shelters are used commonly across Shetland, including on Unst. An example from Unst is shown in Photo 9.

Photo 9: A artificial sheep shelter designed to provide shelter from different wind directions, Norwick, Unst.

Indicative locations for sheep shelters are provided in Figure 3, although this should be discussed and agreed with crofters and the contractors at the time of the restoration works.

Careful consideration of the timing of this work will be needed to avoid breeding bird disturbance and to prevent further erosion from the wind exposure. Works for peatland restoration at Loomer Shun are scheduled to begin in August-September 2022, after the bird breeding season.

Peatland restoration work at Loomer Shun will be undertaken under the supervision of an appropriately trained ecologist.

A baseline monitoring survey measuring species composition, vegetation height, peat depth and areas of bare peat will be undertaken prior to the peatland restoration beginning at a range of monitoring and control sites around Loomer Shun. The changes to the vegetation/peat will then be monitored at regular intervals, using standardised systematic methods.

The specific objective for the peatland restoration will be to:

1. Reduce bare peat areas at cutting and erosion faces;
2. High overall vegetation cover;
3. Increase in the number of bog-mosses, particularly at the original bog surface;
4. Increase in the species richness of blanket bog species; and
5. Increase in wetness of the blanket bog, e.g. an increase in bog pools.

Current situation – Skaw Paet Hoose

The indictive area identified as Skaw Paet Hoose in Figure 2 is ca. 28.6ha in size. It is situated on the north slope of the Ward of Norwick, above the Burn of Skaw has been historically and extensively cut for peat. The historical peat cuttings were between ca.1m and 2m in height. There was little evidence of recent peat cuttings, and, as at Loomer Shun, the low sheep levels had allowed wide-scale revegetation on the bases of historically cut surfaces. The tops of the peat cuttings were dry, and heather dominated, and there were many exposed bare peat areas on the faces of the cuttings. These cut faces continue to release carbon through wind and rain erosion and microbial decomposition, along with reducing drying out of the remnant adjacent blanket bog.

Photo 10: Peat cutting around the 'Paet hoose'

Baseline – Skaw Paet Hoose

A site visit and PCA was undertaken at Skaw Paet Hoose in February 2022.

Figure 4 provides an indicative PCA map (based on a site visit and aerial photos). All of the peatland was classified as Modified and Drained, largely through peat cutting but also through some erosion features. The peat cuttings faces and erosion feature faces were considered to be actively eroding in most instances, although some exceptions are noted in the Target Notes (Table 2).

The total length of peat cuttings at Skaw Paet Hoose (based on aerial photos) was estimated to be ca. 3.7km[2].

The total length of erosion features at Skaw Paet Hoose (based on aerial photos) was estimated to be ca. 1.0km.

[2] Note that these metrics and locations shown in Figure 4 are based on aerial images, viewed between 1:2,000 and 1:4,000 and have not been fully ground truthed. It is possible some 'peat cuttings' are actually 'erosion features' and visa versa. Lengths are estimates only.

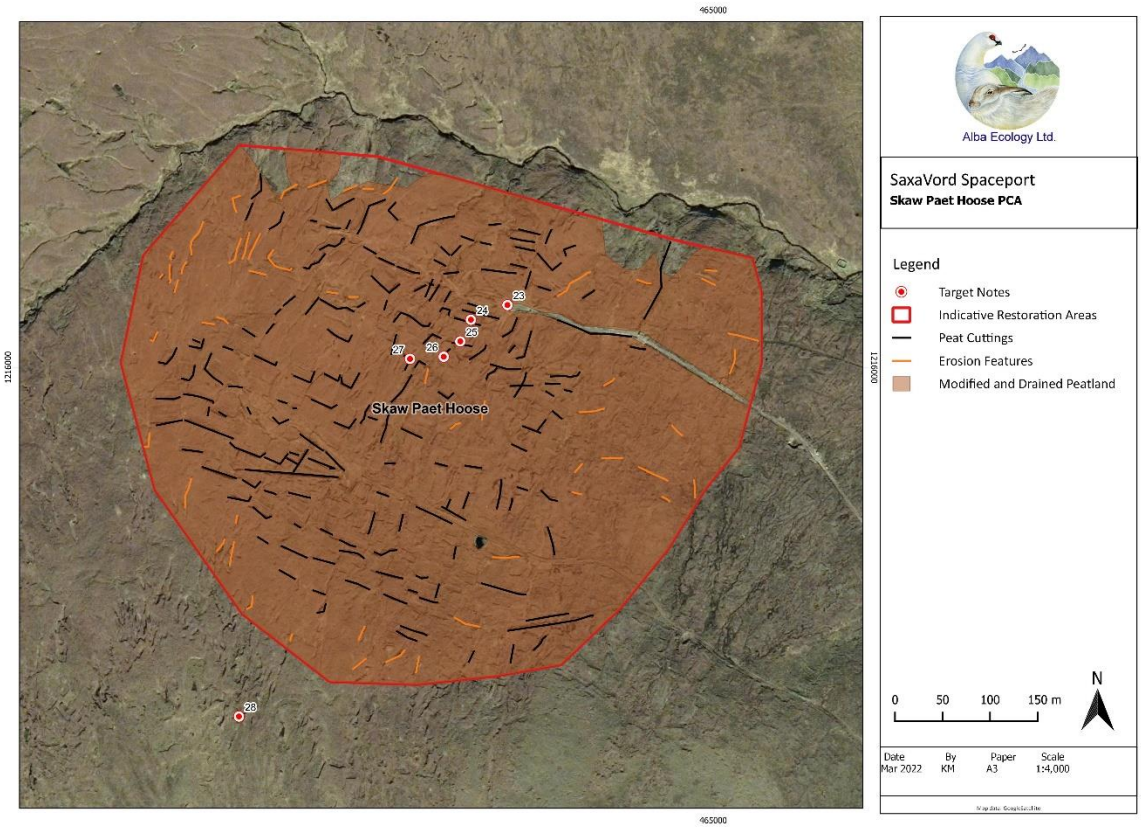


Figure 4: PCA and Target Note locations for Skaw Paet Hoose

The habitats were similar to those at Loomer Shun with a similar array of species present and the type of habitat dependent on the impact of peat cuttings. There was modified bog at the original bog surface which was usually dry particularly at the edges of peat cuttings. Heather, crowberry, common cottongrass, hare's-tail cottongrass, red bog-moss and glittering wood moss were the most common species.

The modified bog that had revegetated at the base of the cut surface where the remaining peat was >0.5m was generally damper underfoot than the original bog surface vegetation with occasional bog pools. There were patches of bare peat at the base of some erosion features.

Wet heath, dominated by heather and common cottongrass was present where vegetation had formed at the base of the cut surface where the peaty soils were <0.5m.

Unlike at Loomer Shun, some of the peat cuttings at Skaw Paet Hoose had collapsed over and fully revegetated, leaving little sign of the cutting except a raised profile. This demonstrates the sort of reprofiling that is anticipated and shows that revegetation is not only possible but is happening naturally in some areas, albeit at a slow rate of change. It is unclear how long this process has taken to naturally occur, but the peat cuttings in some places appear to be very old.

Table 2 provides details of the baseline through a series of Target Notes of the peatland habitats at the Paet Hoose. The Locations of the Target Notes are shown in Figure 4.

TG	Grid	Note	Photo
23	HP 64783 16065	Historic peat cutting. There was generally revegetation on the cut surface and on some cut edges. Suitable for reprofiling to connect the peat, re-wet the original bog surface and to form hydrological connectivity.	 
24	HP 64745 16050	Example of a historic peat cutting. It was ca. 1m high, with dry, heather dominated vegetation sloping over the edge. There was evidence of continued erosion from undercutting. The cut surface was well vegetated with common cottongrass and heather, forming a wet heath vegetation over ca. 0.5m of peaty soils.	
25	HP 64733 16027	Another example of a historic peat cutting. It was ca. 1.5m high. There were some patches of bare peat along the base of the cutting face. These were ca. 2m x 2m in size and were actively eroding. The cut surface had blanket bog vegetation over deep peat with occasional pools and patches of bog-mosses present.	

TG	Grid	Note	Photo
26	HP 64716 16011	This historic peat cutting was fully revegetated with areas of acid grassland and dry heath.	
27	HP 64680 16008	A more recent peat cutting. It was ca. 1.5m high and 20m long with evidence of active erosion and drying influences seen on the top.	
28	HP 64501 15633	A view of the area around Skaw Paet Hoose.	

Table 2: Target Notes for Skaw Paet Hoose

Delivery – Skaw Paet Hoose

There is suitability at Skaw Paet Hoose for careful and sensitive peatland restoration of the historic peat cuttings. Re-using peat extracted from the construction of the SaxaVord Spaceport is not anticipated as access is along an un-made track, unsuitable for taking large loads of peat along, but suitable for driving Argo cats and diggers on caterpillar tracks for the purpose of restoration.

Reprofiling would be undertaken as described for Loomer Shun and detailed in Appendix 1. The reprofiling would halt the current erosion on bare peat faces through wind and rain erosion; halt the bare peat faces losing mass through microbial decomposition; and reduce drying out of the remnant adjacent blanket bog. This will stop areas of Skaw Paet Hoose from being a carbon source. Furthermore, reprofiling the peat cuttings will wet-up and hydrologically link the existing bog vegetation, which is currently fragmented, and allow a more natural surface pattern and hydrology to develop. In turn, this will benefit the species that rely on wet bog vegetation such as craneflies and other insects, which further benefit associated bird

species. This hydrologically linked wet bog will likely deliver additional carbon sequestration as the bog-mosses and bog vegetation form peat over a wider area, locking carbon into the peatland habitat. Hence, the Skaw Paet Hoose area would be transformed from being a source of carbon, to potentially an area with widespread carbon sequestration (i.e. a carbon sink).

Photo 11: A peat cutting at Skaw Paet Hoose suitable for reprofiling

The crofters (who we understand hold the peat cutting rights to this area) have agreed to a permanent cessation of peat cutting at Skaw Paet Hoose. This secures the long-term effectiveness of restoring the peat and blanket bog in this currently degraded area.

Similar to Loomer Shun, Skaw Paet Hoose has a low level of sheep grazing which is evidenced in the revegetation of the degraded bog habitat. Securing an agreement not to increase sheep levels would be beneficial.

Careful consideration of the timing of this work will be needed to avoid breeding bird disturbance and to prevent further erosion from the wind exposure. Works for peatland restoration at Skaw Paet Hoose are not scheduled until at least 2023/2024 and would be completed outside the bird breeding season.

Peatland restoration work at Skaw Paet Hoose will be undertaken under the supervision of an appropriately trained ecologist.

A baseline monitoring survey measuring species composition, vegetation height, peat depth and areas of bare peat will be undertaken prior to the peatland restoration beginning at a range of monitoring sites within Skaw Paet Hoose. The changes to the vegetation/peat will then be monitored at regular intervals, using standardised systematic methods.

The specific objective for peatland restoration and Skaw Paet Hoose will be to:

1. Reduce bare peat areas at peat cuttings;
2. High overall vegetation cover;
3. Increase in the number of bog-mosses, particularly at the original bog surface;
4. Increase in the species richness of blanket bog species; and
5. Increase in wetness of the blanket bog, e.g. an increase in bog pools.

Current situation – Ritten Hamar

Ritten Hamar, as identified in Figure 2, is an area of blanket bog in the very north of Unst and is ca. 14.3ha in size. It is characterised by numerous small lochans and widespread erosion features. Erosion is likely to have been due to a combination of sheep grazing and the extreme exposure to wind and rain erosion in the very exposed location. The erosion was active and noticeable. For example, in some areas the drier surface vegetation had been lifted and folded over in the wind (e.g. Photo 13).

Photo 12: Erosion features at Ritten Hamar

Photo 13: Surface vegetation lifted and folded over in the wind, exposing bare peat.

Baseline – Ritten Hamar

A site visit and PCA was conducted at Ritten Hamar in February 2022.

Figure 5 provides an indicative PCA map (based on a site visit and aerial photos). All of the peatland was classified as Modified and Drained. At Ritten Hamar the drainage was from erosion features rather than peat cutting. Active erosion was present along most the erosion features, which reached up to 3m in height. These had bare peat, exposed on the faces and exposed along the base of the erosion features.

The total length of erosion features at Ritten Hamar (based on aerial photos) was estimated to be ca. 3.6km[3].

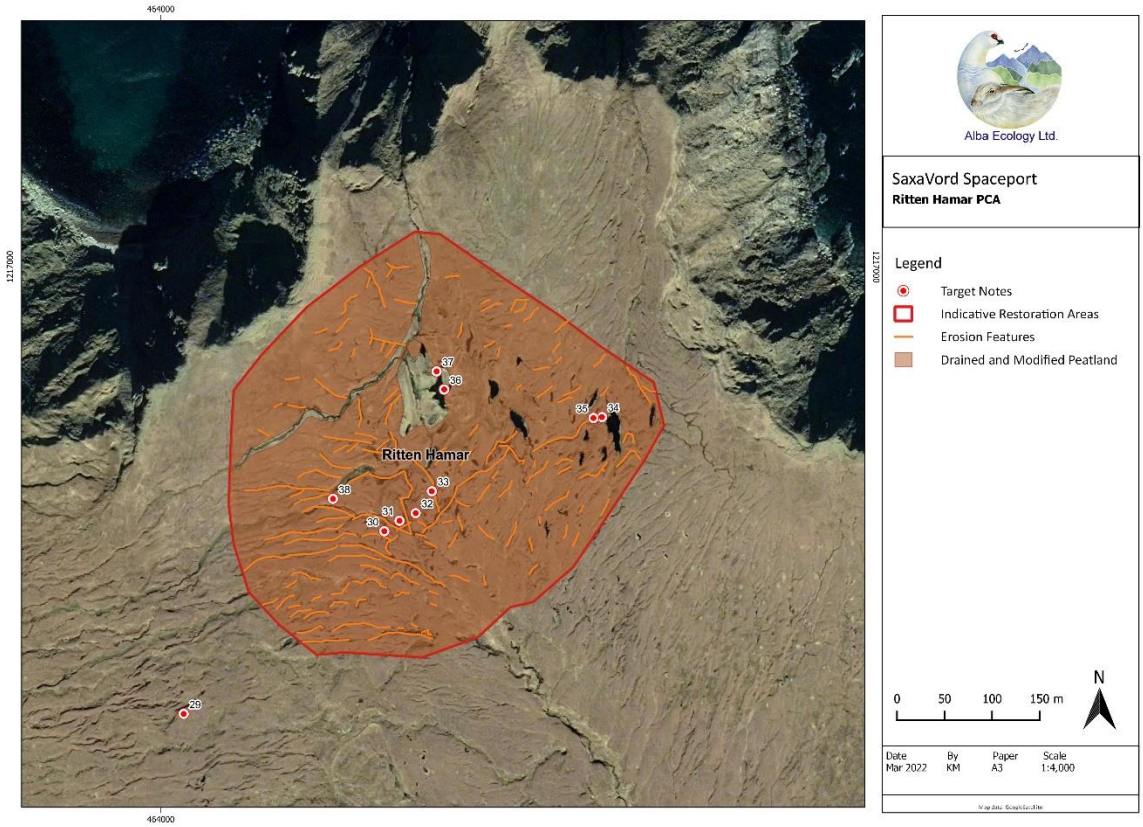


Figure 5: PCA and Target Note locations for Ritten Hamar

The vegetation across the wider area seen whilst walking to Ritten Hamar, where the bog was more intact, was blanket bog with heather, common cottongrass, crowberry, and a little hare's-tail cottongrass being the most common plants and making up the bulk of the vegetation. Mosses most frequently encountered were red bog-moss and glittering wood-moss. Heather was more common on drying edges of the erosion features. Around the numerous bog pool bog-mosses were more common and the ground was noticeably wetter.

Table 3 provides details of the baseline through a series of Target Notes of the peatland habitats at the Ritten Hamar. The locations of the Target Notes are shown in Figure 5.

[3] Note that these metrics and locations shown in Figure 5 are based on aerial images, viewed between 1:2,000 and 1:4,000 and have not been fully ground truthed. It is possible some 'erosion features' are actually other features in the landscape. Lengths are estimates only.

TG	Grid	Note	Photo
29	HP 64024 16530	View of Ritten Hamar. Erosion features evident from a distance. These were not from peat cutting but were likely formed from a combination of sheep grazing and climatic impacts. The surround blanket bog was in reasonable condition, with old features revegetating in places.	
30	HP 64235 16722	Erosion feature was ca. 1.5m high and 5m wide. It had a bare peat face and base which was actively eroding. It was very exposed and on a fairly shallow gradient. Therefore, it is considered that reprofiling and blocking this erosion feature would be possible using only peat from Ritten Hamar.	
31	HP 64251 16733	The erosion gully at this location was ca. 3m high and actively eroding. It was suitable for reprofiling. It was on a shallow gradient and may require blocked, but peat may be sufficient. There was a small pool at the base of this erosion feature. It was on shallow soil (ca. 0.3m), but with bog mosses present.	 
32	HP 64268 16741	Erosion gully going on a slightly steeper gradient. Some rocks may be required to block this gully. The erosion features were ca.1.2m high and would be suitable for reprofiling.	

TG	Grid	Note	Photo
33	HP 64285 16764	Illustrative photos from Ritten Hamar. The erosion features were ca. 1.2m high. Photos show the views from the east, south then west.	  
34	HP 64464 16842	An erosion gully suitable for blocking and reprofiling. It was at a shallow gradient so peat blocking may be sufficient.	
35	HP 64455 16841	There were also some small erosion features. This one was ca. 0.5m high.	

TG	Grid	Note	Photo
36	HP 64298 16871	Example of surface vegetation lifted and folded over in the wind, exposing bare peat.	
37	HP 64290 16890	Another example of surface vegetation lifted and folded over in the wind, exposing bare peat.	
38	HP 64181 16756	The vegetation across this area was made up of heather, common cottongrass, crowberry, and a little hare's-tail cottongrass. Snow cover prevented a clear view of the moss layer although there appeared to be a red bog-moss and glittering wood-moss component. The vegetation was generally short and open. There was an erosion feature nearby which was ca. 1m high and 3m wide. There was some bare peat exposed to mineral soil at the base.	  

Table 3: Target Notes for Ritten Hamar

Delivery – Ritten Hamar

Peatland restoration is recommended for Ritten Hamar. The erosion features should be restored through reprofiling and where appropriate gully blocking. Peatland restoration is often most effective if it is concentrated within a catchment area or hydrologically linked area. Ritten Hamar is ideal because it is at a watershed location and so the restoration work would support not only the bog habitat but also the associated lochans.

Erosion gullies could be blocked or re-profiled following best practice guidelines (e.g. Appendix 1). The exact location and number of dams required will necessarily be determined on the ground by the contractors. Blocking the gullies will be dependent on the size and the slope of the gully or erosion feature. Small gullies on shallow gradients may be able to be blocked with peat dams from adjacent areas in Ritten Hamar. However, as some of the haggs and gullies were large, stone dams may be required in some circumstance to ensure that water would be dammed and to prevent further erosion (see Appendix 1 for more details and best practice guidelines). Hagg reprofiling would be suitable for all the haggs >0.5m. A form of hagg reprofiling, called cross tracking, may be suitable for haggs and erosion features <0.5m.

The peatland restoration will deliver a series of benefits to the Ritten Hamar area, including halting the degradation, improving the hydrological connectivity and improving the area for wide bog species such as invertebrates and birds. The long-term outcome would be turning the areas from a carbon source to a carbon store and sink through carbon sequestration.

There is no direct road, or track access to Ritten Hamar. Therefore, bringing rocks (or other materials) to Ritten Hamar may be logistically challenging and restoration plans for this work element will need to consider how to do this work. The sea cliffs surrounding Ritten Hamar are ca. 80-100m high. Therefore, the beach at Wick of Skaw would be the closest location to bring the materials via the sea. Likewise, bringing materials by road, would likely to Skaw. Moving material from Skaw to Ritten Hamar may require either Argo cats or in some circumstances may may need to be lifted in by helicopter.

Similar to Loomer Shun and Skaw Paet Hoose, Ritten Hamar appeared to have a low level of sheep grazing. Securing an agreement not to increase sheep levels would be beneficial.

Careful consideration for the timing of this work will need to be taken into account to avoid breeding bird disturbance, but also to prevent further erosion from the wind exposure. The peatland restoration work at Ritten Hamar is not anticipated to begin until 2024/2025 and will take place outwith the bird breeding season.

Peatland restoration work at Ritten Hamar will be undertaken under the supervision of an appropriately trained ecologist.

A baseline monitoring survey measuring species composition, vegetation height, peat depth and areas of bare peat will be undertaken prior to the peatland restoration beginning at a range of monitoring sites within Ritten Hamar. The changes to the vegetation/peat will then be monitored at regular intervals, using standardised systematic methods.

The specific objective for the peatland restoration at Ritten Hamar will be to:

1. Reduce bare peat areas erosion features;

2. High overall vegetation cover;
3. Increase in the number of bog-mosses;
4. Increase in the species richness of blanket bog species; and
5. Increase in wetness of the blanket bog, e.g. an increase in bog pools.

Objective 3. Create native riparian broadleaf tree/scrub cover

Current situation

Given historical clearance of all native woodland on Unst, there is now little woodland cover anywhere on the island outside of private residential gardens. Such cover, as it exists, is highly fragmented and offers very limited opportunities to benefit resident and migrant bird species.

Delivery

The Burn of Skaw lies within is a sheltered west to east facing valley. Many of the bends are well sheltered and contained old planticrubs (small circular dry-stone enclosures formerly used for growing crops in) which provided soil, shelter from the sheep and also, to some extent wind. There is no woodland this far north in Unst and the creation of several small, but discrete planted up areas of native broadleaves on the sheltered bends of the Burn of Skaw would create Britain's most northerly woodland, albeit mainly scrub and localised in nature.

Such woodland/scrub expansion will likely benefit a range of songbird species, which should occur in greater numbers/densities and which also form the main basis of merlin prey, which although not breeding, do forage in this area.

Figure 6 indicates the area intended for planting as part of the HMP, which totals ca. 8ha. Table 4 gives the baseline conditions for this area.

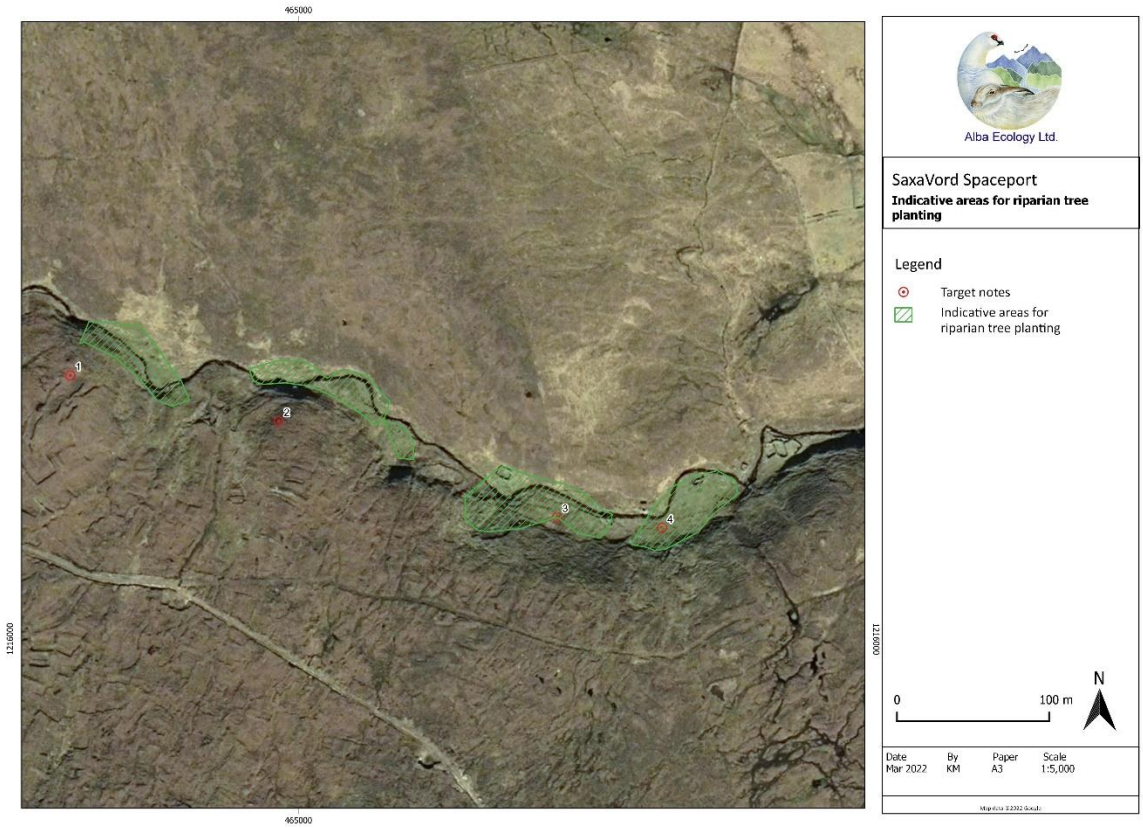


Figure 6: The indicative area for tree riparian tree planting along the Burn of Skaw

TG	Grid	Note	Photo
1	HP 64850 16173	Sheltered valley with suitable areas for planting riparian species along the site of the Burn of Skaw. The existing riparian vegetation was sheep grazed acid grassland.	
2	HP 64987 16143	The flat areas, beside the Burn of Skaw, were relatively sheltered from the prevailing wind.	

TG	Grid	Note	Photo
3	HP 65170 16080	This fenced area with a broken sheiling was considered ideal for planting. It was primarily acid grassland with bent grasses, mat grass, heather, heath bedstraw and tormentil. There were patches of heather and soft rush. The fenced area was ca. 10m wide and 20m long.	
4	HP 65239 16073	This small flat area alongside the Burn of Skaw was considered ideal for riparian tree planting. It was made up of acid grassland with tormentil, bent grasses and mat grass with some soft rush also present. It was c. 10m x 10m is size.	

Table 4: The target notes for the areas identified for riparian tree planting, Burn of Skaw.

The location of the native riparian planting along the Burn of Skaw is on land on which SaxaVord Spaceport have a long-term management agreement on and so the work will be guaranteed to be taken forward.

The riparian corridor along the Burn of Skaw was heavily grazed by sheep and native broadleaved scrub woodland would not survive without effective stock-proof fencing. There will need to be gaps between planted areas to facilitate sheep access across the valley. The indicative areas for planting and fencing are shown in Figure 6. In addition to providing habitat for species which would form part of merlin diet, this action will also allow heather to increase in height which could provide cover and suitable habitat for nesting.

Following discussions in 2020 with the Shetland Amenity Trust on planting trees in Shetland, downy birch, with a mix of other species in appropriate locations including alder, hazel, grey willow, rowan and aspen will be planted in the areas indicated in Figure 6. It is considered that the most appropriate species for planting here are likely to be downy birch, grey willow and alder. The Shetland Amenity Trust will be commissioned to grow and plant trees within this area during the appropriate time of year in 2023-2024.

Objective 4. Coastal grassland habitat management

Current situation

The coastal grassland habitat on the cliff tops of Lamba Ness and The Garths meets Annex 1 habitat and Scottish Biodiversity List (SBL) descriptions and so is of conservation interest (e.g. Photo 14). The coastal grasslands were dominated by red fescue with a variety of maritime species such as thrift, plantains and a variety of wild flowers at varying abundances (e.g. Photo 15).

These types of coastal grasslands are dependent on low-intensity, traditional farming (PlantLife, 2014). Low-intensity sheep grazing, where animals are removed in late spring and returned in autumn, is extremely important to maintain the community and species richness. Abandoning these traditional management practices is considered the key threat to coastal grasslands across the UK (PlantLife, 2014). Without seasonal grazing, the coastal grassland habitats tend to become less species rich as micro habitats close up. This means fewer opportunities for the rarer species to seed or spread (PlantLife, 2014).

Photo 14. Example of coastal grassland at Lamba Ness

Photo 15. Wildflowers in the coastal grassland - ragged robin and thrift

Delivery

With careful sheep management the coastal grassland habitats can be maintained and enhanced. It is known that "*Traditional grazing regimes use sheep to maximise flowering success. This means grazing in winter with short exclusions during the summer to allow plants to flower and set seed (roughly May - September). Heavy grazing in the autumn is important as it removes the year's crop of grasses and herbs. Ideally this should take place from September when the grasses and herbs are still nutritious. Lighter grazing until April produces the ideal conditions for many plants to survive in healthy populations"* (PlantLife, 2014).

Sheep grazing on Lamba Ness will continue and will follow traditional management regimes. The number of sheep and timing of sheep grazing will follow traditional grazing management regimes and be agreed in consultation interested parties (e.g. NatureScot, SIC).

An agreement will been made with the crofters for a suitable grazing regime on Lamba Ness between mid-September and April once the construction of SaxaVord Spaceport has been delivered.

Monitoring

In order to monitor progress of the HMP, it will be necessary to regularly monitor the effectiveness and success of the restoration measures implemented. To do this an initial assessment of baseline conditions would be required (establishing the baseline, including photos), followed by regular post restoration monitoring (including photos)

Table 5 displays the type of monitoring that should be considered for each restoration technique, before and after implementation.

The most commonly used methods for the pre and post restoration monitoring will be moorland breeding bird surveys, vegetation quadrat assessments and assessment of the planted trees.

Moorland breeding bird survey

The modified Brown and Shepherd (1993) Moorland Breeding Bird survey is the standard survey technique for moorland/upland breeding birds (Gilbert *et al*., 1998). The Brown and Shepherd methodology is based on a constant search method involving spending 25 minutes every 500m × 500m quadrant. This equates to spending 100 minutes for every km^2. The restoration area would be split into a number of 500m x 500m quadrants. Each quadrant would be walked to ensure that all parts were approached to within 100m. At regular intervals, the surveyor will pause, scanned the area for species and listened out for calls and songs. All registrations will be marked on a 1:25,000 scale map using British Trust for Ornithology symbols with a note of the species activity. The main habitat is broadly defined as open moorland so this survey technique was used across all parts of the Study Area.

Vegetation quadrat assessment

Quadrat data will be taken in a standard 2×2m quadrat. All higher plants and common mosses will be identified and their percentage cover assessed. The height of heather and bog mosses will be assessed in each quadrat with a tape measure, six times per quadrat. Quadrat data will provide details on the NVC communities present and any changes in the NVC community. Height data will provide a measure of the structural changes with e.g. reduced grazing pressure.

Tree assessment

Visual inspection for tree/scrub mortality and general will be undertaken on a regular bases. Any dead or dying trees will be replaced. Replanting. The integrity and effectiveness fencing will also be assessed regularly.

Objective	Type of monitoring	Method	Why	Frequency (Years)
Objective 1. Sea-watching hide	Hide maintenance	Vigilance by local community users	To ensure repairs are undertaken promptly	Ongoing
Objective 2. Blanket bog/peatland habitat restoration	Birds	Breeding Bird surveys	To demonstrate whole ecosystem change	Pre restoration, 1, 2, 3, 5, 10, 15, 20, 25 and 30.
	Vegetation	The percentage cover of bog-moss and indicator plant species, bare peat and vegetation height with the use of quadrats, including within control areas not under favourable management	To demonstrate any changes in species composition and structure	Pre restoration, 1, 2, 3, 5, 10, 15, 20, 25 and 30.
Objective 3. Native broadleaf woodland	Vegetation	Visual inspection for tree/scrub mortality (replanting if necessary) and measures of tree height	Ensuring that the planted trees are growing successfully	Pre restoration, 1, 2, 3, 5, 10, 15, 20, 25 and 30.
	Monitoring of exclosures	Visual inspection of integrity of fences and exclosures	To ensure tree/scrub growth takes place	2-3 times annually
Objective 4. Coastal grassland habitat management	Vegetation	Assessment of species richness through quadrats	To demonstrate successful maintenance and enhancement of coastal grassland habitats.	Pre restoration, 1, 2, 3, 5, 10, 15, 20, 25 and 30.

Table 5: The type of ecological/ornithological monitoring recommended for the approved HMP

References

Bird Guides. 2022. DPFv2HPW0AkGtkF.jpg (2048×1280) (birdguides-cdn.com).

Brown, A.F and Shepherd, K.B. 1993. A method for censusing upland breeding waders. Bird Study 40: 189-195.

Moors for the Future. 2020. Grip and gully blocking. Grip-and-gully-blocking-Factsheet.pdf (moorsforthefuture.org.uk)

Natural Born Birds. 2022. Sea watching Hides. Seawatching Hides (naturalbornbirder.com).

Peatland Action. 2016. Peatland Condition Assessment. Guidance-Peatland-Action-Peatland-Condition-Assessment-Guide-A1916874.pdf (nature.scot).

PlantLife. 2014. Coastal grasslands, a management guide. www.plantlife.org.uk/application/files/4714/8155/7847/Coastal_grasslands_FINAL.pdf.

SaxaVord Spaceport. 2020. Shetland Space centre Outline Habitat Management Plan.

SaxaVord Spaceport. 2022. A Summary Report Outlining Peatland Restoration Proposals for Unst Space Port.

SNH Peatland ACTION. 2015. Video 3 Reprofiling: https://youtu.be/xHURdFQycO8?t=3

Appendix1: Peatland Restoration techniques

Restoration technique	*Description*	*Best practice guidelines*	*Logistics/Constraints*	*Photograph*
Hagg reprofiling	Hagg reprofiling is a process of reducing the steepness of the edge of the hagg, revegetating the bare peat with the use of diggers. • Roll back vegetation from the top of the hagg. • Remove the newly exposed peat and make a gentle slope (33-45º angle). • Replace the vegetation, stretching it across the bare peat. • Take vegetation from 'vegetation borrow pits' in the blanket bog at the top of the hagg to cover any gaps. • Compact the peat and newly laid vegetation with the digger. • Stretch the vegetation around the vegetation borrow pits to ensure there are no areas of bare peat. • Large stone would likely be needed to block large gullies in some areas, these would need to be placed at ca. 5-10m interval in large gullies.	NatureScot guidelines	At a minimum two diggers would need to work together, with at least one of them being a large 14 tonne digger. Once the diggers have accessed the site, they would be able to reprofile approximately 0.5-1km of hagg per day (i.e. 250-500m each). The foreman/project manager should be experienced and have a good understanding of peatland systems, peatland vegetation and peatland hydrology. Digger drivers would require suitable training and experience of peatland restoration, e.g. working in remote areas and driving/digging on the peatlands.	 *Two diggers reprofiling a large erosion gully*
Blocking erosion gullies	Erosion gullies can be blocked and reprofiled with the aim of restoring the natural water table, reduce erosion and allowing re-vegetation. Peat dams are best for shallow gradients, whereas other materials such as plastic, are more effectives on steeper gradients. Wide gullies can be reprofiled as well as dammed to maximize effectiveness.	Some details of best practice guidelines are available from Peatland Action and Moors for the Future.	Gully blocking would have similar requirements as the hagg reprofiling; including large diggers and a competent foreman.	 A digger creating a peat dam.