CHAPTER 3: SITE SELECTION AND ALTERNATIVES

INTRODUCTION

3.1. As set out in Chapter 1 (Introduction), the original Seagreen Project (herein referred to as the originally consented Project) received development consents from Scottish Ministers in 2014. This was confirmed in November 2017, following legal challenge to the consent award decision. Seagreen is now applying for additional consents for an optimised design (herein referred to as the optimised Seagreen project), based on fewer, larger, higher capacity wind turbines that have become available since the 2014 consent decision and inclusion of monopiles as a foundation option.

3.2. The Seagreen Project is located within Phase 1 of the Firth of Forth Round 3 Offshore Wind Zone (the Zone) and comprises two component offshore wind farm projects, Project Alpha and Project Bravo and the offshore Transmission Asset Project. The offshore Transmission Asset, licensed separately, remains unchanged and is therefore not included within this assessment.

3.3. Project Alpha and Project Bravo have been defined through the Seagreen Zone Appraisal and Planning (ZAP) process and were subsequently assessed in the 2012 Offshore ES. Further studies and refinement of the Projects have continued since 2012, to ensure advances in technology and construction methods can be included within the scheme design, as part of the design evolution process. However, the location, area and boundaries of the Project(s) have not changed from that assessed within the 2012 Offshore ES.

3.4. This chapter presents an overview of the Phase and Site selection process for the Seagreen Project within the Zone. Alternatives that Seagreen considered in terms of number, size and capacity of turbines, types of foundations and layouts are summarised in relation to the optimised design and the key alternative, which would be developing the Seagreen Project as the originally consented Project.

3.5. All figures referred to in this chapter can be found in Volume II: Figures.

SITE SELECTION AND ALTERNATIVES

Site/Phase Selection within the Firth of Forth Zone

3.6. Site selection for the proposed optimised Seagreen Project comprised the following stages:

- Initial zone selection in 2008, undertaken by The Crown Estate following their SEA and Round 3 (R3) zone identification process;
- Followed by the subsequent stages undertaken by Seagreen:
  - Identification of three development Phases within the Firth of Forth Zone;
  - ZAP (A discretionary, non-statutory process to aid developers in managing development risks within their zones (The Crown Estate, 2010); and
  - Identification of the Project Alpha and Project Bravo sites within the Phase 1 development area of the Zone.

3.7. The R3 offshore wind development programme instigated by The Crown Estate in 2008 was designed to facilitate delivery of a larger scale of Offshore Wind Farm (OWF) development than had previously occurred in the UK. Strategic national planning for R3 was undertaken jointly by the Department of Energy and Climate Change (DECC) and The

Crown Estate in 2008/2009. Suitable areas for the development of offshore wind were assessed through the statutory process of SEA which was undertaken by DECC (DECC, 2009). This ensured that the R3 zones were carefully selected and consulted upon, to identify most suitable areas for large scale wind energy development in UK waters, meeting DECC objectives.

3.8. Through the process led by The Crown Estate, nine OWF development zones (the R3 zones) were identified and tendered within the area covered by the SEA. The total target generation capacity for the R3 programme was identified as 32.2GW, with a target of 25GW operating, or in construction by 2020.

3.9. In response to the call for bids by The Crown Estate, in 2009 Seagreen submitted a proposal and was awarded the exclusive developments rights to the R3 Zone 2 (named the 'Firth of Forth Zone'). Seagreen and the Crown Estate then entered into a Zone Development Agreement (ZDA) in January 2010, with a target Zone generation capacity of circa 3.5GW.

3.10. The ZDA grants Seagreen certain rights over the seabed within the Zone, including the right to identify specific areas for the development of OWFs. Seagreen does not have these rights outside the area described within the ZDA. Therefore, the ability to select alternative OWF sites has been constrained by the work undertaken at national level, in selecting zones which were suitable for offshore wind development. However, the Zone covers sufficient area to allow Seagreen a degree of flexibility in identifying the most appropriate areas to develop, based on the potential constraints within the Zone. While the boundary of the Zone is fixed, development phase and project boundaries remain flexible within the Zone.

3.11. The main considerations for selection of preferred sites for OWF development are environmental, engineering and economic factors and seeking to avoid areas which are unsuitable (for example as a result of seabed geology), or areas where the project would not be economically viable (for example where the wind resource is insufficient).

3.12. Seagreen considered that for project financing and supply chain availability reasons, there was a sensible upper limit to individual projects of a nominal 500MW capacity. Therefore at the R3 bid stage, the larger potential development areas identified within the Zone were split into smaller indicative project areas with potential capacities of this scale. A phased approach to delivery of these projects was then defined, to achieve the target zone capacity. This was based around prioritising those areas considered to have the least potential constraints and considering the practicalities of resourcing delivery of the target capacity for the Zone.

3.13. Seagreen adopted the ZAP approach, considering the Zone as a whole, to collate data on the potential environmental and engineering constraints within the Zone and to define Phase and Project boundaries in a rational and strategic manner, in order to identify the area's most suitable for development. In summary, Seagreen adopted the ZAP process to:

- Present an overview of the baseline data and information relevant to the Zone and its wind farm projects;
- Define the most suitable areas for development in the Zone;
- Document key decisions;
- Consider potential cumulative and in-combination effects at a Zone level; and
- Engage with key consultees early in the development process with respect to Zone planning and site selection.

3.14. The Seagreen ZAP was set out as an iterative process which would continue for further phases/projects within the Firth of Forth Zone. To date, three ZAP reports have been issued by Seagreen, to inform stakeholders about this process.

3.15. An initial ZAP report was issued in June 2010 (Seagreen, 2010a) to The Crown Estate, Marine Scotland and other interested parties. This described the initial site identification process, comprising a detailed, desk based assessment of constraints to development. This ZAP report informed the Zone Consenting Strategy (Seagreen, 2010b) and presented the ranking of sites based on the level of constraint and the ability to construct. The Seagreen strategy was the development of seven OWFs within three phases. The phase boundaries were designed to permit maximum flexibility for each OWF site within it. Phase 1, consisting of Project Alpha and Project Bravo, was considered to be the least constrained for development. The initial boundaries of each Phase within the Zone, after the initial ZAP work, are shown in Figure 3.1.

Boundary Refinement for the Seagreen Project (Project Alpha and Bravo)

3.16. Following completion of the first ZAP report, significant additional environmental baseline data was gathered through specialist surveys and studies, to inform the 2012 Offshore ES. Seagreen therefore issued a ZAP Update Report in December 2011 (Seagreen, 2011) which presented the following:

- Current data availability and Seagreen survey results;
- Revisions to proposed site boundaries for Project Alpha and Project Bravo; and
- Potential changes to project boundaries for Phase 2 and Phase 3.

3.17. Table 3.1 summarises the data updates presented in the 2011 ZAP Update Report (Seagreen, 2011).

3.18. The shallowest water depths within the initial Phase 1 area identified occur in the immediate area over the Scalp Bank. Initial surveys suggested that the Scalp Bank area is of higher importance to ornithology, marine mammal and fishing interests. To reduce the potential impact on these interests, Seagreen delimited waters of 40m depth or less as representing the Scalp Bank (see Figure 3.2) and excluded this area from consideration for development in Phase 1. The initial Phase 1 boundary and the refined Project Alpha and Project Bravo boundaries are shown in Figure 3.1 and Figure 3.2 respectively. This is the overall boundary for both projects that was assessed in the 2012 Offshore ES. At this stage an indicative north to south boundary was used to distinguish between the two projects. Further decisions regarding the location of Project Alpha and Project Bravo within this boundary are described in Section 'Seagreen Project Design Evolution: Location' of this chapter.

3.19. In summary, the initial Phase 1 boundary was revised to exclude the Scalp Bank feature following the initial modelling of collision risk for birds and consideration of ornithology impacts. Potential effects on marine mammals and migratory fish and the potential for conflict with the fishing industry, particularly with regard to scallop dredging was also considered.

3.20. By specifically developing away from a location of apparent ecological sensitivity, Seagreen proactively sought to minimise adverse impacts upon features of environmental sensitivity. The flexibility to adjust site boundaries within the Zone extent, to mitigate potential impacts, while maintaining site capacity was a key element of The Crown Estate's zonal approach for R3.

Table 3.1 Zone Environmental Data to Inform ZAP Update Report, 2011

Parameter	Data Update Summary
Physical Environment	Geophysical survey of Phase 1 and Export Cable Route (ECR) corridor area (2010) - bathymetry, seabed sediment features and sub-bottom profiles. Preliminary geotechnical survey of Phase 1 area (2011) comprising borehole samples and core penetration tests. UK Hydrographic Office (UKHO) multibeam bathymetry data of the Zone (~90% coverage). Metocean survey outputs. Met Office 10-year wind dataset.
Water and Sediment Quality	Analysis of contaminants in a number (~50) of grab samples collected (150) as part of the benthic ecology survey within the Phase 1 and ECR corridor area.
Ornithology	24 months of boat-based survey sightings data covering the entire Zone, with analysis and reporting of initial 12 months bird survey data in 2011, followed by analysis of 24 months data in 2012 after 2011 ZAP update). Sightings data gathered during aerial surveys commissioned by The Crown Estate (2009/2010). Bird tracking studies of Special Protected Areas (SPA) species undertaken in 2010.
Benthic Ecology and Intertidal Ecology	Phase 1 and ECR corridor area benthic survey (benthic grabs, drop down video survey, epibenthic trawls) completed in 2011. Phase 1 and ECR corridor area benthic habitat map.
Natural Fish and Shellfish Resources	Updated fish and shellfish spawning and nursery ground maps produced by Centre for Environment, Fisheries and Aquaculture Science (Cefas). Phase 1 and ECR corridor area benthic survey epibenthic trawl data. Multiple datasets relating to fish ecology and life cycle, fishing activity from Marine Scotland.
Marine Mammals	18 months of boat-based survey sightings data, covering the entire Zone (2009 to 2011) Incidental sightings data gathered during aerial surveys commissioned by The Crown Estate (2009 to 2010). Analysis of existing seal telemetry data.
Commercial Fisheries	Fisheries activity charts issued by Marine Scotland.
Shipping and Navigation	Updated vessel tracking data resulting from Automated Identification System (AIS) survey. Summer and winter radar surveys (2010 to 2011) carried out for the Forth and Tay Offshore Wind Developers Group (FTOWDG)
Archaeology and Cultural Heritage	Geophysical seabed anomalies within Phase 1 and ECR corridor area identified in survey.
Military and Civil Aviation	Desk-based assessment of potential aviation issues to be taken into account in Zone development. Closure of a military Practice and Exercise Area (PEXA) within the Zone.

3.21. The repositioning of the Phase1 boundary further to the east has increased the distance of the nearest turbines from the coastline by up to approximately 10km. This is helpful in reducing the visibility of the wind farm for a number of reasons, not least because the turbines are all at least 50% further offshore than the nearest boundary of the Round 3 zone allows. The increased distance from the coastline also means that the screening effects associated with Earth's curvature will also have a greater influence in reducing visibility. Additionally, Met Office visibility data indicates that turbines sited at 20km distance from the coastline will be visible for approximately 64% of the days within a year (234 days) compared to only 37% (135 days) when sited more than 30.1km from the coastline. The Seascape, Landscape and Visual Amenity (SLVIA) assessment in Chapter 13 of this EIA Report expands upon these reduced levels of visibility.

Seagreen Project Design Evolution: Location

3.22. Seagreen further considered the environmental (consent) and the engineering (buildability) constraints to development with reference to the data updates presented in the ZAP update report (Seagreen 2011) and summarised in Table 3.1. Boundary implications arising from the key environmental constraints identified are given in Table 3.2. Potential mitigation was achieved by limiting development within environmentally constrained parts of the Zone influencing site boundaries.

Table 3.2 Summary of Constraint Implications for Phase 1 Boundaries

Topic	Phase 1 Constraint within Original Phase 1 Boundary	Identified Response to Constraint
Ornithology	Recommendation that the original Phase 1 boundary may have a significant impact due to predicted level of collision for key protected species based on 2010 data and collision modelling.	Relocate the Project Alpha and Project Bravo Site boundaries to the east to reduce collision and displacement risk.
Marine mammals	Potential for effects upon passage of bottlenose dolphins, due to piling noise. Potential auditory injury and behavioural impacts due to piling noise on harbour seals foraging within or in close proximity to the Zone.	Relocate the Project Alpha and Project Bravo Site boundaries to the east to reduce potential effects.
Commercial fisheries	Potential conflict with fishing activity, principally scallop dredging, with higher intensity in western part of Phase 1.	Relocate the Project Alpha and Project Bravo Site boundaries to the east, to avoid higher intensity scallop dredging areas and reduce potential conflict with fishing activity.
Natural fish and shellfish resources	Potential for effects upon migratory fish due to piling noise.	Relocate the Project Alpha and Project Bravo Site boundaries to the east, to increase distance to salmon rivers and reduce potential impact upon migratory fish.
SLVIA	Potential visibility of WTG on the western Phase 1 boundary from coastal viewpoints.	Relocate the Project Alpha and Project Bravo site boundaries to the east by up to approximately 10km, to reduce levels of visibility.

3.23. Subsequent to this, and based on a further review of consenting strategy options, Seagreen finalised the Project Alpha and Project Bravo Site areas taken forward into the 2012 Offshore ES and consent applications, to a north east to south west project boundary. The basis for this decision was to achieve two comparable OWF assets with broadly equal site area, wind resource and capacity that could be constructed and operated separately, if this strategy for delivery was adopted by Seagreen. At this time Seagreen also defined the site capacities and Wind Turbine Generator (WTG) parameter ranges. These are described in Chapter 5 (Project Description) of this EIA Report, with reference to design updates as a result of further studies carried out since 2012 and developments in technology.

3.24. The decision by Seagreen to relocate the Project Boundaries to the east of Scalp bank also reduced:

- The potential impacts on seabirds, marine mammals and on commercial fishing activity in the Zone; and
- The potential cumulative and in-combination effects with the two other Scottish Territorial Waters (STW) Projects, the Inch Cape and Neart na Gaoithe OWFs (see Figure 6.1), in relation to seabirds, marine mammals and commercial fishing and potentially also in relation to shipping and navigation and physical processes.

3.25. As set out above, by specifically developing away from a location of apparent ecological sensitivity Seagreen was proactively seeking to minimise adverse impacts upon features of environmental sensitivity.

SEAGREEN PROJECT DESIGN EVOLUTION AND ALTERNATIVES

3.26. Throughout the development process for the Seagreen Project there has been a dynamic relationship between environmental constraints and engineering requirements, in order to retain design flexibility whilst seeking to minimise and mitigate potential environmental impacts.

3.27. The main alternative to the optimised Seagreen Project is the originally consented project. The parameters of the consented and optimised projects are summarised in section 'Project Design' of this chapter and further details of key parameter alternatives considered in the design process are then discussed.

Design Envelope Parameters

3.28. As discussed in Chapter 6 (EIA Process), a parameter based approach to defining the design, known as the 'Rochdale Envelope' principle, has been adopted for assessment purposes. This is referred to as the project 'Design Envelope' in this EIA Report.

3.29. The envelope, defining the range of parameters for the OWFs was developed based on a series of design decisions taken by Seagreen and is provided in detail within Chapter 5 (Project Description) of this EIA Report.

The Project Design

3.30. The optimised Seagreen Project comprises:

- Seagreen Alpha OWF ('Project Alpha') and Seagreen Bravo OWF ('Project Bravo') with a maximum of 70 WTGs in both Project Alpha and Project Bravo and a maximum of 120 WTGs in total across both Sites.

3.31. The offshore Transmission Asset Project infrastructure (which includes the Offshore Substation Platforms [OSPs] and export cables to transport the power generated by the OWFs to the landfall) remains consented and no changes are proposed, therefore no further assessment is required.

3.32. The original consents awarded in 2014, enable the construction, operation and decommissioning of:

- Up to 75 Wind Turbine Generators WTGs in both Project Alpha and Project Bravo (150 in total);
- Up to six Meteorological masts (three in each OWF project);
- Up to six wave buoys (three in each OWF project);
- Up to five OSPs; and
- Up to six export cables.

3.33. The key design parameters for the optimised Seagreen project, in comparison to the 2014 consented project are summarised in Table 3.3. Design parameters are provided for Project Alpha, Project Bravo and where relevant, for the wind farms combined. For ease of reference, design parameters that have been optimised are highlighted.

3.34. Full details of the Project Design Envelope and the changes that have been made to optimise the project since the 2014 consents are provided in Chapter 5 (Project Description).

3.35. The following sections summarise the alternative key design parameters that have been considered in defining the optimised Seagreen Project. The parameters considered are;

- WTGs, number and size;
- OWF Capacity and Indicative Array Layout; and
- Offshore Windfarm Structures, in particular with regard to the inclusion of monopiles as a foundation option.

Wind Turbine Generators, Number and Size

3.36. The optimised Seagreen Project design is based on fewer, larger, higher capacity wind turbines that have become available since the 2014 consent decision. The initial design basis for the Seagreen Project in the 2012 Offshore ES was drawn from a market assessment of WTG models currently available and in development, and review of publicly available information on seabed topography and ground conditions. Evaluation of WTG options at the time was based on parameters for a WTG capacity range of between 3.6MW to 7MW, representative of the extent of existing proven WTG technology, as well as likely available WTG technology at the time of construction (Seagreen, 2012).

3.37. Experience and technical understanding from other projects, including those Round 3 offshore wind farms that that were successfully consented and are now commencing construction, or are operational, have also been considered. At the present time, the potential availability of WTGs up to 15MW capacity is considered realistic within the revised Project timescales and the dimensions of these turbines are therefore now considered as a design option, setting the limits of the design envelope.

3.38. Two design envelope adjustments were made by Seagreen during the two year determination of consents, following the 2012 submission of offshore applications and the 2012 Offshore ES. During this period the Seagreen Projects and two other projects in STW were all being determined in parallel. As there was an unresolved cumulative effects issue, Seagreen committed to an increased minimum blade tip clearance in order to further reduce predicted collision impacts, reducing predicted gannet and kittiwake mortalities and an increased minimum separation distance between WTG (as discussed below) in order to reduce displacement effects on auks.

3.39. The 2014 consents gave permission for up to 75 WTGs each in the Project Alpha and Bravo Sites (up to 150 WTGs in total for both projects), with a maximum rotor diameter of 167m and a maximum blade tip height of up to 209.7m. Seagreen are now applying for consents for an optimised project design, with the addition of a new option of larger WTGs of up to 220m rotor diameter and up to 280m blade tip height. The maximum number of WTGs would be reduced to 70 within each of the Project areas and not more than 120 WTGs in total for both projects. The design envelope for this EIA Report therefore considers a maximum number of 120 WTGs.

3.40. In summary and as set out in Table 3.3 the Seagreen project has been optimised since the award of the original consents in 2014. The key WTG design parameters that have been changed include:

- The maximum combined number of WTGs has reduced to from 150 to 120.
- The 2014 consented maximum rotor diameter has increased from 167m to 220m;
- The 2014 consented maximum blade tip height has increased from 209.7m to 280m;
- The 2014 consented minimum blade tip clearance has been increased from 29.8m to 32.5m; and
- The 2014 foundation options have been expanded to include the introduction of a monopile foundation option at up to 70 locations.

Offshore Wind Farm Capacity and Indicative Array Layout

3.41. The initial, combined capacity for Project Alpha and Project Bravo was derived from a uniform distribution of regularly 'standardised' spaced WTGs across the project areas, identified at desk study stage, based on a nominal 5MW WTG capacity. The 1,050MW connection agreement with National Grid established on this basis then formed the upper capacity limit.

3.42. Evaluation of WTG options by Seagreen for the 2012 Offshore ES was based on parameters for a WTG capacity range of between 3.6MW to 7MW, representative of the extent of existing proven WTG technology, as well as likely available WTG technology at the time of construction (Seagreen, 2012). Achieving the target capacity across both Sites therefore implied installation of up to 299 WTGs (WTG rated at 3.6MW).

3.43. Following initial collision risk modelling for birds (see Chapter 10 (Ornithology)) of the 2012 Offshore ES), Seagreen took a decision to remove parameters associated with the lower capacity WTG options from consideration. This had the beneficial effect of limiting the total number of WTGs and lowering the total swept area within each Site, thus significantly reducing the risk of collisions. These decisions and the Design Envelope assessed in the 2012 Offshore ES Seagreen effectively set an upper limit of 75 WTGs within each of the Project Alpha and Project Bravo areas, giving an upper limit of 150 WTGs for both projects combined.

Table 3.3 Summary of Key Parameters of the Originally Consented Project (2014) and the optimised Seagreen Project Design Parameters for Project Alpha and Project Bravo

Design Parameter	2014 Consented Project			2018 Optimised Project		
	Project Alpha	Project Bravo	Combined	Project Alpha	Project Bravo	Combined
Area (km²)	197	194	391	197	194	391
Distance from shore (closest point) (km)	27	38	-	27	38	-
WTG						
Number of wind turbine generators (WTG)	75	75	150	70	70	120
Maximum rotor diameter	167	167	-	220	220	-
Maximum hub height above Lowest Astronomical Tide (LAT) (m)	126	126	-	170	170	-
Maximum tip height above LAT (m)	209.7	209.7	-	280	280	-
Minimum blade tip clearance above LAT (m)	29.8	29.8	-	32.5	32.5	-
Minimum separation distance between turbines	1000	1000	-	1,000	1,000	-
Maximum number of foundations (comprising one or more of the following options up to an individual maximum as specified):						
Gravity Base	75	75	150	70	70	120
Pin pile jacket	75	75	150	70	70	120
Suction caisson jacket	75	75	150	70	70	120
Monopile	-	-	-	70	35	70
Inter-array cables (maximum length in km)	355	355	710	325	325	650
Meteorological masts	Up to six (three in each wind farm)			None required WTGs to be fitted with Light Detective and Ranging Equipment (LiDAR)		
Wave buoys	Up to six across both projects			Up to six across both projects Alternative option to fit mounted wave radar to WTG		

3.44. Initial OWF capacity estimates for the 2012 Offshore ES were based on an indicative standard array layout where WTGs are positioned on a standardised grid. To allow the flexibility for innovative WTG array design, to optimise array efficiency, no preferred layout was defined at this stage. Notwithstanding this, a minimum WTG spacing of five rotor diameters was defined, based on manufacturer recommendations and was to be applied to any preferred layout. As set out above, during consent determination Seagreen increased the minimum WTG separation to 1000m (increased from the 2012 design envelope value of 610m). This second design envelope adjustment made by Seagreen, during the two year determination of consents, was in order to reduce displacement effects on auks.

3.45. To take advantage of the developments in turbine technology, which have occurred since the 2014 consented Project, Seagreen have submitted a Capacity Variation to increase the maximum generating capacity of the consented Project. This Capacity Variation application seeks to remove entirely the capacity limit of the consented Project so that higher MW turbines, within the parameters defined in the consented 2014 Design Envelope (such as maximum turbine height and rotor diameter and minimum WTG spacing) can be constructed.

3.46. In the light of the above the optimised Seagreen Project is not seeking a maximum WTG or project capacity for flexibility. Wind turbines available to the market for the construction timescales will be selected and will not exceed the maximum rotor diameter, or maximum height defined in the Design Envelope for the optimised Project.

3.47. Two indicative WTG array layouts for the optimised Project are shown in Figure 3.3 and Figure 3.4. Figure 3.3 shows a layout with a split of 70 WTG in project Alpha and 50 in project Bravo and Figure 3.4 shows 60 WTG in both Alpha and Bravo. These are purely illustrative and it should be noted that, as with other design parameters for which there is uncertainty, a realistic worst case layout has been assessed on a receptor by receptor basis within the impact assessments presented in technical Chapters 8 to 15 of this EIA Report. Complete flexibility is required to enable the WTG layout, and OSP locations and structural design to be optimised following consent and after detailed ground investigation works have been undertaken. The final layout will be fixed following completion of the Preliminary Engineering Design work. This will then inform the array cable arrangement and the locations of the OSPs and transmission cables. While flexibility is required on WTG layouts, in reality, the maximum number of WTGs, for any given WTG size(s) will primarily be driven by optimising the spacing and arrangement of WTGs. This is to provide maximum efficiency from the wind resource. WTGs will also be located based on the impact of foundation feasibility studies (both engineering and commercial).

Offshore Wind Farm Structures

3.48. Geophysical survey and preliminary geotechnical survey (GEMS, 2010, 2012a and 2012b and Osiris Projects, 2011) informed initial engineering concept designs (Garrad Hassan, 2011a and 2011b) for foundations and substructures and established the initial ranges for the Design Envelope parameters.

3.49. The feasibility of each substructure/foundation type was considered, based on a number of technical and financial criteria, including proven experience of installation and Safety, Health and the Environment (SHE) issues. Suitability to the Project Alpha and Project Bravo Sites was addressed, based on existing understanding of bathymetry and ground conditions.

3.50. The preferred options taken to the concept evaluation stage and assessed in the 2012 Offshore ES were a piled steel jacket structure, a steel jacket with suction piles and a concrete gravity base structure (GBS). These are described in more detail in Chapter 5 (Project Description) of this EIA Report

3.51. As a result of further developments in technology and construction methods since these initial engineering studies, monopile foundations are now considered to be a feasible option for foundations in water depths of up to 50m. These are now considered a viable foundation option for areas of the Seagreen Project and therefore monopile foundations are now included within the optimised Seagreen Project design and are described in Chapter 5 (Project Description) of this EIA Report, along with the three foundation options assessed and consented within the 2012 Offshore ES.

The Application vs the Originally Consented Project

3.52. The original consents and licences received in 2014 are not affected by the current applications and therefore remain valid. It is Seagreen's intention to construct either the originally consented Project, or the optimised Seagreen Project presented within this EIA Report, but not both. Therefore, the primary alternative to the optimised Project is the 2014 originally consented Project. If the 2018 Application is not successful Seagreen will proceed with the 2014 originally consented Project. The environmental impacts of the originally consented Project are assessed and presented in full within the 2012 Offshore ES.

3.53. The increased output per turbine that is now achievable means that a reduction in turbine numbers is possible while still delivering the desired renewable energy output. A reduction in turbine numbers (compared with the originally consented Project) would result in a need for fewer foundations, fewer turbines and turbines of a higher blade tip and increased blade clearance. This is considered beneficial from environmental, technical and commercial perspectives.

'Do-nothing' Approach

3.54. A 'do nothing' scenario is a projection of the existing baseline for comparison to show what changes, if any, would take place if the project did not go ahead. The 'do nothing' scenario for the optimised Seagreen Project would be construction of the originally consented project, in relation to predicted changes in the environment, such as climate change.

3.55. As discussed in Chapter 4 (Policy and Legislation), climate change and the need to reduce carbon emissions underpins the need to move towards low carbon energy production and specifically renewable energy. Climate change is predicted to give rise to significant adverse environmental, societal and economic impacts.

3.56. The Seagreen Project will contribute in combatting climate change by reducing Greenhouse gas (GHG) emissions from the electricity generation sector. As set out in Chapter 2 (Need for the Project), the Seagreen Project is the first phase of the development of the Zone and the Applicants' contribution to meeting the Scottish Government policy on renewable energy (100% of electricity from renewables by 2020) and climate change policy. There are multiple benefits associated with the Seagreen Project, including:

- The production of over 1 GW of renewable energy;
- Very low lifetime CO_2 emissions per unit of electricity generated;
- Address climate change through a move to a low-carbon generation mix for a secure energy future; and
- Contribution to sustainable economic growth.

3.57. The principle that an OWF is a suitable development at the Site has been established through the consenting of the original Project for 150 WTG. If the optimised Seagreen Project is not consented, the reduction in WTG numbers to a maximum of 120 will not be realised and the 'do nothing' scenario will be the construction and operation of the consented Seagreen Project, in accordance with the 2014 Consents. Consenting the optimised Seagreen Project will enable an OWF project to be constructed that uses the most up to date technology with its corresponding economic and environmental benefits and one that maximises the potential for electricity generation from offshore wind, to meet renewable energy targets as compared with the 'do nothing' option of construction of the originally consented Project.

SUMMARY

3.58. In summary, since the 2012 Offshore ES, additional options for WTG parameters are available with regard to MW rating, size and swept area. In addition monopile foundations are also now a viable foundation option in the shallower water depths (up to 50m) of the Seagreen Project.

3.59. The process of R3, ZAP, EIA and site/design refinement that Seagreen has undertaken, both before and after 2012, has led to the identification of sites and designs that can be considered as optimal and this gives confidence that there are no obvious alternatives i.e. that are technically and commercially feasible, that could lead to better outcomes.

3.60. It is Seagreen's intention to construct either the originally consented Project, or the optimised Seagreen Project presented within this EIA Report, but not both. Therefore, the primary alternative to the optimised Project is the 2014 originally consented Project.

3.61. The increased output per turbine that is now achievable means that a reduction in turbine numbers is possible while still delivering the required energy output. A reduction in turbine numbers (compared with the originally consented Project) would result in a need for fewer foundations, fewer turbines and turbines of a higher blade tip and correspondingly increased blade clearance. This is considered beneficial from environmental, technical and commercial perspectives.

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