Visual/Natural Character Effects
The visual impacts of the proposed Ōnuku kelp farm are very low. All lines and buoys are approximately 5m below the surface, therefore all that is visible from the surface is surface-reaching kelp fronds and any required navigational markers. During harvesting, vessels will also be present within the site; however, any visual effects of these will be less than minor within Akaroa Harbour given the commercial fishing and port shipping in this area.

Environmental Effects
Kelp farming has few adverse impacts on the marine environment and is increasingly being recognised for its' environmental benefits globally. The proposed kelp to be farmed is the indigenous *Macrocystis pyrifera* kelp, which is locally a highly valued foundation species for marine ecosystems known for restoring food production, assisting nutrient elimination and cycling, and carbon removal.

No feed inputs or discharges occur as part of the kelp farming process and good water quality is vital to the success of this species. The harvesting method ensures that over half the kelp biomass remains permanently in the water column whilst only the surface 1.5-2m is harvested. This allows for maintained ecosystem function, water purification and habitat stability during all phases of the grow-out and harvesting process.

Site selection is focused on avoiding any known habitats of distinctive nature or regional/national significance (integrating the work of the Īōngāiro project -link here:, including significant habitats for marine mammals, seabirds or other marine and taonga species.

Kelp farming does not require the addition of feed or nutrients to the water column, the benthos below a kelp farm is not anticipated to be adversely altered beyond additional shading through the formation of a productive kelp canopy habitat. It provides underwater forest processes that include the absorption of carbon, nitrogen, and phosphorus, and filtration of coastal waters, whilst also creating new habitats for a diversity of marine life. Species such as mussels, sponges, ascidians, and hydroids are likely to attach to submerged lines and mooring screws and as such the biodiversity within the site footprint is likely to increase. This may in turn add rugosity to the seafloor via shell debris as a secondary effect from non-farmed species. Scientific investigations will be undertaken to inform detailed kelp farm design and ensure that any currently unknown impacts on ecological habitats are avoided or mitigated. Further to this, the use of Marine Flex screw-in anchor systems significantly reduces any benthos disturbance or displacement at the mooring points for the farm and allows for adaptive management in the placement of these structures (which have placement precision of +-0.4m) to avoid any sensitive benthic species identified through the monitoring programme prior to establishment.

The project partnership can benefit from Kelp Blue's learnings from the Namibia 200-ha farm inshore (scaling to 700-ha). The Namibia site has been closely monitored since it was installed in alignment with global best practice for kelp farms and, to-date no adverse environmental impacts have been identified, nor are anticipated.

The design for Akaroa will closely mimic the Namibia inshore site, taking into account localised environmental differences such as the long and narrow characteristics of Akaroa harbour, proximity of human habitation, sea vehicles, wind, wave height and coastal processes.

A particular benefit of kelp farming is that, in the unlikely event that there are some unanticipated and unacceptable adverse effects, the farm can be easily removed without causing any long-term or irreversible effects. Further to this, bottom-mounted kelp beds can be used in areas where marine mammal corridors are identified which avoids potential risks to these species.

It is also noted that that in October 2023, the Sustainable Sea National Science Challenge (NZ) released two reports on the environmental considerations for seaweed aquaculture in Aotearoa which are available here. The reports conclude that the environmental effects of a seaweed farm are likely to be less than, or similar to, those of a mussel farm of an equal scale.

Seaweed farms were also identified as delivering additional benefits such as attracting fish communities and providing habitat to a wide variety of species. Furthermore, seaweed farms have the potential to help reduce nutrient levels in coastal waters and can be used as a tool to mitigate coastal eutrophication.

The potential environmental effects and avoidance or mitigation strategies are described below in relation to the three phases of development: the construction and development phase, the kelp cultivation grow-out phase and the kelp harvesting phase. The effects from the construction and development phase and the kelp cultivation grow-out phase will only occur during the initial start-up period of 1 year and will not be ongoing beyond this.

Although adverse impacts are not anticipated, the business will benefit on the integration of mātauranga and kelp farming, through the partnership of Ōnuku (and Kelp Blue) ,

The business will safeguard the interests of unique and threatened marine species known to utilise Akaroa harbour and the wider marine area through development, consultation with key stakeholders and final adoption of an integrated suite of environmental management plans to ensure best practices and correct procedures are maintained.

These plans are:

1. Mātauranga plan
2. Marine monitoring which will be initiated prior to farm establishment
3. Marine Mammal and Seabird Management Plan
4. Biosecurity Management Plan.

Stage one: Start-up, Construction and Development Phase of the Kelp Cultivation	
Potential Effect	**Avoidance or mitigation strategy**
Mātauranga Māori for Akaroa	Akaroa harbour is considered a wahi taonga to Ōnuku and Ngāi Tahu, which has underpinned hapū action for critical issues such as the discharge of waste water into the harbour. Ōnuku measures all activities against this intergenerational guardianship commitment. Management of taonga species management is a tribal priority both for Ōnuku as mana whenua and mana moana, but shared and supported by for Te Rūnanga o Ngāi Tahu through legislation. Ōnuku seeks to uphold customary access to māhinga kai, as well as taking action to protect and ensure a natural balance

	of activities (rāhui to protect depletion of fisheries or to acknowledge an accident resulting in loss of life). Mātauranga Māori is a crucial component of the Ōnuku Kelp Farm, ensuring management and protection of taonga species has priority as a cultural, taiao-environmental and financial (eco-service) priority. Specific mātauranga / tikanga applies for the deaths of marine animals / taonga species involving Ōnuku Kaitiaki Reference is made to the following guiding objectives of the Mahaanui Iwi Management Plan (2013) Akaroa Harbour is recognised and provided for as a Ngāi Tahu cultural landscape (pg 278).
Possible Localised and short-term disturbance of benthic habitats and associated communities during installation and anchoring of the arrays.	Site selection avoids any known significant benthic habitats and the Marine Flex screw-in anchoring system reduces the effects and disturbance on the benthic environment to within the immediate anchor pin vicinity. Further to this, detailed farm design will be informed by benthic monitoring prior to farm installation, which will allow for demarcation and anchoring avoidance of any distinctive benthic habitats identified.
Possible localised disturbance of any marine mammals and seabirds that may be present at the site during the installation of the arrays.	Experienced personnel will ensure efficient installation of the structures whilst crew will maintain marine mammal and seabird observations as per the Marine Mammal & Seabird Management Plan.
Noise effects from machinery required during array installation.	Noise generated by vessels required during the installation and maintenance of the arrays and harvesting of the kelp will be low intensity (less than piling). However, installation will be timed to ensure that adverse effects, particularly fauna disturbance (mammal and seabird) is avoided or minimised.
Marine mammal entanglement risks from ropes and buoys during construction.	All ropes and buoys in the water column will be kept under constant tension whenever possible and during installation crew will be observing lines and marine mammals at all times. Best practice procedures will be outlined in the Marine Mammal and Seabird Management Plan. If areas of high

	marine mammal use are identified bottom-mounted kelp beds can be utilised.
Biosecurity risks of introducing associated diseases, parasites and biofouling pests from vessels arriving from overseas.	All vessels and plant utilised to install, construct, or operate within the marine will be cleaned and checked in accordance with the Biosecurity Management Plan. Ongoing monitoring and regular maintenance checking of lines and underwater structures will include biosecurity checks by appropriately trained personnel. The procedures and reporting of any identified exclusion marine pest species listed in the Canterbury Regional Pest Management Plan 2018-2038 (Environment Canterbury, 2018) will be included in the Biosecurity Management Plan and will be in accordance with Biosecurity NZ regulations. Further details on the proposed kelp farm biosecurity measures are provided in the section below.

Stage two: Kelp Cultivation Grow-out Phase	
Potential Effect	**Avoidance or mitigation strategy**
Marine mammal or seabird entanglement risks from the use of ropes and buoys.	As per response in table above. All ropes and lines will be maintained in accordance with best practice including ensuring constant tension is maintained at all times. The proposed farm has incorporated global research for the avoidance of marine mammals into the design of the arrays and overall structure. To-date Kelp Blue have trialled this design and to date, it has proved successful in Namibia within an area highly utilised by marine mammals. However, if areas of high marine mammal use are identified bottom-mounted kelp beds can be utilised. This is further discussed in the following section.
Habitat creation and/or exclusion due to the physical presence of floating structures in the pelagic zone.	Bottom mounted, eco-friendly artificial reef structures can be utilised to avoid and mitigate adverse effects of floating structures. Any structures used to bottom-mount kelp to avoid adverse effects, or to restore/mitigate effects on natural habitats will be made from eco-friendly materials, will be engineered and assessed to ensure stability in the receiving environment, and will provide substrate and refuge suitable to support indigenous species.
Effects on seawater nutrient chemistry and clarity.	Effects on seawater nutrient chemistry and clarity are anticipated to be less than minor. However, a monitoring programme will be implemented to establish nutrient availability and uptake by the arrays relative to 'control' sites

Alteration of plankton community structure around arrays.	The potential alteration of plankton communities would be of low intensity due to the high spatial and temporal variability of nutrient supply and uptake by the kelp forests. Any alteration around the arrays would be short-term and highly localised due to the high variability in coastal water flow and strength and because phytoplankton has a high turn-over rate. Plankton abundance, biomass and species richness will be monitored within each plot and at selected sites at increasing distance from the arrays relative to suitable control sites.
Deposition of organic detritus below the arrays and associated changes to physical, chemical, and biological properties of the sediments.	Akaroa is a deep drowned valley with seascapes varying from mudflat areas at the upper apex of the harbour to those areas of strong ocean tidal outflow and inflow closer to the harbour heads. Kelp detritus remaining in situ will depend on location. Site selection is favoured for areas where less tidal disturbance means kelp detritus can remain (mid to upper regions). In addition, the wider outflow of kelp detritus to the benthos and wider marine environment can provide benefit and will support natural food webs in the wider vicinity.

Stage three: Kelp Cultivation Harvesting Phase	
Potential Effect	**Avoidance or mitigation strategy**
Noise and effects from machinery required during kelp harvesting.	Vessel and harvesting noise may lead to temporary behavioural changes in marine mammals and diving seabirds when they are in close proximity to harvesting vessels. The impact of this noise will be mitigated through timing and management measures (to be detailed in the Marine Mammal and Seabird Management Plan) as well as adaptive management and monitoring measures. Longer term the applicant is investigating the development of a slow solar powered harvesting vessel, which will produce very low levels of noise disturbance. Given the proximity of commercial and recreational vessels, and other aquaculture, the kelp farm operations are not expected to increase noise significantly beyond what is currently experienced in this area.
Disturbance of any seabirds present at the site during harvesting.	Harvesting will be timed and managed to ensure that adverse effects, particularly fauna disturbance (mammal and seabird) is avoided and minimised. Additional mitigation measures will be developed and incorporated within the detailed in the Marine Mammal and Seabird Management Plan.

Stage Four: Evaluation and Monitoring	
Potential Effect	**Avoidance or mitigation strategy**
Continuous Improvement	Reporting of incidents and accidents will be a feature enabling continuous quality improvement and training Specific mātauranga / tikanga applies for the deaths of marine animals / taonga species involving the local tangata tiaki Bench-marking, best practice, and quality assurance of eco-system management, including the customary practices for management of marine animals and seabirds, is a critical element of indigenous biodiversity carbon credits

Adverse effects on Marine Mammals and Seabirds
Taonga species are considered wahi taonga (sacred treasures) to Ōnuku and tikanga applies aligned with mātauranga. Adverse effects will be avoided through careful site selection and detailed farm design which will be informed by scientific investigations to understand the ecological characteristics and values of the project site.

Before commencing operations, Ōnuku will incorporate known Ngāi Tahu taiao policy with hapū mātauranga to approve a Marine Mammal and Seabird Management Plan. This will be aligned with the Mātauranga plan. Development will incorporate best practice protocols developed by experienced marine mammal and seabird experts. The business will consult with the Department of Conservation, to align the mātauranga and internal protocols with other relevant protection measures (as advised).

The plan will detail how regular marine animal and bird monitoring will be used to improve knowledge of how marine mammals and seabirds perceive offshore farm structures visually and acoustically. The plan will include analysis to confirm mammal and bird reactions to the application site and farming structures. Use of acoustic surveys will characterise species occurrence and migration pathways in the region.

Kelp Blue have developed training programs for their Akaroa operation teams, which will be adapted for the Ōnuku kelp farm. As noted both the mātauranga and tikanga practices as well as mainstream eco-protection protocols will form the basis of management and employee training programs.
Specific marine mammal identification will be combined with Ngāi Tarewa tikanga including for all legislatively recognised 49 bird species, and 6 marine mammal taonga species (i.e. Bottlenose (Terehu) & Hector's Dolphins (Tūpoupou) and Yellow-eyed Penguin (Hoiho) have their homes in Akaroa harbour).

Detailed protocols- tikanga for marine mammal and seabird disentanglement techniques will include Ngāi Tarewa mātauranga and tikanga as protecting taonga species in accordance with Ngāi Tahu values of mahinga kai and mātauranga must follow specific requirements - these are over and above the mainstream ecological protocols because of the great importance Ngāi Tahu place on the natural world and all inhabitants

The farm structure design will include all mooring lines/blocks and tensioning lines being more than 25m apart, and navigational devices installed to mark the outer boundaries of the structure.

For the installation and maintenance of the farm, all mooring hawsers, rope arrays and ropes to floats should be rigid or under constant tension. The tension is to be monitored and maintained regularly.

Where areas of marine mammal migration or high use are identified via acoustic monitoring; bottom-mounted kelp farm structures will be established to remove the risk of entanglement.

Permanent artificial lighting at farming sites will be avoided unless dictated by maritime regulations. Green or red flashing lights have been identified as reducing disturbance to seabirds rather than white permanent lighting and will be utilised wherever possible.

Twine and rope materials to be used will be (a) thick enough to limit tangling into shapes in which seabirds could become entangled (i.e. 10-15cm), and (b) not be prone to produce loose strands that break off easily.

Risks and Management Measures for Marine Biosecurity

The business will approve a Biosecurity Management Plan, developed in consultation with Ōnuku whānau, tangata tiaki (customary guardians) and Ngāi Tahu (Customary Fish Manager). The business would include best practices both mainstream and specific to Ngāī Tahu, implementing stringent controls to avoid risks of introducing associated diseases, parasites and biofouling pests from vessels arriving from overseas. Ngāi Tarewa mātauranga will incorporate enhanced tikanga for the treatment of mixed waterways along with waste management. Deployment of the Biosecurity Management Plan would form a key part of staff training as well as information continuous improvement of the marine operations.

Some Kelp Blue (global) and Akaroa management practices to be applied alongside Ōnuku mātauranga:

- Only kelp plants propagated from Akaroa sporophylls, would be replanted in Akaroa Harbour
- Ōnuku/Ngāi Tahu kaitiaki would oversee sporophylls gatherings, as well as overseeing the design and ongoing operation of all Hatcheries where Akaroa kelp is transported to or from. Mātauranga will be observed in relation to key events at the Hatchery
- Akaroa kelp would be propagated in areas that are separate to other areas - i.e. Ocean Beach kelp
- All Akaroa juvenile kelp will be propagated under laboratory conditions subject to strict biosecurity procedures, making it unlikely that diseases will be transmitted into the natural ecosystem through the introduction of sporophytes and seeded twine.
- All locally harvested sporophylls will be checked to have no additional organisms present prior to entering the hatchery.
- Surface sterilisation of sporophylls will occur before spore release, spores are also washed in sterile seawater before seeding of strings to prevent any contamination cultures.
- Regular inspection of the arrays for the establishment of biofouling organisms will occur. Any arrays or kelp frond colonising species will be recorded and quantified, where possible.
- Any marine pest organisms identified within the Akaroa farm footprint, which is listed within the Canterbury Regional Pest Management Plan 2018-2038 (Environment Canterbury, 2018), will be removed and reported to Environment Canterbury and Biosecurity NZ in alignment with current regulations.
- Kelp will be regularly monitored for any sign of disease or parasites.