Nova Innovation Ltd

Marine Scotland Licence Application and Shetland Islands Council Works License Application

Shetland Tidal Array Extension – Environmental Assessment Report

45 Timber Bush
Edinburgh
EH6 6QH

Tel: +44 (0)131 241 2000

www.novainnovation.com

Author:	Gavin McPherson
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Prepared for:	Marine Scotland, Shetland Islands Council
Contact:	Panos Pliatsikas (MS), Ryan Leask (SIC)
Report Distribution:	
Marine Scotland	Panos Pliatsikas, Rhianna Roberts, Nicola Bain, Joao Queiros, Roger May, Sophie Humphries
Shetland Islands Council	Ryan Leask
Nova Innovation Ltd	Gavin McPherson, Simon Forrest
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Approval Record

	Name	Job Title
Prepared by:	Gavin McPherson	Head of Policy and Research
Reviewed by:	Simon Forrest	CEO
Authorised by:	Simon Forrest	CEO
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Executive Summary

This Environmental Assessment Report (EAR) has been prepared in support of Nova's applications for a Marine Licence from Marine Scotland and a Works Licence from Shetland Islands Council.

Nova Innovation proposes to expand the Shetland Tidal Array (STA) in Bluemull Sound from 5 to 6 turbines. This expansion is part of the Enabling Future Arrays in Tidal (EnFAIT) Project, a Horizon 2020 flagship project, led by Nova in collaboration with 8 leading European industrial and academic partners. The project aims to demonstrate the development and operation of the world's first offshore tidal array over a five-year period, to prove a cost reduction pathway for tidal energy that shows it can be cost competitive with other forms of renewable energy.

Based on earlier advice from MS-LOT and SNH, collision of the turbine blades with marine mammals and birds was identified as the most significant environmental risk for the proposed extension. The EAR presents the results of a revised collision risk assessment conducted by SNH, which found that there would be no adverse impacts of extending the array from 5 to 6 turbines, assuming a suitable PEMP is agreed and implemented for the array.

The EAR provides the following key information:

- Identification of potential environmental impacts of the STA extension
- Assessment of the key potential environmental impacts
- Contextualisation of the potential environmental impacts
- Approach to mitigating and addressing residual uncertainty about key environmental impacts.

1 Introduction

Nova Innovation intends to expand the Shetland Tidal Array (STA) in Bluemull Sound from 5 to 6 turbines. This Environmental Assessment Report (EAR) presents an assessment of the potential environmental impacts of the expansion of the STA, in support of applications for the necessary consents. These are a Marine Licence from Marine Scotland (under Part 4 of the Marine (Scotland) Act 2010) and a Works Licence from Shetland Islands Council (under Zetland County Council Act 1974).

Nova currently holds a Marine Licence (04859/15/1), Shetland Islands Council (SIC) Works Licence (2016/025/WL) and seabed lease from The Crown Estate for a five turbine offshore tidal array. The Marine Licence was issued on December 4, 2015 and is valid until January 1, 2035. An extension to the existing Crown Estate lease is also being sought to permit the expansion of the number of turbines in the array from 5 to 6. The SIC Works License was issued on 26th August 2013 and is valid until 26th August 2019.

The proposed expansion of the STA from 5 to 6 turbines will be undertaken as part of the EnFAIT Project (Enabling Future Arrays in Tidal). EnFAIT is an EU funded Horizon 2020 flagship project, led by Nova, in collaboration with 8 partners. The project aims to build investor confidence in tidal energy, allowing the technology to move closer to commercialisation.

1.1 Purpose of Environmental Assessment Report

In their formal EIA screening opinion on the proposed STA extension issued on 9 January 2018, Marine Scotland advised Nova that the Scottish Ministers are of the opinion that:

> *"an Environmental Impact Assessment (EIA) will not be required to be undertaken in support of … [the proposed project]".*

However, MS-LOT did advise that certain information will be required to support the marine licence application, including updated collision risk modelling and information on the monitoring and analysis from the current operating STA, to provide context for this extension.

This EAR has been prepared in support of Nova's applications for a Marine Licence and Works Licence for the STA extension, to meet requirements set out by MS-LOT and SIC, on advice from their consultees including SNH[1]. The EAR provides the following key information:

- Section 2: The project (including a summary of the existing operational STA and the proposed extension)
- Section 3: Identification of potential environmental impacts of the STA extension
- Section 4: Assessment of the key potential environmental impacts of the STA extension
- Section 5: Contextualisation of the key potential environmental impacts of the STA extension
- Section 6: Approach to mitigation and addressing residual uncertainty about key environmental impacts
- Appendix A: List of other designated sites potentially linked to the project
- Appendix B: Potential impact of the STA on other designated sites

In relation to Section 5, the EAR provides a summary of the status of the STA project, the associated environmental assessment and operational monitoring, along with additional available evidence, for example from other tidal energy deployments and relevant research programmes. This additional information provides important context and evidence to inform the assessment of the potential effects of the proposed extension and the implications for features of natural heritage importance associated with the Bluemull Sound area.

[1] Including the Screening opinion on the Installation of the Nova Innovation Ltd Tidal Array Project in Bluemull Sound, Shetland (MS-LOT, 9 January 2018) and associated advice, and responses to the Works License consultation received by SIC from SNH and RSPB.

2 The project

2.1 Site location

The Shetland Tidal Array is in the Bluemull Sound, Shetland, between the islands of Unst and Yell. The site is located near the Ness of Cullivoe, a narrow 1 km long headland to the north-east of Yell. Figure 2.1 shows the exact location of the STA lease area and cable corridor. All turbines will be located in the area delineated by the black box, as per the existing Marine Licence, Shetland Island Council Works Licence and Crown Estate Lease.

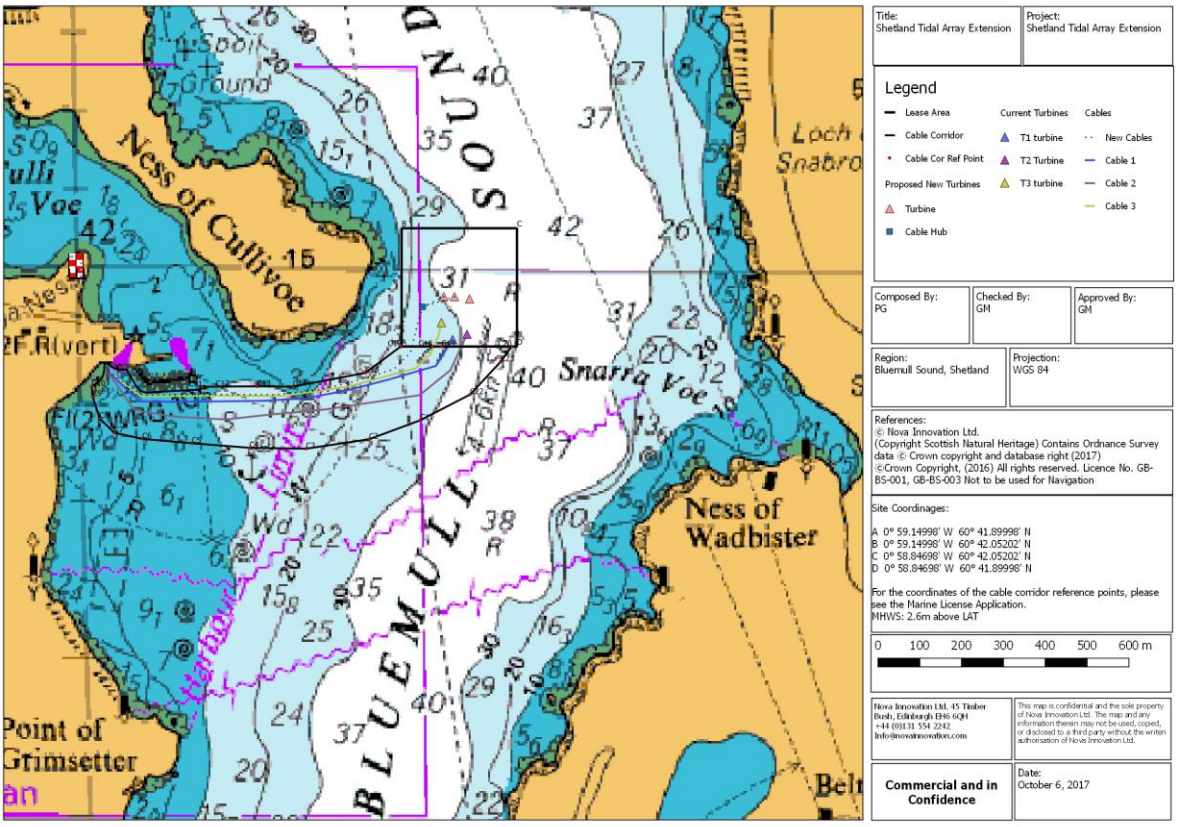

Figure 2.1 Location of the STA site and cable corridor. Please note, the exact location of the proposed new turbines is still to be finalised.

2.2 The existing Shetland Tidal Array (5 turbines)

2.2.1 Consented under existing licenses

Five Nova M100 turbines each with individual cables running back to shore. Turbine locations are shown in Figure 2.1.

2.2.2 Currently deployed on site

Three Nova M100 turbines: T1, T2 (deployed in 2016) and T3 (deployed in January 2017).

2.2.3 Project schedule

Following deployment of the two final turbines (T4, T5), the array would operate until 2035, at which point the turbines and all associated equipment would be decommissioned.

2.3 The requested STA extension (6 turbines)

2.3.1 Requested STA extension

An additional sixth turbine (T6) will be deployed after T4 and T5. These three turbines will be connected to shore via a subsea hub and a single export cable, as shown in Figure 2.1.

Following an initial period of operation, T4, T5 and T6 will be repositioned within the site to explore the effect of turbine wakes on array performance. The repositioned turbines will still be located within the existing seabed lease area.

2.3.2 Future project schedule

- Cable, subsea hub and T4 deployment (Q3 2019)
- T5, T6 deployment (Q1 2020)
- Reconfigure array (Q1 2021)
- Array operation (2018 to 2038)
- Decommissioning (2038)

Further project details are provided in the Schedule and Method Statement and maps that accompany the licence application.

2.4 The Nova M100 turbine

The turbines to be deployed in the array are Nova M100 tidal turbines: a 2-bladed, horizontal axis device installed subsea at a depth of 30-40m. The turbines use gravity base foundations that require no piling or drilling. An illustration of the Nova M100 turbine is shown in Figure 2.2.

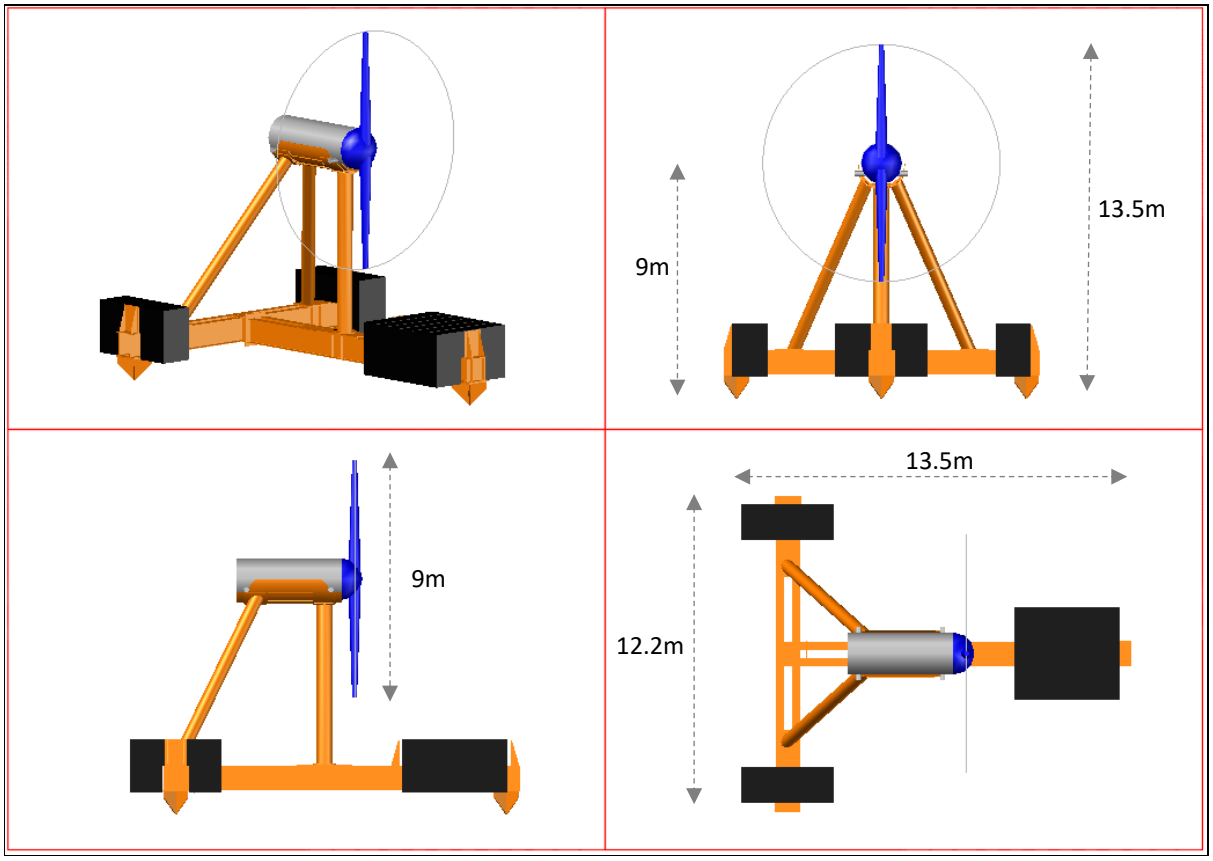

Figure 2.2 The Nova Innovation Nova M100 Tidal Turbine *Source: Nova Innovation 2018*

3 Potential impacts on Designated Sites

3.1 Initial identification of impacts

Appendix A provides an overview of all sites and receptors that could potentially be impacted by the Shetland Tidal Array, identified using Marine Scotland's IMPACT assessment tool[2]. Advice provided by MS-LOT and SNH as part of the EIA screening process and pre-application discussions[3] has enabled Nova to refine this list of potential impact pathways and sensitive receptors to those on which the environmental assessment to support consent applications for the STA extension should focus. These are detailed in the following sections.

3.2 Previous advice from MS-LOT, SIC and SNH

In their advice to MS-LOT and SIC on the EIA screening request, SNH advised that:

> *"Due to the location of the proposed turbine within Blue Mull and Colgrave Sounds pSPA, we advise that, as part of any marine licence application, consideration is given to this SPA and the potential impacts of the proposed additional turbine to the qualifying feature – breeding red throated divers. We also advise that consideration is given to the other key nature conservation features assessed as part of the array application".*

For the existing 5 turbine STA, SNH identified physical interactions between marine wildlife and the operation of the turbines as the main impact pathway of concern[4]. It is proposed that this should be the focus of additional effort to support the STA extension application, building on the assessment of these impacts undertaken to support the existing STA project.

Impact pathways such as disturbance or displacement are also considered semi-quantitatively within this report, building on information provided to support the original application. Additional context is provided in the form of some initial data from ongoing monitoring associated with the STA project and evidence gathered from other tidal energy sites, such as the European Marine Energy Centre.

3.3 Identification of relevant Natura features

On advice from MS-LOT and SNH, Nova has identified the features of Special Protection Areas and Special Areas of Conservation that could potentially be affected by the Shetland Tidal Array extension, and therefore require further assessment[5].

> *… [SNH] advised as part of the Habitats Regulations Appraisal – a likely significant effect for:*
>
> - *the harbour seal feature of Yell Sound Coast SAC due to the risk of collision from operating turbines and disturbance effects during installation of each turbine from associated marine work, and*
> - *features at the Hermaness, Saxa Vord and Valla Field SPA due to the potential for collision with operating turbines for puffin, gannet, red-throated diver, guillemot and shag.*

3.3.1 Special Protection Areas

The STA, including the proposed extension, is located within the Bluemull and Colgrave Sounds proposed Special Protection Area (pSPA), for which the qualifying feature is breeding red throated diver (*Gavia stellata*). The STA

[2] http://www.gov.scot/Topics/marine/Licensing/marine/tool

[3] Nova meeting with MS-LOT, SIC and SNH in Aberdeen on 26/02/2018

[4] MS-LOT, Consideration of a Proposal Affecting a Designated SAC or SPA, November 2016

[5] Advice received from SNH 15th August 2017

extension also has the potential to impact on the features of the nearby Hermaness, Saxa Vord and Valla Field SPA[6], given the foraging range of its breeding seabird features[7].

3.3.2 Special Areas of Conservation

The STA extension has the potential to impact the harbour seal (*Phoca vitulina*) feature of the Yell Sound Coast SAC[8]. Whilst the project is not located within the boundary of this site, the potential for harbour seals associated with this SAC to interact with the operating devices and any consequences need to be considered and assessed.

3.3.3 Impact on other designated sites

In consultation with SNH (regarding the STA Decommissioning Programme), Nova has identified additional designated sites that could potentially be affected by the array. Based on the results from collision model analysis discussed below, the potential impact on other linked designated sites is outlined in Appendix B.

In cases where the Designated Sites were included based on the foraging range of breeding seabirds, only those seabirds within foraging range of the site were included as qualifying features.

3.3.4 European Protected Species and basking shark

The environmental assessment for the initial STA application included a consideration of possible disturbance to species provided strict protection under Annex IV of the Habitats Directive ("European Protected Species"). Possible disturbance to basking shark, also strictly protected, under Schedule 5 of the Wildlife and Countryside Act (As amended) was also considered. Licences for the possible disturbance of European Protected Species (EPS) and basking shark were issued to Nova for the STA on 21st July 2017.

Monitoring to date has not recorded any sightings of basking shark in or around the STA. Nova are therefore of the view, on advice from MS-LOT provided verbally in a pre-application meeting (26 January 2018), that a licence to disturb this species will not be required for the STA extension. A licence to disturb EPS may be required; an EPS license has been awarded for the existing project by Marine Scotland, valid to 23 April 2018.

3.4 Potential disturbance

For the 5 turbine STA, SNH advised that in addition to collision risk it was necessary to consider the likely significant effects (LSE) of the development on the distribution of harbour seals within the Yell Sound Coast SAC. They have therefore also been considered for the STA extension. The main mechanisms of disturbance will be the noise and an increase in vessel movements arising during the installation (and decommissioning) operations as well as potential collisions with the devices. SNH considered for the 5 turbine array that the proposal is of a sufficiently small scale so as not to require consideration under the following conservation objectives[9]:

- Distribution of the species within site
- Distribution and extent of habitats supporting the species
- Structure, function and supporting processes of habitats supporting the species

[6] Partially underpinned by Hermaness Site of Special Scientific Interest (SSSI), Saxa Vord SSSI and Valla Field SSSI.

[7] The assessment of foraging ranges of bird species is based on the following sources:

Christ Eastham, Scottish National Heritage, The use of breeding seabird foraging ranges for assessing impacts to Special Protection Areas (SPAs) from wave and tidal renewable energy proposals, and

Thaxter et Al, Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas, Biological Conservation, December 2012

[8] Partially underpinned by the Yell Sound Coast Site of Special Scientific Interest (SSSI)

[9] MS-LOT Habitat Risk Assessment, November 2015

Section 5 provides further context on the potential impact of the six-device array in terms of disturbance, and section 6 discusses how monitoring and adaptive management can be used as mechanisms for managing any residual risk associated with this potential impact.

3.5 IMPACT tool

The Scottish Government has developed an online tool called IMPACT that allows developers to assess the impact of tidal and wave energy development on Scotland's marine ecological environment. The tool provides developers with an initial assessment and overview of:

- The key potential issues (impact pathways) affecting wildlife and natural heritage;
- Preliminary desk-based studies that can be undertaken to further assess the site-specific impacts;
- Further baseline characterisation surveys;
- Further desk-based studies; and
- Options for monitoring during and post installation.

The IMPACT tool allows Nova to identify the following potential impacts of extending the Shetland Tidal Array.

Table 3.1 Potential Impacts of expanding the array on marine mammals and basking sharks

Risk	Description	Comment
Barrier to Movement	Potential barrier to movement for marine mammals and basking sharks due to the physical presence of wave and tidal energy converters and associated moorings / support structures	The impact of adding one turbine to the project is unlikely to be significant, but key impact pathways are further considered in this Environmental Assessment Report. Potential impacts will continue to be addressed through measures to be set out in the PEMP, including surface and subsea video monitoring.
Displacement of Essential Activities	Potential displacement of essential activities of marine mammals and basking shark due to the presence of wave and tidal energy converters and associated moorings / support structures	
Collision	Potential for collision between marine mammals and basking shark and offshore wave and tidal energy converters and associated moorings / support structures	
Underwater Noise	The potential effects on marine mammals and basking shark from underwater noise generated by wave and tidal device operation.	
Noise above the surface	The potential effects on marine mammals from above surface noise generated by operations associated with wave and tidal energy converters.	

Table 3.2 Potential impacts of expanding the array on marine birds

Risk	Description	Comment
Displacement of Essential Activities	Potential displacement of marine birds due to the presence of wave and tidal energy converters and associated moorings / support structures	The scale of the project and the distance from the designated sites means the effects adding one more turbine to the project are unlikely to be significant, but key impact pathways are further considered in this Environmental Assessment Report. Potential impacts will continue to be addressed through measures to be set out in the PEMP.
Collision	Potential for collision between diving birds and the moving turbine blades of tidal energy converters	
Underwater Noise and Vibration	The potential effects on diving birds from underwater noise and vibration generated by wave and tidal energy converters	
Changes in Turbulence	Potential effects of changes in turbulence on foraging success of marine birds due to the presence of wave and tidal energy converters and associated moorings / support structures	

4 Assessment of potential impacts of the STA extension

4.1 Habitats Regulations Assessments undertaken in 2015

As part of Nova's existing Marine Licence (04859/15/1) and SIC Works Licence (2016/025/WL), Habitats Regulations Assessments (HRA) including Appropriate Assessments (AA) were carried out by Marine Scotland and Shetland Islands Council, in consultation with SNH. The AAs considered potential impacts of the STA on the qualifying features and conservation objectives of the following designated sites:

- Yell Sound Coast Special Area of Conservation
- Hermaness, Saxa Vord, and Valla Field Special Protection Area

As a result of their AAs, Marine Scotland and Shetland Islands Council concluded that the installation of devices in the STA would have no adverse effect on the features of designated sites. For the operation of the 5-turbine array, analysis was undertaken of the impact on the following species qualifying interests:

- the common/harbour seal at Yell Sound Coast SAC, and
- the gannet, guillemot, puffin, red throated diver, and shag at the Hermaness, Saxa Vord, and Valla Field SPA.

The AAs concluded that the 5-turbine array, operated in conjunction with an appropriate Environmental Management and Mitigation Plan (EMMP), would not on its own, or in-combination with other plans or projects, adversely affect the integrity of the designated sites.

4.2 Initial collision assessment for the 5-turbine array undertaken in 2015

To inform the AA, SNH undertook modelling to provide an estimate of the potential for encounters between the operating devices and sensitive receptors (species). The Encounter Rate Model (ERM), detailed within their own guidance on assessing collision risk between underwater turbines and marine wildlife[10], was used to establish the potential impact of the project on the following species: Harbour Seal; Puffin; Red-throated Diver; Northern Gannet; Guillemot; European Shag.

SNH have subsequently updated this modelling to allow for the additional sixth turbine. The updated results are presented in Section 4.3.

The ERM uses a physical model of the rotor and the body size and swimming activity of the animal to estimate a potential encounter (or collision) rate for the species assessed, based on the measured or estimated density of each of the species at the development location. The model contains a number of simplifications, whilst the lack of empirical information on near-field interactions between devices and wildlife further limits the accuracy of the calculations. As such, the outputs from the ERM provide a useful tool to indicate the possible magnitude of collision risk but should not be interpreted as a precise indication of collision risk. The outputs should be interpreted and contextualised, drawing on additional evidence and information.

The results of SNH's 2015 modelling (which assumed a 98% avoidance rate for all species assessed) can be found in Table 4.1 and Table 4.2

[10] Scottish Natural Heritage (2016). Assessing collision risk between underwater turbines and marine wildlife SNH guidance note.

Table 4.1 Collision Modelling on SPA qualifying features for Hermaness, Saxa Vord and Valla Field SPA (2015)

Species	Estimated annual mortality rate for 5-turbine array, BREEDING SEASON	Estimated annual mortality rate for 5-turbine array, ALL YEAR	SPA breeding population
Puffin	1.21	1.13	55,000
Red-throated diver	0.11	0.12	52
Northern Gannet	0.00	0.00	32,800
Common Guillemot	0.31	0.30	25,000
European Shag	4.06	9.37	900

Table 4.2 Collision Modelling on Harbour Seals for Yell Sound Coast SAC (2015)[11]

Species	Estimated annual mortality rate for 5-turbine array, BREEDING SEASON	Estimated annual mortality rate for 5-turbine array, ALL YEAR	Estimated annual mortality rate for 5-turbine array, Seals-at-sea density (availability accounted for)	Potential Biological Removal for Shetland
Harbour seal	0.14	3.30	3.33	20

4.3 Updated collision assessment for the 6-turbine array, undertaken in 2018

An updated Collision Risk Assessment was carried out by SNH in February 2018. This assessment revised the original assessment discussed above to include the deployment of a sixth turbine in the array. The results of the assessment (assuming a 98% avoidance rate) are summarised below.

Table 4.3 Collision Modelling on SPA qualifying interest for Hermaness, Saxa Vord and Valla Field SPA and Bluemull and Colgrave Sound pSPA (2018)

Species	Updated ERM model with 6-turbine array, BREEDING SEASON	Updated ERM model with 6-turbine array, ALL YEAR
Atlantic puffin	1.45	1.36
Red-throated diver	0.13	0.15
Northern gannet	0.00	0.00
Common guillemot	0.37	0.36
European shag	4.87	11.25

Table 4.4 Collision Modelling on SPA qualifying interest for Yell Sound Coast SAC (2018)

Species	Updated ERM model with 6-turbine array, BREEDING SEASON	Updated ERM model with 6-turbine array, ALL YEAR	Updated ERM model with 6-turbine array, Seals-at-sea density (availability accounted for)
Harbour seal	0.17	3.96	4.00

Table 4.5 Collision risk estimates for other marine mammals recorded in the Bluemull Sound (2018)

Species	Updated ERM model with 6-turbine array, BREEDING SEASON	Updated ERM model with 6-turbine array, ALL YEAR	Updated ERM model with 6-turbine array, SCANSII (Area J) (availability accounted for)
Grey seal	2.85	7.15	N/A
Harbour porpoise	N/A	2.20	1.74
Minke whale	N/A	0.16	1.06

Based on the updated Collision Risk Assessment, and assuming a suitable PEMP is agreed and implemented, SNH concluded the following[12]:

[11] For PBR see the Scottish Government website http://www.gov.scot/Topics/marine/Licensing/SealLicensing, accessed on 27/10/2017

[12] Advice received from SNH 09/02/2018

- “These collision rates will not lead to an adverse effect on site integrity for Hermaness, Saxa Vord and Valla Field SPA and Bluemull and Colgrave Sound pSPA”
- “This collision rate is unlikely to lead to an adverse effect on site integrity for Yell Sound Coast SAC”
- “These rates of collision do not necessitate mitigation for wider seal interests, as previously advised”
- “The rate of collision will not be detrimental to the maintenance of the populations of [Cetaceans] at a favourable conservation status in their natural range”
- “The Shetland Tidal Array will not have a negative impact on the conservation status of basking sharks”
- “The Shetland Tidal Array will not have a negative impact on the conservation status of black guillemot”

5 Context of predicted impacts of the STA extension

5.1 Preliminary results from environmental monitoring of the STA

Nova Innovation conducted an analysis of monitoring data collected from the STA, covering the period from August 2015 to January 2017. The review considered results from ongoing Vantage Point (VP) bird and mammal surveys, and subsea video data collected using cameras located on the turbines. Over 4,000 hours of video footage was analysed from the two turbines deployed during that period (T1 and T2).

Figure 5.1 A shoal of Atlantic Pollock at the T1 turbine, March 2016 *Source: Copyright © Nova Innovation 2018*

In analysis of video footage, no cases were observed of any collision between an animal and the turbine blades. Fish, birds and seals were observed on the cameras; however, both the fish and their predators were seen to exit the region of the turbine blades while the tide was flowing (and the blades were rotating), with fish moving to areas sheltered from the flow on the seabed. This behaviour, which should reduce the chance of interaction between marine animals and the blades, is not directly reflected in the parameters within the Encounter Risk Model, though a 98% avoidance rate was applied, based on the assumption that not all encounters would lead to collisions.

5.1.1 Summary of bird and mammal vantage point surveys conducted on-site

A continuous record of VP surveys has been undertaken at the Bluemull Sound site since November 2010. Approximately 3x 4-hour surveys have been conducted each month, recording: species, number, time, presence, location, behaviour, weather and sea-state.

Analysis has been conducted of 85 surveys conducted during the period from August 2014 to January 2017. A summary of the bird species observed on and around the site is given in Table 5.1. A summary of cetacean observations is given in Table 5.2. No basking sharks were observed during VP surveys.

Table 5.1 Summary of bird species observed in 85 VP surveys conducted between Aug 2014 and Jan 2017

Species	Number of counts in which species was recorded
Black guillemot	85
European shag	85

Northern gannet	53
Great black-backed gull	47
Common guillemot	47
Northern fulmar	45
Red-throated diver	34
Atlantic puffin	27
European herring gull	27
Common gull	21
Great cormorant	19
Black-legged kittiwake	12
Razorbill	11
Great skua	10
Arctic tern	8
Common eider	7
Long-tailed duck	7
Red-breasted merganser	5
Arctic skua	4
Eurasian wigeon	3
Great northern diver	3
Greylag goose	1
Storm petrel	1

Table 5.2 Summary of cetacean observations in VP surveys

Observation	Survey period	Total #individuals observed
Harbour porpoise	Aug 14 – Oct 14	29-32
Harbour porpoise	Nov 14 – Jan 15	5
Harbour porpoise	Feb 15 – Apr 15	9
Harbour porpoise	May 15 – Jul 15	4
Harbour porpoise	Aug 15 – Oct 15	70
Risso's dolphin	Aug 15 – Oct 15	3-4
Harbour porpoise	Nov 15 – Jan 16	40
Harbour porpoise	Feb 15 – Apr 16	55
Risso's dolphin	Feb 15 – Apr 16	20
Humpback whale	Feb 15 – Apr 16	2
Harbour porpoise	May 16 – Jul 16	12
Harbour porpoise	Aug 16 – Oct 16	19
Harbour porpoise	Nov 16 – Jan 17	25
Killer whale	Nov 16 – Jan 17	8-10

*Source: Copyright © Nova Innovation 2018, *Individual records, not necessarily different animals*

5.1.2 Summary of subsea video monitoring analysis results

Video footage collected during deployment and initial operation of T1 and T2 was analysed, covering the period from March 2016 to January 2017. Over 4,000 hours of footage were collected from six cameras located on the turbine nacelles at approximately 21m depth. Visibility was generally very good, providing clear images of the area swept by the blades and surrounding area. A small number of birds and seals were observed on the footage, but no interaction was observed between any animals and the turbine blades.

Table 5.3 Summary of bird and seal recordings in video analysis

Species	Date	Number of recordings*
Common seal	Oct 2015	2
	Nov 2015	9
	Mar 2016	1
	Sep 2016	1
European shag	Nov 2015	3
	Mar 2016	3
	Apr 2016	1
	Aug 2016	1
	Oct 2016	3
Black guillemot	Oct 2015	1
	Nov 2015	1
	Oct 2016	2
	Nov 2016	2

*Source: Copyright © Nova Innovation 2018; *Individual records, not necessarily different animals*

5.1.3 Ongoing monitoring of the array

There would be benefit in taking a more strategic approach to monitoring and data analysis for the project once a greater volume of data is available, and questions about methodology and monitoring will be addressed in the finalised PEMP. Section 6 discusses ongoing monitoring and data analysis as part of ongoing management of the project.

5.2 Disturbance and displacement effects

In their Appropriate Assessment of Nova's five-device STA project, Marine Scotland considered the possible effects of disturbance resulting from the project, on the features of the Hermaness, Saxa Vord and Valla Field SPA, Bluemull and Colgrave Sounds pSPA and Yell Sound Coast SAC. In undertaking this assessment, MS drew on advice from SNH. For all the assessed features of these sites, it was concluded that the effects of disturbance would be insignificant and there would be no adverse effect on the integrity of the sites. This assessment and the supporting evidence for its conclusions remain valid for the six-device STA.

Since Marine Scotland undertook this assessment of the possible impacts of the five-device STA, SNH have published a report presenting the analysis of land-based bird and mammal data gathered at the Billia Croo and Falls of Warness test sites at the European Marine Energy Centre (EMEC) in Orkney[13]. The study specifically investigated the potential influence of device installation, operation and related activity, on bird and mammal distribution and abundance to assess whether there were any displacement or disturbance effects.

Data from the Falls of Warness tidal test site off Eday indicated a change in density and redistribution of some bird species, including the great northern diver, black and common guillemot, cormorants, shags, ducks and geese, during construction work. However, in nearly all cases, numbers returned to around previous levels once the turbines were installed and operational. Observations of seals, whales and dolphins revealed similar findings. The analysis suggested the temporary effects of disturbance were likely to be due to increased vessel movements.

The vessels that Nova utilises for installation and operational activities—multicat vessels (Figure 5.2) or smaller—are significantly smaller and less intrusive that those often utilised at the EMEC test site.

[13] Long, C. 2017. Analysis of the possible displacement of bird and marine mammal species related to the installation and operation of marine energy conversion systems. Scottish Natural Heritage Commissioned Report No. 947.

Figure 5.2 Representative turbine deployment and retrieval vessel *Source: Leask Marine*

The Bluemull Sound is an active channel for shipping and the site is located next to a busy port. Cullivoe pier, located less than 1km from the site, is the 13th largest whitefish landing port in the UK[14], and is also busy year-round with traffic associated with the operation of nearby fish farms.

The level of activity in the vicinity of the site is illustrated in Figure 5.3, which shows surveys of Automatic Identification System (AIS) tracks from vessels in the Bluemull Sound from two, 2-week periods in July 2014 and February 2015. On a typical day, 10 or more AIS-enabled vessels pass within 1 km of the array site, with a similar level of activity observed for smaller, non-AIS enabled vessels. The AIS enabled vessels are of a similar size to, or larger than, the multicat vessels used for array operations.

[14] https://www.nafc.uhi.ac.uk/news/1-million-per-day.html

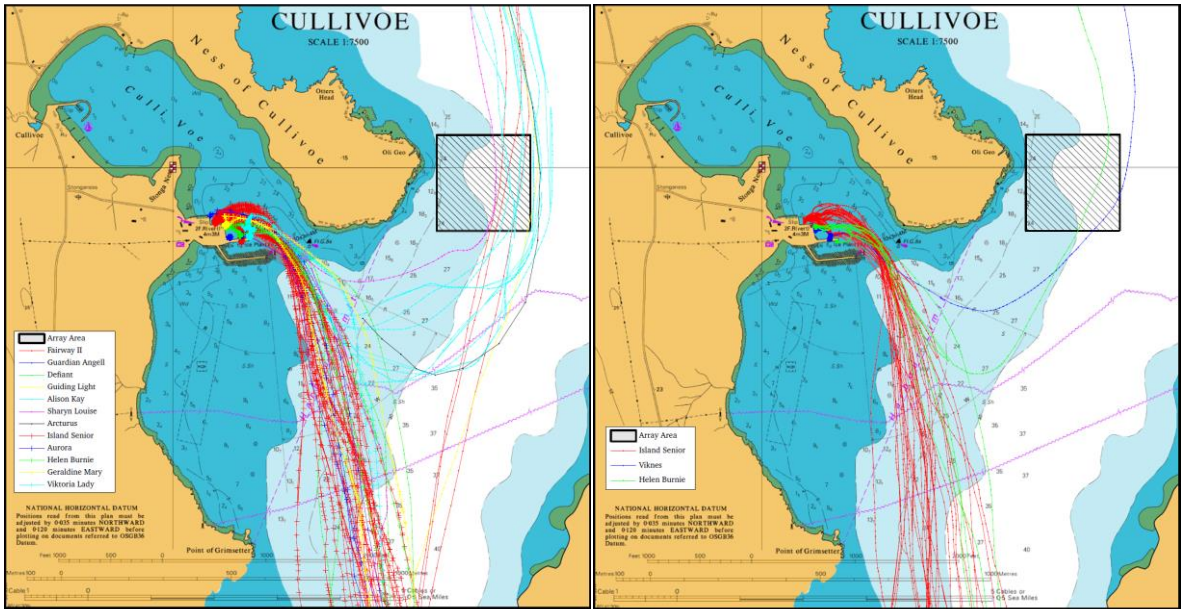

Figure 5.3 Vessel tracks from AIS surveys conducted over two 2-week periods in July 2014 (l) and Feb 2015 (r)
Source: Nova Innovation 2018

Given this local context, combined with the findings of the detailed analysis at EMEC, it would be reasonable and proportionate to assume that whilst the addition of a sixth turbine to the STA would be likely to increase the magnitude of any potential disturbance effects posed by the project, the impact is unlikely to be significant.

5.3 Interpretation of modelled encounter rates

5.3.1 Introduction

The outputs from the encounter modelling undertaken by SNH for the STA extension (based on 6 turbines) for diving birds and harbour seals are presented and discussed in the following section to provide some context for interpretation.

As stated in their 2016 guidance on collision risk modelling, and in their advice to Nova and Marine Scotland on this project, SNH consider that the principal concern about collision risks is likely to be whether levels of injury or death resulting from collisions will have an adverse effect on the species population. The SNH guidance goes on to state that to interpret whether additional mortality due to collisions would have an adverse effect on animal populations requires identification of the population affected by the collision mortality, and potentially a population viability analysis. Such population modelling requires a sound body of data – on the size and bounds of the population, age structure, and breeding success. Such a body of information is not readily available for the populations assessed within this report and to gather such information would not be proportionate to the risk that the small scale of this project poses, so a pragmatic approach has been taken to assessing the possible population consequences for populations in question, drawing on available evidence.

For all species, modelled encounter rates have been expressed as a percentage of the population associated with the corresponding protected site(s). For harbour seal, the modelled encounter rate has also been expressed as a percentage of the population of the Shetland Management Unit (MU) for the species, and in the context of the Potential Biological Removal (PBR) figure for this population, as calculated by the Sea Mammal Research Unit on behalf of Marine Scotland[15].

It is important to note that all the figures presented in this section require interpretation and should not be taken as definitive or absolute predictions of the likely impacts of the six turbine STA. The Encounter Risk Model on which the predicted encounter rates are based uses a physical model of the rotor and the body size and swimming activity of the animal to estimate a potential encounter rate for the species assessed, based on the

[15] For PBR see the Scottish Government website http://www.gov.scot/Topics/marine/Licensing/SealLicensing, accessed on 27/10/2017

measured or estimated density of each of the species at the development location. The model contains several simplifications, whilst the lack of empirical information on near-field interactions between devices and wildlife further limits the accuracy of the calculations. As such, the modelled encounter rates provide a useful tool to indicate the possible magnitude of the collision risk for the project, but they should not be interpreted as an absolute quantification of risk.

Similarly, figures expressing the modelled encounter rates in the context of populations of the protected species should not be interpreted as possible predicted declines in populations due to the six turbine STA. The overall effect of pressure or mortality on any population is the consequence of many different factors including existing pressures, density dependence and population demographics.

The modelled encounter rates and the figures presented within this Environmental Assessment Report should therefore be interpreted and contextualised, drawing on additional evidence and information, as discussed further in this section. Collision rates below are based on the updated collision assessment conducted by SNH in February 2018 and presented in section 4.3.

5.3.2 Quantification of encounters/collisions

Table 5.4 Modelled encounter rates for relevant (diving bird) features of Special Protection Areas

Species	Updated ERM model with 6-turbine array, ALL YEAR	SPA population	Annual encounters as % of population
Hermaness, Saxa Vord and Valla Field SPA			
Puffin	1.36	55,000 individuals*	**<0.01%**
Red-throated diver	0.15	26 pairs* 28 pairs**	**0.5 - 0.6%**
Northern gannet	0.00	12,000 pairs** 16,400 pairs*	**<0.01%**
Common guillemot*	0.36	25,000 individuals* 11,363 pairs**	**<0.01%**
European shag	11.25	450 pairs* 540 pairs**	**2.0 – 2.5%**
Bluemull and Colgrave Sound pSPA			
Red-throated diver	0.15	194 pairs***	**0.08%**

* Population cited in SPA citation and JNCC standard data form[16].
** Population cited in JNCC species account[17].
*** Population cited in SPA site selection document.

Table 5.5 Modelled encounter rate for harbour seal feature of Yell Sound Coast Special Area of Conservation

Species	Updated ERM model with 6-turbine array, ALL YEAR	SAC population* MU population**	Annual encounters as % of population	Potential Biological Removal for Shetland
Harbour seal	3.96	501—1,000 individuals* 3,039 individuals**	0.40—0.79% 0.13%	20

* Population cited in JNCC standard data form.
** Population for Shetland harbour seal management unit, from SCOS 2013[18].

[16] For JNCC Standard Data Forms, see http://jncc.defra.gov.uk/page-1409

[17] For JNCC Species Accounts see http://jncc.defra.gov.uk/page-1418

[18] SCOS 2013. Scientific advice on matters related to the management of seal populations, 2013. Available at: http://www.smru.st-andrews.ac.uk/pageset.aspx?psr=411

5.3.3 Model assumptions and contextual information

The modelled encounter rates detailed above are based on an assumed avoidance rate of 98%[19], since the outputs from the Encounter Risk Model do not take account of the probability that animals will avoid the site, choose routes of safe passage between turbines, or take successful evasive action in an escape response. The avoidance factor takes approximate account of these factors, but there remain precautionary assumptions within the model. Further, monitoring data gathered to date in and around the STA provide additional which should be considered when interpreting the outputs from the modelling exercise, as follows;

- The modelled encounter rates detailed above assume that an 'encounter' between a diving bird or seal with the turbines equates to a fatal collision, or an injury that will eventually lead to death. This is unlikely to be the case in reality.
- The modelled encounter rates are based on surface densities of birds and seals rather than underwater densities in or around the array area which would provide a more accurate quantification of the numbers of animals likely to be at risk of collision. There is currently no reliable methodology for gathering such data, particularly for birds and non-vocalising mammals. Underwater densities of wildlife interacting with the array are likely to be far lower than surface densities, since some birds and seals observed on the surface will be transiting through the area, and not diving and so at no risk of collision. Underwater camera footage to date gathered around the operating devices supports this assumption, with limited observations of birds and mammals in the underwater footage, even at times of relatively frequent greater surface observations[20].
- Concurrent observations from the underwater video footage and land-based Vantage Point surveys gathered as part of the monitoring programme strongly suggest that only a proportion of the birds and mammals observed in or around the array area are behaving in a way that would be expected to place them at actual risk of collision (i.e. diving or foraging). Even fewer were observed interacting directly with the turbines themselves. During the 4,000 hours of video footage analysed, there have been no observations of any marine wildlife colliding with the turbine blades.
- Modelled encounter rates have been expressed as a % of breeding bird populations associated with each SPA. A precautionary assumption has been made that if a single bird is removed, an entire breeding pair will be effectively lost from the population. This may be the case for species such as gannet or puffin, for which there is evidence that the species' mate for life. For other species this assumption may be unnecessarily precautionary, and it would be reasonable to assume that the loss of an individual will not lead to long term loss of a breeding pair of birds from the population. Further, this interpretation of the modelled encounter rates assumes that all losses will be adults of breeding age. This is clearly overly precautionary, given that all of the species breed in the locality, such that juveniles and sub-adults will also be present.
- The legal requirements to assess the impacts of the project on the features of protected sites which includes the SPA and SAC populations is acknowledged. However, seals and birds associated with the protected sites considered above are part of larger biogeographical populations. This is particularly important when considering whether the impacts of the STA will lead to population level consequences for the species in question.

The overall consequence of the points above is that the modelled encounter rates and interpreted figures in Table 5.1 and 5.2 are likely to be precautionary estimates of the actual collision risk, or of the likelihood that the project will negatively affect the population of the species in question. Figures in these tables indicate that the encounter or collision risk posed by the six turbine STA is unlikely to be of significant consequence for most species, with the possible exception of red-throated diver, European shag and harbour seal. Additional context to enable further interpretation and consideration of this risk for these species is therefore provided below.

[19] As stated in MS-LOT Appropriate Assessment for five device Shetland Tidal Array and SNH advise received on 09/02/2018

[20] Additional analysis of the monitoring data will enable this assumption to be tested and validated—see Section 6.

5.3.4 Further contextual information for Red-throated diver

Based on population size alone, the potential consequences of the modelled encounter rate are greatest for the population of birds associated with Hermaness, Saxa Vord and Valla Field SPA, as reflected in Table 5.1. However, the mean max foraging range for this species is 12.2 km[21] with a typical maximum foraging range of 10 km from the breeding site[22]. Statistically, birds encountering the array are far more likely to be associated with Bluemull and Colgrave Sounds pSPA, where the larger population size means any impacts are far less likely to affect population growth rate.

During the breeding season, birds forage primarily along the coast at tidal estuaries and over shallow sandy substrates close to their freshwater breeding territories[23]. The predominantly rocky habitat in which the STA is located is unlikely to be of optimal foraging value for the species, thus reducing the likely risk of collisions.

The typical range of depths for foraging dives by red-throated divers is cited as between 2 and 9m[24]. An analysis of the depth frequency distribution of 3,871 divers (unidentified but considered largely red-throated and black-throated diver) in the Kattegat showed that 88% of the observed divers were recorded in water of depths between 6m and 16m, with the largest group of records (20%) in the 10-12 m depth interval[25] (Petersen *et al.*, 2003). Although some birds may dive deeper, this evidence suggests that red-throated diver are unlikely to forage to the depth range of the turbines, which are located in water depths of 30 to 40m and maintain a minimum clearance of 15m between the tip of the blades and the surface, for navigational safety reasons.

Whilst red-throated divers have been observed during land-based VP surveys, no individuals have been observed on the underwater cameras, supporting the theory that the habitat in and around the STA is not of high foraging value for the species and that the species rarely forages to this water depth.

During the 4,000 hours of video footage recorded, there have been no observations of any marine wildlife colliding with the turbine blades. Whilst birds were observed on the cameras, they have not been observed near the swept area of the blades while the tide was flowing. The same behaviour was observed for fish species on which red-throated diver might prey. This behaviour should reduce the chance of any interactions between red-throated diver and the operating turbine blades.

In their Appropriate Assessment of Nova's five-device Shetland Tidal Array, Marine Scotland concluded no adverse effect on the integrity of the Hermaness, Saxa Vord and Valla Field SPA, with respect to possible effects on the red-throated diver feature. This conclusion drew on advice from SNH, that the predicted collision rate for the species was unlikely to lead to an adverse effect on site integrity of the SPA.

Whilst the addition of a sixth turbine to the STA would clearly increase the collision risk posed by the project, the evidence presented in this report indicates that the modelled encounter rates and interpreted figures in Table 5.1 for red-throated diver are likely to be very precautionary estimates of the actual collision risk and an unrealistic worst-case scenario. For reasons presented, the species is unlikely to come into close proximity with the turbines anything other than infrequently and monitoring to date supports this hypothesis. As a result, the collision risk is likely to be very low.

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[21] Thaxter CB, Lascelles B, Sugar M, Cook ASCP, Roos S, Bolton M, Langston RHW and Burton NHK (2012). Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biological Conservation **156**: 61-53.

[22] Black J, Dean BJ, Webb A, Lewis M, Okill D and Reid JB (2015). Identification of important marine areas in the UK for red-throated divers (*Gavia stellata*) during the breeding season. JNCC Report Number 541.

[23] Okill JD and Wanless S (1990). Breeding success and chick growth of red-throated divers *Gavia stellata* in Shetland 1979-1988. Ringing and migration **11**: 65-72.

[24] Cramp S. and Simmons KEL (Eds.). 1977. Handbook of the Birds of Europe, the Middle East and North Africa: the Birds of the Western Palaearctic, Volume I. Oxford University Press, Oxford.

[25] Petersen IK, Fox AD and Clausager I (2003). Distribution and numbers of birds in the Kattegat in relation to the proposed offshore wind farm south of Læsø - Ornithological impact assessment. Report commissioned by Elsam Engineering A/S. National Environmental Research Institute. 116 pp.

It would therefore be reasonable and proportionate to conclude that the STA extension will not result in any negative consequences for the red-throated diver populations associated with either the Hermaness, Saxa Vord and Valla Field SPA or the Bluemull and Colgrave Sound pSPA. This agrees with the conclusion reached by SNH in their updated collision assessment for the six-turbine array, conducted in February 2018, and summarised in section 4.3. As an additional mitigation measure however, Nova will continue with the operational monitoring and anticipate this will be conditioned within the licence.

5.3.5 Further contextual information for European shag

Whilst European shag are capable of foraging to depths which take them into the area swept turbine blades, the species feeds exclusively diurnally[26]. It is therefore reasonable to assume that the underwater video provides an accurate evidence base on likely any interactions around the operating devices. During the 4000 hours of video footage recorded, there have been no observations of any marine wildlife colliding with the turbine blades. Whilst European shag were observed on the cameras (11 individual recordings over 16 months of reviewed video data, not necessarily different animals), they were not observed near the turbine while the tide was flowing. The same behaviour was observed for fish species on which European shag might prey. This behaviour should reduce the chance of any interactions between birds and the operating turbine blades.

European shag have also been recorded in and around the Shetland Tidal Array location during land-based Vantage Point surveys. For 85 4-hour counts conducted between August 2014 and January 2017, European shag were observed in all of them. Of these observations, only a small proportion of the birds were observed diving or exhibiting foraging behaviour, indicating that many were simply transiting the area. This has significant implications for the assessment of collision risk for the species which was based on surface density of birds.

European shag is part of the seabird assemblage feature of the Hermaness, Saxa Vord and Valla Field SPA rather than an independently qualifying feature. Birds associated with the SPA are likely to be part of a much larger population associated with Shetland.

In their Appropriate Assessment of Nova's five device STA project, Marine Scotland concluded no adverse effect on the integrity of the Hermaness, Saxa Vord and Valla Field SPA, with respect to possible effects on European shag, which are part of the seabird assemblage feature of the site. This conclusion drew on advice from SNH, who undertook an apportioning exercise and stable population analysis to understand what the impacts might be within the context of all breeding shag colonies within foraging range of the STA development. These further analyses concluded that whilst the overall modelled encounter risk for European shag was 9.37 birds annually, of these between zero and one bird would be expected to originate from Hermaness, Saxa Vord and Valla Field SPA. SNH advised that this collision rate would be unlikely to lead to an adverse effect on site integrity of the SPA.

Whilst the addition of a sixth turbine to the STA clearly increases the collision risk posed by the project (see section 4.3), the evidence presented in this report indicate that the modelled encounter rates and interpreted figures in Table 5.1 for European shag are likely to be precautionary estimates of the actual collision risk and an unrealistic worst-case scenario. The conclusions drawn from the apportioning exercise and stable population analysis undertaken by SNH are that the collision risk is likely to remain very low with the addition of a sixth turbine to the array.

It would therefore be reasonable and proportionate to conclude that the STA extension will not result in any negative consequences for the European shag population associated with the Hermaness, Saxa Vord and Valla Field SPA, or the wider Shetland population. However, it is acknowledged that populations of European shag, including those in Shetland, have declined over the past few decades, due in part to mass mortality events (or 'wrecks') which occur during prolonged periods of onshore gales, when the species finds it hard to forage[27]. Whilst the additional possible impacts to the population as a result of the Shetland Tidal Array are not likely to

[26] BirdLife International (2018) Species factsheet: *Phalacrocorax aristotelis*. Downloaded from http://www.birdlife.org

[27] Heubeck M, Mellor MR, Gear S and Miles WST (2015). Population and breeding dynamics of European Shags *Phalacrocorax aristotelis* at three major colonies in Shetland, 2001–15. SEABIRD **28**: 55–77.

be significant, as an additional mitigation measure, Nova will continue with the operational monitoring programme associated with the Shetland Tidal Array and anticipate that this requirement will be conditioned within the licence.

Monitoring to date has indicated that European shag are identifiable from the underwater video footage, providing confidence that continued data gathering will enable a fuller evidence base to develop on how this species interacts with the devices. If monitoring indicates that additional measures to further reduce collision risk might be necessary at any point in the future, to maintain the integrity of the Hermaness, Saxa Vord and Valla Field SPA, such decisions will be able to draw upon the monitoring data. For example, analysis of monitoring data should enable a greater understanding for the functional importance of the array area for the species, or of key factors influencing collision risk.

5.3.6 Further contextual information for Harbour seal

During the 4,000 hours of video footage recorded, there have been no observations of any marine wildlife colliding with the turbine blades. Whilst harbour seals were observed on the cameras, they were not observed near the swept area of the blades while the tide was flowing. The same was observed for fish species on which animals might prey. This behaviour should reduce the chance of any interactions between harbour seal and the operating turbine blades.

Field trials to measure the response of harbour seals to simulated tidal turbine sound in a narrow coastal channel subject to strong tidal flow indicated significant spatial avoidance by animals[28]. These findings suggest that a proportion of seals encountering tidal turbines will exhibit behavioural responses resulting in avoidance of physical injury. Whilst the modelled encounter rates detailed in this report have factored in a degree of avoidance of the turbines by animals, this work provides further evidence that collision risk may not be as severe as worst-case scenarios might suggest.

In 2015, the Scotland Government commissioned field trials to improve the evidence base on the physical consequences of collisions between seals and the blades of operating tidal turbines[29]. The study involved a series of collision trials between grey seal carcasses, using a shaped rigid bar fixed to the keel of a jet drive boat, to simulate the leading edge of a turbine blade. Carcasses were impacted at a range of effective speeds from 1.95 m/s to 5.32 m/s and the resulting injuries assessed. In all simulated collisions there was no evidence of skeletal trauma, nor obvious signs of trauma such as tears, avulsions or rupture in the integument, musculature or organs. Whilst these are just preliminary results, the authors did conclude that it seems likely that a significant proportion of slow speed collisions with the tips of tidal turbines, at less than 5.32 m/s would not be fatal.

During normal operation (assuming 90% turbine availability) the maximum tip speed for Nova M100 turbine blades in the Shetland Tidal Array would be less than 5.32 m/s for 40% of the time (this includes time when the blades are either stationary during slack tide, rotating slowly when leaving or approaching slack tide, or the device is removed for or awaiting maintenance). This further reduces the likelihood of harbour seals suffering damage from collisions with the turbine blades.

In their Appropriate Assessment of Nova's five device STA project, Marine Scotland concluded no adverse effect on the integrity of the Yell Sound Coast SAC, with respect to possible effects on harbour seal. In reaching this conclusion, they took advice from SNH, drawing on detailed collision risk modelling for the species and on calculations of Potential Biological Removal for the Shetland harbour seal Management Unit. SNH considered that the modelled collision rate for the five-device array would be unlikely to lead to an adverse effect on site integrity of the SAC and noted the value of ongoing monitoring in support of this conclusion.

[28] Hastie GD, Russell DJF, Lepper P, Elliott J, Wilson B, Benjamins S and Thompson D (2017). Harbour seals avoid tidal turbine noise: Implications for collision risk. Journal of Applied Ecology **2017**:1-10.

[29] Thompson D, Brownlow A, Onoufriou J and Moss SEW (2015). Collision risk and impact study: Field tests of turbine blade-seal carcass collisions. Sea Mammal Research Unit, University of S Andrews. Report to Scottish Government No. MR 7.2.3.

Whilst the addition of a sixth turbine to the STA clearly increases the collision risk posed by the project, the evidence presented in this report indicate that the modelled encounter rates and interpreted figures in Table 5.2 for harbour seal are likely to be precautionary estimates of the actual collision risk and an unrealistic worst-case scenario. The conclusions drawn from the analysis undertaken by Marine Scotland and SNH for the five-device array remain valid with the addition of a sixth turbine.

It would therefore be reasonable and proportionate to conclude that the STA extension will not result in any negative consequences for the harbour seal population associated with the Yell Sound Coast SAC. However, it is acknowledged that declines in the abundance of harbour seals have been noted in recent years throughout most of Scotland, including in Shetland. Whilst the additional possible impacts to the population as a result of the Shetland Tidal Array are not likely to be significant, as an additional mitigation measure, Nova will continue with the operational monitoring programme and anticipate that this requirement will be conditioned within the licence.

Monitoring to date has indicated that harbour seal are identifiable from the underwater video footage, providing confidence that continued data gathering will enable a fuller evidence base to develop on how this species interacts with the devices. If monitoring indicates that additional measures to further reduce collision risk might be necessary at any point in the future, to maintain the integrity of the Yell Sound Coast SAC, any decisions will be able to draw upon the monitoring data. For example, analysis of monitoring data should enable a greater understanding for the functional importance of the array area for the species, or of key factors influencing collision risk.

6 Monitoring and Mitigation

6.1 Project Environmental Monitoring Programme

Only a small number of tidal turbines have been deployed globally to date, resulting in a correspondingly limited evidence base about their potential interactions with the environment. It is therefore not possible at the point of application to draw conclusions about possible environmental impacts with absolute scientific certainty. The conclusions presented in this report are based on best available evidence and what Nova consider to be reasonable assumptions about the likely impacts of the STA extension, proportionate to the scale, location and nature of the project.

However, to acknowledge residual uncertainty about key impacts such as collision risk, Nova will produce a Project Environmental Monitoring Programme (PEMP) detailing the activities that will be carried out to improve the evidence base on the environmental impacts of the array on the environment which in turn, will inform the ongoing management of the project. This will help validate the conclusions in this EAR and ensure that any residual uncertainty about impacts is managed within acceptable limits. Monitoring will be used to identify risk factors for key impacts such as collision risk, and will help inform understanding about possible mitigation and adaptive management should they be required.

In operating the existing Shetland Tidal Array, Nova Innovation has collated a unique data set of turbine operational and environmental data. Under the PEMP this data set will be extended, and used to inform ongoing management of the STA, as detailed above. This data has the potential to benefit the wider tidal energy industry by expanding the evidence base on potential environmental impacts of marine energy. Given the cost and potential wider benefit of this work, Nova Innovation has partnered with Marine Scotland to apply for European funding that would enable detailed analysis of this data, as well as further expanding the environmental dataset through the deployment of additional sensors at the site.

Central to the PEMP is the use of video monitoring to observe underwater interactions of wildlife with the turbines. Every Nova turbine is equipped with cameras that are triggered by the presence of wildlife. To date, no collisions between the turbines and wildlife have been observed (see section 5).

Nova anticipate that the requirement for environmental monitoring, and the PEMP, will form an integral part of the Marine Licence and Works Licence for the STA extension. The PEMP will be developed and agreed in consultation with Marine Scotland and Shetland Islands Council, with guidance from SNH, prior to the deployment of the additional, sixth, turbine. Nova appreciate the guidance and advice received to date from SNH on the monitoring programme and will work with them to finalise and deliver the PEMP. Nova are fully committed to delivering on the monitoring requirements for the array and in recognition of the importance of monitoring, have employed an Environment Manager to oversee this programme.

7 Conclusion

This Environmental Assessment Report (EAR) has been prepared in support of Nova's applications for a Marine Licence from Marine Scotland and a Works Licence from Shetland Islands Council for extending the Shetland Tidal Array from 5 to 6 turbines.

The EAR provides the following key information:

- Identification of potential environmental impacts of the STA extension
- Assessment of the key potential environmental impacts
- Contextualisation of the potential environmental impacts
- Approach to mitigating and addressing residual uncertainty about key environmental impacts.

Based on earlier advice from MS-LOT and SNH, collision of the turbine blades with marine mammals and birds was identified as the most significant environmental risk for the proposed extension. The EAR presents the results of a revised collision risk assessment conducted by SNH, which found that there would be no adverse impacts of extending the array from 5 to 6 turbines, assuming a suitable PEMP is agreed and implemented for the array.

Nova Innovation will develop a PEMP for the array in consultation with Marine Scotland and Shetland Islands Council, and with guidance from SNH and other statutory consultees.

Appendix A List of designated sites potentially linked to the project

Table A.1 Designated Sites potentially linked to the project

Site Name	Designation Status	Date of Designation	Qualifying Features	Conservation Objectives	Site conditions
Hermaness, Saxa Vord & Valla Field	Special Protection Area	29/03/1994	Fulmar (Fulmarus glacialis), breeding, Gannet (Morus bassana), breeding, Great skua (Catharacta skua), breeding, Guillemot (Uria aalge), breeding, Kittiwake (Rissa tridactyla), breeding, Puffin (Fratercula arctica), breeding, Red-throated diver (Gavia stellata), breeding, Shag (Phalacrocorax aristotelis), breeding	To avoid deterioration of the habitats of the qualifying species (listed) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and to ensure for the qualifying species that the following are maintained in the long term: - Population of the species as a viable component of the site - Distribution of the species within site - Distribution and extent of habitats supporting the species - Structure, function and supporting processes of habitats supporting the species - No significant disturbance of the species	Favourable: Fulmar, Gannet, Great Skua, Guillemot, Puffin, Seabird Assemblage Unfavourable: Kittiwake, Red-Throated Diver, Shag
Yell Sound Coast	Special Area of Conservation	17/03/2005	Harbour seal (Phoca vitulina), Otter (Lutra lutra)		Favourable: Harbour Seal Unfavourable: Otter
Yell Sound Coast	SSSI	17/03/1998	Otter (Lutra lutra)		Considered as part of the Yell Sound Coast SAC
Bluemull & Colgrave Sounds	Proposed Special Protection Area	At consultation Stage	Red-throated diver (Gavia stellata), breeding		N/A
Fetlar	Special Protection Area	29/03/1994	Arctic skua (Stercorarius parasiticus), breeding, Arctic tern (Sterna paradisaea), breeding, Dunlin (Calidris alpina schinzii), breeding, Fulmar (Fulmarus glacialis), breeding, Great skua (Stercorarius skua), breeding, Red-necked phalarope (Phalaropus lobatus), breeding, Seabird assemblage, breeding, Whimbrel (Numenius phaeopus), breeding		Favourable: Arctic skua, Arctic tern, Dunlin, Great skua, Red-necked phalarope, Seabird assemblage, Whimbrel Unfavourable: Fulmar
Foula	Special Protection Area	27/11/1995	Puffin (Fratercula arctica), breeding, Red-throated diver (Gavia stellata), breeding, Arctic tern (Sterna paradisaea), breeding		Favourable: Red-throated diver Unfavourable: Puffin, Arctic tern
Mousa	Special Protection Area	27/11/1995	Arctic tern (Sterna paradisaea), breeding		Unfavourable
Noss	Special Protection Area	16/08/1996	Gannet (Morus bassanus), breeding, Puffin (Fratercula arctica), breeding		Favourable: Gannet Unfavourable: Puffin

Otterswick & Graveland	Special Protection Area	31/12/2001	Red-throated diver (Gavia stellata), breeding		Favourable
Fair Isle	Special Protection Area	16/12/1994	Gannet (Morus bassanus), breeding, Puffin (Fratercula arctica), breeding		Favourable: Gannet Unfavourable: Puffin
Sule Skerry & Sule Stack	Special Protection Area	29/03/1994	Gannet (Morus bassanus), breeding		Favourable
North Rona & Sula Sgeir	Special Protection Area	30/10/2001	Gannet (Morus bassanus), breeding		Favourable
St Kilda	Special Protection Area	31/08/1992	Gannet (Morus bassanus), breeding		Favourable

Appendix B Potential STA impact on other designated sites

The distance from the array to each potentially linked designated site (see Appendix A) was calculated. Foraging distance was used to identify potentially impacted species within each designated site; only those species within foraging distance of the array are included in the analysis below.

The approach adopted was to consider the same annual mortality rates shown in Table 4.3, which is informed by observations taken at the site. For all relevant species in each designated site, this mortality rate was then calculated as a percentage of the population to indicate the maximum potential impact of the six-turbine array on each designated site.

Note that the potential impacts below should not be added together to produce a total cumulative impact across all linked sites. The total impacts are assumed to be the values given in Section 4.3: the results below provide context by illustrating the small scale of these impacts on potentially linked designated sites.

Table B.1 Potential impact on Fetlar

Species	Estimated annual mortality rate for 6-turbine array	SPA breeding population	Mortality rate as % of population
Arctic skua	Of these species, only the Arctic tern is a diving bird, often employing plunge diving to gather food. The diving depth of the Arctic Tern is unlikely to be more than 50cm, therefore the Arctic tern will not encounter the turbines[30].		
Arctic tern			
Dunlin			
Fulmar			
Great skua			
Red-necked phalarope			
Whimbrel			

Table B.2 Potential impact on Foula

Species	Estimated annual mortality rate for 6-turbine array	SPA breeding population	Mortality rate as % of population
Atlantic puffin	1.36	96,000	**0.00%**
Red-throated diver	0.15	22	**0.68%**
Arctic Tern	The diving depth of the Arctic Tern is unlikely to be more than 50cm. As such, the Arctic tern will not encounter the turbines.		

Table B.3 Potential impact on Mousa

Species	Estimated annual mortality rate for 6-turbine array	SPA breeding population	Mortality rate as % of population
Arctic Tern	The diving depth of the Arctic Tern is unlikely to be more than 50cm. As such, the Arctic tern will not encounter the turbines.		

[30] Natural England Technical Information Note TIN137, Arctic tern: species information for marine Special Protection Area consultation, available at:

http://publications.naturalengland.org.uk/publication/3740693?category=9001, accessed on 27/10/2017

Table B.4 Potential impact on Noss

Species	Estimated annual mortality rate for 6-turbine array	SPA breeding population	Mortality rate as % of population
Northern Gannet	0.00	25,000	**0.00%**
Puffin	The puffin is part of the breeding assemblage; no SPA breeding population figures are available for puffins at this site.		

Table B.5 Potential impact on Otterswick & Graveland

Species	Estimated annual mortality rate for 6-turbine array	SPA breeding population	Mortality rate as % of population
Red-throated diver	0.15	54	**0.28%**

Table B.6 Potential impact on Fair Isle

Species	Estimated annual mortality rate for 6-turbine array	SPA breeding population	Mortality rate as % of population
Northern Gannet	The gannet is part of the breeding assemblage. No SPA breeding population figures are available for gannets at this site.		
Puffin	The puffin is part of the breeding assemblage. No SPA breeding population figures are available for puffins at this site.		

Table B.7 Potential impact on Sule Skerry & Sule Stack

Species	Estimated annual mortality rate for 6-turbine array	SPA breeding population	Mortality rate as % of population
Northern Gannet	0.00	9,780	**0.00%**

Table B.8 Potential impact on North Rona & Sula Sgeir

Species	Estimated annual mortality rate for 6 turbines	SPA breeding population	Additional mortality rate as % of population
Northern Gannet	0.00	18,000	**0.00%**

Table B.9 Potential impact on St Kilda

Species	Estimated annual mortality rate for 6 turbines	SPA breeding population	Additional mortality rate as % of population
Northern Gannet	0.00	120,800	**0.00%**