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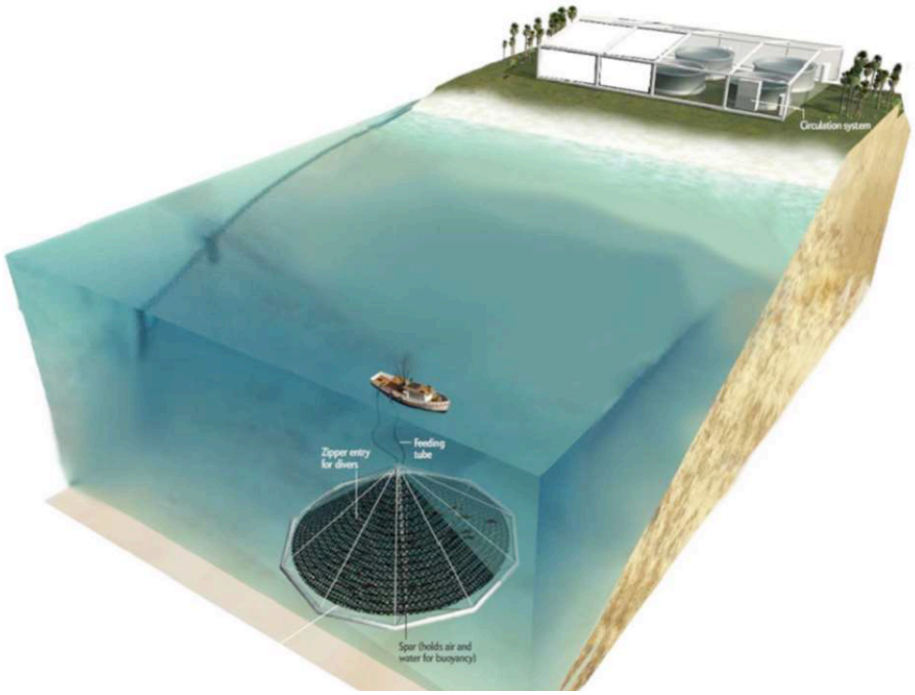
Environmental Impact Assessment



Open Ocean Aquaculture Fish Farm Aruba

Rev 06

Report	Environmental Impact Assessments for Aquaculture Fish Farm
Client	Petros Aquaculture Operations
Date	**July 10, 2025**
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1 Acronyms, Abbreviations and Special Terms

Items	Meaning
ACF	Aruba Conservation Foundation
ADA	Americans with Disabilities Act
ASC	Aquaculture Stewardship Council
AWSS	Aruba Wastewater Sustainable Solutions
BAP	Best Aquaculture Practices
BET	Best Environmental Technology
BMP	Best Management Practice
BwN	Build(ing) with Nature
CBA	Centrale Bank Aruba
CDC	The US Center for Disease Control and Prevention
CE	Circular Economy
CFU	Colony-Forming Unit
CITES	Convention on International Trade in Endangered Species of wild fauna and flora
COVID-19	Coronavirus Disease of 2019
dBA	A-weighted decibels (expresses the relative loudness of sounds in air as perceived by the human ear)
DEZHI	Directie Economische Zaken, Handel en Industrie (Department of Economic Affairs, Trade and Industry)
DIP	Directie Infrastructuur en Planning (Department of Infrastructure and Planning)
DLVVM	Directie Landbouw, Veeteelt en Visserij en Markthallen (Department of Agriculture, Fisheries, Husbandry and Market Halls)
DNM	Directie Natuur en Milieu (Department of Nature and Environment)
DSA	Departement Scheepvaart Aruba (Maritime Department Aruba)
DVG	Directie van Volksgezondheid (Department of Public Health)
DO	Dissolved Oxygen
DOW	Dienst Openbare Werken (Department of Public Works)
ELMAR	Electriciteit-Maatschappij Aruba (electricity producing company)
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency of the US
EU	European Union
FCR	Food Conversion Rate
GFSI	Global Food Safety Initiative's
FSMS	Food Safety Management System
FPNA	Fundacion Parkenan Nacional Aruba (Aruba National Park Foundation)
GIS	Geographical Information System
GMP	Good Manufacturing Practices
GO	Governmental Organization
GoA	Government of Aruba
GUB	Gronduitgifte Beleid (spatial development policy for issuing land)
HACCP	Hazard Analysis Critical Control Points
HOH	Horacio Oduber Hospital

HVAC	Heating Ventilation Air Conditioning
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IFC	International Finance Corporation (sister association of the World Bank and member of World Bank Group)
ISO	The International Organization for Standardization
LAeq	A-weighted equivalent continuous sound level in decibels
LAmax	A-weighted maximum noise levels in decibels
L90	Indicator for background noise levels
LCA	Life Cycle
LED	Light-Emitting Diode
LVEA	Landscape –Vegetation Ecological Assessment
LRO	Landsverordering Ruimtelijke Ordening (The Spatial Development National Ordinance) defines the roles of government and the rights and duties of citizens, businesses and institutions in the creation and modification of spatial plans
MEP	Mechanical Electrical Plumbing
MIIA	Matrix of Importance of Environmental Impact
MMP	Mitigation Management Plan
MRP	Master Recovery Plan
NAMA	National Archaeological Museum Aruba
NA	Not Applicable
NGO	Non-Governmental Organization
NSP	National Strategic Plan
OSHA	The US Occupational Safety & Health Administration
PE	Polyethylene
PM2.5	Particulate Matter with diameter of 2.5 microns or less
PM10	Particulate Matter with diameter of 10 microns or less
PPGIS	Public Participation GIS (a participatory approach to spatial planning and spatial information and communication management)
PP	Polypropylene
PPE	Personal Protective Equipment
RAS	Recirculating Aquaculture System
RECIP	Reciprocating Engine – Power Generation
RO	Reverse Osmosis
ROP	Ruimtelijke Ontwikkelingsplan (Spatial Development Plan)
ROPV	Ruimtelijk Ontwikkelingsplan met Voorschriften (Spatial Development Plan with Regulations)
RWZI	Rioolwaterzuiveringsinstallatie (Sewage Treatment Installations/Plant)
SDG	Sustainable Development Goal established by the United Nations
SMB	Sociaal Maatschappelijke Bijdrage (Societal Contribution)
SOP	Standard Operating Procedure
SPAW	The protocol concerning Specially Protected Areas and Wildlife
TEEB	The Economics of Ecosystems and Biodiversity
UN	United Nations
VOC	Volatile Organic Compound

WEB	Water en Energie Bedrijf (water and energy production company of Aruba)
WHO	World Health Organization

Table 1 - Abbreviation list

2 Executive Summary

This Environmental Impact Assessment (EIA) study serves as a source of information for Government authorities of Aruba (GoA) to provide an option agreement for the proposed project development, Open Ocean Aquaculture project in the Balashi onshore area and the 8.5 km offshore area, as well as providing guidance to the client, Petros Aquaculture Operation, in preventing, mitigating, and monitoring the impacts of the project proposed design. This report follows following the criteria and EIA format established by the Government of Aruba's Department of Nature and Environment (DNM). In addition, it is based on environmental best practices and information from local and international publications and environmental organizations.

The main purpose of Petros Aquaculture Operation is to develop an Open Ocean Aquaculture Facility that will produce 500 MT/year in the initial phase for export and distribution into the existing local network. Petros will consider, in close cooperation with the GoA, scaling up to 2000 MT/year of fish, post year 8 of being in production.

The Open Ocean Aquaculture project plans to obtain certification from Best Aquaculture Practices (BAP). The BAP program standards help producers mitigate their impact on the environment. Additionally, the Open Ocean Aquaculture project plans to obtain certification from the Aquaculture Stewardship Council (ASC). The Aquaculture Stewardship Council is an independent, international non-profit organization that sets standards for responsible aquaculture. It aims to improve the environmental and social impacts of aquaculture production.

The proposed onshore operation area for the Fish Farm is at Barcadera, neighboring the W.E.B Aruba. The plot/property is within the Industrial Zone; an area specifically destined for industries such as gas company, cleaning companies etc. where the development is according to the Spatial Development Plan (ROP 2019).

All local applicable regulations and laws and relevant international conventions are identified and addressed in this EIA. Relevant government policies applicable to the environmental aspects and purpose of the project development are derived from the following policy documents.

- National Strategic Plan and a roadmap for Sustainable Development Goals implementation in Aruba
- ROP 2019
- "Gronduitgifte beleid"
- "Natuur en Milieubeleidsnota 2018-2021"
- "Beleid" Build with Nature
- Economic Policy: Strong and Resilient Economy 2019-2022
- Masterplan, Repositioning Our Sails

To gain an understanding of the baseline conditions of the project site, a field study and desktop study was conducted for the onshore and offshore location, and information was obtained/retrieved from governmental and non-governmental organizations by means of in person consultations. Furthermore, information and proposed design provided by the project

developer helped to evaluate the environmental impacts from the different features of the project development.

Onshore Field assessment in and around the project site were conducted throughout January and February of 2024 and complimented with data and observations. A range of different surveys were carried out to assess the biotic and abiotic environmental components. This was done in order to physically inspect the areas and document the observations with regards to soil, geology, topography, hydrology, seawater, air, light, noise, terrestrial and marine flora and fauna, beach debris, cultural and historical heritage and human health and safety.

It must be highlighted that during the baseline assessment, the following observations were made:

- On the Project Site itself, three types of habitats can be distinguished;
  - a xeric shrubland,
  - a low xeric woodland,
  - a disturbed habitat containing sandy hills.
- The Aruban Whip-tailed Lizard (*Cnemidophorus arubensis*), and the endemic lands snails, namely *Cerion uva* & *Tudora megacheilos*, were found in the Project Site.
- The most dominant flora species in the area were the Eleusine Indica or grass.
- With respect to sulfur dioxide (SO2) and particulate matter (PM) pollution, the air quality is negatively affected by the surrounding industry, in particular as a result of the industrial exhaust in the area. This can be a concerning matter for the health of (future) workers in the area.
- Noise pollution is considered high, note shall be taken that the project site is in an economic/industrial area (Appendix H) and a variety of construction work is taking place nearby the plot.
- Locally protected **fauna** that were observed within the Project Site include:
  - the striped anole (*Anolis lineatus*).

Offshore Field assessment at different offshore sites were performed to identify the best offshore location which is 8.5km offshore Aruba. A range of different surveys were carried out to assess the environmental components. This was done in order to physically inspect the areas and document the observations with regards to Ocean Currents, Bathometry, temperature, Dissolved Oxygen, Benthic, Water Chemistry Sediments, Bacteriological and Marine Megafauna.

It must be highlighted that during the baseline assessment, the following observations were made:

- With the high ocean current measured, the impact on the Nitrogen content shall be low. This is also shown in the research done in Panama in 2019.
- The depth is on average 90m at the proposed offshore area and no cetaceans, pinnipeds, turtles, or other megafauna were observed during fieldwork.
- The benthic environment is characterized primarily by exposed sandy/muddy bottom with sparse colonization by invertebrates. Biodiversity was low and the ecosystem is not considered to be sensitive or unique and does not support or provide critical habitat for fisheries resources

A **comparison of impacts** was carried out against different courses of actions to determine the relative impacts for each scenario and the additional measures needed to ensure the best

environmental outcome for the Project Development. This ultimately serves to determine whether impacts are acceptable or not.
The comparative analysis showed that in both the Construction Phase, as well as the Operation Phase the majority of the impacts can be mitigated. The minor negative impacts in the construction phase are expected to occur in relation to the site clearance. The minor negative operational impacts are related to an increase in pollution and disturbance in the area. It has to be noted that the added effects will be minimal considering the already current levels of environmental pressures in the area. Nevertheless, these impacts can be mitigated using various measures, such as dust abatement techniques, proper handling procedures and creating a contained setting.

To conclude, the Project Development should be acceptable, as long as mitigation measures, appropriate technologies and compensation measures are applied both in the construction and operation phase of the project as provided in this report.

3 Introduction

In a world where the demand for high-quality protein continues to surge, the focus is increasingly turning towards aquaculture as a sustainable solution to meet the growing needs of our global population. Aquaculture represents a viable solution in this narrative, offering a promising avenue for responsible and efficient food production.

As we stand at the intersection of innovation and environmental stewardship, the practice of fish farming becomes a potential solution for the future of food security. This dynamic industry not only addresses the imperative of meeting rising nutritional demands but also holds the key to mitigating the strain on our natural fisheries. To achieve this the Open Ocean Aquaculture project will seek Best Aquaculture Practices (BAP) and Aquaculture Stewardship Council (ASC) accreditations as a basis to comply with all international regulations and sustainability standards.

Moreover, the economic growth associated with fish farming is a compelling aspect of this flourishing industry. As aquaculture operations expand, they not only create job opportunities but also contribute significantly to local and national economies. The ripple effect of a thriving fish farming sector extends beyond the water's edge, fostering community development, enhancing trade, and providing a sustainable source of income for countless individuals involved in the aquaculture value chain.

This Environmental Impact Assessment (EIA) serves as a source of information for the **department of the Government of Aruba (GoA)** in charge of approving the proposed project development, **Aruba Open Ocean Aquaculture** of **'Pisca Cora'** Red Snapper (*Lutjanus Campechanus*) as well as providing guidance to the project management in preventing, mitigating, and monitoring the impacts of the project proposed design.

This EIA has been prepared in accordance with the requirements of GoA, according to the EIA format provided by the Department of Nature and Environment (DNM) (Appendix 1) Additionally, all local applicable policies, regulations and laws are described and addressed in this EIA. Lastly, this EIA draws upon environmental best practices and information provided by local and international publications and environmental organizations.

4 Policies, Legal and Administrative Framework

To achieve the objectives set out by the GoA, various governmental departments are tasked with formulating policies and policy frameworks, as well as gathering the information required for the formation and evaluation of policies. Moreover, DIP plays a crucial role in initiating the development of policies.

Aruba has a civil law system; laws are referred to as a national ordinance “Landsverordening”. A national ordinance is a generally binding regulation containing a decree “Landsbesluit” taken jointly by the GoA and the States in accordance with a procedure as described in the Constitution of Aruba. National ordinances are a source of law but are not the only form in which legal rules occur. Land decrees, containing general measures and ministerial regulations “Regelingen” also contain generally binding rules. In addition, there are international conventions or decisions of international organizations, such as the European Union (EU) which may contain generally binding rules “Rijkswetten”. Decisions from the Court of First Instance can be appealed at the Joint Court of Justice “Gemeenschappelijk Hof van Justitie” of Aruba, Curacao, St. Maarten and Bonaire, St. Eustatius and Saba and decisions of the Joint Court of Justice can be appealed at the Supreme Court of Justice in the Netherlands. In addition, matters such as the principle of equality and general principles of good governance also play a role.

Of importance to the proposed development is the need to identify those regulations and legislation which will need compliance for the development of its activities in respect to the proposed project site. The objective of this section is to review relevant legislation and regulations to ensure that the project meets policy and legislative criteria, and that relevant requirements are taken into consideration during project design and implementation.

4.1 Governmental policy

The governmental policies and plans with a direct or indirect relation to the project are the following.

4.1.1 Sustainable Development

National Strategic Plan 2020-2022 and a roadmap for SDG implementation in Aruba, Department of Economic Affairs, Trade and Industry (DEZHI)

The National Strategic Plan (NSP) 2020-2022 ((DEZHI, 2020) is the first NSP in a series of NSPs to come. It sets out to achieve the Sustainable Development Goals (SDGs) drafted by the United Nations (UN). The SDGs form the core of the UN 2030 Agenda, which is a plan of action for people, planet, and prosperity. The focus of the NSP is long-term planning.

While the NSP was being drafted, an alignment was sought with the Master Recovery Plan (MRP). The MRP is a fast-track strategy plan for recovery after the Corona Virus Disease of 2019 (COVID-19) crisis to foster policy coherence. The NSP facilitates the adoption of SDGs into existing national and sectoral policy plans, strategies, budget. Furthermore, it is aligned with the government program known as “Hunto pa Aruba”.

The roadmap for SDG implementation in Aruba (SDG Aruba, 2018) serves as a guide for the implementation of SDGs in Aruba. The roadmap contains a variety of governmental actions

that are expected to accelerate the principles of the SDGs. This document is likewise being used by various governmental departments to align their policies with the SDGs.

The strategic objectives in the NSP: 2020-2022 repeat the actions proposed in the Roadmap for SDGs Goal #2 & Goal #14 (Appendix 3) for Aruba, however greater details are described in the NSP. As such, the following strategic objectives described in the NSP are of specific relevance. The project developers should consider such actions that can be relevant to the project development.

Ref.	Text
NSP.1	Quality of Life & Wellbeing ➢ Addressing the needs of Vulnerable Groups in the Society ➢ Strengthen and Integration of Mental Health, Social and Emotional Wellbeing at all levels
NSP.2	Natural Resource Management ➢ Achieve a national environmentally friendly behavior and mindset ➢ Working towards Circular Economy (CE) ➢ Strengthen institutional capacity for ecological and environmental data, and secure focus on research (including research policy support)
NSP.3	Entrepreneurship & Enabling Business Environment ➢ Stimulating New Economic Sectors
NSP.4	Energy Efficiency & Energy Diversification ➢ Reduce the impact of climate change ➢ Increase renewable energy production ➢ Increase energy efficiency among households and businesses ➢ Make more efficient use of fossil fuels for power production ➢ Reduce transportation emissions ➢ Institute a favorable policy & regulatory framework
NSP.5	Aruba as a Model for Sustainable Development ➢ Enhance partnership for sustainable development

Table 2 - Identified (principal) relevant policy within NSP 2020-2022. Ref.: code serves for referencing.

4.1.2 Spatial Planning

Ruimtelijke Ontwikkelingsplan (ROP) Aruba 2019, DIP en Ruimtelijke Ontwikkelingsplan met voorschriften (ROPV) Aruba 2021, DIP

A Spatial Development Plan "Ruimtelijke Ontwikkelingsplan" (ROP) contains the spatial policies of Aruba and is the result of a process of spatial planning and investigation which starts with the creation of the current situation, the possible and desirable development of the island. As such the ROP serves as a tool for implementing spatial development plans of Aruba. The ROP is created in such a way that it contains the outline, as well as maps, an explanatory memorandum, the underlying thoughts, plans and the reports. After publishing the ROP, the public is given time to react, give comments and ask questions about the new ROP. The announcement of the ROP is published in the Dutch and Papiamento in the local newspapers. A ROP is valid for 10 years and afterwards a one-time extension is possible for a maximum period of five years. After this, a new ROP is required. The ROP is an integral policy plan of the GoA. The legislative basis of the ROP is determined in the National Ordinance of Spatial

Development “Landsverordening Ruimtelijke Ontwikkeling” (LRO) (see 4.2.1 National Legislation).

The latest ROP was established in 2019 (Ministerie van Ruimtelijke Ontwikkeling, Infrastructuur en Milieu, 2019). A more detailed spatial plan with binding rules/requirements is provided through the ROP with Regulations “Ruimtelijke Ontwikkelings Plan met Voorschriften” (ROPV). ROPV 2021 (refer to Section 4.2.1 National Legislation) is based on the ROP 2019. An ROPV is valid for only 5 years and may be extended with another 5 years. The ROPV contains defined instructions, as to the destination of certain lands (i.e., zoning), describing the method structures within the vicinity of designated zones can be constructed, and restrictions for existing lands and existing structures. Among other things, the ROP provides rules to protect cultural and natural heritage and it determines when a Construction Permit “Aanlegvergunning” is required for construction activities.

The main goal of ROP 2019 is a sustainable living and working environment. Besides policies, the ROP 2019 provides actions that should be carried out and therefore provides substance to the policies as well as concretizing the policies.

The following relevant policies have been identified for the project development. Important to note, is the classification of the project site as an Industrial zone at Barcadera, according to the ROP 2019 map (Appendix 4).

Ref.	**(Translated) Text**
ROP.3	Inside the Ecological Corridor no new construction is allowed.
	- Artikel 3 lid 3.1 onder f sub 1 is het niet toegestaan constructies, waaronder pieren en steigers, te bouwen binnen de bestemmingen Strand, Marinegebied of Marinezones met uitzondering van bestaande havens en de bijbehorende beheersgebieden en ter plaatse van de aanduiding – De artikelen 7.3 en 7.5 geven de Minister de mogelijkheid het ROPV te wijzigen ten behoeve van infrastructurele zaken als pieren, steigers en havenvoorzieningen en zend- en antennemasten. Ook deze zaken hebben een algemeen belang, bijvoorbeeld in de veiligheid, de bereikbaarheid of de communicatie.

Table 3 - Identified relevant policies within ROP 2019. Ref.: code serves for referencing a specific policy.

Furthermore, the ROP 2019 specifies the following policy choices “Beleidskeuzes”.

Ref.	(Translated) Text
ROP.5	Room for innovation of promising sectors (tourism, primary sector, creative industry, logistics, knowledge, CE)
ROP.6	Applying modern techniques for sustainable land use and prevention of nuisance
ROP.7	Adjusting commercial facilities and business activities to needs
ROP.9	On-site parking, innovative and multi-level parking solutions.
ROP.11	Sustainable use of space by: ➢ restructuring and multifunctional use of space; ➢ Build with Nature (BwN)
ROP.12	Room for innovation water extraction and energy generation (solar park, farm) and sustainable waste processing
ROP.14	Sustainable water system by: • protecting the system and keeping it clear of dry stream beds; • increasing water collection
ROP.15	Not allowing (construction) activities in: dry stream beds, salt flats, dams and ponds “tanki’s” with corresponding buffer zones; ➢ ecologically valuable areas ➢ valuable landscape areas ➢ rock formations
ROP.16	No disturbance (light, noise) by activities in adjacent areas
ROP.17	Landscaping and green integration of roads and sites
ROP.18	Protect Ecological Corridor
ROP.20	Identity of Aruba is the starting point for developments

Table 4 - Identified relevant policy choices within ROP 2019. Ref.: code serves for referencing a specific policy.

Ruimtelijke ontwikkeling en Gronduitgifte beleid, 2018, DIP

The main goal of the Spatial Development and Land Issuance Policy “Ruimtelijke ontwikkeling en Gronduitgifte beleid” (GUB) is to provide in the demand of land (and water) with the end goal of guaranteeing sustainable social and economic wellbeing (Ministerie van Ruimtelijke Ontwikkeling, Infrastructuur en Milieu, 2018). The ROP serves as a guideline for this policy.
The principal text in the GUB that is relevant to this project includes the following.

Ref.	(Translated) Text
GUB.1	Within the option period the option holder should provide an Environmental Impact Assessment to DIP, in the case of projects with an environmental impact.
GUB.2	Development and preparation of the terrain should be sustainable and in consultation with DNM and the Department of Agriculture, Husbandry, Fisheries and Market halls (DLVVM)

Table 5 - Identified relevant policies within GUB. Ref.: code serves for referencing a specific policy.

4.1.3 Environment

Natuur en Milieubeleidsnota 2018-2021, DNM

This policy document describes the policies for topics regarding nature and environment during the governance period of 2018-2021 (Ministerie van Ruimtelijke Ontwikkeling, Infrastructuur en Milieu, 2018). It contains both strategic goals, as well as a governmental action plan for successful implementation.

The following actions are of specific relevance.

Ref.	(Translated) Text
NMBN.1	Introduction of a waste material ordinance
NMBN.2	Regulating waste separation
NMBN.3	Updating the Nuisance Ordinance "Hinderverordening"
NMBN.4	Establishing requirements for users of the central sewage system
NMBN.5	Lowering import duties on environmental-friendly products
NMBN.6	Regulating hazardous materials
NMBN.7	Implementing a wastewater structure plan
NMBN.8	Educating users of the wastewater system to protect the state of the sewage system
NMBN.9	Inspection on the illegal dumping of waste in the sewage system
NMBN.10	Inspection on the dumping of waste in illegal dumpsites
NMBN.11	Stimulating CE
NMBN.12	Stimulating cooperation between the Government and companies with regards to waste
NMBN.13	Implementing a sustainable and adequate waste processing facility
NMBN.14	Updating Nature Protection Ordinance "Natuurbeschermingsverordening"
NMBN.15	Establishing legislation regarding invasive/exotic species
NMBN.16	Updating list of protected flora and fauna
NMBN.17	Reforestation - BwN
NMBN.18	Introduction ROPV
NMBN.19	Research on brown water and brownfields
NMBN.20	Notifications of invasive species as well protection of habitats, emergencies, and legislative exemptions.
NMBN.21	Installment of Commission Flora and Fauna
NMBN.22	Introducing standards to regulate air pollutants

Table 6 - Identified (principal) relevant governmental actions within "Natuur en Milieubeleidsnota 2018-2021". Ref.: code serves for referencing a specific policy.

Note that while the actions listed in Table 6 were planned to be implemented by the end of 2021. Many of these actions are either still in development or have yet to be developed.

"Beleid" Build with Nature 2019, DNM

The BwN policy document guides and provide tools for sustainable design on the island (Directie Natuur en Milieu, 2019). It is a systematic strategy, where the protection of threatened endemic species and ecosystem services serve as a basis for urbanization of parcels. It complements regulatory and or policy tools for spatial planning. Of particular

importance is the zoning function to determine how a certain site should be developed, taking its nature into account.

The following actions are of specific relevance.

Ref.	(Translated) Text
BwN.1	Training and certifying contractors of heavy machinery
BwN.2	Stimulating the public and the private sector to plant endemic flora
BwN.3	Share physical and chemical standards with target groups
BwN.4	Department of Public Works (DOW) establishes a Green Policy plan
BwN.5	Procedure of Allotment Plan "Verkavelingsplannen" of parcels >750m2 to be evaluated by DNM on Flora and Fauna
BwN.6	Societal Contribution "Sociaal-maatschappelijke bijdrage" (SMB) implementation (e.g., company informs to which goal the SMB will be targeted while requesting concessional land)
BwN.7	Establishment of a voluntary emission reduction system
BwN.8	Development of climate legislation
BwN.9	Design of EIA legislation
BwN.13	Voluntary Emission Reduction (VER) systeem opzetten (a.k.a. Carbon Credits zonder Kyoto protocol)

Table 7 - Identified (principal) relevant policy actions within Build with Nature 2019. Ref.: code serves for referencing a specific policy.

Besides these actions DNM has developed a BwN concept for urbanization that can be referenced as a tool for the project developer (0).

4.1.4 Economic

Economic Policy: Strong and Resilient Economy 2019-2022, DEZHI

The main topic of this economic policy document is sustainable economic growth. The objectives include: "(1) to contribute to a higher quality of life for all citizens, (2) to create inclusive and decent jobs, (3) to facilitate new innovative business opportunities and (4) to stimulate local and foreign investment." (Minister of Finance, Economic Affairs and Culture, 2021)

In contrast to the environmental and spatial policies, the economic policies are described in broader lines, i.e., do not go into much detail on how to achieve the objectives. However, notable policies regarding the development of the economy are as follows.

Ref.	Policy
EP.1	Stimulating the niche market development as a form of diversification of the economy, with mention of the new subsector
EP.2	Stimulating the knowledge economy, through showcasing successful adoption of new technologies as export services, with specific mention of Solar Energy.
EP.3	Stimulating CE and recycling and reuse in business models

Table 8 - Relevant policies within the Economic Policy. Ref.: code serves for referencing a specific policy.

4.1.5 General Affairs

Masterplan, Repositioning Our Sails, DEZHI

The acute socio-economic crisis that ensued because of the COVID-19 pandemic demonstrated how vulnerable the Aruban economy was. Consequently, strengthening the economic resilience of Aruba is the central theme of the MRP (Committee Economic Recovery and Innovation Aruba, 2020). This Masterplan is a strategic policy framework that sets policy directions and priorities for economic recovery and resilience between 2020 and 2023.

The following actions are of specific relevance. Note, some of these actions are repeated in the NSP.

Ref.	Policy
MRP.1	Catalysts for transition towards a CE ➢ Circularity preference in government procurement policy to favor circular service providers, boosting new environmentally responsible markets ➢ Amend the Building and Housing Ordinance "Bouw en Woning Verordening" to promote energy efficiency, green coverage and better material re-use, refurbishing, and remanufacturing in construction, including the use of innovative and bio composite building materials and guidelines ➢ Explore and stimulate the adoption of circular tourism business by earmarking funds for niche-based circular tourism sector and services ➢ Launch national awareness campaign to highlight CE businesses ➢ opportunities, local/micro-farming, promote climate action, energy saving & cooling efficiency; explain the value and benefits of ecosystem services (incl. value and purpose ROPV) ➢ Engage social entrepreneurs and tourism innovators in fostering CE pilots and practice ➢ Institutionalize national taskforce for addressing opportunities and pathways for a climate-resilient tourism, including regulation, supervision and compliance with new building codes, transportation, and residential construction (especially in coastal and flood-risk zones) ➢ Design a human-centered plan for inclusive real estate ownership with a focus on locals, young professionals and future generation needs, to address the growing lack of affordable options and lack of space issue (e.g., stimulate going vertical, repurpose abandoned/unused properties etc.)
MRP.2	Collaborative management of waste streams as resources ➢ Introduce and implement the revised serlimar legislation (AB 2005 no. 5) ➢ Solid waste treatment facility ➢ Remediation of the landfill at Parkietenbos ➢ Sanitary landfill & hazardous waste ➢ Build new wastewater treatment facility at the Sewage Treatment Installations/Plant (RWZI) of Bubali ➢ Expand & upgrade effluent treatment for reuse ➢ Improve effluent quality (reuse landscaping, agriculture, golf courses) ➢ Introduce levy (e.g., "rioolheffing" or fee) to cover maintenance of sewage line ➢ Develop policy for wastewater treatment

	➢ Eliminate open air burning (emissions) ➢ Introduce sustainable waste practices (medical waste) ➢ Finalize and implement process for safely discarding of COVID-19 related waste ➢ Explore the possibility and assess the feasibility of a zero-waste tourism industry on long-term ➢ Reduce the volume of single-use materials to Landfill ➢ Design and introduce zero food waste policy ➢ Develop and launch awareness campaign to reduce food waste ➢ Align ROP, ROPV, building and living requirements with environmental policy, as well as with the development of an integral and sustainable waste management and waste processing model ➢ Approval of crucial environmental policies that are pending ➢ Establish and enforce legal framework for environmental conservation and restoration (including environmental impact assessment) ➢ Introduce and implement Environmental Ordinance "Milieu Verordening" (governs the permitting system, rules and regulations) and Waste Materials Ordinance "Afvalstoffenverordening"
MRP.3	Transition towards renewable energy and energy security ➢ Continue increasing renewable energy, reduce fuel imports, reduce emissions and seek nature balance (in accordance with energy affordability and reliability requirements) ➢ Introduce awareness campaign and consider tax incentives to engage private sector and households in renewable energy transition ➢ Focus on initiatives related to energy efficiency and conservation (e.g., reduce (cooling) electricity consumption in commercial and residential settings to offset carbon footprint) ➢ Pursue tariff structure reform for electricity & water as a catalyst for accelerating the energy transition

Table 9 - Relevant policies within the Economic Policy. Ref.: code serves for referencing a specific policy.

4.2 Legal and Administrative framework

Legally binding legislation, such as laws and decrees and are one of the main tools used by governments to ensure they achieve the goals set out in their policies. In Aruba, both national, as well as international legislation (e.g., treaties and conventions ratified for Aruba by the Dutch Kingdom).

This comprehensive legislative review is of great importance to the knowledge of project developers to ensure compliance. It is the responsibility of the project developer to stay updated on any legislative changes during both the development, as well as the operational phase of the project.

4.2.1 National Legislation

Table 10 represents an overview of national legislation that are either directly or indirectly related to various aspects concerning the project. Note, the articles of specific relevance within these legislative documents should be referred to for more information.

Table 10 - Comprehensive Overview of identified national ordinances and decrees relevant to the project. Source: (Gobierno Aruba, 2021)

SPATIAL PLANNING/PHYSICAL DEVELOPMENT POLICY			
National Ordinance	**Reference**	**National Decree**	**Reference**
LRO	AB 2006 no. 38	ROP Landsbesluit	AB 2009 no. 7
		Landsbesluit ROPV 2021	AB 2021 no. 123
Bouw en woningverordening	AB 1999 no. GT 9	Bouw- en woningbesluit	AB 1999 no. GT 10
Uitgifte eigendommen verordening	AB 1989 no. GT 21		
Kadasterverordening	AB 1989 no. GT 23		
ENVIRONMENT			
Natuurbeschermingsverordening	AB 1995 no. 2	Landsbesluit CITES-registers	AB 1995 no. 69
		Landsbesluit ontheffingen beschermde niet-inheemse flora en fauna	AB 1996 no. 1
		Landsbesluit Natuurbeschermings verordening	AB 2020 no. 67
		Landsbesluit bescherming inheemse flora en fauna	AB 2017 no. 48
Landsverordening verbod voor milieu schadelijke producten	AB 2019 no. 67	Landsbesluit verbod voor milieu schadelijke producten	AB 2019 no. 73
Hinderverordening	AB 1988 no. GT 27	Hinderbesluit Aruba	AB 1995 no. GT 20
Hinderlijke geluidenverordening	AB 1988 no. GT 22		
CULTURAL			
Monument Ordinance	AB 1991 no. GT 46		
HUMAN HEALTH AND SAFETY			
Bestrijdingsmiddelen verordening	AB 1991 no. GT 69	Landsbesluit \Bestrijdingsmiddelen	AB 1991 no. GT 52
		Landsbesluit Bestrijdingsmiddelen	AB 1991 no. GT 53
		Landsbesluit Bestrijdingsmiddelen	AB 1991 no. GT 57
Landsverordening Besmettelijke Ziekten	AB 1992 no. GT 11	Landsbesluit Besmettelijke Ziekten	AB 1992 no. 117

		Landsbesluit Besmettelijke Ziekten	AB 1992 no. 018
Landsverordening uitoefening geneeskunst	AB 1996 no. GT 50	Uitvoeringsbesluit beroepen in de gezondheidszorg	AB 2017 no. 54
Landsverordening bevoegdheid apothekers en apothekersassistenten	AB 1991 no. GT 7		
Landsverordening op de geneesmiddelenvoorziening	AB 1990 no. GT 9	Landsbesluit verpakte geneesmiddelenvoorziening	AB 1990 no. GT 48
		Landsbesluit geneesmiddelen uitsluitend op recept afgeleverd	AB 2006 no. 69
		Landsbesluit inrichting apotheken	AB 1989 no. GT 86
		Landsbesluit vergiften	AB 1992 GT no. 16
		Landsbesluit dienstregeling apotheken 1991	AB 1991 no. 16
		Landsbesluit, houdende algemene maatregelen	AB 1991 GT no. 60
		Landsbesluit, houdende algemene maatregelen	AB 1991 no. GT 59
		Landsbesluit, houdende algemene maatregelen	AB 1991 no. GT 58
Warenverordening	AB 1996 no. GT 12	Personeelsbesluit Warenverordening	AB 1995 no. GT 2
		Landsbesluit Warenverordening	AB 1997 no. GT 1
		Algemeen warenbesluit	AB 1997 no. GT 2
		Consumptie-ijsbesluit	AB 1997 no. GT 3
		Landsbesluit voorkoming gebruik kaliumbromaat	AB 1997 no. 43
Landsverordening verdovende middelen	AB 1990 no. GT 7		
Landsverordening ontplofbare stoffen	AB 1990 no. GT 51	Landsbesluit ontplofbare stoffen	AB 1999 no. GT 11
Landsverordening op stoomketels	AB 1992 no. GT 8		
Landsverordening brandweer	AB 1991 no. 64	Landsbesluit brandpreventie en brandveiligheid voor verblijf en ontspanning	AB 1991 no. 10
		Landsbesluit tot wijziging Landsbesluit brandpreventie en brandveiligheid voor	AB 1992 no. 97

		verblijf en ontspanning (AB 1991 no. 10)	
		Landsbesluit tot wijziging Landsbesluit brandpreventie en brandveiligheid voor verblijf en ontspanning (AB 1991 no. 10)	AB 1993 no. 28
Calamiteiten verordening	AB 1989 no. 51	*	
Veiligheidsverordening	AB 1990 no. GT 31	Veiligheidsbesluit I	AB 1991 no. GT 21
		Veiligheidsbesluit II	AB 1991 no. GT 22
		Veiligheidsbesluit gasreservoirs en gasinstallaties	AB 1992 no. 101
		Wijziging Veiligheidsbesluit gasreservoirs en gasinstallaties (AB 1992 no. 101)	AB 2005 no. 57
Landsverordening Elektriciteitsconcessies	AB 1991 no. GT 82	Landsbesluit installatievoorschriften elektrische inrichtingen	AB 1996 no. GT 5
GENERAL			
Algemene Politieverordening	AB 1995 no. GT 8		
Afval	No.35		

*: There are continuous publications of Ministerial Orders regarding the COVID-19 pandemic. These are mainly valid for a specified period and reflect mainly the trends regarding the spread of COVID-19 on the island.

Note that by national law, fees should be charged for both waste collection ("Landsverordening instelling Servicio di Limpiesa di Aruba" AB 2005 no. 5), as well as being connected to the sewer system ("Retributiebesluit rioolafvoer" AB 1991 no. GT 26). However, the GoA has to implement this legislation. Considering the infrastructure of the waste and wastewater systems is in dire need of funding for renewal and adequate processing it is highly likely that such fees will be charged in the (near) future.

4.2.2 Ratified International Treaties and Conventions

As a state/country within the Kingdom of the Netherlands, Aruba is signatory to multilateral agreements relating to among other things, protection of the environment cultural heritage and human health and safety. It is important to note that before a treaty enters into force, there are a few steps that are required; 1) negotiations, 2) agreements are made by the states and a treaty is signed, 3) parliamentary approval is sought, 4) upon approval by the Parliament, ratification ensues.

In Aruba, the following treaties and conventions are of relevance.

Table 11 - Relevant International Treaties and Conventions. Membership of Aruba in multilateral agreements relating to nature & environment. Source (s): (Gobierno Aruba, 2021; Verdragenbank, 2021)

Convention	Status Aruba*
Environmental Protection	
Cartagena Convention • Protocol concerning Specially Protected Areas and Wildlife (SPAW) • Protocol concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region • Protocol concerning Pollution from Land-based Sources and Activities (LBS)	01-01-1986 (R) • 17-06-2000 (R) • 30-03-1986 (E) • 06-10-1999 (S)
Convention on Biological Diversity (CBD)	04-06-1999 (E)
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	29-03-1995 (E)
Convention on Migratory Species (CMS)	01-01-1986 (E)
Vienna Convention for the protection of the ozone layer • Montreal Protocol on Substances that deplete the Ozone Layer	27-12-1988 (E) • 01-01-1989 (E)
Health & Safety	
Convention concerning labour inspection in industry and commerce	01-01-1986 (E)
Convention concerning Workmen's Compensation for Accidents	01-01-1986 (E)
Cultural/Historical Heritage	
Convention for the safeguarding of the intangible cultural heritage	15-08-2012 (E)

*Date of: Signature (S); Ratification (R); Entry into Force (E)

4.2.3 Beneficiaries and parties involved

The parties that are directly beneficiary to the development of this project include:

- Petros Aquaculture Operation VBA (Chamber of Commerce registration number: H51691.0) including its team of project developers.

Parties that will be involved but are not necessarily beneficiaries.

- Nature Non-Governmental Organization (NGO) and Governmental Organization (GO); relevant, though undefined, partners include among others, Stichting Piscado, Aruba Bird Life Conservation, AHATA, ATA, Turtuga foundation, DLVVM, DSA, DEHZI, NAMA, and Aruba National Park Foundation (FPNA) for their local knowledge on successful biodiversity, xeri-scaping and translocation for the proposed project development.

4.2.4 Documentation available

Petros Aquaculture Operation is requesting The Minister of Spatial Development, Infrastructure and Environment a ministerial option for the development of the Open Ocean Aquaculture Fish Farm at the parcel located in the Barcadera industrial area.

5 Scope of the Study

The scope of this Environmental Impact Assessment (EIA) adheres to the format requirements outlined by the Department of Nature and Environment (DNM), as detailed in Appendix 1, the EIA will be focused on:

- Onshore Site: proposed development area located at Barcadera.
- Offshore Site: 8.5 km from the Aruba shore.

The assessment conducted for the project **Onshore Site** in Aruba include the following:

1. Geology, and Topography
2. Hydrology and Seawater
3. Air
4. Light
5. Noise & Odor
6. Terrestrial and Marine Flora and Fauna
7. Cultural and Historical Heritage
8. Health and Safety

The assessment conducted for the project **Offshore Site** in Aruba include the following:

1. Hydrology and Seawater
2. Bathymetry
3. Seawater Quality
4. Marine Flora and Fauna
5. Health and Safety

The Social and Economic Assessment are not within the scope of this study. Refer to Appendix 50 for additional SEIA execution plan. However, cultural-historic aspects and human health and safety have been included as required by the EIA format set by DNM.

Throughout this document, the term "Onshore Site" refers to proposed development area located at Barcadera (12° 28’ 39.8640”N, 069° 59’ 03.2244”W) and the term “Offshore Site” refers to proposed development area located at (12° 32’ 49.2”N, 070° 08’ 29.76”W) 8.5 km Southwest of the coast and the elements within its boundaries. The baseline field surveys studies focus is on the Onshore and Offshore Sites.

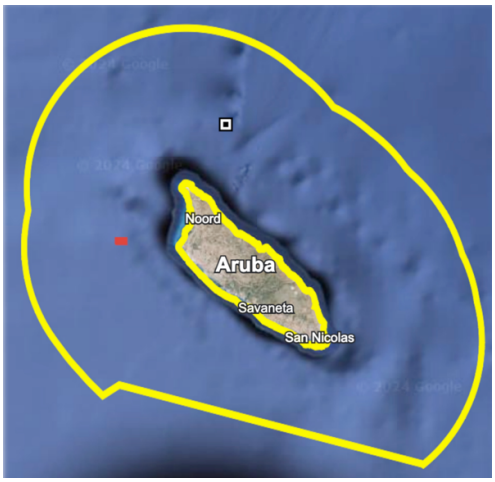


Figure 1 – Offshore / Onshore site Locations

5.1 Overall Objectives

The primary purpose of this EIA is to serve as a comprehensive source of information for the permit application process. It assesses the significance of the impact of the proposed **project Open Ocean Aquaculture** activity on the surrounding environment.

The following approaches were used to gain a comprehensive understanding of the environmental impacts:

1. Field Study: In-depth site visits were conducted to examine the environmental and cultural-historical settings, including potential threats.
2. Comprehensive Study: Public information on the environmental settings, flora and fauna records, and threats in the project site were thoroughly investigated.
3. Communication with Project Developers: Information from various features of the project development was utilized to evaluate its impacts.
4. Communication and meeting presentation with stakeholders, Governmental Organizations (GOs) and Non-Governmental Organizations (NGOs). Relevant project information was presented and feedback was provided by the stakeholders, GOs and NGOs.

The gathered information was used to establish a baseline for assessing potential impacts of proposed project activities. The EIA includes:

1. Description of Applicable Legislation: Local and international principles and standards relevant to the project.
2. Description of Property and Location: Details regarding the proposed activity's location.
3. Description of Project Activity: Features and policies associated with the proposed Open Ocean Aquaculture project.
4. Current Conditions at Project Site: A snapshot of the existing conditions.
5. Description and Comparison of Scenarios: Evaluation of different scenarios, with or without mitigation measures.
6. Description and Assessment of Environmental Issues: Both positive and negative impacts associated with the proposed project.
7. Identification of Appropriate Measures: Recommendations to avoid, mitigate, or compensate for adverse impacts.
8. Appendices: Documents, maps, photographs, detailed method descriptions, recorded data, and results.

It is important to note that the impact assessment section does not encompass the whole life cycle of products and materials (Life Cycle Analysis - LCA). However, impacts during the usage phase of products, waste production, water consumption, and electricity consumption have been considered. Additionally, an essential objective of this EIA is to guide the project developers in aligning development with relevant policies, legislation, and best practices.

5.2 Description and Overview of the Locations

5.2.1 Onshore Site

The proposed development of The Fish Farm processing and Hatchery Facility will be located at (12° 28’ 39.8640”N, 069° 59’ 03.2244”W) Barcadera. The proposed area is approximately 11,200 m^2 and is located in an industrial designated area as per ROP, 2019. Barcadera has a cargo port facility, other industrial activities and coastal infrastructure. As with any coastal area, environmental considerations in Barcadera would include the marine ecosystems, water quality, and the potential impact of development on local flora and fauna.

The onshore site area consists of about 10% of vegetation from the total area. The onshore site area is characterized as a xeric landscape mostly overgrown with *Acacia tortuosa* (Twisted Acacia/Hubada).
It must be noted that due to seasonal changes this vegetated area can be expected to vary to some degree.
The Barcadera Onshore site surrounding area description are as follow:

- On the North Side – Multiple smaller warehouses with light manufacturing activities.
- On the East side – A laydown area is used by the local drinking water production plant W.E.B Aruba NV. Wartsila backup generators are present in support of W.E.B.
- On the South side – The Barcadera lagoon is located.
- On the West Side – A construction company producing aggregate materials.

5.2.2 Offshore Site

The proposed development of the Offshore Site area description is as follows.

- Located 8.5 km West-South-West off the coast of Aruba. Refer to Figure 2 - Proposed Offshore Site location - Site 1.
- The Offshore site project area is estimated at 0.84 km^2 which is approximately 0.03% of total territorial seas of Aruba.
- The seawater water depth varies between 85 to 95 m deep.

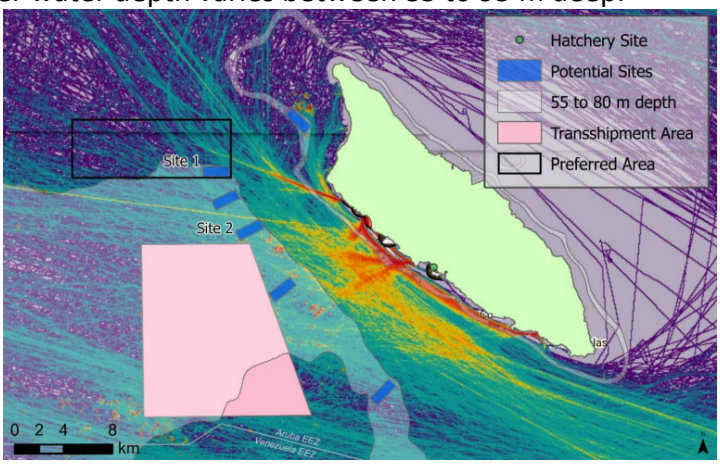


Figure 2 - Proposed Offshore Site location - Site 1

The potential offshore site was selected based on the information received on the transshipment and economic zone in alignment with engagement of the respective GO’s. An marked area was provided outlined by the black box in Figure 2. Within this area, Petros conducted extensive studies to pinpoint the site with the most ideal conditions for our target

species and farm operations. Also considered were marine traffic data, existing underwater telecommunication infrastructure and environmental data projections.

5.3 Features of the Proposed Project

5.3.1 Onshore Proposed Features of Project

The projected constructed area is approximately 11,200 m^2. The hatchery and operational area account for about 90% of the total constructed area. The hatchery is located on the North end of the property. The hatchery will be physically separated from the operations areas and will operate independently. The operations area is located on the South end of the property, closer to the Barcadera lagoon and the operation pier. The operation area will support key activities of the open ocean farm. It will house feed storage, maintenance area, back-up generators, logistics, dive support, ice production, administrative offices, employee cafeteria/lockers/parking, and fish processing.

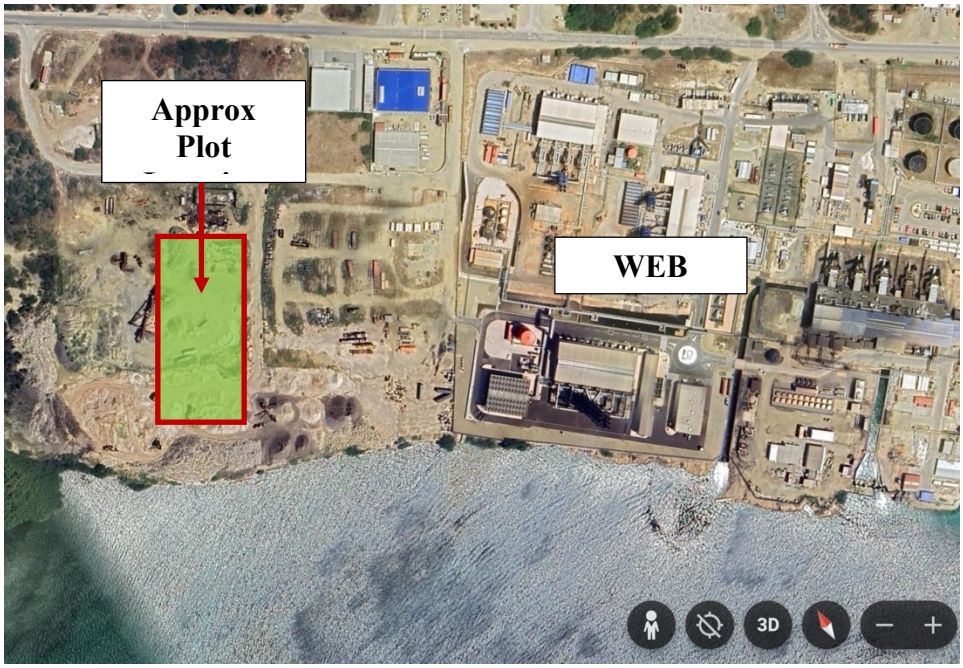


Figure 3 - Approximately Proposed Project Site Onshore Location

The property will be fully fenced in and will apply design features into its operations area to reduce and minimize any operational material to blow away or wash away during windy/rainy conditions. This is to minimize contamination of the Barcadera lagoon and Rooi Bosal. The onshore operations may also need to house Petros' own onsite wastewater treatment equipment, pending confirmation of AWSS capacity at Petros' start of production time. A more detail explanation of this proposed wastewater treatment equipment is detailed in Appendix 47.

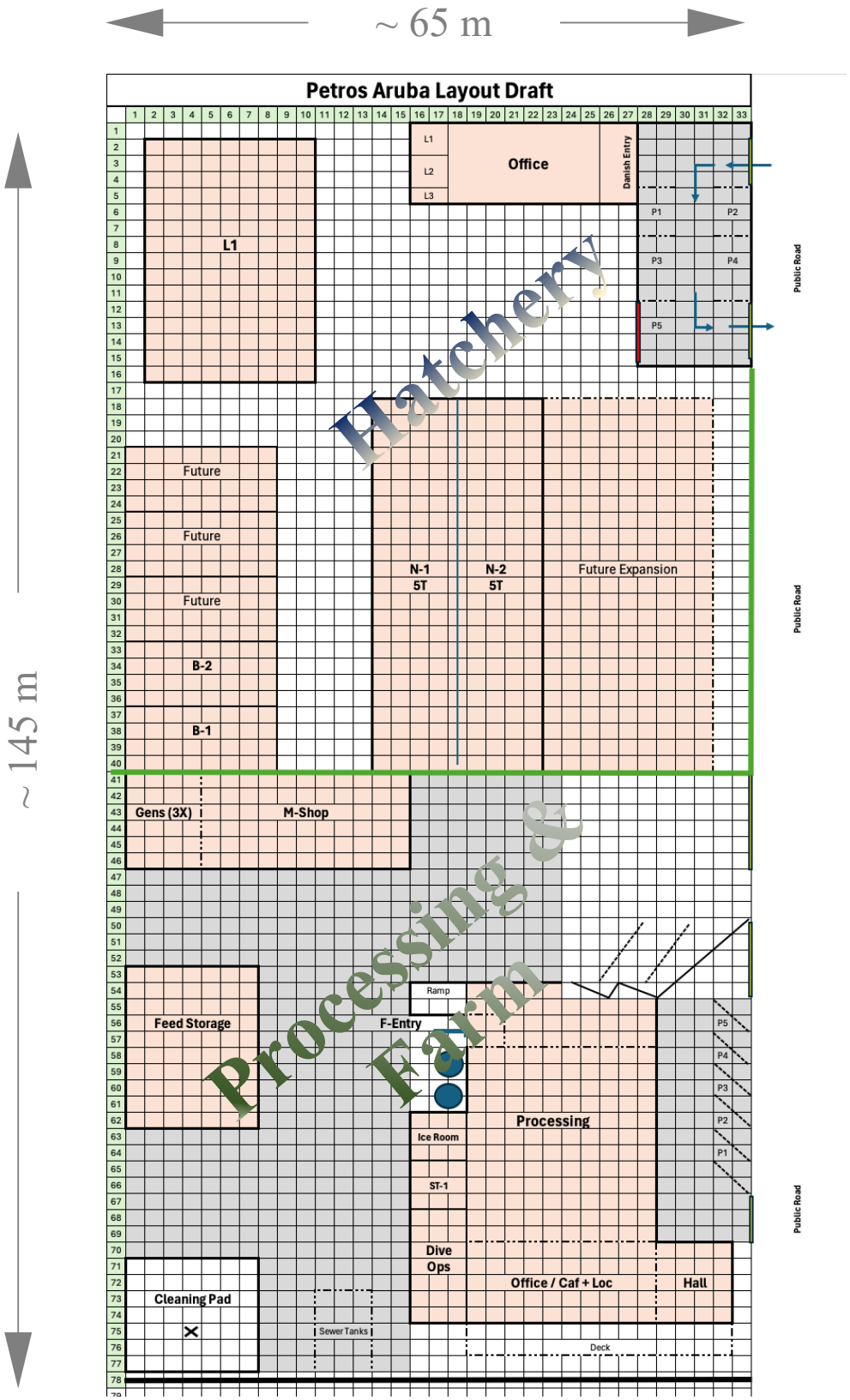


Figure 4 - Petros Proposed Layout (Details in Appendix 9)

5.3.1.1 *The Hatchery*

The Petros hatchery is a Recirculating Aquaculture Systems (RAS). RAS are closed-loop water treatment systems designed for raising fish on land, featuring a complex network of tanks, pipes, pumps and filters. RAS systems have a proven track record providing a tightly controlled environment that's conducive to the particular species being cultivated. This hatchery is a strict biosecurity area, as dictated per industry standards, providing over **600 m^3** of clean and processed seawater for the breeding and growth processes of the Aruban native Red Snapper (*Lutjanus Campechanus*). The biosecurity measures are meant to minimize the risk of introducing and spreading disease to the fish being cultivated in the hatchery. These measures also focus on reducing any risk of spreading disease into the Barcadera lagoon or to the open ocean farm site and the its surrounding environment.

The hatchery layout consists of a Broodstock area, Larvae Cultivation area, Nursery area, Pump House area, and administrative offices with its associated Biolabs. Figure 4 is the proposed hatchery layout based on the available land at the Barcadera target site.

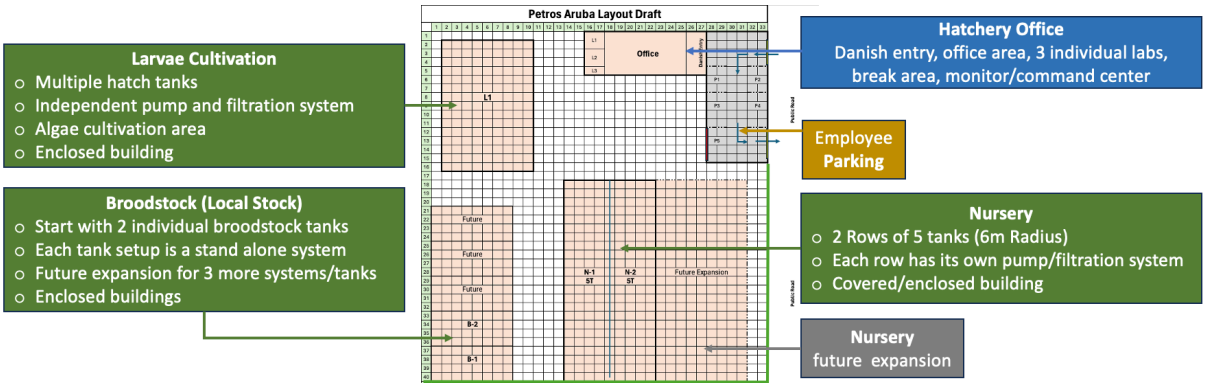


Figure 5 - Hatchery Proposed Layout.

Every aquaculture operation needs roe/eggs to supply its on land nursery and juveniles to supply its open ocean farm. At Petros, the roe/eggs will come from the onsite broodstock cohorts consisting of wild male and female Red Snappers caught in the local waters of Aruba. Petros expects to have between 15 and 25 individual mature fish per broodstock tank. A 2-tank system will be the start of the project and in a controlled manner add 3 additional tank systems.

Post spawning in the broodstock tanks, the roe/eggs are transferred to the larvae cultivation area. Here the eggs will hatch. The hatchling/larvae will be tended to till they are ready to transfer to the nursery tanks. Here they will reside for up to 3 months till they reach about 40 grams. It is at this point that these juveniles will be transferred to the open ocean farm for continued growth. All the fingerlings resulting from this broodstock production, are considered wild offspring.

The RAS system is set up to reuse the seawater already in the system, by capturing and removing all waste from the hatchery process. It allows farm operators to create an optimized environment for growth by providing ideal temperatures, water quality, feeding protocols and other factors.

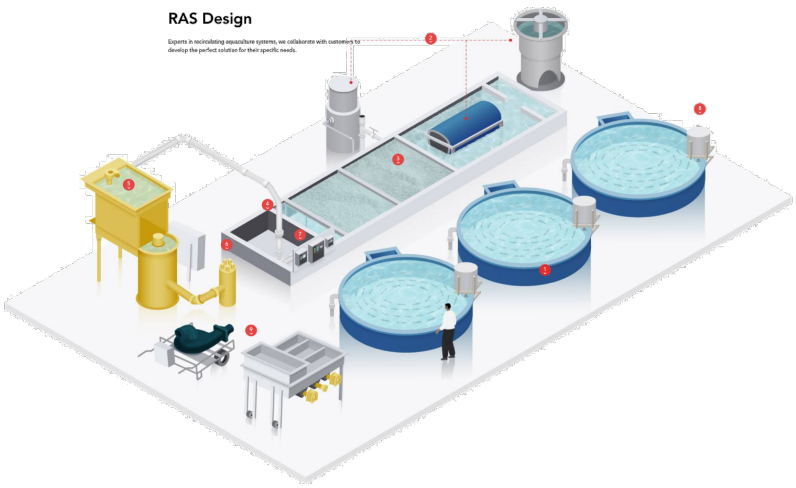


Figure 6 - Hatchery RAS Generic Design

One crucial component of a hatchery, is its water intake and discharge. The RAS system will have an intake connected to the seawater in the Barcadera lagoon. In this full RAS design, between 2% and 5% of the total system volume is replenished daily with seawater during peak operation periods, mainly to replace the volume lost to natural evaporation and the water used during the mechanical filtration process. Peak operations periods are when the biomass within the system is at its highest, which are the last few weeks of the 3-month growth cycle. The 5% is equal to 30 m^3, over a span of 24 hours, of new water entering the hatchery.

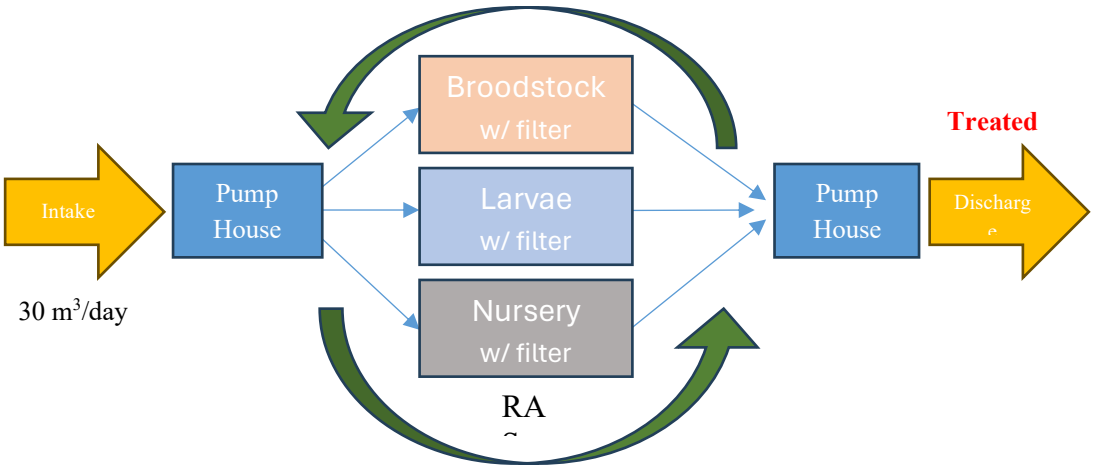


Figure 7 - Seawater Intake & Discharge

The seawater return stream, not to exceed 30 m^3 per day, will be cleaned and treated prior to being discharged into the lagoon. Quality checks will be performed, documented, and shared with the responsible Governmental departments, but also made publicly available, in order to comply with Aruban Laws, Cartagena LBS Protocol, and BAP & ASC accreditation quality targets. For a breakdown of the TSS, BOD, and other parameter targets, please refer to Appendix 44.

The hatchery RAS equipment's are designed to minimize the usage of seawater and Include the following:

- tanks,
- pumps,
- bio and mechanical filtration system,
- disinfection components,
- temperature control equipment,
- water quality monitoring,
- control systems,

The advantages of a RAS System include:

- Environmental benefits such as limited water usage and discharge
- Disease prevention
- Proper water quality control
- A smaller physical footprint.

5.3.1.2 The Operations

The operations area will have numerous activities, all supporting the open ocean farm and the post-harvest processing of the fresh Red Snapper. Overall the operations area is a self-contained area, fully fenced in, with no excessive noise pollution or odor contamination into the facilities surroundings. The 4 main pillars of this operations are feed storage, fish processing, maintenance, and administrative.

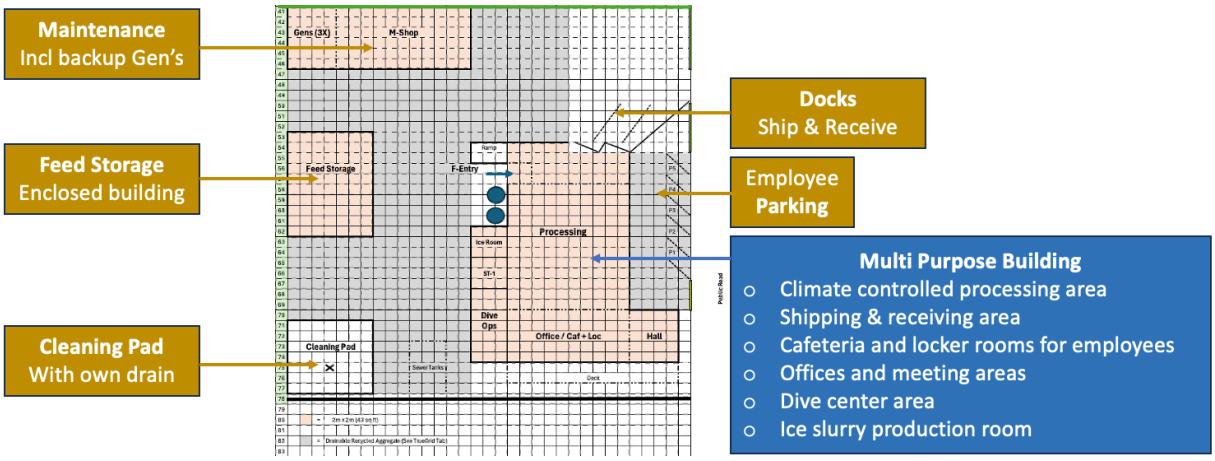


Figure 8 - Operations Proposed Layout.

The overall layout is designed to meet optimum operational efficiencies and worker safety, critical focus on Design-with-Nature principles, and a professional and best in class work environment for Petros' team members. The operations site is the first point of contact prospective customers and the general public will have with Aruba's first open ocean sustainable aquaculture company.

Feed Storage Building is an enclosed building with concrete floors, designed to store fish feed in a dry and clean area. The building will be secured with doors in order to eliminate critter intrusion and protect this valuable feed.

Maintenance Shop is a covered area where the maintenance technicians will have a workshop and secure areas for tools and equipment. Backup diesel generators will be housed next to this area in case of electricity disruption.

Multipurpose Building is where numerous activities happen during a traditional workday. The offices will be located on the 2nd floor with all required amenities like meeting rooms, sanitary, desk areas. An elevator will be considered to facilitate possible team members with disabilities. Located under the offices will be locker rooms, cafeteria/break area, and sanitary facilities, including showers for the employees. At the other end is where the shipping and receiving docks will be located. The center of this building is where the state-of-the-art processing area will be housed. It will be a climate-controlled area, with the latest food processing standards meeting local (DVG) and international standards. The ice making mechanical room and dive center will also be part of this building.

. More details can be found in Appendix 21. The main goals are food safety and expeditiously process of the harvested fish, in accordance to both local and international standards, and to customer requirements. Petros team members will be laboring in a safe environment with the highest levels of worker amenities.

Petros' Mitigation Management Plan (MMP) and Environmental Monitoring Plan (EMP) will include specific monitoring protocols for both noise and odor; with clear action thresholds and remediation procedures should any issues arise.

Noise mitigation are considered in the choices of refrigeration systems, electrical conveyors, hydraulic lifts, water pumps and filtration equipment, packaging equipment, which will all remain below 70 dBA.

Odor mitigation is achieved by having a climate controlled and enclosed facility. The rapid processing flow, immediate byproduct management infrastructure (collected in sealed containers, maintained in a temperature-controlled environment, transported to the incinerator, and no byproduct will be left outside at room temperature), advanced air handling system, and sanitation protocols, will all ensure no odor pollution at the facility and its surroundings.

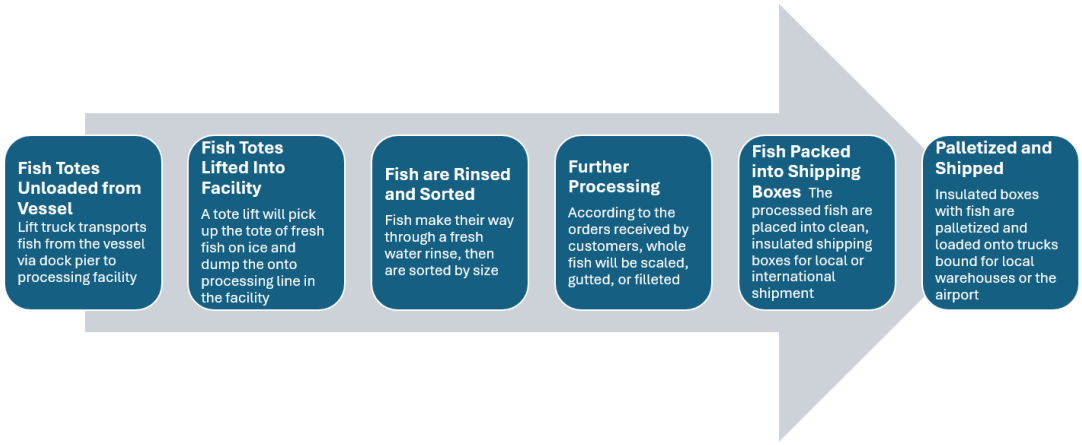


Figure 9 - Fish Processing Steps Overview

The high level processing line layout in Figure 10 is further detailed in Appendix 21. The line adheres to international standards such as the Global Food Safety Initiative's (GFSI) benchmark. At the heart of the food safety strategy within the Petros facility will be effective Food Safety Management System (FSMS) like Hazard Analysis Critical Control Points (HACCP), Good Manufacturing Practices (GMP), record keeping, sanitation, microbiological testing, and more.

The Petros processing facility will comply with all local and international government inspections, licenses, and permitting requirements.
To comply with Aruban government requirements, the Petros processing facility will maintain an active Aruban Food & Beverage License, Health Certificate, and Declaration of Good Health. Any other regulatory requirements from the Aruban government will also be adhered to.

For the purpose of exporting to the United States, the Petros processing facility will maintain an active US Food & Drug Administration registration, which requires documentation, periodic in-person facility inspections and product inspections upon importation. Any other regulatory requirements from the US government will also be adhered to.

For the purpose of potentially exporting to the EU market, Petros will maintain the EU Export Health Certificate, residue monitoring plan, traceability documentation and compliance with EU Hygiene Standards. Any other regulatory requirements from the EU will also be adhered to.

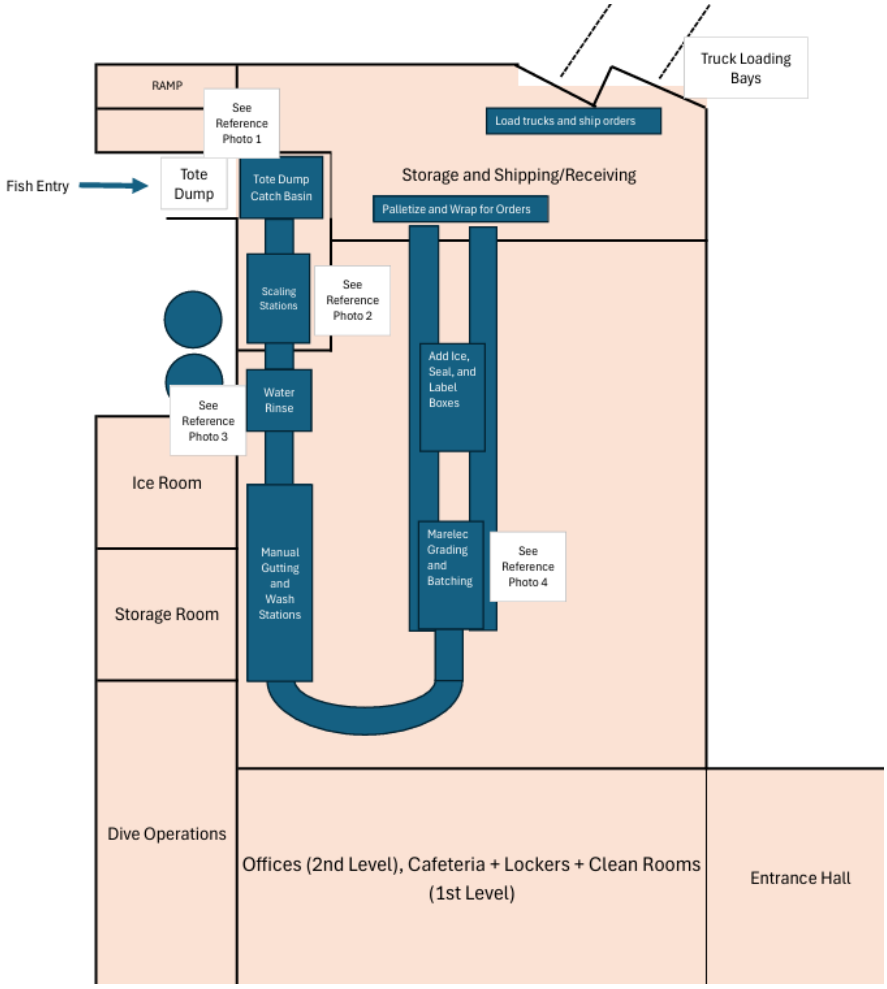


Figure 10 - Fish Processing Line & Stations Overview

5.3.1.3 Pier Design

Petros is considering installing an industrial floating concrete pier to enhance operational efficiency. This facilitates seamless daily transportation needs and streamlining logistics for the offshore fish farm. It will support the daily loading and offloading of fish feed and harvested fish. These operations will be performed by material handling equipment like electrical forklifts. The floating concrete pier system consists of two sections of 20 m by 8 m each. The pier system will be plumbed with electrical/data outlets, water lines, compressed air lines, and navigational aid lights.

The pier will be anchored by approximately 5 helix anchors on the leeward side of the pier. Helix anchors are installed by screwing them into the seabed, with metal pilings extending above the water surface. The helical plates, screwed into the seabed, create a strong and reliable grip, offering superior holding power compared to traditional mooring methods like concrete blocks or deadweight anchors. Helix anchors minimize seabed disturbance (no dragging chains), and does not significantly impeded the natural seawater flow within the

Barcadera lagoon, thus making this approach a preferred choice for environmentally sensitive areas. Additional information is compiled in Appendix 10.

Figure 11 - Example of Floating Pier

5.3.1.4 Waste Stream

The primary waste stream from the onshore facility based on a production rate of 500 MT/year are:

1. Hatchery - 2% - 5% Return seawater (Fully processed prior to return)
2. Hatchery – Sludge waste 3 MT/ year
3. Processing Plant – Wastewater (RWZI or Onsite Processing) – 625 m^3/ month
4. Processing Plant – Solid fish waste (guts, mortalities) – 75 MT/year

The Hatchery 2% -5% seawater return stream shall be treated and sampled to comply with the Cartagena LBS Protocol and ASC/BAP Accreditations, prior to disposal back to the sea.

The Hatchery sludge 3 MT/ year and the wastewater of the processing plant 625 m^3/month shall be collected in a septic tank. If AWSS can guarantee consistent capacity, the wastewater shall be trucked to the RZWI plants located at either Parkietenbos Barcadera or Zeewijk, for processing to the established regulations and quality standards. In the case that Aruba/AWSS is unable to guarantee the service of wastewater processing to Petros, the operation will consider installing its own onsite state-of-the-art wastewater infrastructure to meet all quality standards prior to discharge. Additional details on one of the wastewater treatment options are discussed further in Appendix 47.

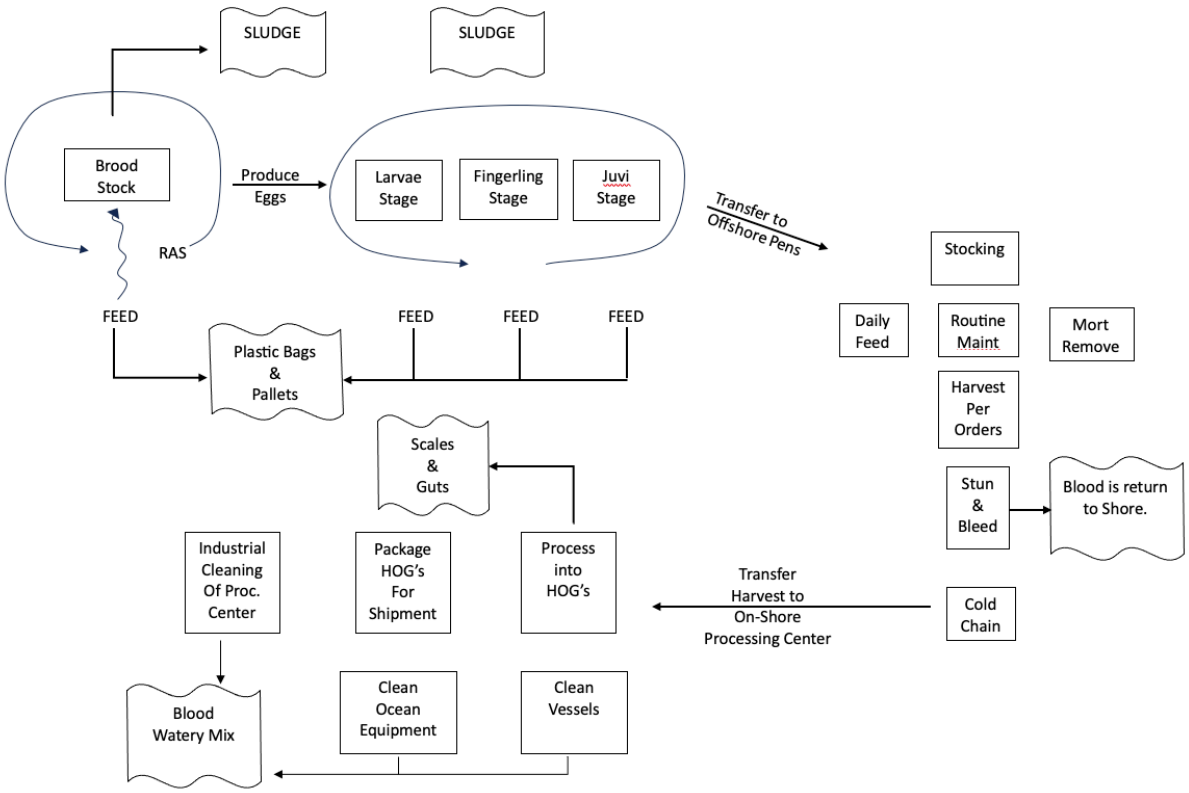


Figure 12 - Onshore Process Fish Related Waste

The solid waste from the Processing plant, which includes, guts and mortalities of the fish, shall be incinerated at the local incinerator plant.

5.3.1.5 *Climate Control Facilities*

The hatchery and processing building ventilation and air conditioning design shall be of high energy efficiency type to reduce the energy usage.

5.3.1.6 *Electrical Installations*

The plan is to install electrical equipment and technology that contain a rating between A+ and A+++ (EU Energy rating) in order to lower costs and reduce the carbon footprint.

Additionally, **the vision is to install solar panels to supply most of the energy demand**. The policy of the national electricity producing company (ELMAR) states that a maximum of 100 kW solar energy supply can be connected to the grid (ELMAR, 2020). This is equivalent to 15.000 kWh per month. The total projected electricity usage is calculated at around 240.000 kWh/yr. 180.000 kWh of this projected total could be produced by solar energy from the onsite on-grid solar panels.

Local solar systems providers have been engaged and preliminary plans agreed upon. The EV forklift will have a multiple battery system, where one set of batteries is charged with an off-grid solar system, while it uses the batteries which were charged the previous day.

Based on the proposed RAS System and multipurpose building usages, the following are the estimated energy consumed.

	Full RAS @ Peak Production	Multipurpose Building
Total Flow (Internal)	1350 gpm	Not Applicable (N/A)
New Water	5.5 gpm or 30 m3 per Day	625 m3 per Month
Power (/Yr)	~200,000 kWh @ 4 cycles per year (7kWh/kg)	38,000 kWh/yr

Table 12 - Energy Data of RAS & Multipurpose Building

5.3.1.7 Generator

A backup generator is designed to work in case of failure of the power network. As such, it will be designed to transfer, synchronize, and switch systems in a low voltage main electrical enclosure. The generators sourced for this operation will be through local licensed suppliers in order to guarantee optimal maintenance protocols and an efficient service life. The primary function of these generators is to keep the hatchery operation when there is a electricity supply disruption.

5.3.2 Offshore Proposed Features of Project

The Aruba Open Ocean Aquaculture project is set to specialize in the cultivation of Red Snapper (Lutjanus Campechanus). The project's offshore fish farm targets an initial production capacity of 500 metric tons (MT). The project developer intends to continue collaborating with experts in the field of fish farming like Innovasea, University of Miami, University of New Hampshire, University of Wageningen, University of Aruba, BAP, ASC, and others. Refer to Figure 13 for multiple global installations of Innovasea's proven Open Ocean Fish Pen technology.

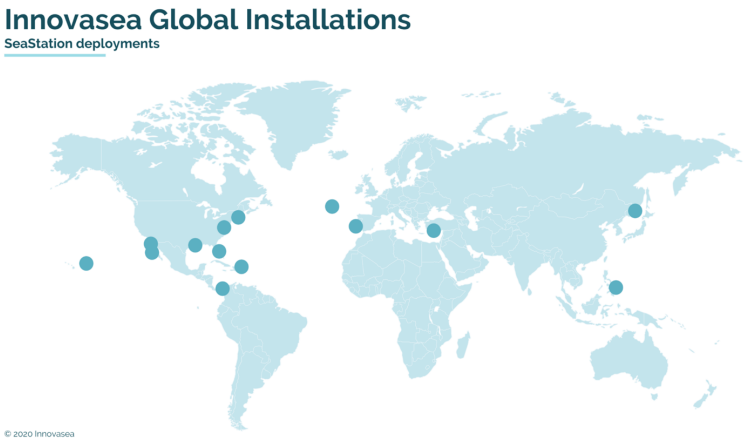


Figure 13 - Innovasea Global Installations

5.3.2.1 Submersible Pens

The proposed development core infrastructure will consist off 4 submergible pen system arranged in a 2x2 grid system (refer to figure below).

- Each Pen size will be approximately 35 m in diameter and 24 m height.
- The pens will be submersed to 15 m below sea surface.
- The grid system is designed to operate per the current and depth analysis of the targeted area.
- The coordinates are calculated using the World Geographic System 1984 and the footprint was drawn using the WGS1984 Web Mercator (auxiliary Sphere) projection system.
- A 100 m buffer between the grid edge and the box is provided. This is good practice for the space since placing anchors in not precise (although field tolerance is less than 100 m).
- The coordinates listed below reflects the grid system of an estimated 2x2 grid in approximately 90 m of water with the grid 15 m below the surface, 80 m grid cells, and 5:1 anchor scope. The total area for the 4 pens will be approximately **846 m x 846 m**.
    - 2x2 @ approximately 85 meters depth
    - 80 m cell size = 846 m x 846 m ~72 Ha.
    - Each pen is 6400 m^3. 4 Pens will equal 25,600 m^3.
- Pens, Grid System coordinates.
    - Grid center – 12° 32' 49.2"N, 070° 08' 29.76"W
    - North edge – 12° 33' 03.96"N
    - West edge – 070° 08' 55.32"W
    - South edge – 12° 32' 34.08"N
    - East edge – 070° 08' 04.92"W

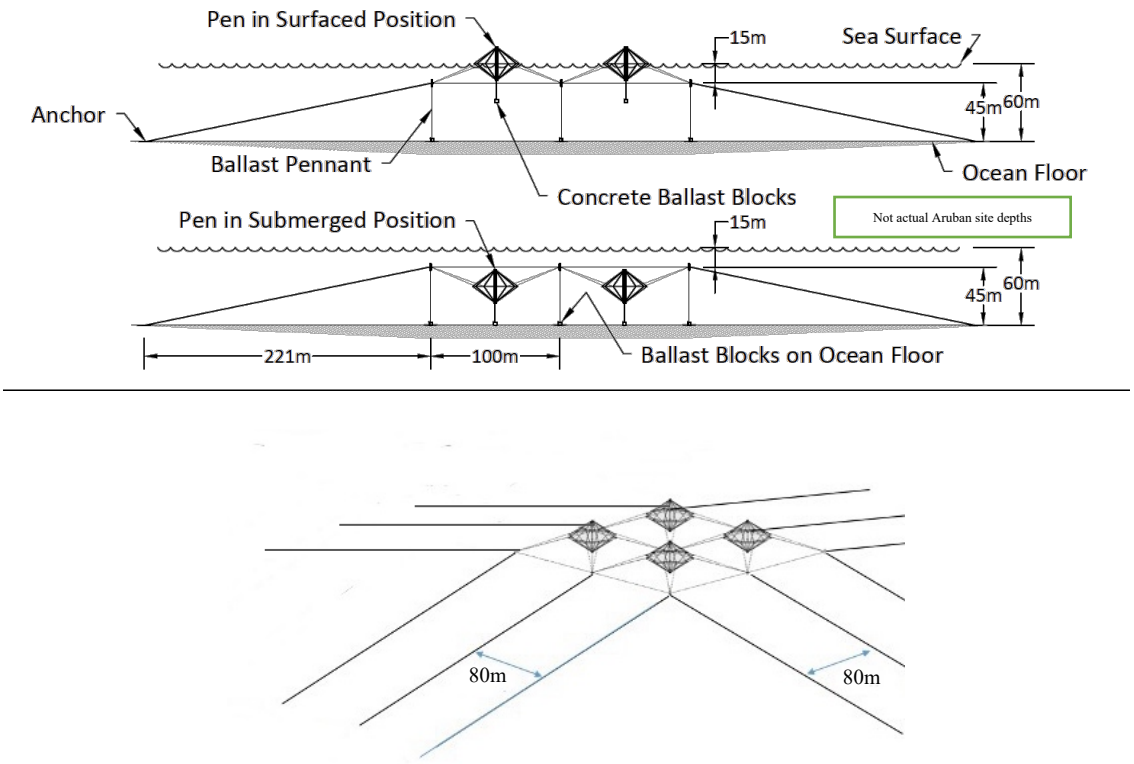


Figure 14 - Generic Pen Grid System

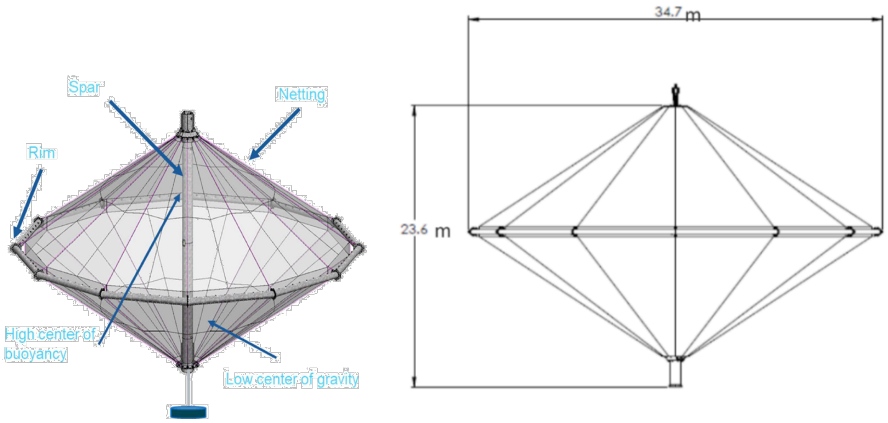


Figure 15 - Example of Pens

The pen structural construction material will be primary made of steel material.

The net around the pen will be Kikko netting - Polyethylene Terephthalate (PET) monofilaments material. Tensioning features hold the pen net uniformly taut, so that a "wall" is presented to any underwater predator, with no slack areas for entanglement. The use of a net tensioning system removes the need for predator nets and therefore eliminates the risk of entanglement for predators and other marine mammals.

The antifouling for net and gear is the desiccation of fouling on the top net when the pens are at the surface and net cleaning on the bottom with an industry standard Ideema net cleaner from Akva Ltd. Nets are subject to a regular strength testing and maintenance programs.

In the case of a catastrophic financial collapse of the company, the removal of any and all equipment installed in the open ocean is covered under an insurance policy serviced by an aquaculture and fisheries focused insurer. This ensures a responsible management of Aruba's natural resources and risk mitigation, in case of bankruptcy.

5.3.2.2 *Sensor, Cameras, Communication Buoy*

Within each pen and throughout the grid, Petros will install an intricate array of underwater sensors to measure dissolved oxygen, current speed/direction, and temperature. Underwater cameras with AI capabilities are installed to measure biomass and to record fish behavior throughout their growth cycle. These recordings, with the help of AI computation and the extended scientific community, will help Petros predict animal welfare and any upcoming issue due to stress on the Red Snapper. These are proprietary protocols being developed at the University of Miami.

This complete array of sensors and cameras, is connected with a communication buoy at the surface. This comm's buoy will adhere to IALA Guidelines. Some of the regular data, like wave height, wind speed and direction, water temperature, and live surface video feed, will be shared with the public. This data will be helpful for the charter fishing community and the artesian fishing community. The public will know what is happening on the open ocean and make accurate safety decision prior to leaving the docks.

Figure 16 - Communication Buoy, Dissolved O_2 & Chlorophyll/Temp/Tilt Sensors, Cameras

5.3.2.3 *Mooring*

Pens are connected to the grid at multiple points on the mid rim structure. This reduces wear and makes it easier for boats to access the pen without having to navigate surface lines. The pens will be securely within a network of high-tenacity polyester fiber linen - 12 strand 48mm arranged in a grid pattern. The mooring system will be 100% under high tension. No loose lines will be present on site and thus eliminating any possibility of entanglement of marine mammals or other marine fauna. Refer to below Figure 17 for anchoring system example.

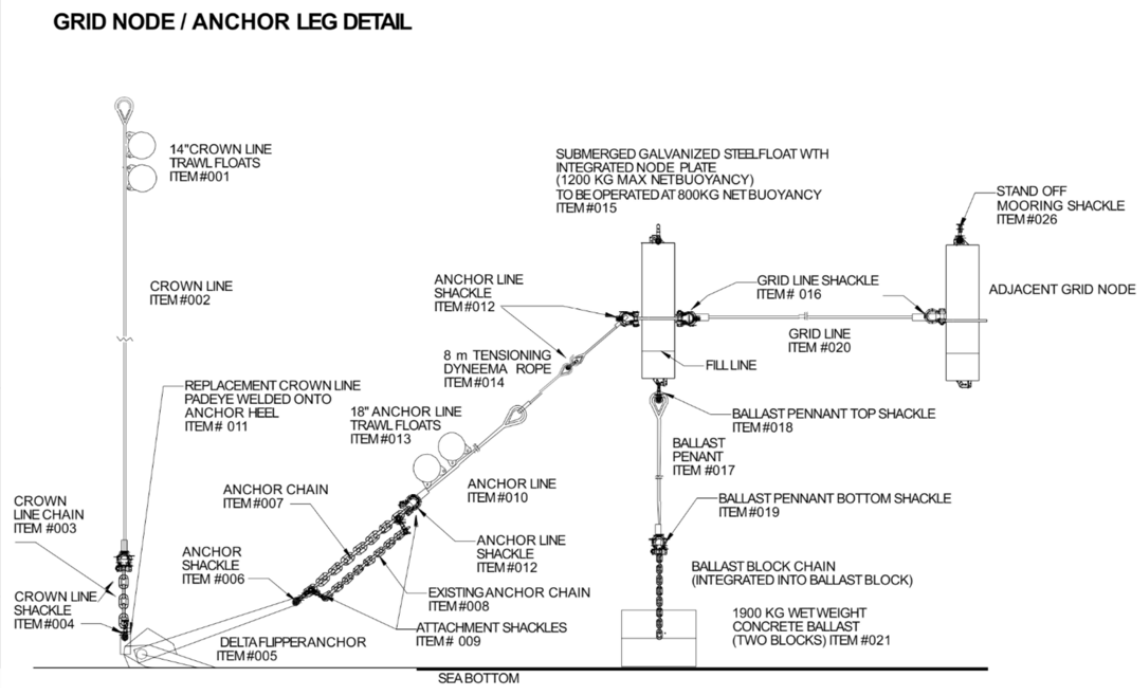


Figure 17 - Anchor example detail.

The fiber lines will be anchored by a drag embedment anchors method, with a slip mitigation system of Crown lines at 30 m below the surface to allow vessel to adjust anchors if needed. The mooring system will be regularly checked by divers in order to ensure optimal operation and performance. Refer to Figure 18, for a detail overview of the pen design.

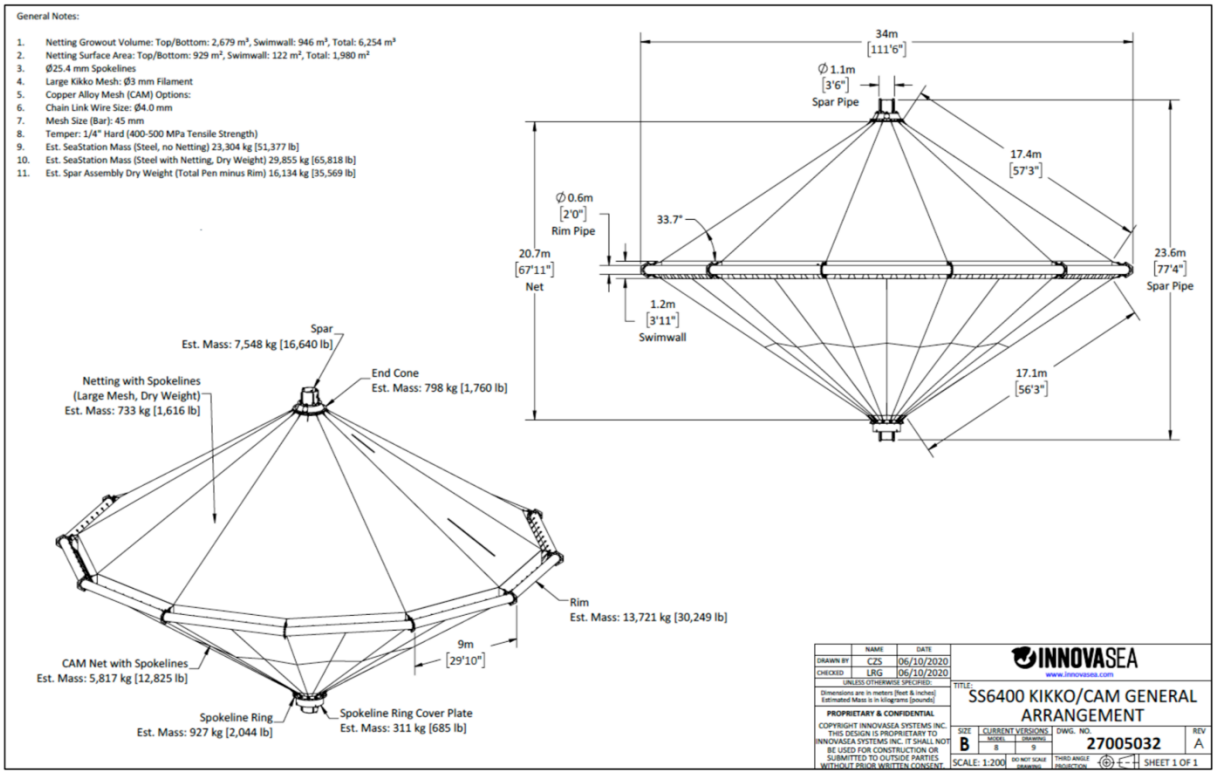


Figure 18 - Detail overview of the Pen design.

5.3.2.4 *Feeding System*

The feeding system can deliver feed to multiple pens on the grid from a centralized location. Since feed is delivered to submerged pens, it enables farm operators to feed even when faced with rough conditions.

This improves feeding regimens and helps reduce the number of lost feed days to keep growth targets on track. In addition, the waterborne delivery system requires significantly less power than air-blown systems and can reduce energy costs by more than 50 percent.

An array of sophisticated sensors and high-resolution cameras are continuously collecting and storing data in the cloud. The cameras are AI enabled in order to further optimize the operations and support decision making. This advanced system provide real-time visibility into:

- Feed satiation in order to dial in efficiency, optimize fish growth, and improve animal welfare.
- Feed pellet detection improves Feed Conversion Ratio (FCR) and reduces feed waste into the surrounding environment.
- Biomass data in order to obtain an accurate inventory of the fish stocks and growth rates. This reduces continuous handling of the animals for count and biomass assessments, thus reducing stress on the Red Snappers.

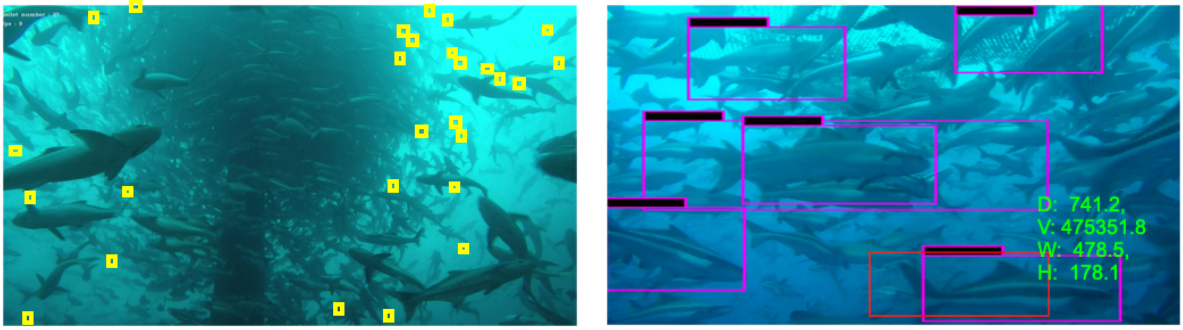


Figure 19 - Pellet Detection & Biomass Estimation.

5.3.2.5 *Mortality retrieval*

An innovative and proven mortality retrieval system is installed in each pen. This system safely and quickly retrieves fish mortalities within each pen. It is a best in class operational practices with the goal to improve animal welfare and eliminate predator attraction. When a fish is deceased, it is initially negatively buoyant. This causes it to sink to the bottom of the pen and in doing so, it enters the mortality retrieval system. Each day that Petros' vessels are at the farm for activities such as feeding or routine maintenance, they will be removing the mortalities and return them to the land base for analysis and proper disposal.
Not having decomposing mortalities at the bottom of the pen, will avoid changing the natural behavior of sharks and other predatory animals. The unnatural attraction to the farm area due to mortalities is fully avoided due to the application of the mortality retrieval system and good husbandry. These processes are part of Petros' SOP and MMP.

5.3.3 Onshore construction activities

The project developer is expected to use the services of local construction companies for the construction of the Onshore facility. Construction activities will take place mainly during daytime, between 8 AM and 5 PM.

The project developer will facilitate compliance with guidelines for health, safety and environmental management through contractual agreements made between the parties, ensuring liability for negligence or incompliance. Furthermore, environmental trainings and meetings with construction workers will take place prior to construction. The project developer will contract experts for environmental trainings, inspections, and monitoring.

Work site preparation will consist of:

1. Surveying the area to verify the location, line (i.e., determine route of piping systems and sanitary structures and systems) and grade (profiling the elevation);
2. Land clearing including waste management.
3. Earth movement and perforations/land cutting/excavation, where removed soil will be stored for reuse in grading, gardening and landscaping;
4. Creating an even platform with safe embankments (grading)
5. Set up of construction camp: storage of equipment, materials, and chemicals to be used during construction, fencing, waste containers, placement of facilities (e.g., portable toilets)

The subsequent construction work will include:

1. Foundation laying and paving
2. Structural work
3. Construction of buildings (masonry, doors, windows)
4. MEP installations
5. Finishing
6. Interior/exterior Design
7. Landscaping

During the construction process, personal, material and heavy/-small equipment will continuously be on-site circulating around the project site, therefore a provisional construction area will be installed for a safe working environment. The construction material used on the project will be purchased at local construction suppliers, if in any case the materials required for the developing of the project cannot be bought locally, they will be bought abroad and brought to the island paying all local taxes.

The provisional construction area will be set up on the south area of the project site with designated locations for:

a. Tools and small equipment warehouse:
   This space will stay locked to store materials and small equipment that can be damaged by rain or long-term sun exposure. Warehouses will be set up on compressed soils, wooden structures covered by galvanized sheets and roofs made of plastic (waterproof in case oil, grease, or fuel is used)
b. Break Area:

Area is in an open space away from green areas and staff. Bins with lids will be provided for collection of staff rubbish and food waste. Signs against littering will be placed here.

c. Offices:
   Enclosed set up where wind cannot blow away paper materials.
d. Heavy equipment/machinery operational area:
   This area will be setup outside vegetated areas to avoid contamination of soils. Areas where heavy equipment/machinery is stationed for extended periods will be covered. Oil and grease contaminated sand will be removed and collected by Serlimar or Ecotech. For a list of small- and heavy equipment/machinery to be used during construction refer to Appendix 6
e. Inert waste storage area:
   This area will be set up near the road. All waste will be placed in containers which are covered with tarps.
f. Toilets:
   Portable toilets will be placed away from vegetation. One toilet for every 10 workers on a standard 40-hour work week.

Solid waste would be generated by construction workers by construction activities involved in the building process and resulting from personal usage (e.g., lunch). Personal waste from construction workers (similar to household waste) consists usually of packaging and containers for food and drinks as well as small amounts of organic waste (estimated to be approximately 0.25Kg/person/day). Either Serlimar or Ecotech will be contracted to collect the construction worker waste on a regular basis. This waste will be delivered to Seroe Teishi (area currently designated by the GoA for the storage of household waste).

During construction the workplace will have a suitable number of portable toilets operated and maintained by a reputable contractor. The maintenance mainly includes the sanitation of portable toilets, pumping of the wastewater out of waste tanks, and collection of the wastewater generated by construction workers which is transported and disposed of at the RWZI of Bubaliplas.

During land clearing, the waste will consist mainly of spiny vegetation such as *Acacia tortuosa*, grasses, weeds, and the top layer of soil. Wherever vegetation can be reused for landscaping or other purposes the land is not cleared or vegetation is carefully removed for later trans-/replantation.

The excavations during groundworks will be mainly to lay out foundations (Civil), MEP installations, and tanks. The developers will install the electrical cables/wiring prescribed according to the law. While a minimum depth of 0.6 m is usually required, lower depths are acceptable in the case of bedrock subsurface formations, providing the cables are sufficiently protected against mechanical tearing/damage.

The excavation excesses will consist of earth and stone and will be directly reused for this project. These excesses will be used as filling and leveling of the land and wherever possible it will also be used for landscaping and gardening.

Rough waste generated from the construction activities will be stored in commercial size dumpsters for construction activities in an area within the plot. Construction wastes consist mainly of the presence of residues (e.g., gypsum), wood, metals and packaging. Serlimar (national waste management company) will collect the dumpster waste weekly. It has to be noted that construction waste was found scattered on the terrain. Such waste will be removed during land clearing and mainly disposed of in the container designated for construction waste to separate organic waste from inorganic waste.

Considering there are no existing structures on the property, no demolition waste is expected.

5.3.4 Offshore Construction activities

The offshore Pens construction material and equipment's will be shipped in containerized section and assemble onshore after assembling it will be shipped to the offshore location.

Specialized moorings will be engineered to withstand the expected meteorological, hydrological, and topographical conditions at the proposed development site. These moorings will undergo daily inspections as part of containment checks, with a comprehensive examination of all components conducted by trained personnel at the conclusion of each production cycle. The total surface area of the proposed development, including the moorings, is 0.84 square kilometers. Approximately 98% of the wave and surface energy is lost when the gear is submerged half the distance of the wavelength (crest to crest). 15m below sea-level is well below most of the energy. This gear has been submerged during many Categories 3, 4, and 5 hurricanes/typhoons, without incident because of the ocean engineering principle above.

5.3.5 Onshore and Offshore Operational Activities

During the operational phase of the Open Ocean Aquaculture fish farm, a range of activities will be undertaken to ensure the well-being of the aquatic environment, the health of the fish stock, and the overall success of the Open Ocean Aquaculture Project.

Environmental Responsibility and Standards

Best Aquaculture Practices (BAP)

Environmental responsibility is one of the foundational pillars of the Best Aquaculture Practices (BAP) certification program. The BAP program standards help producers mitigate their impact on the environment:

1. **Certification Standards**: BAP provides comprehensive standards that cover the entire aquaculture production chain, including hatcheries, farms, feed mills, and processing plants. These standards are designed to address critical issues in aquaculture such as environmental impact, social responsibility, animal health and welfare, and food safety.

2. **Four-Star Certification**: BAP offers a star-based certification system. The highest level, four-star BAP certification, indicates that a product has been sourced from a BAP-certified processing plant, farm, hatchery, and feed mill. This level of certification represents the highest standard of integrated supply chain responsibility.
3. **Environmental Responsibility**: BAP standards promote sustainable practices to minimize the environmental footprint of aquaculture. This includes managing water quality, preventing habitat destruction, and reducing the use of chemicals and antibiotics.
4. **Social Responsibility**: BAP-certified operations must comply with labor laws and ensure fair treatment and safety for workers. This includes prohibiting child labor, ensuring fair wages, and maintaining safe working conditions.
5. **Animal Welfare**: BAP standards require humane treatment of animals, including proper handling, health management, and measures to minimize stress and suffering.
6. **Food Safety**: BAP certification ensures that seafood is produced under conditions that minimize the risk of contamination and ensure the safety and quality of the final product.
7. **Traceability**: BAP standards emphasize traceability, ensuring that products can be traced back through the supply chain to their origin. This enhances transparency and accountability in the aquaculture industry.
8. **Global Reach**: BAP certification is recognized worldwide and is used by many of the leading seafood retailers and food service companies as a benchmark for responsible aquaculture practices.

Aquaculture Stewardship Council (ASC)

The ASC is an independent, international non-profit organization that sets standards for responsible aquaculture. It aims to improve the environmental and social impacts of aquaculture production such as:

1. **Certification**: The ASC provides certification for aquaculture farms that meet their rigorous standards. This certification assures consumers that the seafood they are buying comes from farms that operate responsibly, minimizing environmental impact and ensuring good social practices.
2. **Standards**: The ASC standards cover a wide range of criteria, including environmental sustainability, fish health and welfare, feed sustainability, water quality, and social responsibility (e.g., fair treatment of workers and community impacts).
3. **Labeling**: Products from ASC-certified farms carry the ASC label. This label helps consumers make informed choices by identifying products that adhere to high standards of sustainability and responsibility.
4. **Impact**: By promoting best practices and transparency in the aquaculture industry, the ASC aims to drive improvements in the way seafood is produced. This contributes to the health of aquatic ecosystems, supports biodiversity, and promotes fair labor practices.
5. **Global Reach**: The ASC operates globally, certifying farms in many countries and working with various stakeholders, including farmers, retailers, and environmental organizations, to advance sustainable aquaculture practices.

The key operational activities proposed include:

- Hatchery Management:

Oversight of the hatchery area, including breeding, egg incubation, and early-stage fish rearing to maintain a consistent and healthy fish population.

- Water Quality Management

Continuous monitoring and management of water quality parameters such as temperature, dissolved oxygen, pH levels, and nutrient concentrations to maintain an optimal environment for fish growth. Established SOP's will drive a culture of data collection and mitigation protocols. Refer to Appendix 16, Appendix 29 and Appendix 44.

- Air Quality Management

Continuous monitoring and management of air quality parameters through established SOP's and equipment choices. Please refer to Appendix 20.

- Fish Health Monitoring

Regular monitoring of fish health, including visual inspections and health assessments, to ensure early detection of any signs of decease or stress. For the deceased fish in the pens a mortality trap will be used to remove the deceased fish following extraction by an air lift system from the vessel. To mitigate the attraction of sharks to the Offshore Farm Area, any deceased fish will be expeditiously removed and brought to shore for proper disposal.

- Feeding and Nutrition

The aquaculture project will utilize industry leading feed producers, like Cargill, Biomar, and Skretting, to name a few. These corporations have to meet BAP and ASC accreditations, focusing on feeds that enhance fish health and are environmentally sustainable. These feeds are tailored for various marine life stages and incorporate sustainable ingredients with no GMO, no medication, and specifically no antibiotics. Petros' corporate values are to not include fish oils and fish meals from forage fish. Thus reducing the already elevated stress on the world's wild fish population. No fish oils or fish meal will come from illegal fisheries. Those that do make it into our feed, will be from accredited and quality controlled fish trimmings. This approach aligns with responsible farming practices and marine resource management. For additional information, please refer to Appendix 52.

Figure 20 – Feed International Accreditation

- Stocking and Harvesting Operations:

Planning and executing stocking activities to introduce new fish from the hatchery to the farm, and coordinating harvesting operations to ensure efficient and sustainable production. The fish shall be harvest with the latest humane commercial stunner used in the industry.

- Disease Prevention and Treatment:

Implementation of decease prevention measures, including biosecurity protocols, and prompt treatment responses, with local veterinary advise if any signs of illness are detected. One key aspect of prevention is avoiding extremely high density of biomass in the pens. The goal is to start below expected industry biomass densities and gradually raise the density to meet proven industry targets.

- Infrastructure Maintenance:

Conducting routine maintenance of farm infrastructure, including nets, cages, and feeding equipment, to ensure optimal functionality. The whole system relies on a taut setup. So the constant maintenance checks also eliminate any potential for loose ropes and netting, which would have increased entanglement risk for marine mammals, turtles, and other marine animals.

- Logistics and Transportation

Managing the logistics of fish transportation, both within the farm (e.g., moving fish between different tanks or cages) and external transportation for distribution to markets. For additional transportation impact information, please refer to Appendix 7.

- Marine Vessels

The operational plan for the fish farm at Barcadera, Aruba, involves regular trips from the dock to the offshore fish farm. Specifically, it is calculated that these trips will occur daily. These frequent trips are essential to maintain the farm's daily operations efficiently.

These trips may serve various purposes, including feeding the fish, monitoring their health and conditions, performing maintenance tasks, and transporting personnel such as divers and farm workers.

Ensuring that the farm's activities are well-coordinated and that the fish receive the necessary care and nutrition is crucial for the farm's success in producing high-quality seafood in an environmentally responsible manner. The multiple trips per day exemplify the farm's dedication to meeting these objectives and maintaining the well-being of the aquatic ecosystem at Barcadera and at the offshore farm location.

Vessel Type	Length /Size	Engines	Construction material	Total Fuel usage while moving	Hrs moving vs idle
Feed & Harvest Vessel	22m	Twin Diesel	Aluminum	80L/hr	3 hrs vs 5 hrs
Center Console	10m	Twin Outboard	HDPE	25L/hr	2 hrs vs 5 hrs
Pilot House	10m	Twin Outboard	HDPE	25L/hr	2 hrs vs 5 hrs

Table 13 - Marine Vessels

- Environmental Impact Monitoring

Regular assessment of the farm's environmental impact, with a focus on minimizing any potential negative effects on the surrounding ecosystem. For additional information, refer to Appendix 41, Appendix 42 and Appendix 43.

- Record Keeping and Data Analysis

Maintaining detailed records of operational activities, water quality parameters, and fish health data for continuous analysis and improvement of farm practices.

Other miscellaneous activities expected includes i.e.:

- Administration and Human Resources (HR) management
- Wastewater Treatment (for sewage) (Appendix 44 and Appendix 47)
- Waste Management (Appendix 46)
- Maintenance MEP
- Information Technology (IT)
- Security

5.4 Project Purpose

The primary objective the Open Ocean Aquaculture project is to establish a technically appropriate aquaculture facility, for local and export markets. The aquaculture facility aims to follow proven standards in sustainable fish farming by incorporating best practices in aquaculture. The project focuses on responsible resource management, low-impact farming methods, and the utilization of advanced technologies to ensure the ecological integrity of the marine environment.

By establishing a state-of-the-art aquaculture facility, the project aims to develop a new economic source. This includes creating employment opportunities and fostering skill development. The project seeks to play a role in supporting local food security initiatives and providing a sustainable solution to address dietary gaps.

The Open Ocean Aquaculture Operation can possibly diversify the local tourism industry by offering unique and educational aquaculture experiences. To promote awareness and understanding of aquaculture practices, the fish farm plans to collaborate with educational institutions. This involves offering educational programs, tours, and internships to students interested in marine biology, aquaculture, and related fields. The project is committed to environmental stewardship by implementing eco-friendly aquaculture practices. The Fish Farm will focus on minimizing its environmental impact, optimizing water usage, and exploring alternative energy sources to reduce the carbon footprint associated with fish farming.

5.5 Definition and Description of Scenarios

The following paragraphs describe the three courses of action in the project development: Scenario 0, Scenario I, Scenario II. These scenarios were determined according to the requirements of DNM. This allows a qualitative comparison of the levels of environmental impacts between scenarios and where mitigation measures should be applied. Note, while it is customary in an EIA to provide alternative sites as a scenario, this option is not available considering the EIA requirements in a Ministerial Option agreement is directly connected to

the parcel and its location. Hence, an alternative site might have other requirements attached and would require the developers to apply for a new building permit.

5.5.1 Scenario 0: No-Action

The no-action alternative is the situation without the project but considering the evolution of the baseline conditions (Section 6), including other known projects, approved or reasonably foreseen in the future. Scenario 0 is taken as the reference situation. Assumptions of the evolution of the baseline conditions are described in Section 7.

5.5.2 Scenario I: Prevention of All Negative Environmental Impacts

The alternative scenario refers to the situation were recommended Best Environmental Technologies (BETs) that can help prevent and mitigate negative environmental impacts related to the project development are implemented. All these technical measures are described in Appendix 33 and Appendix 34.

5.5.3 Scenario II: Best Practical Means

In Scenario II the currently proposed environmental technologies and applications by the project developers are implemented in the project development. The technical measures proposed by the project developers are described in Appendix 35 and Appendix 36. Considering the Best Management Practices (BMPs) are proposed by the project developer, this scenario is the most credible to occur. The project development was in its conceptual phase during the writing of this EIA and that the baseline information, desktop study and recommendations in this EIA is serving as information for the project developer to further adapt the project development to meet sustainability criteria.

5.5.4 Comparison of Scenarios

Before comparing the scenarios, the appropriate technologies and applications are described for both Scenario I and Scenario II. Comparisons of the impacts between the scenarios are divided between the operational and construction phase. These comparisons are based on:

a) the observations regarding the baseline conditions at the project site
b) the Scenario 0 assumptions in Section 7,
c) the appropriate technologies/applications that are shown in Appendix 33, Appendix 34, Appendix 35 and Appendix 36.
d) The significance of the impacts following an evaluation method matrix (Leopold, Eldridge Clarke, Hanshaw, & Balsley, 1971)

The resulting score provides the following possible evaluation outcomes:

- -	major negative impact	++	major positive impact
-	minor negative impact	+	minor positive impact
	no impact	±	both positive and negative impacts
Y	mitigation measure		
	negative impact, even with BMP's		
	possitive impact, with BMP's		

Table 14 - MIIA evaluation of the significance (I) value

6 Environmental Situation/Baseline Conditions and Research Activities

To determine the ecological value of the area and to provide a reference for the future, the current environmental conditions in the area of the proposed project development were assessed with regards to various environmental aspects. The description of the Environmental Situation were primarily a benchmark against which to measure environmental changes and to assess impacts. The assessments included the following topics:

- Geology and Topography (Appendix 8, Appendix 9)
- Hydrology (Appendix 14)
- Seawater quality (Appendix 15)
- Noise and Traffic (Appendix 17, Appendix 18)
- Sea turtles and Light Pollution (Appendix 24)
- Air quality (Appendix 25)
- Flora (Appendix 26, Appendix 27)
- Fauna (Appendix 28)
- Human health and safety risks

Details on the methodology and results are found in the corresponding appendices for an overview of all the associated survey points. During field visits notes were also made regarding disturbances and threats. Besides the fieldwork, relevant available data and information was consulted, and personal knowledge of the environmental conditions was used in order to provide a comprehensive description of the baseline settings of the area. For instance, data and information from similar field surveys have been used to complement the data and information in this study.

Note that soil/groundwater investigations are planned according to DNM's guidelines for EIA and shall be carried out prior to the execution of the project development.

6.1 Geology and Soil

6.1.1 Aruba

The island of Aruba is located approximately 32 km North of the Venezuelan coast in the South-Central Caribbean Sea. Aruba has been shaped by it volcanic past, where its primary foundation is also known as the Aruba Lava Formation. The island features a range of slopes and hills on its NE side with ancient magma cones rising in the middle of the island with Yamonata and Arikok hills rising to more than 185 m. The island covers approximately 70 square miles, a 30 km long by 5 km wide (194 km^2), with a semi-desert climate, consisting of uplifted reef carbonates resting on basalt that was intruded about 70 million years ago by Quartz diorite (a kind of volcanic magma) and is composed of igneous batholiths (e.g. tonalite) and basalt core surrounded by an outer ring of Quaternary limestone and Holocene sediments. The Geological map of Aruba of the Rijks Geologisch Dienst shown in Appendix 8, gives an overview of the geological formations found on the island of Aruba.

The igneous batholiths are composed of massive granodiorites and other felsic and mafic rocks. These rocks compose the central core, which form the highlands of the island. The resistance of these rocks to physical and chemical weathering processes is the reason for the topographic differences throughout the island.

The Southern edge and Eastern end of the island are covered with a series of Quaternary limestone, which vary in thickness. This limestone was formed below sea level and has slowly been uplifted. Gently sloping and flat terrain with large areas of limestone are found West and South of the island. These features give Aruba its famous white sand and turquoise water beaches along much of the Southwest coast.

Generally, Aruba's soils are very poor, sandy and somewhat saline with large areas of red clay. Coral rubble is found around the island, particularly along the coastlines. Due to the pore nature of the soils, windy conditions and poor rainfall, there is little agriculture in Aruba aside from the Aloe Vera industry.

6.1.2 Barcadera

The Project Site illustration (Appendix 9) included observations with regards to the geology and soils inside the Project Site. A photographic illustration of the soil and geology is provided in (Appendix 9). All survey points were located on limestone. In general, Barcadera can be classified as Lower Limestone Terrace from the Pleistocene, which is described as "Shallow Marine Limestone" by the Rijks Geologische Dienst (1996). The soil potentiality map of Aruba classifies the soil at Barcadera as "Land only suitable for watershed or recreational purposes or wildlife (Partly also reforestation for erosion control." and "not suitable for cultivation" (de Bilt & Grenoble, 1967). Thus, the quality of soil is mostly relevant for watermanagement and conservation.

The soil in the Project Site consisted mainly of sandy loam. However, as mentioned white sand is also found inside the Project Site. The white sand is derived from the adjacent terrain, which the Department of Public Works (DOW) uses for storing (dredged) white sand. Moreover, loamy and clay soils are found inside the gully system. Moreover, Wagenaar Hummelinck classifies this gully under terrestrial habitats with calcareous sediments (i.e. sand) (Wagenaar Hummelinck, 1981).

With the exception of the western side of the Project Site, no signs of disturbed soils were observed inside the Project Site. Due to the inaccessibility of a large part of the Project Site, litter and other disturbances were very limited inside the Project Site; mostly contained to the WS area or at the fringes of the roadway of Barcadera. However, already in 1981 the nearby gully was described as heavily affected by human activities (Wagenaar Hummelinck, 1981).

6.2 Groundwater

6.2.1 Aruba

Historically several limited groundwater studies have been conducted and reports have been written. Past reports all found that the groundwater on the Island of Aruba is limited in quantity and quality, which was attributed to the depth and high conductivity of the groundwater (Finkel & Finkel Consulting Eng, 1979; de Bilt & Grenoble, 1968; van Sambeek, Eggenkamp & Vissers, 2000). It is not certain at this time how many of the wells included in the historic studies are still in use.

Groundwater within the fractured bedrock aquifers occurs within the fractures which typically constitute a very small fraction of the rock matrix. The small volume percentage limits the volume of water in storage available for use. The recharge rates to the bedrock aquifers are also likely small given the steep sloping nature of the land where the bedrock is exposed at the surface. Therefore, groundwater abstraction on a significant scale may not be possible. However, zones of intense fracturing of the bedrock likely corresponding to alluvial filled valleys have the significant potential to yield usable quantities of higher quality water. In addition, there are areas in which the intense fracturing has allowed the rock to weather into "granite" soil, which is mined for fill material on the island. The weathered bedrock soils, where not mined, may have the capacity to store usable quantities of water.

A large variety of processes influences the groundwater quality in Aruba (van Sambeek, Eggenkamp & Vissers, 2000). Namely, the groundwater composition of Aruba is affected by salt spray, intrusion, rainwater and high evaporation rates. In addition, the study by van Sambeek, Eggenkamp & Vissers (2000) found that the groundwater in Bonaire and Curacao was polluted by cesspools. Due to the similarity in geology and the occurrence of cesspools in Aruba, there is a high probability that Aruba's groundwater is also polluted by cesspools.

6.2.2 Limestone Aquifers

Although the historical studies concluded that groundwater quality in the aquifers of Aruba are generally "bad", due to their brackish nature and their exposure to pollutants. In the limestone formation a few wells were found that contained "better" quality groundwater.

In comparison to the fractured bedrock aquifers, the recharge rates and water transmitting capacity of the limestone aquifers are significantly higher and may allow substantially more water to be abstracted. The net charge rate estimated in the historical studies was 280 mm or 70% of the average annual precipitation of 400 mm.

However, it was expected that seawater intrusion will occur rapidly after pumping groundwater as evidenced by the observations that wells that were being pumped had, in general, higher saline content than those which were not being pumped. The results of the hydrogeochemical study by van Sambeek, Eggenkamp & Vissers (2000) also concluded that the composition of rainwater in coastal areas is close to diluted seawater. This could be explained by the permeable nature of the limestone.

Another remarkable characteristic of limestone terrace is that its run-off usually ends up draining directly into the underground; limestone bedrock tends to have large channels from the surface to groundwater, allowing water to pass through quickly. "Interestingly, despite the

high permeability of limestone, trees in these areas seem to suffer less from periods of drought compared to the trees on the crystalline rock in the batholith. The cracks and cavities of the Limestone are filled with soils that consequently show a higher water retention capacity than the upper soil layers on the semi-impermeable Batholith. The trees on the limestone have the ability to reach these ground water sources during the dry season." (CBS, 2016)

6.2.3 Barcadera

It is suspected that Barcadera contains little to no fresh groundwater, considering its close vicinity to the ocean and the absence of impervious geological features below the limestone plateau. Rainwater will mostly seep into the limestone plateau and through gravitational forces this freshwater will eventually reach the ocean and or the gully system. Additionally, aboveground runoff captured by the gully system is directed towards the ocean (Appendix 14). Although the passage of the gully system has been altered through roadways (i.e. "Green Corridor" and "Barcadera roadway") which pass over the gully system, an open connection is maintained through artificial underground tunnels.

6.2.4 Seawater

Innovasea performed analysis on May 27th, 2021, by the deployment of a Nortek Signature 500 Acoustic Doppler Current Profiler (ADCP) on May 28th, 2021, at 12° 32' 45.96"N, 070° 08' 38.76"W (center of site 1). The equipment was prepared and secured the day prior on shore in an L-style arrangement. Two dissolved oxygen, depth, and temperature (DODT) loggers were attached at 25 and 27 m below the surface on the long leg of the L. The shallower DODT unit was directly below the submerged recovery float. To ensure accurate wave readings, the ADCP was deployed 65 m below the surface despite a bottom depth of 80 m at that location. The ADCP recorded the current profile in 4 m depth bins every hour using a 90-second average interval. Wave data was collected every two hours with a 17.5 min sampling period. An acoustic release was used at the bottom of the long leg of the L to recover the instruments. There were no buoys or sensors at the surface to avoid interactions with vessel activity. A bathymetry survey was conducted using a Helix 7 G2N GPS with sonar made by Hummingbird to ground truth the bathymetry data from the GEBCO-2020 dataset. A video survey and the collection of sediment samples were unsuccessful on this trip due to rough weather conditions.

Innovasea returned to Aruba on July 6th, 2021. The ADCP and DODTs were recovered on July 7th after 40 days of data collection. A water sample was taken at site 1 and tested for alkalinity, pH, ammonia, nitrite, nitrate, phosphate, magnesium, and calcium using a Waterlink SpinTouch photometer made by LaMotte. A 2 mL water sample was taken and incubated on a Roth Biosciences rapid test R-Card to detect and quantify E. coli and coliform bacteria for 24 hours at ambient temperature (around 25 °C). Water samples were also collected and analyzed at four sites near the proposed hatchery/shore base site: one directly adjacent to the hatchery, one outside of the barrier island adjacent to the hatchery site, one near the desalination plant east of the hatchery site, and one near the landfill west of the hatchery site. The water sample locations are described in Table 15 shows the location of the samples taken near the prospective hatchery site. These analyses included the photometer assessment and E. coli and coliform sampling as outlined above as well as salinity measurements using a refractometer, and the collection of water samples for heavy metal analysis by a 3rd party.

Site	Lat	Lon	Water Chemistry	Heavy Metals	Bacteriology
Site 1	12.54804	-70.13963	7/7/21	N/A	7/7/21
Site 2	12.50424	-70.11954	7/9/21	N/A	7/9/21
Near Hatchery	12.47535	-69.98527	7/8/21	7/8/21	7/8/21
Hatchery outside barrier island	12.47136	-69.98856	7/8/21	7/8/21	7/8/21
Near desalination plant	12.47402	-69.98268	7/8/21	7/8/21	7/8/21
Near landfill	12.47680	-69.98889	7/8/21	7/8/21	7/8/21

Table 15 - Water sample location and results

The ADCP and DODT sensors were deployed at site 2, the following day (July 9th, 2021). Water samples were taken from this site for water chemistry and bacterial counts.

Innovasea returned to Aruba for a 3rd time on August 23rd, 2021. Initial attempts to recover the ADCP and DODT sensors were unsuccessful despite communicating with the acoustic release and successfully transmitting the "release" command. Using the horizontal distance measurement on the hydrophone that communicates with the acoustic release mechanism, the team was able to estimate the location of the equipment and recover the ADCP the following day, Aug. 25th, 2021, using a grapple.
Inspection of the line indicated the float and DODT sensor line had been severed approximately 3 m above the acoustic release. It is unknown when or how this occurred. A video transect was conducted of site 2 using a GoPro camera and a sediment sample was collected. On Aug 26th and 27th, additional video footage of sites 1 and 2 respectively were collected using the GoPro camera.
Longer-term datasets were acquired to give a more complete indication of certain parameters. Data sets for waves were acquired from Copernicus's global wave system and NOAA's WaveWatchIII model. Copernicus's global wave system is from Météo-France with a 1/12° resolution and is based on the wave model, MFWAM, a third-generation wave model. MFWAM has a dissipation term developed by Ardhuin et al. (2010).

The model's bathymetry is generated by using 2-minute gridded global topography data from ETOPO2/NOAA. The model is driven by 6-hour analysis and 3-hour forecasted winds from the IFS-ECMWF atmospheric system. The wave spectrum is discretized in 24 directions and 30 frequencies starting from 0.035 Hz to 0.58 Hz. The MFWAM model uses the assimilation of altimeters with a time step of 6 hours. The global wave system provides analysis 4 times a day. Data from WaveWatchIII was from their NW Atlantic model with 10-minute spatial resolution from the NWW3 product. Data is from 2018, the most recent year available.

Long term data on current velocity was acquired from the HYCOM model. HYCOM is a data-assimilative hybrid isopycnal-sigma-pressure coordinate ocean model which produces outputs on several parameters including ocean current velocity and direction. Data was acquired for 2017 and 2018.
Long term temperature data was acquired from NASA's Jet Propulsion Laboratory (JPL) and represents sea surface temperature measured by the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor on the Aqua satellite. Data was acquired for 2019.

6.2.4.1 Location

Site 1 is located 18.3 km away from the prospective hatchery site (Euclidian distance to the nearest point) and site 2 is located 14.4 km away. The route from the hatchery site, which is presumed to also function as an offshore support base, to each site is similar although site 1, being further north, requires traversing a rougher stretch of water when moving away from the coast. While doing field work, trips to site 1 took an average of 71 minutes, while trips to site 2 took an average of 41 min. These travel times were observed during a rough time of year and with a smaller boat than a farm would use so are only indicative of relative travel times between the two sites and are not predictive of the actual travel times for larger farm vessels making the trips during operations.

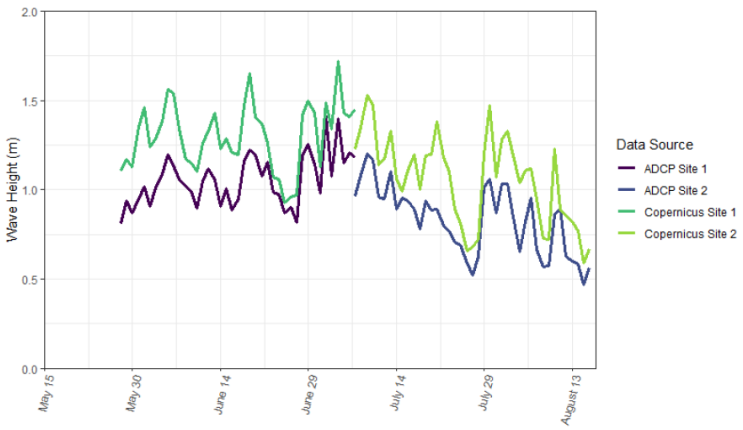
6.2.4.2 Waves

Site 1 showed a rougher wave environment compared to site 2. The key parameters are summarized in Table 16 and a time series for both sites is shown in Figure 21. Data from Open Blue Sea Farms (OBSF) is added to table 15 for comparison. OBSF is a commercial open ocean fish farm located in the Caribbean Sea of Panama's North coast.

Table 16 - Wave Parameters

Parameter	Site 1	Site 2	OBSF
Mean significant wave height	1.06 m	0.83 m	1.54 m
Max significant wave height	1.69 m	1.45 m	4.17 m
Percent of time significant wave height was above 1 m	59.5%	20.0%	78.3%
Mean max wave height	1.59 m	1.23 m	2.50 m
Maximum observed wave	2.74 m	2.19 m	7.24 m
Percent of time max wave height was above 1 m	99.4%	72.3%	93.9%
Percent of time max wave height was above 2 m	7.6%	1.9%	65.4%
Peak Period	6.1 sec	6.0 sec	
Mean 1/3 period	4.9 sec	4.5 sec	
Most common direction	Eastward	Northward	

The data shows good fidelity with modeled data from Copernicus (in Figure 21) although the model is consistently about 0.24 m higher than the measured data, likely a result of the discrepancy between the model spatial resolution and the actual location where the ADCP was deployed.



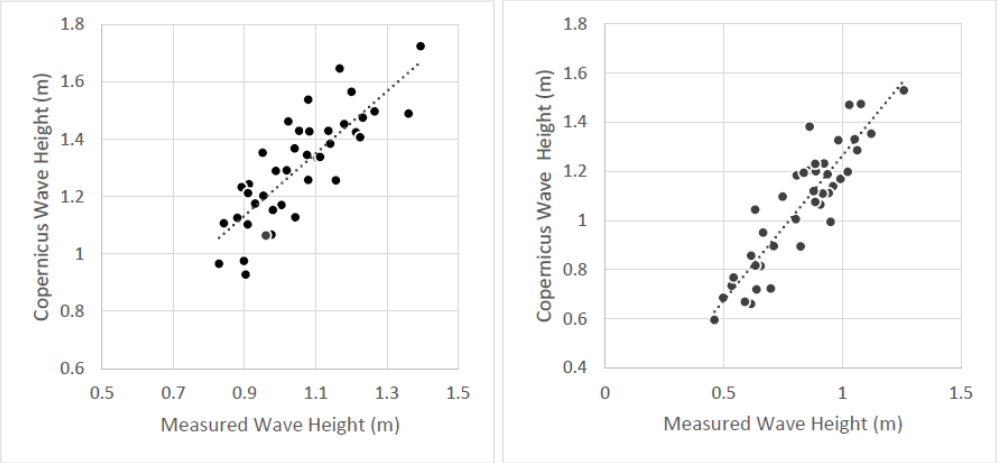


Figure 21 - Wave Graphs.

Given the strong agreement between the measured data and modeled data (R2 values were 0.665 and 0.805 for sites 1 and 2 respectively), the models can be used with confidence to indicate the wave environment over longer time periods. Figure 22 shows the significant wave height from sites 1 and 2 from the Copernicus global wave system for 2020 and the WaveWatch III model for 2018 (both sites fell within the same data cell for the WaveWatch III model so only one time series is shown for both sites).

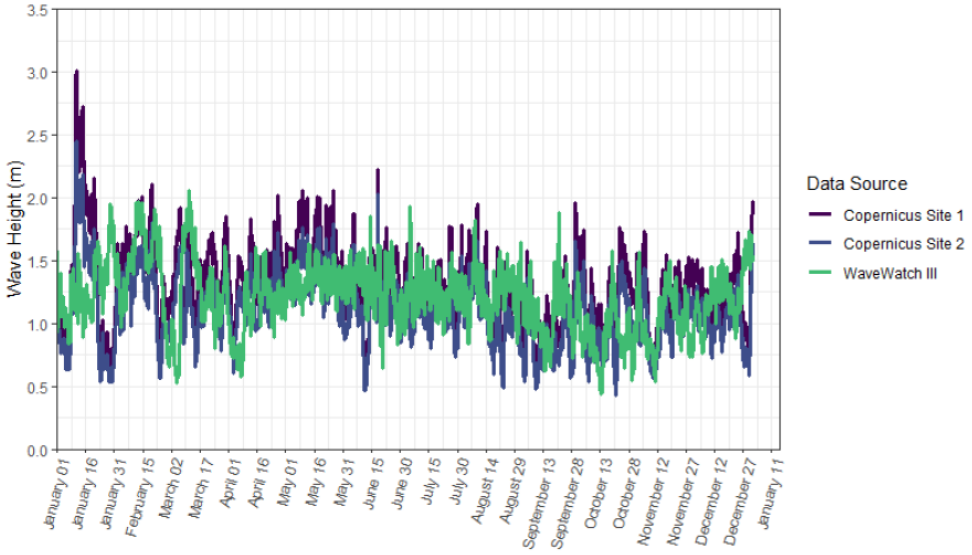


Figure 22 - Wave Heights

The WaveWatchIII model shows a mean significant wave height of 1.20 m, while the Copernicus global wave system shows a mean significant wave height of 1.31 m and 1.09 m for sites 1 and 2 respectively. The maximum observed significant wave heights were 2.05 m for WaveWatch III, 3.01 m for site 1 and 2.45 m for site 2 from the Copernicus data. Individual wave heights are not available from these data sets, so the maximum wave is not known. It is not known what caused the spike in wave heights at the end of January 2020 (as noted above, the WaveWatch III data is showing 2018 data, so it does not show this spike). It is worth noting that several tropical storms in the Atlantic including Hurricanes Eta and Iota which passed close to Aruba on Oct 31st and Nov 13th respectively, do not show an obvious signal in the data. It should be noted when examining the model data that there is a difference in the mean values

of the model and measured data sets during the deployment period, and that modeled often under-represent extreme values.

6.2.4.3 Ocean Currents

Strong ocean currents were observed at both sites although they were slightly stronger at site 2. Figure 23 to Figure 26 shows the current profile of sites 1 and 2 as a time series and as box and whisker plots. Figure 27 show current roses with mean current, maximum current, and percent of time in each direction for site 1 at 9, 21 and 33 m depths, while Figure 28 show the same metrics for site 2 at 11, 23, and 35 m depths.

Table

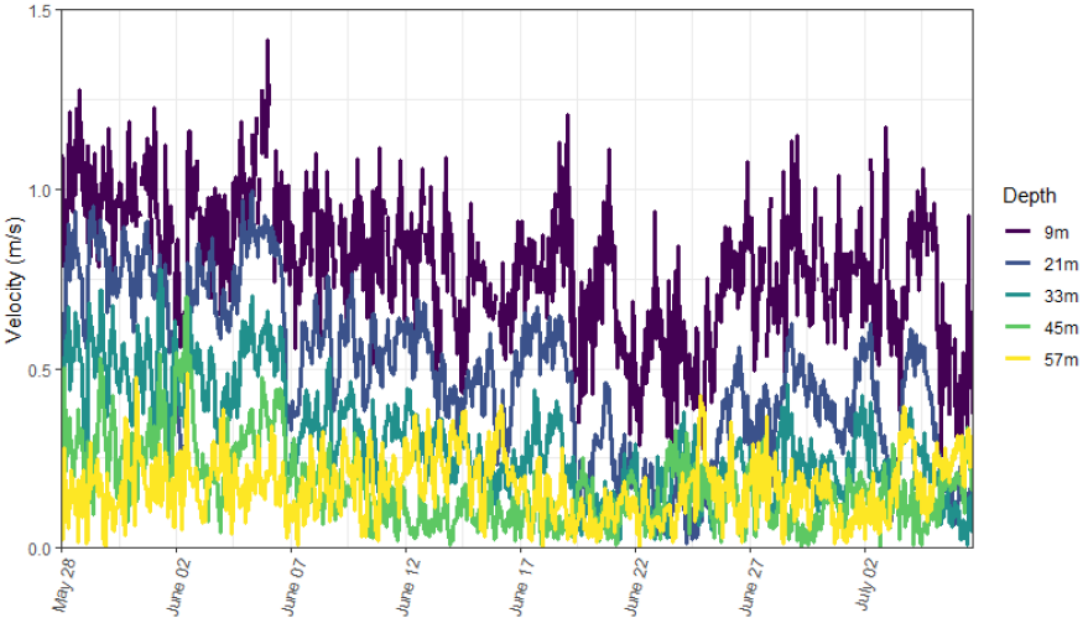


Figure 23 - Seawater Current 1

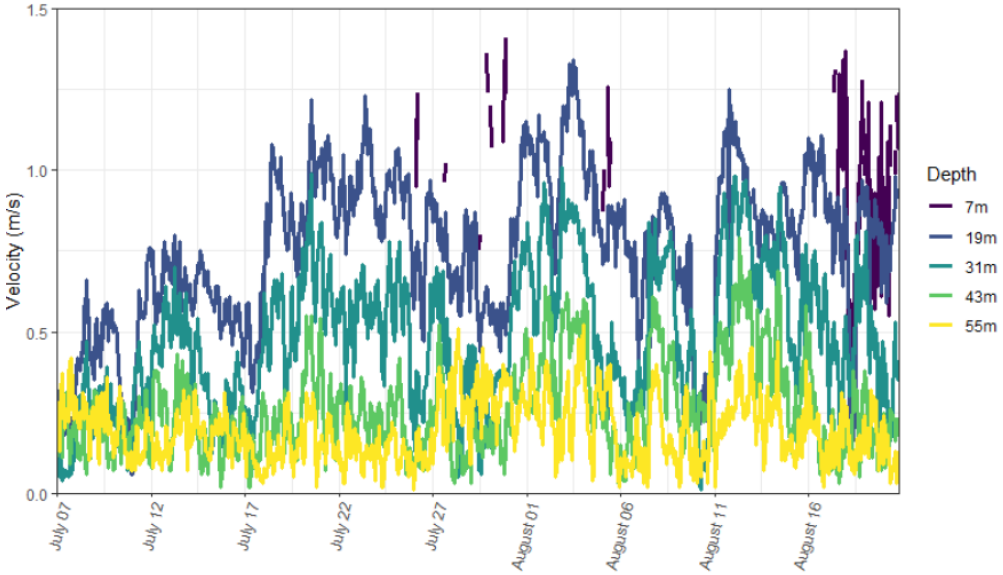


Figure 24 - Seawater Current 2

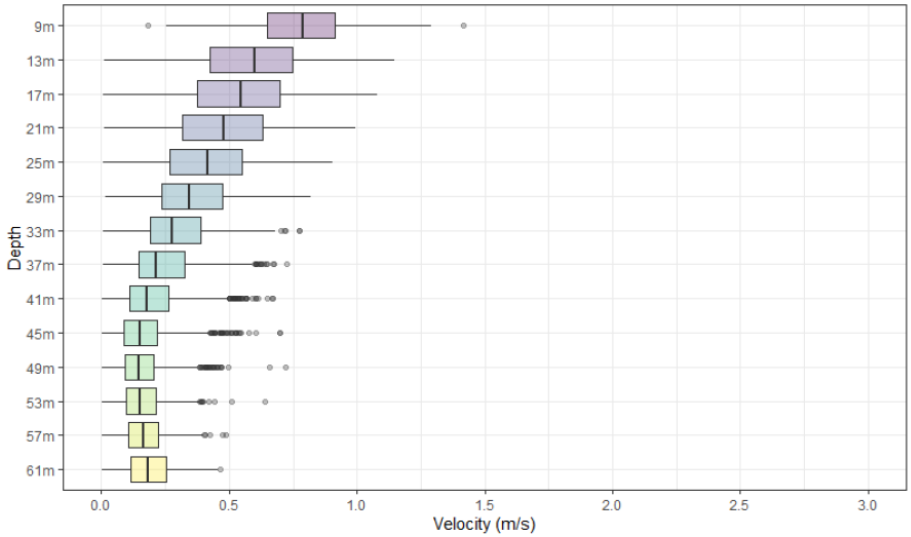


Figure 25 - Seawater Depth and Current 1

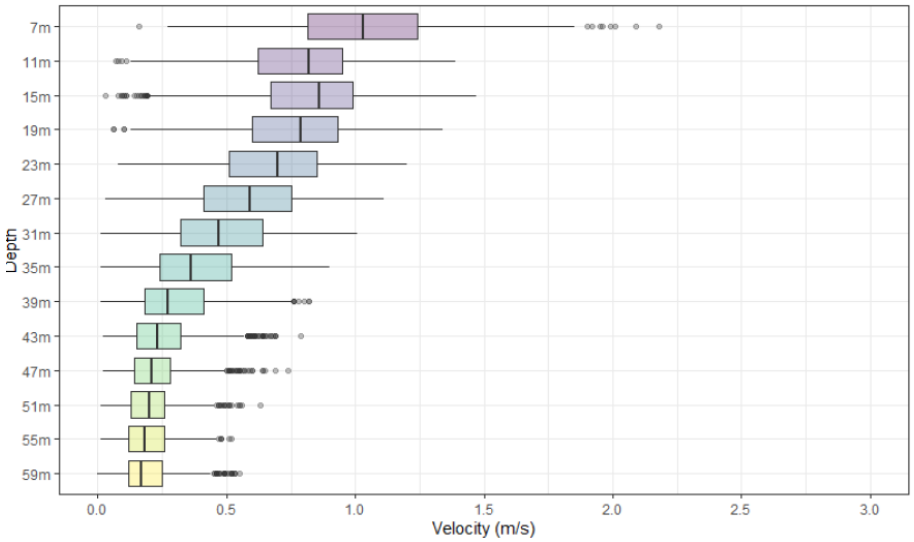
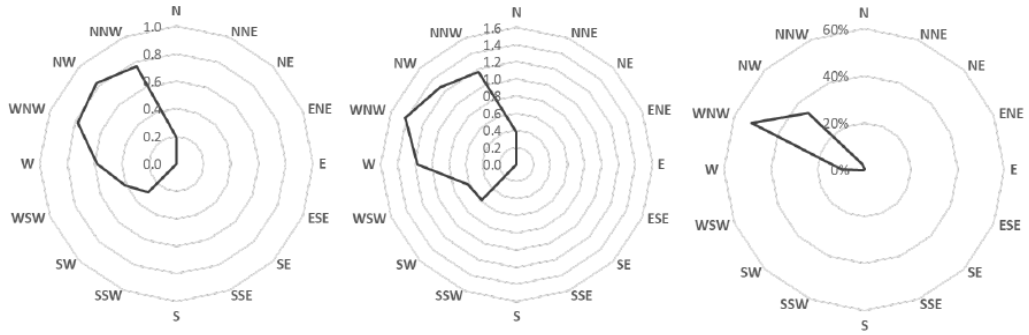


Figure 26 - Seawater Depth and Current 2



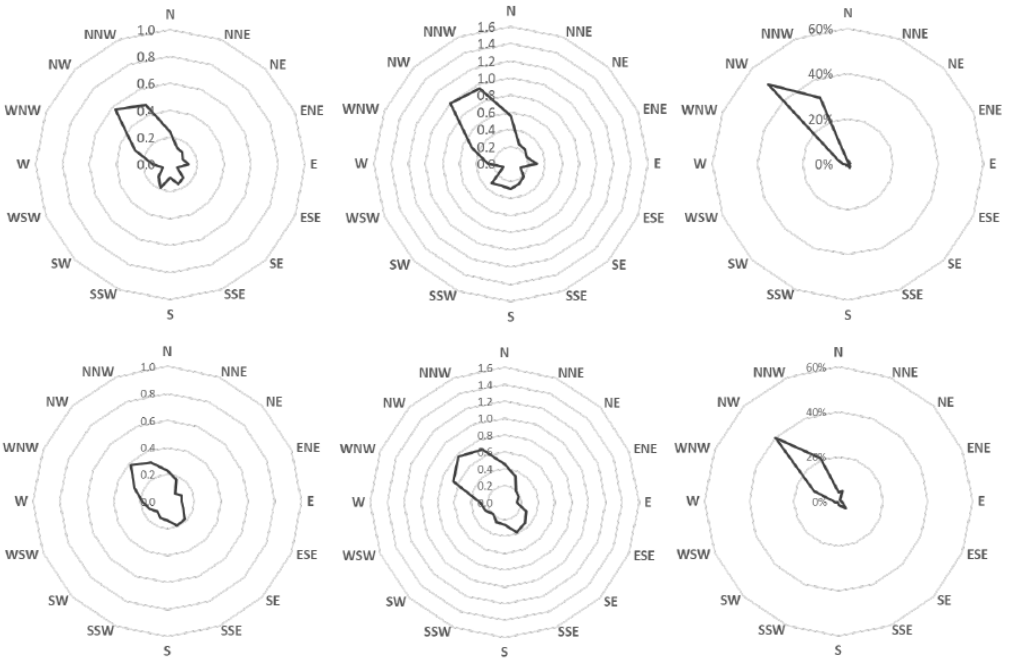


Figure 27 - Mean current, max current and percent of time in each direction for site 1

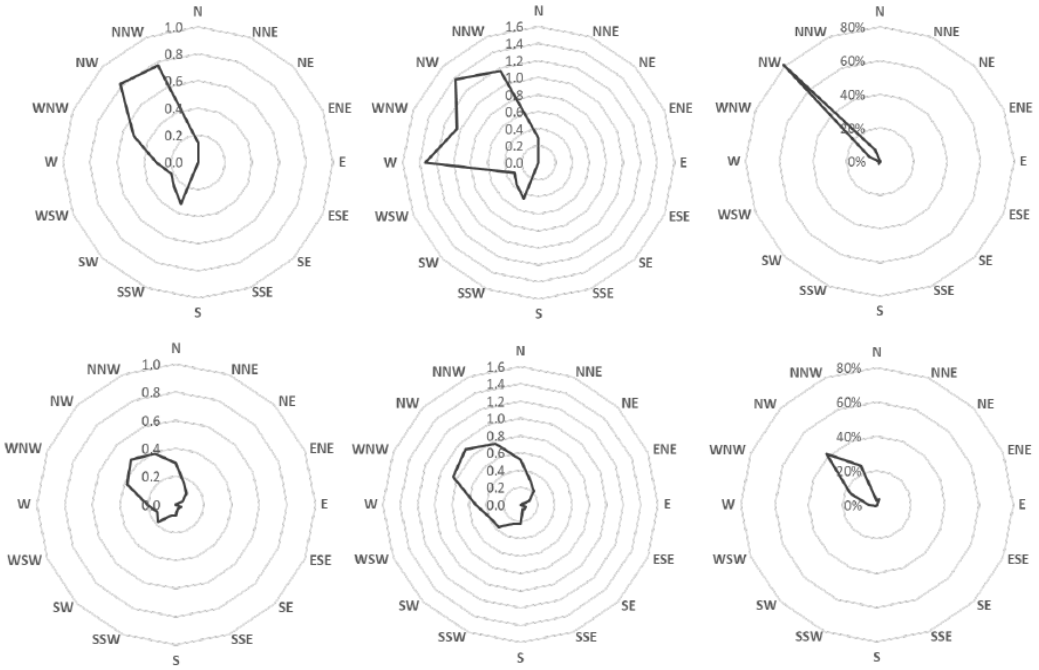


Figure 28 - Mean current, max current and percent of time in each direction for site 2

The currents observed during the deployment period do not show strong agreement with data from these days in previous years in the HYCOM model (Figure 29; HYCOM has a time lag in data availability, so recent data is not available). As such, we cannot confidently use long term models for this location. However, the currents measured are generally consistent with Fratantoni's (2001) measurements of the Caribbean Current which drives current patterns in Aruba as well as Boisvert's (1967) and Febres-Ortega and Herrera's (1976) measurements of the contributing Guiana Current, and Arnault's (1987) measurements of the further upstream North Equatorial Current. Arnault (1987) and Fugliser (1951) noted seasonal trends in current velocity of these upstream contributing currents peaking in April-May and reaching a minimum

in September. Most (85%) current measurements at both sites ranged from 0.41 to 1.23 m/s, aligning with the values observed are during a stronger season. The annual average may be closer to the 0.6 - 0.7 m/s values recorded in Fratantoni (2001) with periods in the 0.3 - 0.4 m/s range during the slower times of the year.
The currents are slower deeper in the water column and the pen netting reduces currents further so fish inside the pen will not be exposed to the full strength of the current.

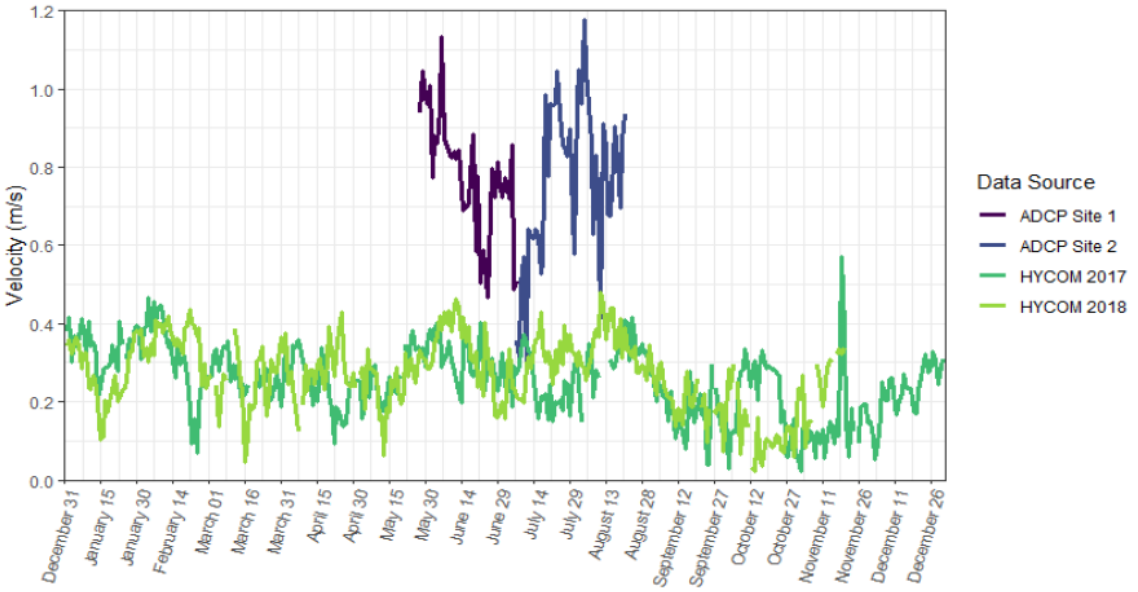


Figure 29 - HYCOM model

6.2.4.4 *Bathymetry*

The GEBCO-2020 data showed good fidelity with the depth measured by the boat's depth sounder in the areas of interest(Figure 31, R2 = 0.834). The depth, according to GEBCO (Figure 19), was 3.91 m deeper on average than the depth sounder reported although the location of the transducer on the boat explained about 0.5m of this difference. Also, the tidal status at the time of the bathymetry survey is not known while the GEBCO data represents mean low tide. In any case, a difference of less than 3.91 m is tolerable for grid design and allows the GEBCO-2020 data to be used with confidence.

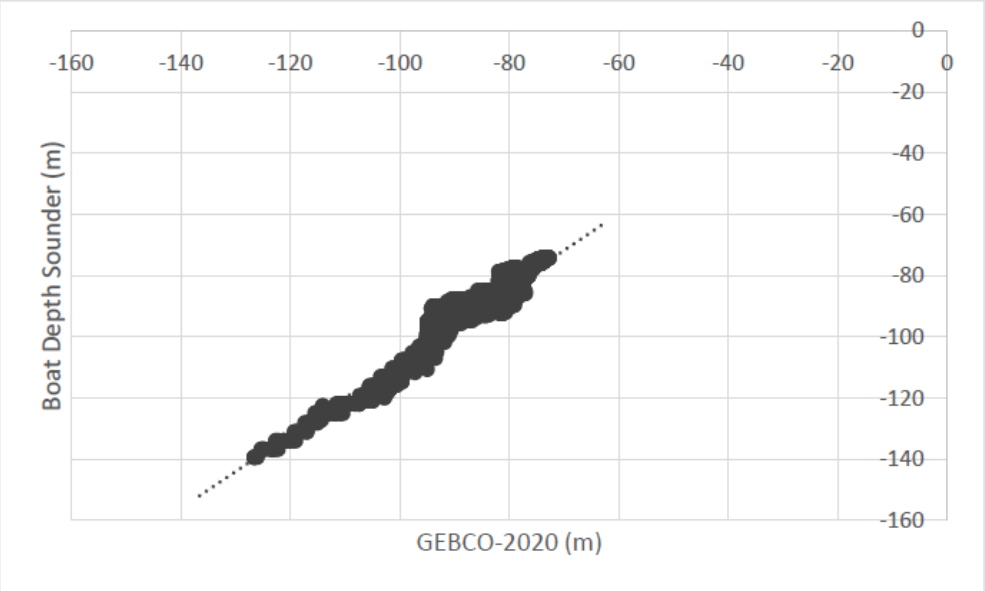


Figure 30 - Bathometry model

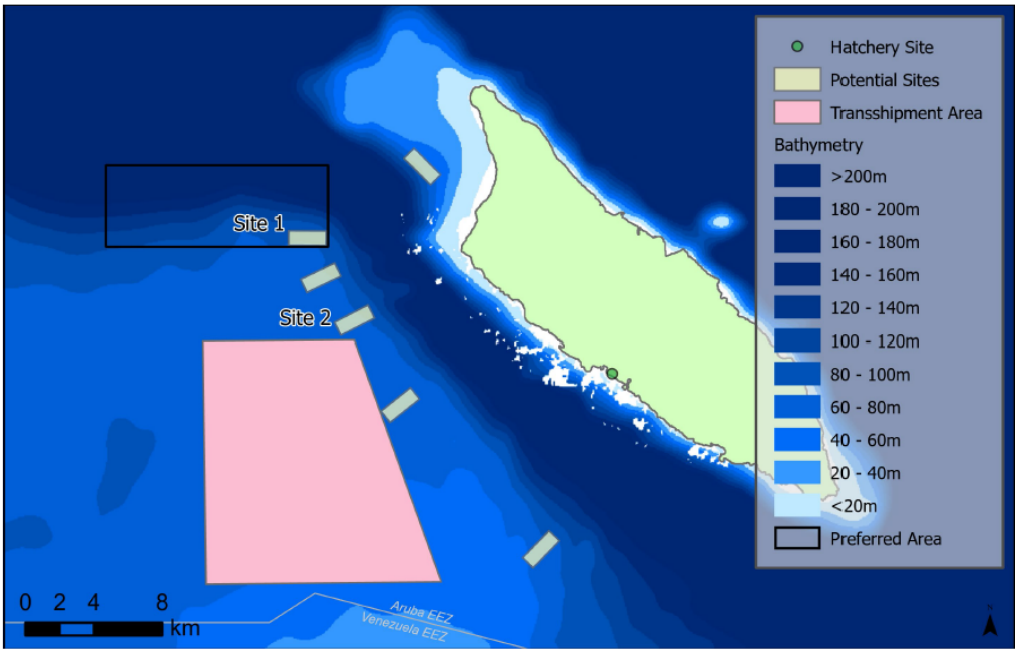


Figure 31 - Areas of interest

6.2.4.5 *Temperature*

The temperature at site 1 (Figure 32) ranged from 25.8°C to 27.58°C over the course of the deployment at that site. The temperature at site 2 was not obtained as the DODT sensors were lost. Site 2 is not expected to be significantly different from site 1 as they are only 4 km apart and sea surface temperature data from NASA's Jet Propulsion Laboratory from 2019 shows a mean annual difference of 0.03°C between the two sites (data not shown).

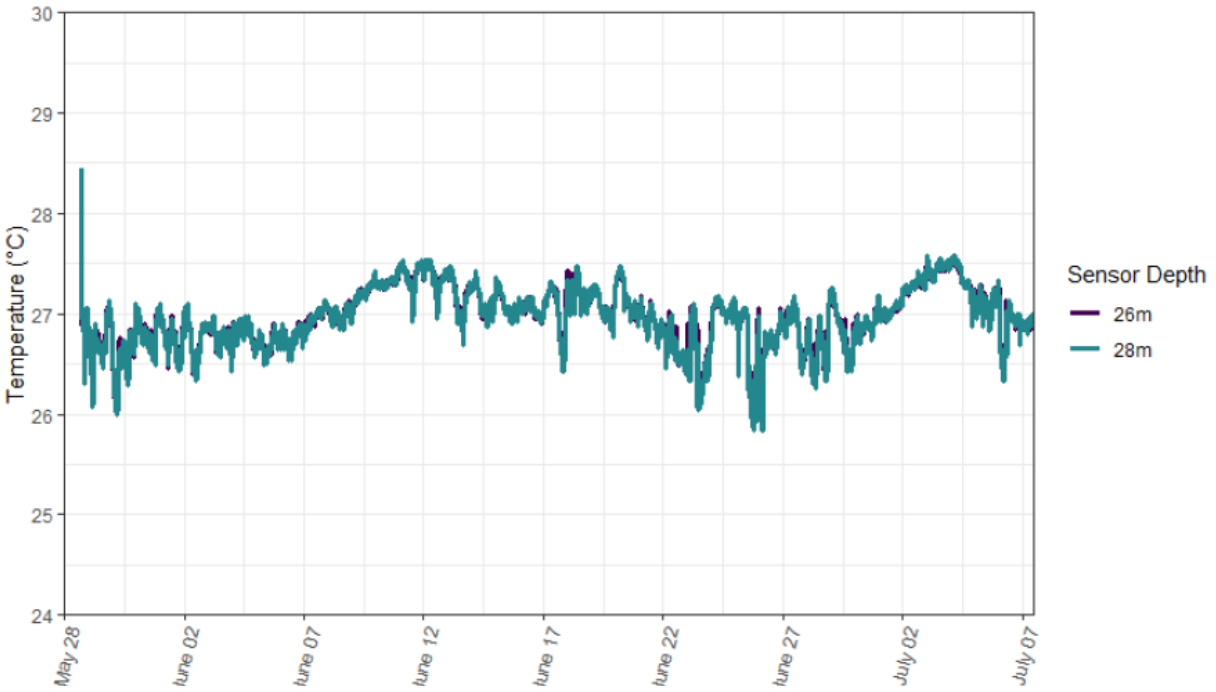


Figure 32 - Seawater Temperature profile

The temperature measurements from the site 1 DODTs show strong agreement with modeled temperature data from HYCOM from 2019 (Figure 33). Since the data is from different years, exact alignment isn't expected but the average over the 40 calendar days during which data was captured was compared for the two data sets. The mean difference was 0.34°C, indicating that the HYCOM data set shows sufficient fidelity that long term data will have sufficient accuracy to assess the suitability of the site for red snapper.

The HYCOM 2019 data showed a maximum value of 31.2°C, a minimum of 24.5°C and a mean value of 27.3°C. Most growth trials have been conducted at the lower end of this range, but good growth is expected at 27°C (McGuigan et al. 2021; Buchalla 2020; Williams et al. 2004). It is not known at what temperature red snapper experience thermal stress, and this may occur during extreme temperature events, although this is less likely in submerged pens.

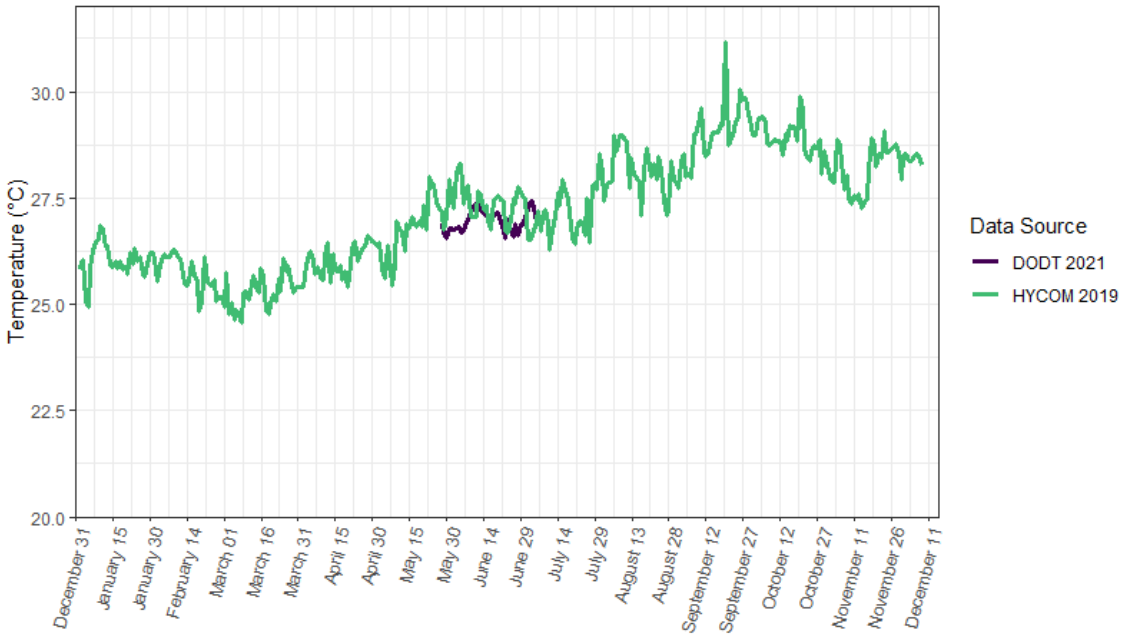


Figure 33 - HYCOM model Temperature.

6.2.4.6 Dissolved Oxygen

The dissolved oxygen saturation at both sites was above 95% for 98.9% of data recordings and never dropped below 90% (Figure 34). This supports data from the World Ocean Atlas which modeled dissolved oxygen at the nearest model output point as being above 95% saturated from the surface down to 50 m deep. Open ocean environments are typically oligotrophic which makes algae blooms or other hypoxic events less likely, and these have not been reported for the region.

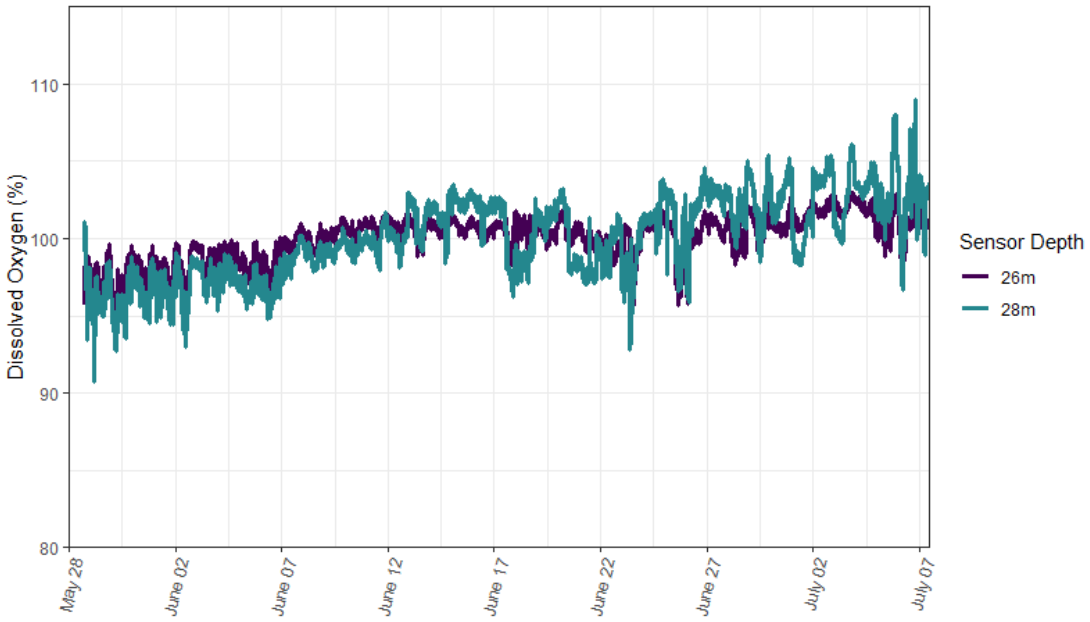


Figure 34 - Dissolved O2 profile

6.2.4.7 Water Chemistry

Water chemistry was within normal ranges for all parameters at all sites (Table 17). As noted above, these results are from point samples on a single day and are indicative of a healthy

environment and functional ecosystem, as would be expected in these locations, but do not offer insight into seasonal fluctuations or changes from episodic events (e.g. heavy rain fall, contributions to the landfill site, uncommon environmental events).

Site	Site 1	Site 2	Hatchery near shore	Hatchery outside island	Near desalination plant	Near landfill
Salinity (ppt)	35	35	36	36	36	35
Alkalinity (ppm)	118	122	125	129	119	129
Calcium (ppm)	443	440	447	448	369	439
Magnesium (ppm)	1478	1491	1562	1544	1574	1559
Ammonia (ppm)	0	0	0	0	0	0
Nitrite (ppm)	0	0	0	0	0	0
Nitrate (ppm)	1	2	2	2	1	2
Phosphate (ppm)	0.0	0.0	0.0	0.0	0.1	0.0
pH	8.1	8.1	8.1	8.1	8.1	8.1

Table 17 - Seawater chemistry parameters

Farms operating in similar environments such as OBSF (Panamá) and Blue Ocean Mariculture (Hawaii) have not observed changes in water chemistry or an increase in algae concentrations as a result of nutrients contributed from farm activity. This is attributed to the high dilution capacity of the physical environment (deep water and strong currents) as well as the high assimilation capacity of the ecosystem (tropical marine waters are typically oligotrophic) (Welch et al. 2019).
Water samples from the locations near the hatchery were tested for copper, total arsenic, lead, antimony, beryllium, cadmium, chromium, mercury, nickel, selenium, silver, thallium, and zinc using ICT mass spectrometry. Total arsenic and lead had minimum detection limits of 0.40 mg/l and all other metals had minimum detection limits of 0.1 mg/l. All metals were below the detection limit for all samples.

A pH of 8.1 at the six sites indicated normal acidity levels. The pH is an important parameter to consider for monitoring the effects of the Project. A slightly high salinity reading was found in the upstream sample's sites, namely varying from 35 to 36 ppt.

6.2.4.8 Sediments

The sediments collected show grain diameters between 250 and 500 microns. There were no particles larger than 2,000 microns. All the sediments collected appeared to be a mixture of silicon dioxide or quartz sand, calcium carbonate, and terrigenous sand. The video footage corroborates these findings as most of the area survey appears to be a mixture of sandy and muddy bottom.

This analysis describes only the exposed sediments and provides no indication of the presence or depth of any hard surfaces beneath the exposed sediment layer. The video footage does not show expansive hard bottom which would indicate near-surface hard material; however, this cannot be determined conclusively without a sub-bottom profile. Core samples taken on the 1958-1960 cruise of the RV Atlantis (Zeigler 1964) in the Gulf of Venezuela describe similar sediments although they also mention “bits of massive limestone”. The cruise included a sampling point at 12° 19’ 49”N by 070° 10’ 48”W which is only 24 km from the perspective farm site. The presence or absence of hard bottom at any specific site is not noted, nor is the depth of the soft sediments which they describe. The report references a 3 m core sample in one instance but offers no other indication of soft sediment depth.

6.2.4.9 Benthic Ecosystem

The transect for Site 1 started at 12° 32’ 30.12”N, 070° 08’ 00.96”W and ended at 12° 33’ 03.24”N, 070° 09’ 06.84”W spanning a distance of 2.3 km and the transect for Site 2 started at 12° 30’ 14.04”N, 070° 06’ 13.32”W and ended at 12° 30’ 18.36”N, 070° 07’ 40.80”W spanning a distance of 2.8 km. Both transects extended diagonally through the respective proposed lease sites.

The benthic environment is characterized primarily by exposed sandy/muddy bottom (Appendix 11 & Appendix 12) with sparse colonization by invertebrates. Biodiversity was low and the ecosystem is not considered to be sensitive or unique and does not support or provide critical habitat for fisheries resources. The environment shows very low rugosity with little complex or vertical habitat.

The two sites did not differ noticeably in the benthic environment or species assemblage. Organisms were predominantly sessile filter feeders with very few active predators observed. Echinoderms of the class Crinoidea, accounted for approximately 90% of the observed fauna, with sea whips (Appendix 11 & Appendix 12) accounting for approximately 5%. Fish were observed on three occasions and were the only vertebrates observed. The survey had limited ability to detect organisms smaller than 5 cm, and no ability to detect infauna.

The sediment was loose at the surface but there is evidence of low rugosity hard bottom structure interspersed within an otherwise homogenous matrix of sand and organic material from burrowing organisms.

Appendix 11 & Appendix 12 show uncolonized bottom typical of both sites. They also show light colonization with crinoids which was the most common habitat with a significant number of organisms. Additionally also captured are how the most heavily colonized areas observed at sites 1 and 2 respectively. Appendix 11 & Appendix 12 show low rugosity hard bottom structure.

6.2.4.10 Bacteriology

Bacterial plates showed low bacterial activity in all samples except the coliform count for site 2 which showed 20.5 CFU/mL on the 2nd visit (Table 18). Open ocean environments typically have very low coliforms, so this is believed to be a contaminated sample which can happen easily in the field. The results are otherwise indicative of clean and healthy ecosystems and bacterial activity is not expected to be problematic at any location.

Location	Depth (m)	Sample Size (mL)	*E. Coli* Colonies	Coliform Colonies
Site 1	85	2	0	0
Site 2	76	2	1	41
Hatchery Near Shore	2.2	2	0	3
Hatchery Outside Barrier Island	42	2	1	0
Landfill	2.3	2	4	6
Desalination Plant	5.6	2	6	2

Table 18 - Bacteriological Results

6.2.4.11 Marine Megafauna

No cetaceans, pinnipeds, turtles, or other megafauna were observed during fieldwork. It is important to note that high levels of filamentous and floating algae are currently present in the coastal waters around Barcadera. It is thus suspected that nutrient pollution is already taking place due to current human activities in the area. Consequently, it is suspected that these nearby onshore ecosystems are already in a state of stress.

Seeing that Barcadera has a relatively open connection with the open sea, oxygen levels are expected to be sufficient for underwater life. However, it is possible that as the algal masses found in the area decompose, oxygen stress to marine life will become an issue at Barcadera.

To ensure that the project development is not contributing to poor water quality in the area, monitoring should still take place, which should include the parameters nutrients (e.g. Nitrates and Phosphates) and dissolved oxygen.

Current locations and sources of pollutants affecting the water quality at Barcadera are suspected to include i.e. the following:

- Brine water effluent
- miscellaneous pollutants from the Palm Island
- miscellaneous land-based pollutants deriving from the industrial area surrounding Barcadera and from residential areas in Santa Cruz
- miscellaneous pollutants deriving from the yacht harbor at Varadero
- subsurface run-off from (leaking) cesspits or direct wastewater outlets from homes in Pos Chikito
- litter and dumped landfill waste

On days when weather phenomena alter currents in Barcadera, pollutant levels are likely to increase at Barcadera, since very polluting industrial activities take place nearby. In this case, possible major sources of pollutants include amongst others the dump and wastewater treatment facility of Parkietenbos, the waste facility at Ecotech and the Port of Barcadera. It is also known that in the past chemical industries were operating at Barcadera such as the

Antilles Chemical Company, which produced fertilizers and ammonia. These former industries might still be contributing to pollution in the area. It is also known that the shoreline of Barcadera has been polluted a few times in the past due to oil spills.

Heavy rain showers are expected to exacerbate water quality in the area by causing high levels of sediment and organic matter input from land, particularly through the gully system. These run-off events can temporarily increase the turbidity, cause eutrophication and consequently increase hypoxia (i.e. oxygen limitation).

6.3 Noise

A Preliminary Noise Assessment was carried out to assess the current background levels and sources of noise in the Project Area (Appendix 17). Noise level measurements are also important to determine noise exposure for employees and to forecast future noise conditions in the Project Area. Noise sampling was performed at two points; one which is outside the Project Site, and one inside the Project Site in the xeric shrub land. The measurements were carried out on the 21st of November and on the 12th of December 2018. Nighttime measurements were only performed. Measurements were not taken in residential areas, since the closest residence is found at a distance of about one kilometer and the sources of noise in these residences are difficult to pinpoint considering the large number of industrial activities occurring in Barcadera.

The sound measurements depicted in the graphs of (Appendix 17). were compared against the noise limit standards for industrial/commercial areas set by the World Health Organization (WHO) and the World Bank Group IFC for commercial areas. Unexpectedly, the results showed that the nighttime survey had the highest average maximum sound level, namely 78.2 dB. This exceeded the WHO-IFC nighttime noise limit of 70 dB. This limit was also surpassed during daytime measurements, with an average maximum sound level of 77.4 dB. Noise levels were generally lower for daytime measurements, yet the graphs show that even during daytime measurements the noise limits are surpassed for part of the survey period, leading to an average maximum sound level of 69.0 dB. It is possible that the mangrove trees, which can absorb noise, caused the slightly slower daytime measurements. Noise levels could also be affected by the wind gusts, unfortunately prevailing strong winds offered few opportunities for measuring under conditions that are more appropriate. Aruba is subjected to trade winds year-round, and that the windy conditions are not very far from the monthly averages[1] found for November and December.

The most common source of noise in the Project Area in both times of the day originated from WEB industrial energy and water production. Additionally, low frequency vibrations were perceived to arrive from machinery in the area. During daytime, the noise levels were observed to also increase in relation to activities that were occurring in the Construction Area, such as movement of heavy equipment, excavations and crushing rocks. During daytime, trucks use the roadway at Barcadera to transport various products, chemicals and materials to and from the industrial area of Barcadera. However, traffic on the roadway of Barcadera was

[1] Monthly average wind conditions, Aruba: https://weather-and-climate.com/average-monthly-Wind-speed,oranjestad,Aruba

observed to be generally low and did not seem have a prolonged effect on noise levels in the area.

6.4 Light

Light pollution is the overall brightening of the night sky by man-made lighting. Fauna sensitive to light pollution includes both terrestrial (e.g., bats, rabbits, birds, and insects) and marine fauna (e.g., turtles and fish). Sea turtles are particularly sensitive to artificial lighting, preferring dark areas for nesting. Artificial lighting can disorient hatchlings, causing them to go towards the roadways where they are run over by vehicles. Artificial lighting is considered the largest issue concerning the conservation of sea turtles in Aruba (Dow, Eckert, Palmer, & Kramer, 2007).

The Light Pollution Map in Appendix 24, the ground-truth data provides higher levels of light emissions. The values found in the Light Pollution Map fall within the category suburban skies (19.50-20.49 mag/arcsec^2), described as encircling light pollution, clouds are brighter than the sky. Considering all these findings, **it can be concluded that the fauna within the project site is already exposed to high levels of light pollution**.

6.5 Air Quality and Climate

6.5.1 Climate

Aruba's climate can be characterized by its low rainfall (i.e., semi-arid), tropical temperatures and strong trade winds (for 1991-2020: average yearly rain of 451.1 mm, average yearly air temperature of 28.4 °C and average yearly wind speed of 7.4 m/s ((Meteorologische Dienst Aruba, 2020).

The climate in Aruba is bound to changes, considering the Earth is undergoing climate change as a result of global anthropogenic greenhouse emissions. Climate change is likely already impacting the environment at a local level. However, due to Aruba's relatively stable oceanic climate, these changes are less visible than in other parts of the World.

Increasingly the local population of Aruba is experiencing temperatures as "hotter". By having reduced the availability of shading from large trees, it is expected that the extensive deforestation of the island in the past centuries is contributing to this issue. Namely, it is known that deforestation can cause increasing microclimate temperatures, evaporation, and loss of groundwater supply. Due to the apparent degraded impression of the vegetation landscapes and the highly developed surroundings in the project site, hotter microclimate conditions are expectedly present in the project site.

On the topic of greenhouse gas emissions, the degraded xeric shrub landscape with its limited soil is not expected to be of significant value to off-setting Aruba's greenhouse gas emissions. While carbon storage is occurring into the woody and leafy matter (i.e., biomass) of the existing vegetation, carbon sequestration (i.e. a natural or artificial process by which carbon dioxide is removed from the atmosphere and held in solid or liquid form) should be limited. This is because carbon storage is dependent on the type of vegetation, type of soil and land management. In contrast to xeric shrubland (particularly degraded shrubland), mangrove-, saltflat-, seagrass- and coral reef habitats are of much higher value to local carbon sequestration.

6.5.2 Air quality

An Air Quality Assessment was carried out to determine the current levels of particulate matter (PM) and sulfur dioxide (SO_2) in the Project Area (Appendix 25). These pollutants are relevant for determining the impact to air pollution. Namely, dust (i.e. particulate matter).. Sulfur dioxide is typically associated with the burning of fuels for production and for transportation. In addition, it was chosen to measure the current levels of SO_2 at the Project Site, because of a) the notable fumes deriving from nearby smokestacks during certain wind conditions, and b) due to the published complaints of employees from the shipping company ASTEC located in the Port Area slightly downwind from the Project Site.

SO_2 levels were measured three times; every 15 min hour on 22 November 2023, and for almost five hours on 12 December 2023. PM levels were measured simultaneously with SO_2. The air quality measurements were graphically referenced against the EPA and WHO air quality standards for PM2.5, PM10 and SO_2 and percentage of measurements exceeding reference levels were calculated (Appendix 25).

The results of the SO_2 surveys shows that the averaged sulfur dioxide levels, namely 0.06 ppm, 0.04 ppm and 0.03 ppm, do not surpass neither WHO's 10-minute mean limit (190 ppb), nor EPA's 1-hour mean limit (75 ppb). However, the average SO_2 levels exceed the WHO's 24-hour mean limit (8 ppb). A maximum SO_2 level of 330 ppb and both occurred during the morning depending on the wind direction. The Air Quality Index (AQI) of EPA[2] for Sulfur Dioxide classifies 75 ppb (averaged over 1 hour) unhealthy for sensitive groups (asthmatics, children, people with heart and respiratory problems) and 150 ppb (averaged over 1 hour) as very unhealthy for everyone. Using the AQI, the air quality during the surveys can be classified as moderate with respect to the overall averaged SO_2 levels at the Project Site. Nevertheless, the risk is perceived to be higher during the mornings, when the wind arrives from the South-East directing WEB's fumes directly towards the Project Site. During prolonged southeastern wind or lighter wind conditions. The current major source of SO_2 pollution in the Project Area can clearly be attributed to combustion activities in the area.

The results of the PM2.5 survey shows that the averaged PM2.5 level, namely 6.3 $\mu g/m^3$, does not surpass neither EPA's, nor WHO's, 24-hour mean limit (35 and 25 $\mu g/m^3$, respectively). A peak of 22 $\mu g/m^3$ occurred during the morning. The AQI of EPA for PM2.5 classifies 35 $\mu g/m^3$ (averaged over 24 hours) unhealthy for sensitive groups (asthmatics, children, older adults, people with heart and respiratory problems) and 70 $\mu g/m^3$ (averaged over 24 hours) as very unhealthy for everyone. While the risk of PM2.5-related health issues seems very low at current levels, the results of the PM10 surveys shows that the averaged PM10 levels, namely 58 $\mu g/m^3$ does surpass WHO's 24 hour mean limit (50 $\mu g/m^3$), where the percentage of measurements exceeding this limit was high namely 46 % of the time. However, if referenced against EPA's 24-hour standard (150 $\mu g/m^3$), only a few times EPA's limits are exceeded, namely 2 % of the survey time. The maximum PM10 level of 310 $\mu g/m^3$ occurred at noon, however another large peak was observed in the morning. The AQI for PM10 classifies 150 $\mu g/m^3$ (averaged over 24 hours) unhealthy for sensitive groups (asthmatics, children, older adults, people with heart and respiratory problems) and 300 $\mu g/m^3$ (averaged over 24 hours) as very unhealthy for everyone. The air quality during the survey can be classified as good with

[2] EPA's AQI indexes for different air pollutants: https://www3.epa.gov/airnow/aqi_brochure_02_14.pdf

respect to the overall averaged PM10 and PM2.5 levels at the Project Site. Prolonged southeastern wind or lighter wind conditions are likely to increase the particulate matter levels and exposure in the area, where PM derives from WEB's smokestacks and from the activities in the nearby Construction Area. However, it is believed that the risks of PM-related health issues are currently low because of prevailing strong windy conditions. It has to be said that temporary exacerbation of particulate matter levels in the area can occur naturally during a Sahara dust phenomenon, particularly under enduring light-wind conditions. In addition, air pollution arriving from traffic (includes pollutants CO, NOx, SO_2, PM, greenhouse gasses, etc.) is currently perceived as low in the Project Area. This is because of the overall low levels of traffic in the area. Lastly, on rare occasions, when the wind arrives from the West/North West, it is possible that the smoke from the Landfill and nearby industry can cause unhealthy air quality in the Project Site carrying various miscellaneous air pollutants.

6.6 Flora and Fauna

The flora and fauna were physically inspected and documented in the Project Area, focusing on the existing flora and fauna to provide a baseline reference for future monitoring, restoration and compensation efforts. This included in (Appendix 27), and additional notes on other recorded species in the Project Area. Refer to Appendix 30 for a list of species that are protected under the national decree "Landsbesluit Bescherming Inheemse Flora en Fauna" (2017, № 48).

The flora and fauna investigations highlight the following:

- A range of marine and terrestrial habitats can be found in the Project Area. On the Project site itself three types of habitats can be distinguished: a xeric shrubland, a low xeric woodland, and a disturbed habitat containing sandy hills.
- The most dominant tree species in the area the Eleusine Indica or commonly known as grass.
- Overall, it is believed that the growth of the vegetation inside the Project Site is limited due to a combination of climatic factors, geological features and limited soils.
- The rather "undisturbed"/intact (i.e. limited fragmentation or land clearing) vegetation at Barcadera can be considered of high importance as a safe haven for fauna outside the boundaries of the National Park.
- Aruban whip-tailed lizard (*Cnemidophorus arubensis*), *Cerion uva*, *Tudora megacheilos megacheilos*, were among the commonly observed terrestrial fauna in the Project Area.
- The only locally protected fauna that were observed occurring within the Project Site included the striped anole (*Anolis lineatus*).
- Although a wide range of species and various ecological habitats occur at Barcadera, there are indications that the health status of the ecosystems is compromised and the nuisance and pressures from the surrounding industrial area is high.

6.6.1 Terrestrial Flora

The consisted of a detailed survey of the flora and the landscape elements. Visual inspection of all flora within three representative quadrats of 100 m^2 were reported. Distinction was made between dominant species and non-dominant species within the plot. Notable plant species within 10 m of the plots have been recorded. For details on the methodology and results of refer to Appendix 27. The following provides a description of the flora that can be

found in the Project Site. This is based on the LVEA and is complimented by observations made during various field visits in 2018.

The Project Site contained vegetation typical of a limestone coastal terrace. Two types of xeric habitats can be distinguished: a) a shrubland, and b) a low woodland. The candle cacti (internationally protected *Stenocereus griseus* and locally protected *Cereus repandus*) conspicuously rise above the vegetation throughout the area. The most dominant tree species in the area were the divi-divi tree (*Caesalpinia coriaria*), the mesquite tree (*Prosopis juliflora*) and the twisted acacia (*Acacia tortuosa*).
The shrubby layer typically contained twisted acacia, *Phyllanthus bothryanthus*. Small cacti, such as the locally protected cacti prickly pear and the melon cactus, were also very common throughout the area. The spotted spurge (*Euphorbia maculata*) was commonly found as ground vegetation on the limestone rock pavement. The overgrowth of vines, combined with spiny vegetation (e.g. cacti, twisted acacia, *Cenchrus pilosus*, cat's claw (*Pithecellobium unguis-cati*)), creates a dense and rather inaccessible landscape. A more open shrubland can be found. Overall, it is believed that the growth of the vegetation inside the Project Site is limited due to a combination of climatic factors (i.e. lack of rainwater input and a continuous presence of strong winds), geological features (i.e. porous coastal limestone bedrock) and limited soils.

The result of this survey indicates that the features of the vegetation (i.e. cover, height and species) in the Project Site, mostly resemble the landscapes classified as "limestone middle terrace (Lt2)" and "limestone middle/tonalite" in Landscape Ecological Survey of Arikok by Oosterhuis (2016). It has to be remarked that the Project Site is located on a lower limestone coastal terrace, rather than a middle terrace. However, the limestone coastal terrace studied by Oosterhuis (2016) inside the Arikok National Park had a much lower species diversity. This can likely be attributed to the saltspray and the disturbance by wild-roaming goats and off-roading vehicles.

For an exhaustive list of the observed marine and terrestrial flora in the Project Area and illustrations of the species identified within the Project Site, refer to Appendix 27.

6.6.2 Terrestrial Fauna

Numerous observations were made of macro- and mesofauna within the Project Site and its surroundings. A list of the marine and terrestrial fauna observed at Barcadera is shown in Appendix 28, 0 and Appendix 12. This comprehensive list is based on observations made from various field visits, online database records and from published literature.
Common terrestrial species in the Project Area included i.e.:

- Aruban Whiptail Lizard
- *Cerion uva arubanum*
- *Tudora megacheilos megacheilos*
- Western honeybee (*Apis mellifera*)
- Striped anole

The vegetation present in the Project Site were observed to provide habitat for some meso-organisms, such as bees and butterflies, and macro fauna, such as birds and lizards. Locally protected fauna recorded within the Project Site included the striped anole (observed on

various occasions the divi divi trees) and the blue-tailed emerald (observed foraging on the flowers of the Prickly pear).
Nonetheless, nuisance levels to wildlife in the area were generally perceived as high as a result of the aforementioned fumes and noise from the surrounding industrial and construction-related activities. It can be expected that these nuisances are compromising the fitness of fauna living in the area.

6.6.2.1 Nesting Sea turtles

For the EIA which requires evaluation of the impacts of the proposed project developments on the sea turtles. This is due to the vulnerability of sea turtles (i.e., red-listed Green turtles and Loggerheads as "Endangered" and Leatherback turtles and Olive Ridley's as "Vulnerable", according to the International Union for Conservation of Nature (IUCN)), their protective status locally and internationally, and their use of several beaches as nesting habitat.

It is known that the Leatherback Sea turtle nests every year between March and September. The eggs hatch approximately 60 to 70 days after nesting. Research by Barmes et al. (1993) determined **that despite the heavy commercial development, the majority of turtle nests are found at Eagle Beach and Arashi and Eagle Beach area**. The Project site Onshore and Offshore is not an identified sea turtle nesting area.

No threats have been identified for sea turtle nesting since the Project site area is not a nesting area.

6.7 Cultural assets, historical heritage, and property

6.7.1 Cultural-historic heritage

A petition for an assessment of the cultural assets and historical values of the project site was sent to the NAMA (National Archeological Museum Aruba). Based on their feedback no historical heritage is present at the project site.

6.8 Human Health and Safety Risks

During visual inspection of the project site **few human health and safety risks were observed**. Construction debris found in the project site, such as iron bars and other sharp objects (i.e., bottle fragments) can be considered a potential risk. Oil-contaminated soils can also be considered a health risk when handled manually.

7 Assumptions

The prediction of the impacts for the different scenarios/alternatives are assumptions based on the overall perception of the following characteristics for each impact; nature, magnitude, extent/location, timing, duration, reversibility, likelihood and significance. Impacts were scaled qualitatively as followed; major positive impact, minor positive impact, no impact/unknown impact, both negative and positive impacts, minor negative impact and major negative impact.

Considering the lack of locally available baseline information and appropriate tools for quantitatively measuring impacts of the different technologies, the impacts from the different scenarios are predicted subjectively based on the available information and expertise.

7.1 Scenario's Assumptions

To compare the scenarios, Scenario 0 is taken as a baseline reference. Scenario 0 represents a situation where nothing is done to the project site. The following assumptions are therefore based on Scenario 0.

It should be noted that due to the complexity of environmental impacts and the difficulty of forecasting management of the government or external actors, the assumptions of the Scenario 0 impacts do not account for cumulative impacts related to other future project developments.

7.1.1 Nature

In Scenario 0 it is assumed that the area will not be developed for any purpose, despite that the area is destined for industrial development according to the ROP 2019. Therefore, in this context the current natural habitat will be conserved. However, it is also assumed that no measures are taken to benefit the environmental state of the area, considering the area is neither a protected area nor a biodiversity hotspot. This means that the (abandoned) natural area at the project site will likely remain degraded and poor in faunal and floral diversity. These expectations are based on:

a) current state of nature in the project site
b) poor to no natural recovery of the project site and many other similar sites from land clearing activities without the aid of humans,
c) the difficulty of natural recovery in xeric landscapes,
d) a history of poor/limited implementation of legislation for nature conservation on the island
e) lack of attention from nature organizations and governmental authorities towards already degraded/low-valued landscapes (i.e., not being a biodiversity hotspot)

7.1.2 Nuisances

Current nuisance levels at Barcadera are very high due to the continuous noise, vibrations and air pollution arriving from the surrounding industries. The noise will likely only increase as a result of the RECIP technology, namely RECIP is known to produce a lot of noise. However, RECIP will require less energy and thus contribute to Aruba's reducing carbon footprint.

Although at the moment dust emissions can be temporarily high due to ongoing excavations and construction activities nearby, it is expected that this nuisance will discontinue once the

construction is completed. Particulate matter deriving from the emissions in the area, however, is expected to continue; possibly, at a lesser degree in the future due to the aforementioned innovations. This innovation will also expectedly reduce the emission of other air pollutants, such as SO_2 and consequently reduced nuisance and health hazard for workers in the area of Barcadera. Although the air quality assessments showed high peaks of PM10 and SO_2, can be the health hazard as limited. Particularly, the prevailing wind conditions reduce the health risks. These air quality conditions are not expected to increase, most likely only a reduction of health risk can be expected when after the transition to more energy efficient technology. The Fish smell may be presence due to the fish farming activities.

7.1.3 Groundwater

While the state of the groundwater is unknown, it is assumed that, if available, little changes will occur within this environmental compartment.

7.1.4 Seawater

Based on the different studies/ research (Panama, 2019) performed at the different offshore locations documenting the levels of Cl, NO_3, NO_2, Nitrogen, Carbon and Oxygen, the dilution will be sufficient to disperse these values and have a low impact in the seawater. Their levels will be closely monitored by the operation of the Open Ocean Aquaculture Project. Refer to Appendix 22.

7.1.5 Soil

The limited and oil-contaminated soils on the limestone will likely remain the same. However, the soil deposited in the southern parts of the project site will likely erode within a few years.

7.1.6 Health and Safety

Limited to no changes are expected with regards to human health and safety.

7.1.7 Waste

The implemented technologies in Aruba by waste processing companies on the island involves mainly storing household waste in environmental bales at Seroe Teishi. As there is no available information regarding its impacts on Seroe Teishi (i.e., potential leakages or air polluting emissions), it is difficult to forecast the impacts of waste production related to collecting household waste. Most other types of waste materials (including hazardous and chemical waste) are deposited on the landfill of Parkietenbos, which has been over its capacity decades ago and as a result has led to a very unsanitary and polluted coastal area. Furthermore, while supposedly unintentional, this waste is often burned and therefore results in air polluting emissions. The landfill has been closed down and the current method is being processed as per Eco Tech Waste bale process, including some waste segregation.

7.1.8 (Waste) Water Production

The national Water and Energy production company (WEB) uses heavy fuel oil as a source of energy to desalinate water in Aruba. As such it is assumed that water consumption contributes to greenhouse gas emissions in Aruba.

The main wastewater treatment plant in Aruba drains into the artificial wetland of Bubaliplas and via the wetland it is indirectly connected to the sea. This RWZI is in a dire state (i.e., overcapacity, old age, poorly maintained) and requires a huge investment for its up hauling. Similar to the Landfill of Parkietenbos, from a conservative point of view, it is assumed that for

the coming years no changes will take place to improve the wastewater management on the island and its negative threats will continue. The main negative threats expected from wastewater management in Aruba is the biological and chemical pollution. This pollution can lead to a range of negative effects on local wildlife, plants and also humans. For instance, the input of nutrients is expected to cause algal overgrowth and the input of pathogens is expected to cause diseases. Both seriously threaten our coral and seagrass ecosystems. The wastewater will be routed to a septic tank and vacuumed trucked to the wastewater facility at Parkietenbos. This stream will not add any additional stress to the wastewater system.

Petros is also considering an onsite wastewater processing infrastructure. Refer to Appendix 47 for additional on the options identified and their benefits to the project and to Aruba. Petros strives to have minimal to no negative impacts to the already stressed coastal corals around Aruba.

8 Analysis of Scenarios

8.1 Policy and Guidelines Support (Scenario II)

The following laws, texts, treaties, and conventions were reviewed:

1. Spatial Planning/Culture:
    a. Landsverordening Ruimtelijke Ontwikkeling (LRO) and Milieubescherming. AB 2006 no. 38
    b. Ruimtelijke Ontwikkelings Plan (ROP) Landsbesluit van 7 mei 2009, no. 7
    c. Bouw en woningverordening AB 1999 no. GT 9
    d. Algemene Politieverordening AB 1995 no. GT 8
    e. Uitgifte eigendommen verordening AB 1989 no. GT 21
2. Environment:
    a. Natuurbeschermingsverordening AB 1995 no.2
    b. CITES AB 1995 no.69 Landsbesluit CITES-registers
    c. SPAW
    d. Marine milieuverordening
    e. Ramsar
    f. Kyoto Convention
    g. Montreal Protocol
    h. Hinderverordening AB 1988 no. GT 27
    i. Hinderbesluit Aruba AB 1995 no. GT 20
3. Public Health
    a. Bestrijdingsmiddelen verordening AB 1991 no. GT 69
    b. Landsbesluit Bestrijdingsmiddelen AB 1991 no. GT 57

Below a summary of all laws, treaties and conventions reviewed and deemed relevant to this EIA.

8.1.1 Spatial Planning/ Culture

a) **Spatial Planning Ordinance** *(Landsverordening Ruimtelijke Ordening (LRO))*

This Ordinance defines the roles of government and the rights and duties of citizens, businesses and institutions in the creation and modification of spatial plans. The process of spatial planning starts with the creation of a spatial development plan (ROP). The current situation, the possible and desirable development of the island, is investigated and an ROP is created. The ROP-must be created in such a way that it contains the outline of the proposed development as well as maps, an explanatory memorandum, the underlying thoughts and plans, the results of the investigation mentioned above and the reports that accompany it. The ROP will be published, and the public will have time to react, give comments and ask questions about the new ROP. The announcement of the ROP shall be published in the Dutch and Papiamento local newspapers.

An ROP is valid for 10 years and afterwards a one-time extension is possible for a maximum period of five years. After this, a new ROP is required. The ROP is an integral policy plan of the Government of Aruba and does not provide for binding rules for use of the land.

Binding rules pertaining to use of land are described in a more detailed spatial plan called an ROPV, which is based on the ROP in force. Practically the same procedure as described above is followed when creating an ROPV.

An ROPV is valid for only 5 years and may be extended with another 5 years. The ROPV may contain defined instructions as to the destination of certain lands and how structures within that vicinity may be constructed as well as restrictions for existing lands and existing structures. It may also provide for rules to protect monuments located in the area of the ROPV, and it may determine that a construction permit ('aanlegvergunning') is required when construction activities are being performed. Construction activities are defined as (not limited to) digging, increasing and leveling off the ground, construction of roads and other pavements, and installation of cables and piping above or under ground level. The rules and regulations of the ROPV are binding on the Government and all citizens and legal entities in Aruba. At the moment, the government is working on updating the LRO, including the development of RPOV's. In preparation of the new LRO, it was recently announced in the "Landscourant" that as of the 1st of January a Ministerial Decree is instituted which requires a construction permit for the clearing of land for both all types of properties (private and public) larger than 750 m^2. This permit serves to avoid clearing land where locally protected species are present or the destruction of important habitat for threatened species.

b) **Spatial Development Plan** *(ROP)*
The proposed plots and nearby zones surrounding the Project Site have been designated as an industrial area, according to the ROP. The spatial zoning map has been attached in Appendix 4, which shows the designation of Barcadera within the Red Circle.

c) **Construction and Property ordinance** *(Bouw en Woning Verordering)*
The Construction and Property Ordinance refers to the technical and general conditions for the establishment of a building. As such it is an instrument of policy. The Ordinance provides rules and procedures for building houses and other buildings. This will be carried out by DOW and Esthetic commissions to make sure the project complies to all regulations.

d) **General Police Ordinance (***Algemene Politie Verordering***)**
This Ordinance contains various rules and regulations for keeping and maintaining the public order and safety. Issues such as regulating noise, collecting and leaving waste, and organizing events are regulated. It is expected from the Project Developers that they will abide by these regulations in both phases of the development whereby they ensure to properly handle their waste and manage nuisance related to the Project.

e) **Proclamation Properties** (*Landsverordening Uitgifte Eigendommen*)
In this Ordinance the Minister of Public Works and Public Health is authorized to issue land in a long lease in accordance with the provisions of the following articles. The issue of land in long-lease is done under the terms and conditions set out in this Ordinance, subject to special conditions by the Minister for Public Works and Public Health in each individual case, against a canon, amounting to six promile (0.06%) per year of the land

value determined by the Minister of Public Works and Public Health, as a rule for no more than sixty years and by notarial deed. National Decree, containing general measures, can lay rules down regarding the cases in which the Minister of Public Works and Public Health can deviate. The Minister of Public Works and Public Health is authorized to grant an option on the issue of land in long-term lease. The grounds for which the option applies are indicated by measurement letters issued by the Land Registry. The Ministerial Decision granting an option states the duration of the option. Option is not granted for more than five years. If an option has been granted for a period of less than five years, a consecutive extension of up to five years is possible. The Minister of Public Works and Public Health is authorized to rent, lease or otherwise use the property of the Land for longer than five years if this takes place by means of a public tender. The renting, leasing or in any other way giving into use of properties of the Land for more than five years, other than by means of a public registration, shall take place by National Decree. Subject to the provisions of in this Ordinance, the alienation of built and unfinished properties of the Land shall be affected by National Decree insofar as the Minister of Public Works and Public Health is not authorized to do so. This legislation is deemed relevant, considering the land for this Project Development will be issued via a long-term lease contract.

8.1.2 Environment

a) Nature Conservation Ordinance (*Natuurbeschermingsverordening*)

The Nature Conservation Ordinance aims to protect the native flora and fauna and to conserve the biodiversity of Aruba. The aforementioned ordinance was created in order to comply with treaty obligations to realize a better protection of wildlife and their habitats on the island of Aruba.

The two conventions this Ordinance has taken into consideration include the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and The Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region (SPAW).

The Nature Conservation Ordinance came into effect in 1995. All legislation in the form of national decrees that should have been passed to implement certain lists or organizations mentioned in the Ordinance have not yet been passed, such as the list mentioned in article 4 of the Ordinance. However, there are (unofficial) lists of protected plants and animals available based on the CITES Convention that should be taken into account as Aruba is a party to the CITES Convention. Refer to Appendix U for the list of locally protected species.

Article 6 of the Ordinance is relevant as it prohibits the removing or damaging of certain species of native flora and fauna designated by national decree due to the threat of their survival in Aruba.

Article 7 is also relevant as it prohibits the deliberate disturbance of certain wild animals protected by national decree due to the threat of their survival in Aruba.
However, it is possible to request that the Minister grant dispensation for either removing protected plants (mentioned on an official list) from their location or disturbing the habitat of wild animals protected (by law).

With Article 10 areas of land or water can be designated as nature reserves by instituting a national decree containing general measures for the protection of species. As of yet no areas in or nearby the Project site have been designated as nature reserves through this Ordinance and hence this Article is not relevant.

Articles 11 and 12 concern the prohibition of importing and or exporting of endangered species and specimens of plants listed as endangered by the CITES Convention and the SPAW Protocol. Presumably the landscaping features of the Project will include the use of exotic plant species; however, it is unlikely that these species will be imported by the Project Developer. Rather the developer is likely to purchase plants from an established local distributor. Thence, these articles will not be applicable.

Lastly, Article 13 prohibits the killing and injuring of animal species listed in both the CITES convention and the SPAW Protocol. Considering the presence of some listed species of Cactaceae at the Project Site, the Project Developer should carefully execute the removal of plants in order to transplant them elsewhere and hence not injure or kill these species. In addition, the Project Developer should take the presence of locally protected fauna at the project site and its nearby surroundings. Particularly, care should be taken during construction not to harm any locally protected species and following measures provided in this report. The Project Developer should implement proper procedures for minimizing the impacts to the flora and fauna in the area, and where impacts cannot be avoided compensation measures should be instituted.

b) Convention on International Trade in Endangered Species of Wild Fauna and Flora (*CITES*)

CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The aim of this Convention is to limit or regulate the trade in wild animals and plants by designating species whose specimens may be exported only subject to certain conditions. The animal and plant species for which this Convention requires an export permit per specimen are listed in three separate appendices to the convention. Aruba is a party to this convention. Refer to Appendix 27 for a list of all the recorded species and their CITES status. Considering the Project Development will not involve any importation or exportation of flora and fauna. The CITES legislation is not relevant to this Project. However, care should be instituted by the Project Developers to reduce harm to CITES protected species due to their local protection and the fact that many of CITES species are considered internationally threatened.

c) The Protocol concerning Specially Protected Areas and Wildlife (*SPAW Protocol*)

This Protocol was concluded in Jamaica on 18 January 1990 and implements article 17 of the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, concluded at Cartagena on 24 March 1983. The Convention and the Protocol are in force for Aruba. The aim of the Protocol is to protect areas of special value and endangered species in the Caribbean region and to regulate and, if possible, prevent activities having adverse effects on these areas and species. The Parties to the Protocol are obliged, where necessary, to establish protected areas

in particular to ensure the survival of representative coastal areas and marine ecosystems. Examples of the measures to be taken for this purpose are fishing and hunting bans, prohibition of the dumping of waste, prohibition of the import and export of endangered species of animals and regulation of shipping, without prejudice to the right of innocent passage. Similar in the case of CITES; the Protocol is not applicable; however, some species are listed in the SPAW Protocol which require the attention of the Project Developer in order to minimize impact to these internationally confounded species within the Project Area.

d) The Wetlands Convention *(RAMSAR Convention)*

The Wetlands Convention focuses on the protection of wetlands. The Convention is also called Ramsar Convention, named after the place, it was signed in 1971. Wetlands are broadly defined in this convention as areas of marsh, fen, peatland, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water with a depth that does not exceed six meters at low tide. Parties to the Convention must designate for inclusion in a list at least one wetland within their territory that is eligible for protection. The Convention focuses on the protection of water birds present in these areas.

The treaty protects wetlands because wetlands form an important function in the field of water management and function as habitats for flora and fauna, especially water birds. These areas perform essential ecological functions for waterfowl flying over borders during migration. The wetlands serve as breeding grounds and play an important role in the international chain of foraging areas.

The Kingdom of the Netherlands ratified the Convention in 1980 and has logged 43 wetlands for the convention, including five in the Netherlands Antilles (all located on Bonaire) and one in Aruba: Spanish Lagoon (Ramsar Site No. 198.). Since 1 January 1986, the Convention is also applicable to Aruba. Recently, the Spanish Lagoon has has been afforded protection according to the National Law by the institution of a Decree which places the area under the management of the Aruba National Parks. Although the Ramsar Convention only contains guidelines for further national policy, all contracting parties must adhere to its rules and guidelines. Considering the Spanish Lagoon is outside the Project Area, the Ramsar legislation is not applicable to this Project Development. However, the coastal area adjacent to the Project Site can be considered a wetland and therefore measures should be taken to reduce impacts deriving from the Project Development.

e) Kyoto Protocol

The Kyoto Protocol is an international treaty that commits State Parties to reduce greenhouse gas emissions, based on the premise that (a) global warming exists and (b) man-made CO_2 emissions have caused it. The Parties to the Protocol commit to setting internationally binding emission reduction targets. Aruba is a party through the Netherlands but has not applied the protocol as of yet. Considering the energy demand for the Open Ocean Aquaculture Project, wherever possible, the Project Development should institute measures to reduce energy consumption and source their raw materials from companies that show a high commitment to reducing greenhouse gasses.

f) Montreal Protocol

This protocol is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. The Montreal Protocol includes a unique adjustment provision that enables the Parties to the Protocol to respond quickly to new scientific information and agree to accelerate the reductions required on chemicals already covered by the Protocol. These adjustments are then automatically applicable to all countries that ratified the Protocol. The Protocol has already been adjusted 6 times since its initial adoption. Aruba is a party to this Protocol. However, there have been no other implementations made in the national legislation to implement any provision of the Protocol. Either way, the global action to protect the ozone layer have led to phasing out of ozone depleting substances in many products nowadays, hence it is doubtful that this Protocol is relevant. However, the Project Developer should control its raw materials, particularly its admixtures, to ensure responsible environmental management.

g) Nuisance Ordinance (*Hinderverordening*)

This Ordinance prohibits establishments that either spread odors, fumes or vapors, or cause noise or otherwise cause nuisance, damage or danger to the environment to operate without a permit. By national decree a list of establishments which are deemed to cause such hindrances will be made available. Establishments are obliged to follow the procedure for applying for a permit stipulated in the Ordinance. The procedure also involves the public submitting their objection to the establishment. The permit can only be denied if there is fear of hindrance of a serious nature, damage to health and properties or danger to the public. Fish Farming specifically are not included in the list of establishments described in Article 1 associated Nuisance Decree. Fish typically has a particular smell, and bad smell is on the list of the Nuisance Decree. Smell can originate from fish waste, uneaten feed, stagnant water, and processing facilities. Therefore, the Project Development is required to apply for a nuisance permit. Wherever possible the Project Developer should institute measures to reduce nuisance. This impact is mainly relevant to the smell release caused by the processing of the fish. Due to the fast processing of the harvest Fish the smell impact will be mitigated by the Project Developer. This will largely solve this issue. The nuisance may also be mitigated since the requested parcel is in an industrial area with no direct neighbor within 200 m.

h) Nuisance Decree (*Hinderbesluit*)

This national decree lists establishments that are deemed to cause such hindrance/nuisance as described in the Ordinance. As discussed before, a permit may be required for the operation of Open Ocean Aquaculture Fish Farm.

8.1.3 Public Health

a) Pesticides Ordinance (*Bestrijdingsmiddelen Verordening*)

The Pesticide Ordinance aims to regulate the import and use of Pesticides in order to protect public health against harmful substances/micro-organisms. Because the Project Developers are likely to use pest control measures to maintain their premises

pest – free, this Ordinance is of relevance. Through Article 6, prohibition on the purchasing and use of a specified harmful pesticide is designated by means of a national decree. Information should be requested on the chemical substances used during pest-control and landscaping and the Project Developer should ensure that no harmful pesticides are applied.

b) Pesticides Decree (*Landsbesluit Bestrijdingsmiddelen*)
This decree associated with Article 6 of the Pesticide Ordinance, prohibits the purchase and use of Phosdrin (Shell Compound 2046) without the permission of the Minister of Public Works and Public Health. It is not expected that the Project Developer will purchase this specific pesticide for this Project.

8.1.4 Proposed Certification Programs and Standards

In the end, the developers are seeking to participate in international audit/certificate programs that evaluate and guide in environmental, health and quality responsibilities of the company's policies and operations. Particular interest has been shown in standards from BAP, ASC, LEED, ISO 9001, ISO 14001 (Environmental Management Guidelines from ISO), the Netherlands Standardization Institute (NEN), the US Occupational Safety & Health Administration (OSHA), Global Food Safety Initiative's (GFSI) benchmark.

8.2 Appropriate Technology/Applications

The appropriate technologies, i.e., alternatives, are described here for both scenarios and separated by the two stages in project development, namely the Design & Construction stage, and the operation stage.

8.2.1 Scenario I (Recommended)

8.2.1.1 Design & Construction Stage

Appendix 33 lists the appropriate BETs/Applications recommended during the Design & Construction phase.

8.2.1.2 Operation Stage

Appendix 34 lists the appropriate BETs/Applications recommended during the operational phase.

8.2.2 Scenario II (Proposed by project developers)

8.2.2.1 Design & Construction Stage

Appendix 35 lists the appropriate BETs/Applications proposed by project developers during the Design & Construction phase.

8.2.2.2 Operation Stage

Appendix 36 lists the appropriate BETs/Applications proposed by project developers during the operational phase.

8.3 Relevant Impacts to the Environment by the Different Scenarios

The significance of the impacts determined via the MIIA analysis are shown in Appendix 41 the construction and operation phase of Scenario I, and II are shown in Appendix 39 and Appendix 40 for the construction and operation phase of Scenario II. Note: no matrixes are shown for Scenario 0, because the MIIA method requires an evaluation against project activities, which do not occur in Scenario 0. Nonetheless, the valuation of Scenarios I and II are based on Scenario 0, which represents the existing situation and its expected development.

The relevant impacts for Scenarios are discussed here for various environmental aspects of the area. A distinction is made for the Construction and Operational phase of the project development.

The following impacts can be highlighted:

- loss, disturbance, and degradation of habitat
- dust and air emissions during construction and operation
- noise nuisance
- smell nuisance
- pollution from wastewater, storm-water run-off & improper handling of materials
- waste production
- energy and water consumption

8.3.1 Nature and Landscape

The ecological impact is discussed in the Flora and Fauna, considering that the proposed Project Development will be located in an already industrialized area, it is a suitable location for this project. Will not significantly alter the aesthetics of the area and it is expected that in Scenario I the design will be harmonizing its structure and landscaping with the elements found at the site. Littering can add to the degradation of the landscape over time due to the continued presence of people in the area. This impact can be significantly prevented.

8.3.2 Flora and Fauna

No Local, CITES and SPAW protected species have been observed at and around the Project Site. Additionally, the area can be considered valuable for its flora and fauna since the baseline study showed that the area is visited and or inhabited by an abundance of endemic lizards, migratory birds, etc.

The Open Ocean Aquaculture project will have to hire contractors with ample experience in proper removal for the site clearance. Careful landscape designing could even enhance the biodiversity in the area.

The nearby seawater marine ecosystems are very sensitive to high nutrient levels, whereby eutrophication of ground water could eventually lead to algae overtake and have serious detrimental implications for the already highly stressed marine ecosystems on the island. Eutrophication could also occur if wastewater is not properly managed, such as simply digging a cesspit for use in wastewater disposal. This wastewater will percolate into the limestone and eventually reach the sea. It can simply be prevented by constructing a hermetically sealed cesspit.

One of the common impacts associated with developments is improper handled waste attracts unwanted species. For example, the black rat and common mouse, which are invasive species in Aruba, can become very prominent in the area. With proper food (waste) management procedures this can be avoided to a large extent. Keeping consumption and waste indoors /enclosed should prevent this.

The influx and outflow of construction and manpower could become detrimental to the flora and fauna around the Project Site, due to smothering/trampling flora and fauna by parking outside premises, littering and increased disturbance. However, this situation is expected in all scenarios. In Scenario I, this can especially be mitigated by creating awareness among staff and suppliers. Moreover, by clearly marking the Project Site, physical harm can be avoided.

The largest impact on the ecology in the direct surroundings of the Project Site could come from the application of pesticides that are non-specific and or toxic. This could bioaccumulate throughout the food chain and potentially reach marine fauna. Obviously, in Scenario I such pesticides will not be applied.

8.3.3 Soil

Landscaping in the Project Site could be beneficial to vegetation growth in the area by adding and improving soil conditions. Scenario II does provide measures for landscaping, since landscaping could also have negative impacts. Soil on a compacted surface could retain irrigation water, which could lead to over nutrition and accumulation of toxic chemicals such as pesticides and fertilizers, this is particularly true for seagrass ecosystems.

8.3.4 Nuisances

Nuisance can be defined as a situation that is annoying or that causes trouble or problems. Two types of nuisances are discussed here, namely noise and light. Although dust is also a nuisance, this topic is discussed under the theme of Air and Climate.

Minor negative impacts are expected in both the construction phase as well as the operation phase of the project development, especially in Scenario II various activities can lead to higher exposure of noise levels in the area. The noise levels and vibrations are expected to be higher during the construction phase (over 70 dBA) as a result of using heavy machinery, clearing land, excavations and drilling. Nevertheless, construction-related nuisances are temporary in nature and occur quite regular in the area as a result of continuous new developments in the area. While it will be difficult to predict exactly how much higher the noise levels will become in the area since it also depends on other developments in the area and the noise of many of the elements are unknown, noise nuisance can be considerably mitigated in the operation phase of the project with the BETs provided in the Scenario I. Furthermore, continuous monitoring of the noise levels as proposed in Section 0 should help inform the project developers, where noise abatement measures are needed. In any case, background noise levels as a result of this project development, should not be allowed to increase more than 3 dB over Scenario 0 (i.e., as a guideline taken from WHO and IFC).

8.3.5 Air and Climate

Air polluting activities from the project development occur mostly in the Construction phase, as a result of:

- particulate matter (i.e., dust) generating activities from land clearing, groundworks, and the use of heavy machinery
- greenhouse gas emissions from electricity consumption (either generators or connected to grid), water consumption (i.e., WEB produces water partly by burning heavy fuel oil) and the use of heavy machinery (exhaust gasses)
- polluting materials (Polyaromatic Hydrocarbons) (PAHs) and other pollutants from asphalt, hydraulic petroleum-based liquids and lubricants, Volatile Organic Compounds (VOCs) from finishing activities)

Minor negative impacts from air polluting activities occur mainly in the construction phase in Scenario II, because of dust generating activities which can directly lead to respiratory health issues and the smothering of plants. Dust screens will be placed around the parameter of the project site in both Scenario I and II, which in theory should prevent the vegetation surrounding the property from not being smothered by the heavy machinery or dust. Nevertheless, dust screens installed by contractors are commonly too low. They should be at least higher than the stockpiles of materials. In Scenario I, additional BETs are recommended to reduce the hazard to not only the surroundings but also the health of workers on-site. For instance, carrying out regular wet suppression and placing tarps over the stockpiles and trucks carrying dust-generating materials. Furthermore, mitigation measures have also been proposed in the MMP that can significantly control dust and other air pollutant levels. For instance, equipment used the building process should be maintained by contractor providers in order to minimize exhaust related pollutants. Preventive maintenance also avoids accidental oil and grease leaks into the soil.

In contrast to the construction phase, in the operational phase air pollutants are mainly the result of:

- greenhouse gas emissions from water consumption
- hazardous air pollutants from hazardous waste and sludge production (i.e. hazardous waste is incinerated)
- vehicles (i.e., exhaust gasses).

The minor negative impacts from air polluting activities in the operation are minimal in both Scenario I and II. Considering that greenhouse gas emissions are becoming ever more relevant as a result of its ongoing impact on our climate, additional BETs and other mitigation measures to reduce the carbon footprint as proposed in Scenario I and the MMP. Additional measures to prevent the production of hazardous air pollutants have also been proposed in Scenario I and should be taken into consideration by the project developers. For instance, the use of add on air-pollutant control devices for incinerating medical waste and sludge-waste (derived from wastewater treatment).

8.3.6 Water

Minor negative impacts to the hydrology are mainly determined as a risk from carrying out groundworks and works in the construction phase. For instance, the excavation of the site could potentially alter the natural drainage of the site if excavations and constructions are sufficiently deep (i.e., reaching the groundwater level). The artificial drainage (i.e., sewer network and culverts) can also be at risk by accidental damage to subsurface structures from drilling and excavations and or subsidence. **Unfortunately, not much is known about the**

groundwater level or sub-surface structures at the project site, hence this needs to be further investigated via a geotechnical survey as required by DNM in their EIA guidelines and a request for information about the sewer network should be requested at DOW. Despite the potential risks, landscaping is expected to contribute to the hydrological system by improving the water-balance on a micro-climate scale, increasing soil infiltration, increasing plant water-uptake, and reducing evaporation of water. **In operational activities are also expected to have minor negative impacts on the hydrology.**

Water consumption will mainly occur in the operation phase as a result of the RAS system. As mentioned in Section 5.3.1.4, this wastewater will be non-polluting**. Further, it should be noted that the project development may have water-depletion minor negative impacts.** Additional water-saving technologies as described in Scenario I and mitigation measures in the MMP should be applied to the extent possible.

In contrast to the construction phase, groundwater polluting activities in the operational phase are mostly related to:

- use of seawater for the RAS system and the make-up water (new water) replenishes of the RAS system
- the leakage of pollutants from vehicles parked in the parking area

It should be noted that in both Scenario I and II, the enclosed wastewater pit with its backfilling and concrete slab should prevent groundwater pollutants deriving from untreated sewage. The return seawater to the sea will be monitored and based on the regulation and standards Refer to Appendix 45 and Appendix 44 for water quality standards. In Scenario I, additional measures are taken to mitigate groundwater pollution.

Seawater polluting activities in the construction phase derive from similar sources as mentioned for the groundwater polluting activities. **Likewise, seawater polluting impacts are minor in the construction phase.**

Seawater polluting activities in the operational phase are mostly related to:

- Use of seawater for the RAS system (Appendix 44) and the make-up water replenishes of the RAS system.
- Marine vessel activities in the Barcadera lagoon (Appendix 16).
- Fish farm presence in the open ocean, mainly due to feeding (Appendix 49)

It can be expected that chemicals (non-biological) waste is brought to the landfill and due to its close proximity with the sea, it can indirectly affect the seawater quality and marine life. Nevertheless, **the seawater polluting negative impacts are minor in the operational phase.**

8.3.7 Cultural assets

The cultural asset is not present in the in the area and no impact is expected at the project site onshore and offshore.

9 Mitigation Management Plan

It should be acknowledged that it is seldom possible to eliminate an adverse environmental impact altogether. Nonetheless, it is often feasible to reduce its intensity with additional measures (not necessarily technical). This reduction in intensity is referred to as mitigation. Therefore, in order to address the environmental issues regarding this project, appropriate mitigation measures have been proposed to reduce and or offset the potential impacts with the goal of improving the overall environmental acceptability of the project. For this purpose, a detailed MMP including the required mitigation options is provided in Appendix 41.

The integration of the MMP into a construction and operation work plan is critical for the adoption of the mitigation measures. Therefore, the project developers should work alongside experts, contractors and operators to set out a time bounded implementation schedule of the MMP for the construction and operational phases. Regular toolbox meeting with the workers under supervision of a potential Sustainability Officer should assure the implementation of the MMP. Furthermore, the developers are seeking to institute contractual agreements that ensures adoption of the measures, accountability and discourages inappropriate environmental behaviors through for example penalties.

10 Monitoring and Evaluation

10.1 Monitoring of the project site

An Environmental Monitoring Plan for the project site is provided in Appendix 42 to monitor environmental parameters that could indicate impacts from the project development. It briefly describes details on how, when, where, how frequent each parameter needs to be monitored.

10.2 Monitoring indicators for the facility

An Environmental and Health and Safety Monitoring Plan for the facility is provided in and Appendix 43 to monitor and inspect sustainability and health and safety of the facilities. It briefly describes details on how, when, where (if relevant), how frequent each parameter needs to be monitored.

10.3 Evaluations

Evaluation of the impacts and implementation of the mitigation measures in this report, particularly those proposed by the project developer, such as BAP, ASC, is recommended to be executed at least once every half a year in the first five years of the project development, and subsequently once every year. An audit should be done by an external organization and reviewed by the GoA.

11 Conclusion

To address the environmental impacts regarding this project, appropriate mitigation measures have been proposed to reduce and or offset the potential impacts with the goal of improving the overall environmental impact of the project. For this purpose, a detailed MMP including the required mitigation options is provided in Appendix 41.

The environmental impacts as well as positive and negative impacts, can be expected to arise as a result of the project development. Nonetheless, if the project developers take on at least part of the BETs provided in Scenario I and discussed in the impact evaluation, as well as applying the mitigation measures proposed in the MMP including adopting at least part of the monitoring plan, the overall environmental performance of the project development can be considerably improved.
The design and implementation of a technologically advanced RAS for the hatchery, ensures animal welfare, reduces water extraction and return from the Barcadera Lagoon, and focuses on a stringent biosecurity plan. This will be accomplished through a continuous water quality monitoring system both onshore and offshore site.

Aruba's coastal corals will not be negatively impacted due to the careful and scienced based siting of the farm. It will be located over 8 kilometers from the closest coastal coral formation, the predominant current direction will be away from Aruba, and the technologies used are safe and proven.

The wastewater processing options have been evaluated for both processing at AWSS via the local infrastructure in Aruba or on-site processing strategy, with specialized equipment designed specifically for Petros fish processing operation.

No to minor impact on turtles and other marine life is expected. The farm infrastructure will apply proven technologies to eliminate entanglements, no underwater lights to confuse marine life, and mortality retrieval systems to prevent changes in shark behavior around the pens. Additionally, an extensive array of sensors and cameras will continuously collect key environmental data, which is essential to maintain international accreditations, but also to make these available to the Aruban public for full transparency.

The project will pursue BAP and ASC Certifications:

- BAP Standards supports practices that are environmentally sustainable, socially responsible, and safe for consumption.
- ASC Certification which promotes sustainable aquaculture, by helping to ensure that seafood is produced in an environmentally and socially responsible manner.

This EIA will serve to guide the project developers in mitigating and preventing environmental impacts in all stages of the project development.

Most of the environmental impacts are minor and can be mitigated or even avoided altogether, the Project Development should be acceptable, provided that mitigation measures and appropriate technologies are applied as provided in this report.

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13 Disclaimer

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14 Appendix

Appendix 1: EIA format DNM

Environmental Impact Assessment report outline

The report will have to be structured according to the standard format:

1. Summary (English)
   - 1.1. Samenvatting (summary Dutch)
   - 1.2. Resumen (summary Papiamento)
2. Policy, Legal and Administrative Framework
   - 2.1. Governmental policy
   - 2.2. Legal and Administrative framework
     - 2.2.1. Environmental policy
     - 2.2.2. Physical development policy
     - 2.2.3. Economic development policy
     - 2.2.4. Public Health policy
   - 2.3. Beneficiaries and parties involved
   - 2.4. Documentation available
3. Scope of the Study
   - 3.1. Overall objectives
   - 3.2. Features of the to be developed facility or facilities
   - 3.3. Project purpose
   - 3.4. Activities
     - 3.4.1. Soil/groundwater investigation (minimal 3 and 1 auger boring per additional 20,000 m^2, minimal depth: till groundwater or teen meters depth)
     - 3.4.2. Flora and Fauna investigation (description of flora and fauna per site)
   - 3.5. Definition and description of scenarios
     - 3.5.1. Scenario nil
     - 3.5.2. Scenario I: Prevention of all negative environmental impacts
     - 3.5.3. Scenario II: Best practical means
     - 3.5.4. Optional other scenarios
     - 3.5.5. Comparison of scenarios
   - 3.6. Description and overview of location(s)
4. Assumptions
5. Analysis of scenarios
   - 5.1. Policy support
   - 5.2. Appropriate technology
   - 5.3. Relevant impacts to the environment by the different scenarios
     - 5.3.1. Nuisances
     - 5.3.2. Soil
     - 5.3.3. Nature and landscape
     - 5.3.4. Air and Climate
     - 5.3.5. Water
     - 5.3.6. Flora and fauna
     - 5.3.7. Cultural assets, property and historical heritage
     - 5.3.8. Human risk to exposures through air, dermis, water and residuals
   - 5.4. Environmental situation at the site(s) (sensibility)
     - 5.4.1. Sensibility of human beings (existing settlements, land use and proposed regional development)
     - 5.4.2. Sensibility of soil
     - 5.4.3. Sensibility of nature conservation and landscape preservation
     - 5.4.4. Air and Climate

5.4.5. Water
5.4.6. Sensibility of flora and fauna
5.4.7. Sensibility of cultural assets, property and historical heritage
5.4.8. Entomology
5.5. Analysis of emergencies and failure scenarios
5.5.1. Physical Health Protection
5.5.2. Labor Protection
6. Monitoring and Evaluation
6.1. Monitoring of the site(s)
6.2. Monitoring indicators for the facility
6.3. Evaluations
6.3.1. Evaluation of scenario nil (per site)
6.3.2. Evaluation of scenario I and II (per site)
6.3.3. Scenario I versus scenario II (result of "best" site of evaluation 6.3.2.)
7. Conclusion and Proposals
7.1. Conclusions
7.2. Proposals
7.2.1. Control systems for safeguarding industrial hygiene
7.2.2. Sanitary regulations in reference to proposed plant to be implemented in daily operations for:
7.2.2.1. Internal Quality Control
7.2.2.2. Application of Safety Standards
7.2.2.3. Certifications of Supervision (using ISO, EPA or OSHA)
8. Annexes
8.1. Statements
8.2. Calculations
8.3. Test results
8.4. Maps
8.5. Curriculum Vitae of writers. They should be environmental engineers, or have a degree in Ecology, or Chemistry or a track record of 5 years experience in writing EIA reports.
8.6. …

List of EIA required projects

Abattoirs and butcher's shops
Asphalt factories and mix installations
Bakeries
Bath and swim establishments
Beer breweries
Bottling companies
Bowling or skittle alleys
Brickworks and tile works
Chemical factories
Chemical laundries
Cinemas
Coffee-roasting houses
Concrete factories
Concrete ware factories
Construction workplaces
Cooperages
Copper and tin workshops
Dairy factories
Depots for light fuels and materials
Depots for unslaked lime
Detergence factories
Distilling plants
Dyeing rooms
Earthenware factories
Electric power plants or electric substations
Establishments for depot or processing scrap or waste
Establishments to galvanize or coat with nickel or chrome
Establishments to vulcanize or retread or recap
Establishments with steam power equipment
Establishments, which uses gasoline engines, gas engines, diesel engines or dy
Firework and ammunition factories and depots
Food processing factories
Garages for transport companies (trucks and busses)
Gas factories
Gasoline stations
Gild establishments
Golf courses or links
Hotels and resorts
Ice plants
Laundries and press houses
Lime-kilns
Liqueur distilleries
Marinas
Mechanical workshops
Mining companies
Oxygen factories
Paint factories
Paint spray establishments
Printers
Pump installations
Refrigerating plants
Rifles
Riveting establishments
Sewage treatment plants
Shipbuilding yards
Smithies
Smokehouses and salteries
Solid waste management facilities
Stone crush establishments
Tannery and depot for animal skin
Tinning factories
Vehicle repair establishments, vehicle grease establishments, vehicle dismantle and carwashes
Water distillation plants
Welding shops
Woodcraft workplaces

Statement

95+% of Aruban seafood consumed on the island is imported from abroad.
86% of Aruban economy is dependent on tourism.
Aruba's food security profile needs to be strengthened and its economy will benefit from industrial diversification.

Aruba Economic & Market Overview

According to World Travel and Tourism Council about 87% of the Aruban GDP is earned through tourism and related activities. Other important activities in Aruba include Trade and Financial Intermediation. Aside from a few interruptions such as the global financial crisis of 2009-2010 and the temporary and ultimately permanent shutdowns of the oil refinery in 2011 and 2012 respectively, Aruba has enjoyed stable growth of its economy, driven by a strong tourism sector.

Any global economy that relies almost entirely on a single economic driver is vulnerable, as any shock to that industry would be detrimental to the whole economy. The years 2020 and 2021 proved to be the most challenging years in recent history as the Coronavirus pandemic hit the world economy and healthcare systems with unprecedented force. The tourism industry was the hardest hit and came to a complete standstill in the second quarter of 2020, due to the lockdown measures taken by the government to stop the spread of the virus and save lives. The years following the lockdown measures were marked by the need for significant Dutch financial assistance and the accrual of additional national debt to manage the Coronavirus disruption to tourism. Despite the difficult multi-year impact that Covid-19 had on the local economy, tourism was able to recover to pre-pandemic levels by the end of 2023. And although tourism and economic numbers are presently at record levels, the Aruban government must also be mindful of the reality that a future global disruption could affect its economy again without notice.

In the below charts, you will see the significant dip, then recovery made by the Aruban economy as a result of tourism halting and beginning again.

TABLE: ARUBA'S KEY STATISTICS

Aruba needs to diversify its economy now more than ever as the one-sided reliance on tourism has been demonstrated to increase the overall vulnerability of the island. The Government of Aruba has identified six promising sectors that provide opportunity for economic diversification. Food production is one of them under the agriculture category.

PICTURE: PROMISING SECTORS ARUBA

This is also consistent with the Sustainable Development Goals (SDGs) as agreed on a global level where the Project would contribute to SDG 3, 8, 9, 11, 12 and 14 of the 17 goals.

PICTURE: SUSTAINABLE DEVELOPMENT GOALS

Overall, the current fishery activities locally are very limited and cater somewhat to the local population while the majority of fish is imported from abroad. In total 1,392 MT of fish is imported per year. For comparison purposes, the initial production of the Project will be 500 MT to increase by later years with environmental oversight. Export of fishery in Aruba is non-existent and this Project will initiate a new industry in Aruba all together in the form of Aquaculture.

TABLE: IMPORTED FISH TO ARUBA

	Value in afls.					
Code	2015	2016	2017	2018	2019	jan-june 2020
0301 Live fish	361,710	189,698	341,627	15,575	38,246	
0302 Fish, fresh or chilled (excl. those of 0304)	4,435,336	4,402,803	5,562,524	3,450,517	2,532,434	1,022,853
0303 Fish, frozen, (excl. those of 0304)	5,861,364	5,609,004	3,941,169	3,516,884	2,123,857	1,854,544
0304 Fish fillets and other fish meat, fresh, chilled or frozen	7,342,782	7,629,546	11,062,620	12,583,227	14,378,681	4,195,314
Grand Total	**18,001,192**	**17,831,051**	**20,907,940**	**19,566,203**	**19,073,218**	**7,072,711**

	Netto weight in kilo					
Code	2015	2016	2017	2018	2019	jan-june 2020
0301 Live fish	54,259	11,773	42,299	950	1,048	
0302 Fish, fresh or chilled (excl. those of 0304)	366,169	331,816	432,443	242,002	173,032	88,991
0303 Fish, frozen, (excl. those of 0304)	551,410	528,021	272,498	253,928	149,953	115,368
0304 Fish fillets and other fish meat, fresh, chilled or frozen	507,351	548,985	793,502	964,991	1,068,351	363,242
Grand Total	**1,479,189**	**1,420,595**	**1,540,743**	**1,461,872**	**1,392,384**	**567,601**

Once the project achieves its goal of 500 MT of production, Petros will be exporting a majority of its Red Snapper and contributing significantly to the overall trade imbalance of Aruba.

The World Bank estimates that Aruba imports goods valued at $1.47 B and export goods valued at $105 M. At 500 MT of production, Petros has the potential to increase the value of Aruban exports by 7+% or more.

Summary

Aruba, being a SIDS island, is challenged with local food production. Especially on a densely populated island like Aruba. Most consumables are imported and very little Aruban produced products are exported. Secondly the vast majority of Aruba's economy is dependent on Tourism. This project will continue to diversify Aruba's economy while improving its product offerings to the tourism industry.

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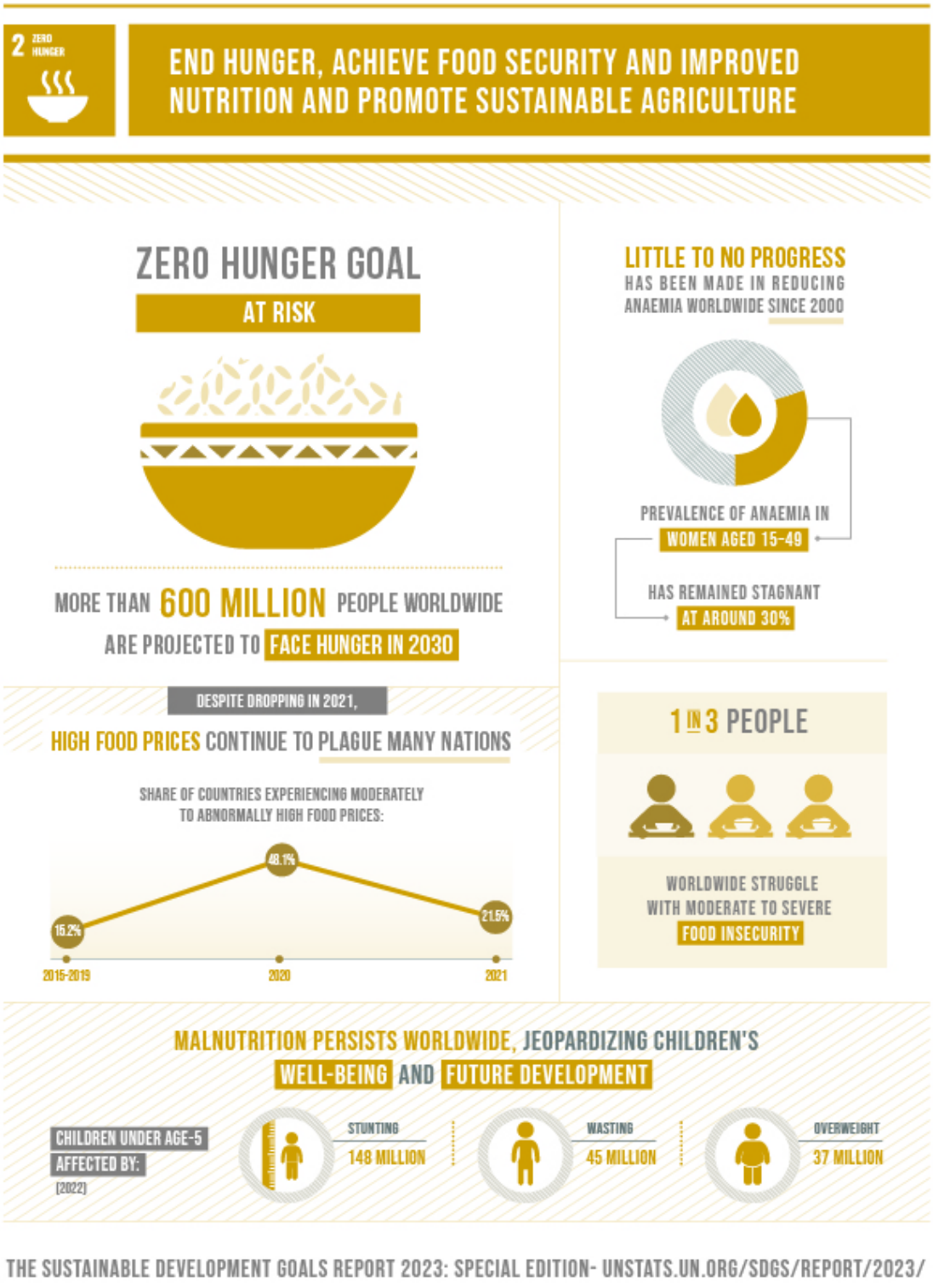
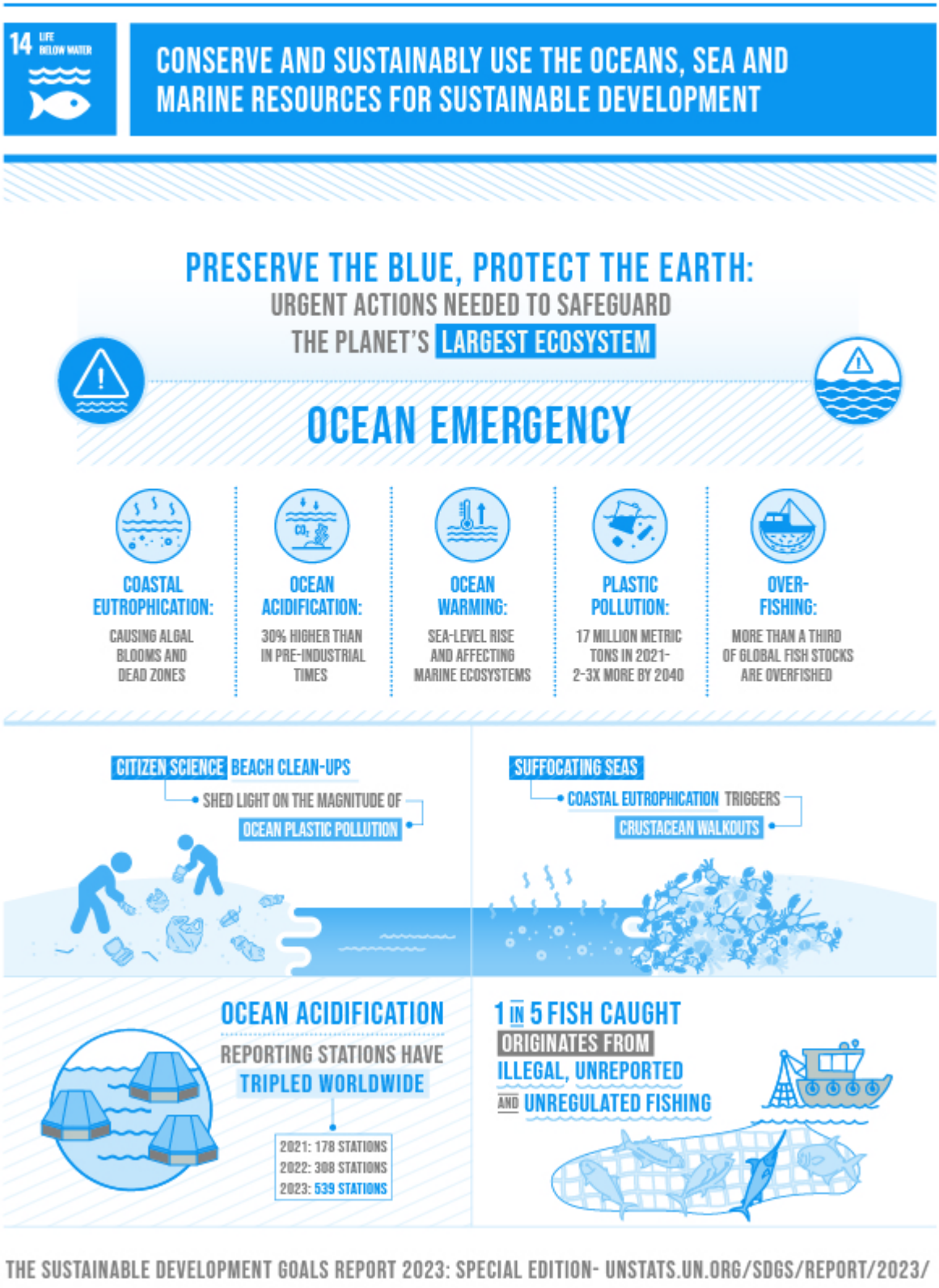
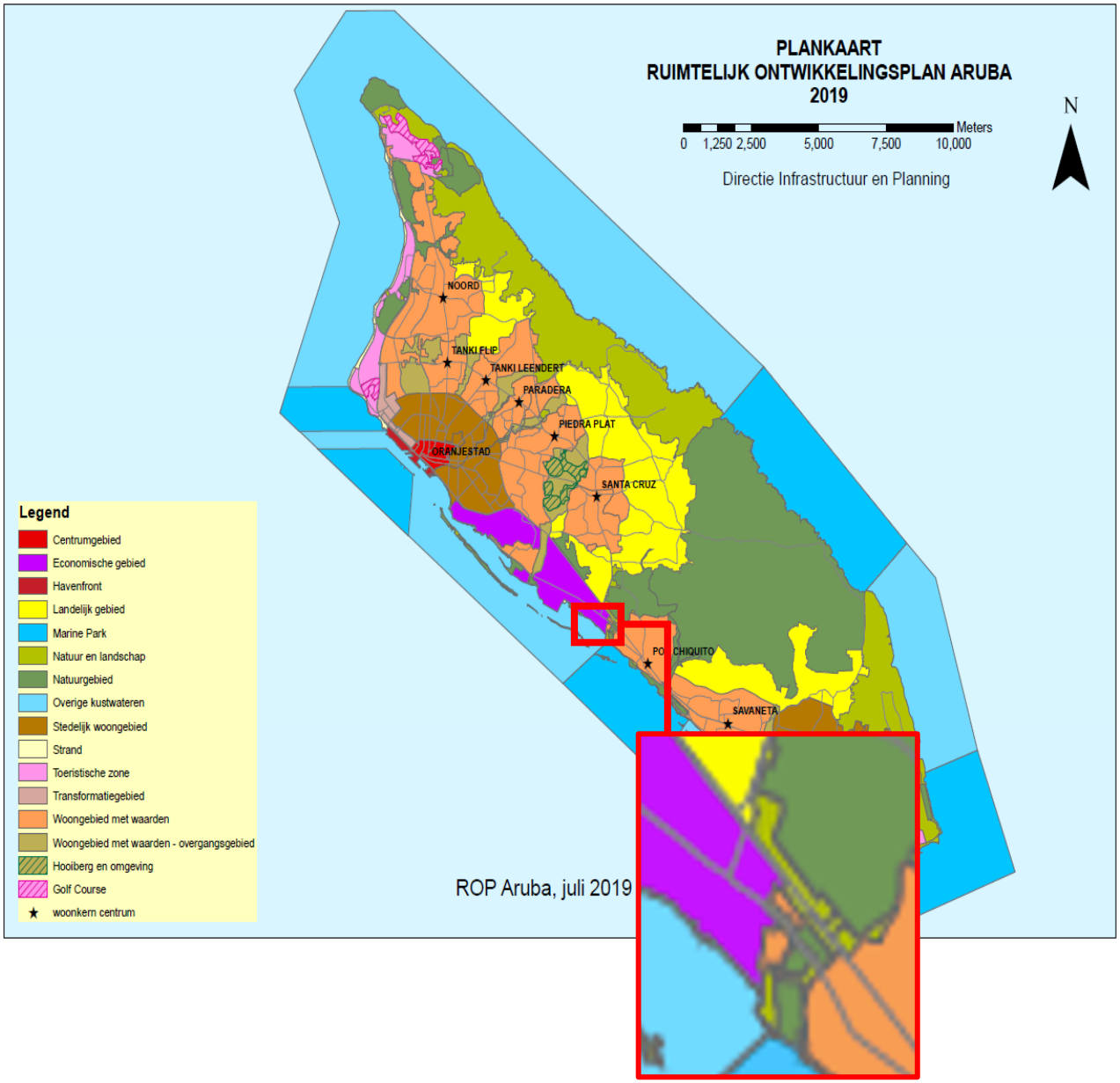
- https://www.deaci.aw/wp-content/uploads/2024/01/FINAL-ECONOMIC-OUTLOOK-11.01.2024-1.pdf
- https://wits.worldbank.org/CountrySnapshot/en/ABW/textview

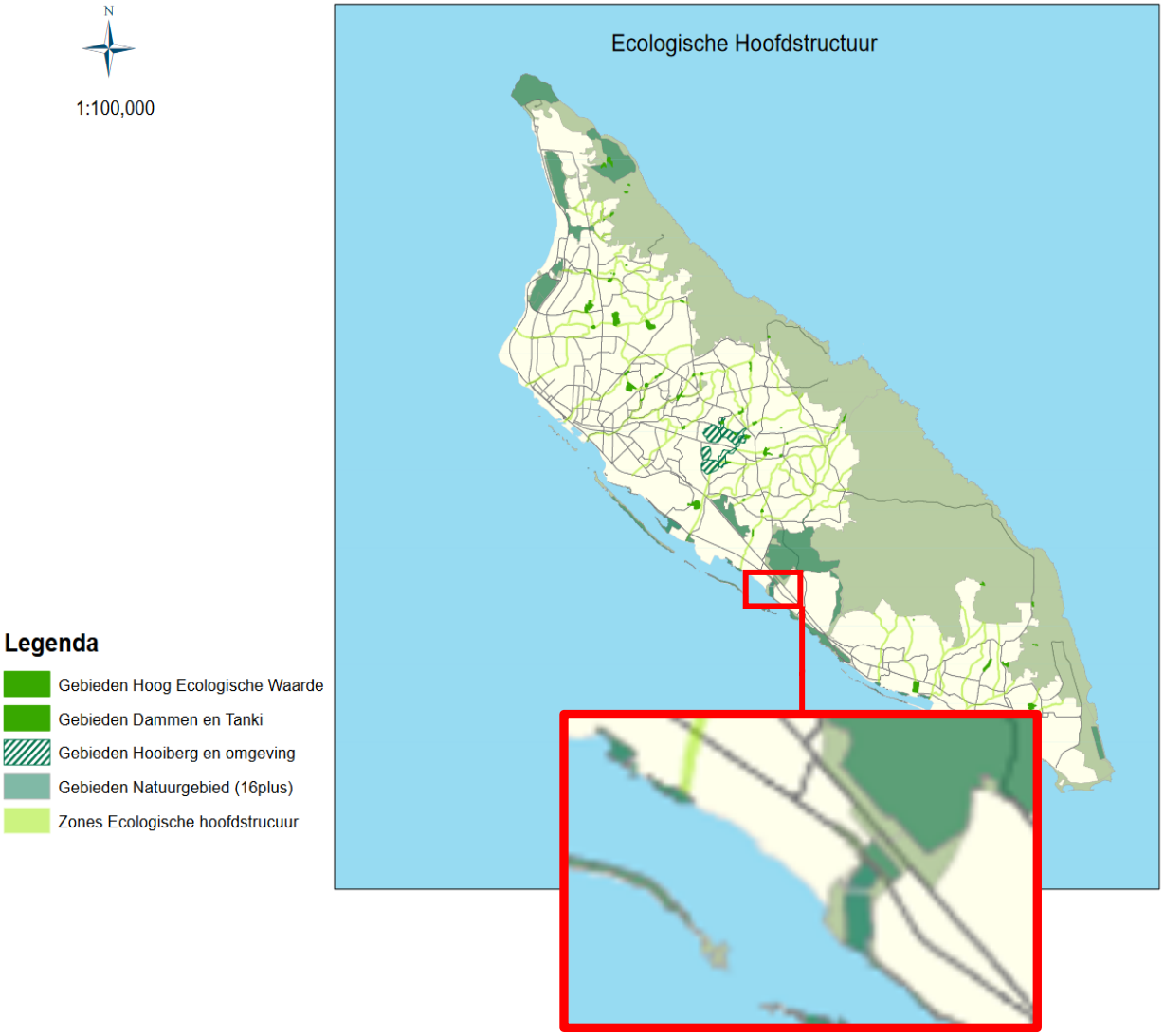
Appendix 3: SDG, Goal number 2 and Goal number 14





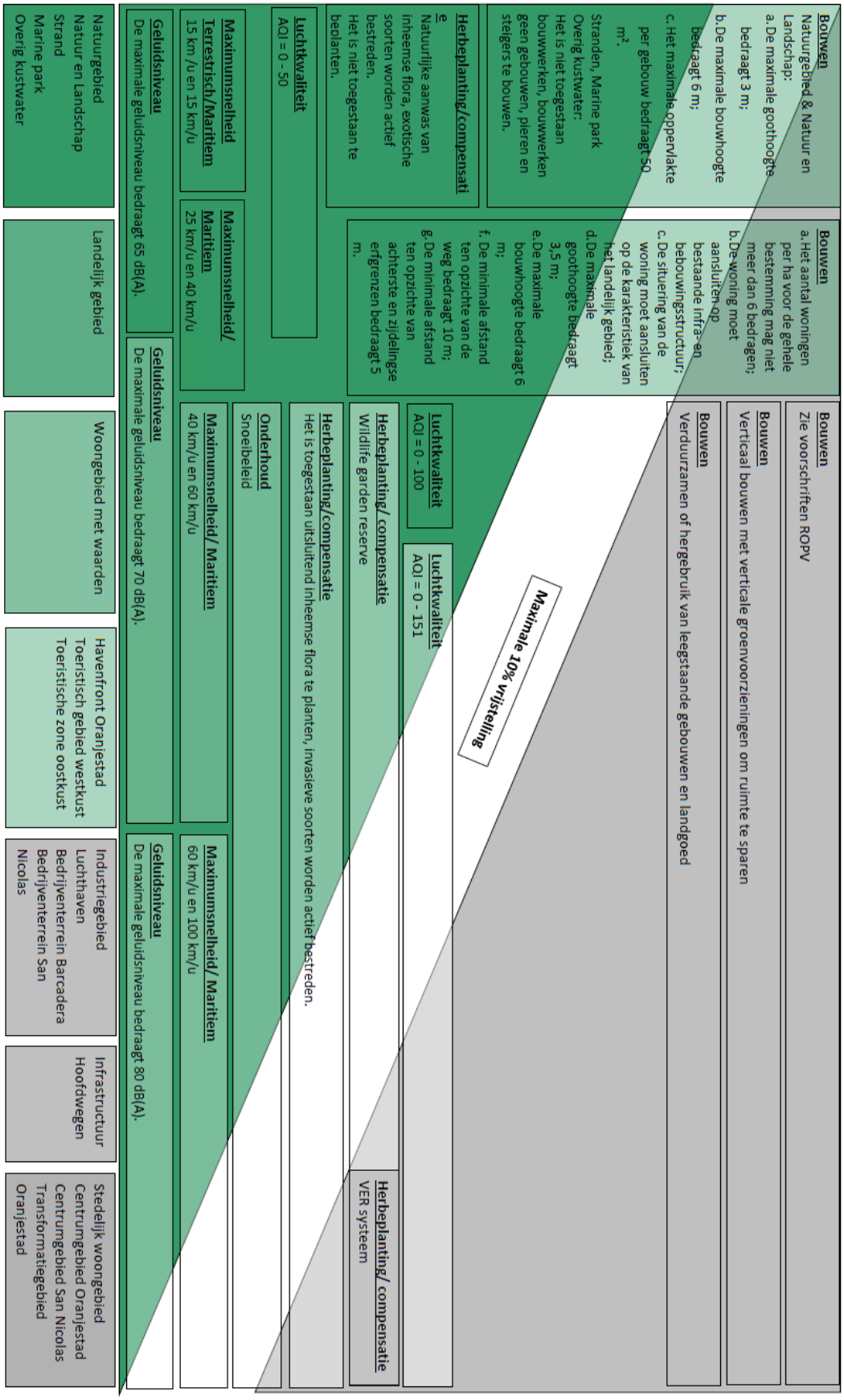


Map: Spatial Development Plan Aruba (ROP 2019) with zoomed in map of project site. ***Source:*** (Ministerie van Ruimtelijke Ontwikkeling, Infrastructuur en Milieu, 2019)



Map: Ecological Corridor Aruba according to ROPV 2021 with zoomed in map of project site. *Source:* (DIP, 2019)

Appendix 5: BwN concept for urbanization, DNM



Appendix 6: List of required small and heavy equipment for use in Construction.

Table: Construction equipment

Small and Heavy equipment
Telescopic Forklift, or a similar equipment
Skid-steer loader
Backhoe
Dump Truck (6m3)
Lorry 2.5 Tons
Pickup truck
Fog Tamping – plate compactor equipment
Concrete mixers
Concrete Vibrator
Welder equipment: electrical welding and oxyacetylene welding
Cutter bar
Tower crane
Construction elevator
Pulley system
Generators

Overview

The following schematics are high level representations of the different product transportation phases and methods.

Stocking Phase

NURSERY
Fingerlings


Photo Credit: Santomar

SEA TRANSPORT
Harvest Vessel (LCM-


Photo Credit: Blue Ocean Mariculture

STOCKING
Open Ocean Pen


Photo Credit: Innovasea

Harvest & Processing Phase

OPEN OCEAN HARVEST

SEA TRANSPORT
Harvest Vessel (LCM-8)


Photo Credit: Blue Ocean Mariculture

PROCESSING
On Land


Photo Credit: Nova Scotia Works

Shipping Phase

POST - PROCESSING
Prep for Packaging

REFRIGERATED TRUCKS
To local wholesalers

REFRIGERATED TRUCKS
To AUA Airport

FLY FRESH
To regional customers

FLY FRESH
To US & NL customers

Phase – Daily Operations

Barcadera

SUPPORT VESSEL – 9M HDPE CABIN
Mort retrieval, surface maintenance,


Photo Credit: AKVA Group

DIVE VESSEL – 9M HDPE CC
Diver support, grid maintenance, versatility


Photo Credit: AKVA Group

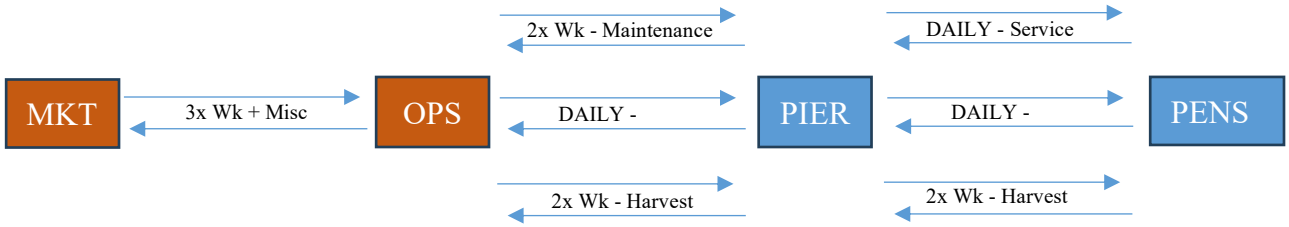
FEED VESSEL – 22M Alum LCM-8
Silo/Hopper setup for daily feeding


Photo Credit: Blue Ocean Mariculture

Open Ocean

Vessel Type	Length /Size	Engines	Construction material	Total Fuel usage while moving	Hrs moving vs idle
Feed & Harvest Vessel	22 m	Twin Diesel	Aluminum	80L/hr	3 hrs vs 5 hrs
Center Console	10 m	Twin Outboard	HDPE	25L/hr	2 hrs vs 5 hrs
Pilot House	10 m	Twin Outboard	HDPE	25L/hr	2 hrs vs 5 hrs
Service Van	Light	EV	Multiple	See Table Below	-
Electric Forklift	Med	EV	Multiple	See Table Below	-

A weekly overview of land & sea traffic.



# Serv Vans	Engine Type	Km/Yr	CO2 MT/Yr
1	EV	10000	-

# Fork Lift	Engine Type	Km/Yr	CO2 MT/Yr
1	EV	-	-

Vessel	Engine Type	L/Hr	CO2 MT/Yr
1	Twin IC Outboard	25	29
1	Twin IC Outboard	25	29
1	Twin Diesels	80	159

Total projected MT of CO_2 from fossil fuels will average 220 MT CO_2 per year. This total includes both transportation activities on land and at sea.
All transportation machinery will meet and improve on existing sound pollution regulations. Transportation vehicle on land will be an EV truck and will pass all Aruban motor vehicle certification and duties. The EV truck will be charged with solar panels and the local electric grid. The electric forklift will be powered by electric batteries, which will be respectively charged by solar renewable energy. The forklift will remain on Petros operations site. The forklift will produce a minimal amount of noise (70 dB). The smaller marine vessels will be powered by efficient and quiet 4-stroke marine outboard engines. The targeted brand for the engines is Suzuki, as Suzuki has an innovative micro plastics strainer/collector built into the engine's cooling system. This will help us clean the Aruban seas of microplastics, every time it leaves the pier. These 4-stroke outboards are very fuel-efficient engines. The larger vessel is powered by twin inboard diesels. Within Petros fleet, this LCM-8 is the one with the largest carbon footprint, also the one moving the most amount of product per round trip. Petros will repower these repurposed vessels with higher environmental standard diesel engines.

Green Propulsion
Environmentally green options will be considered, such as self-stabilizing traction wings out of France. The goal is to implement these to the 10 m service vessels on their downwind leg. Extensive trials will be conducted once the vessels are present on the island. These will significantly reduce the carbon footprint of these vessels.
Another outboard engine option is to replace the IC outboard engines with fully electric marine engines. They would be powered by renewable solar energy stored in stationary batteries on land. The market is growing for this type of marine propulsion option. The commercial marine industry does have to prove its reliability and service life before these solutions can be implemented in our fleet.

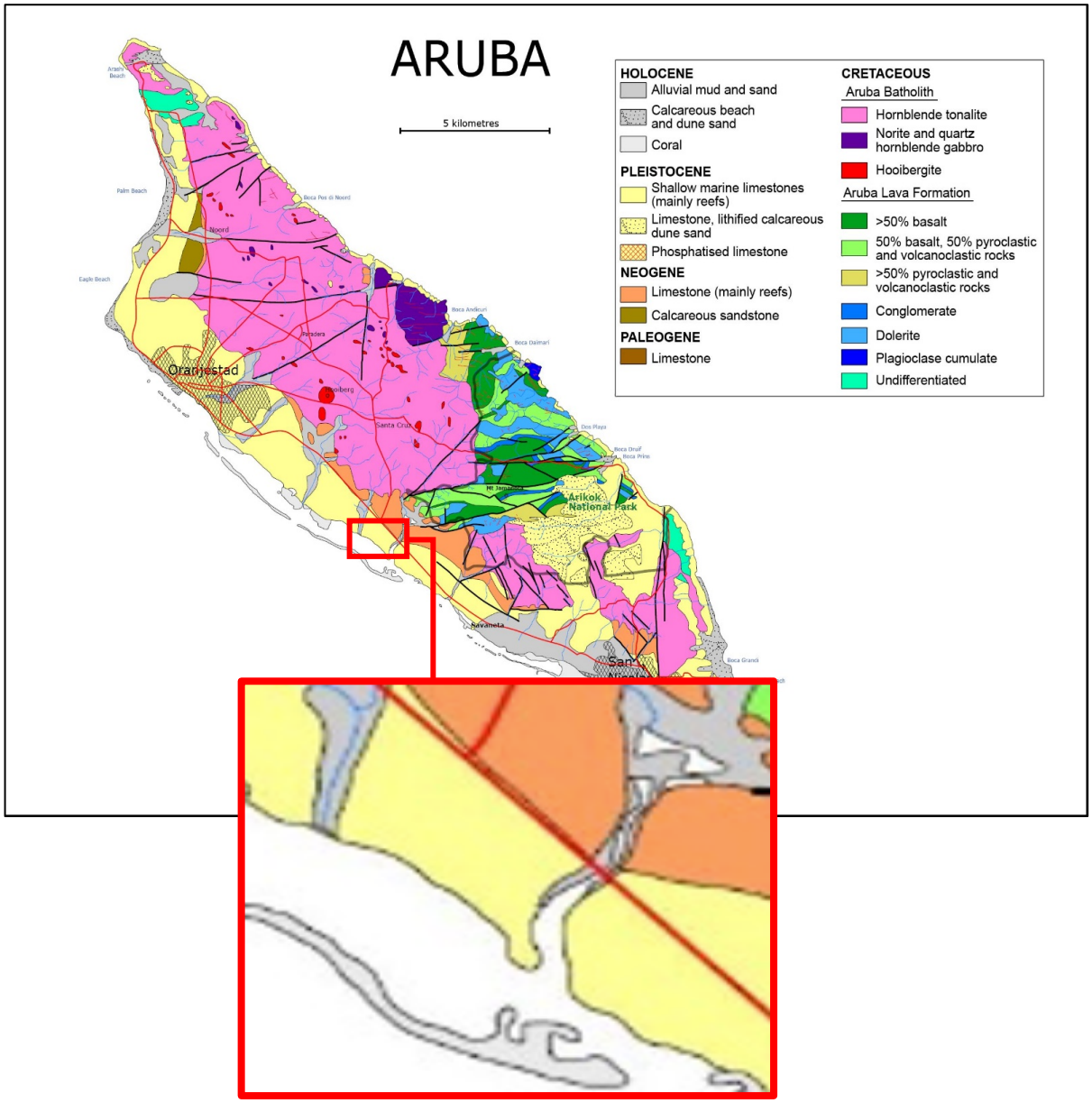
Export Advantage
Aruba benefits from excellent air connections between the US and the Netherlands, with multiple daily connections to these destinations. Flights from the Netherlands (KLM & TUI) and multiple US airline carriers, transport perishables on a regular schedule to Aruba. The goal is to make use of these existing flights to deliver the fresh product to the food service industries in the US and the Netherlands. This will complete the cycle and add value to the empty cargo space left by the Aruba inbound product.

Summary
Land and marine fleet managed by Petros, will target 220 MT of CO_2 per year. Two green propulsion options have promise for near future implementation. These are 100% electric outboard engines and the implementation of self-stabilizing traction wings. The noise levels will meet or improve on all local and international standards.

Reference List

- https://www.kite-boat.com/en/
- https://libertykite.com/en/
- https://visionmarinetechnologies.com/e-motion-180e/
- https://www.photonmarine.com/p300
- https://www.mercurymarine.com/us/en/engines/electric/avator/avator-75-110e

Appendix 8: Geology of Aruba, (Rijks Geologische Dienst, 1996)

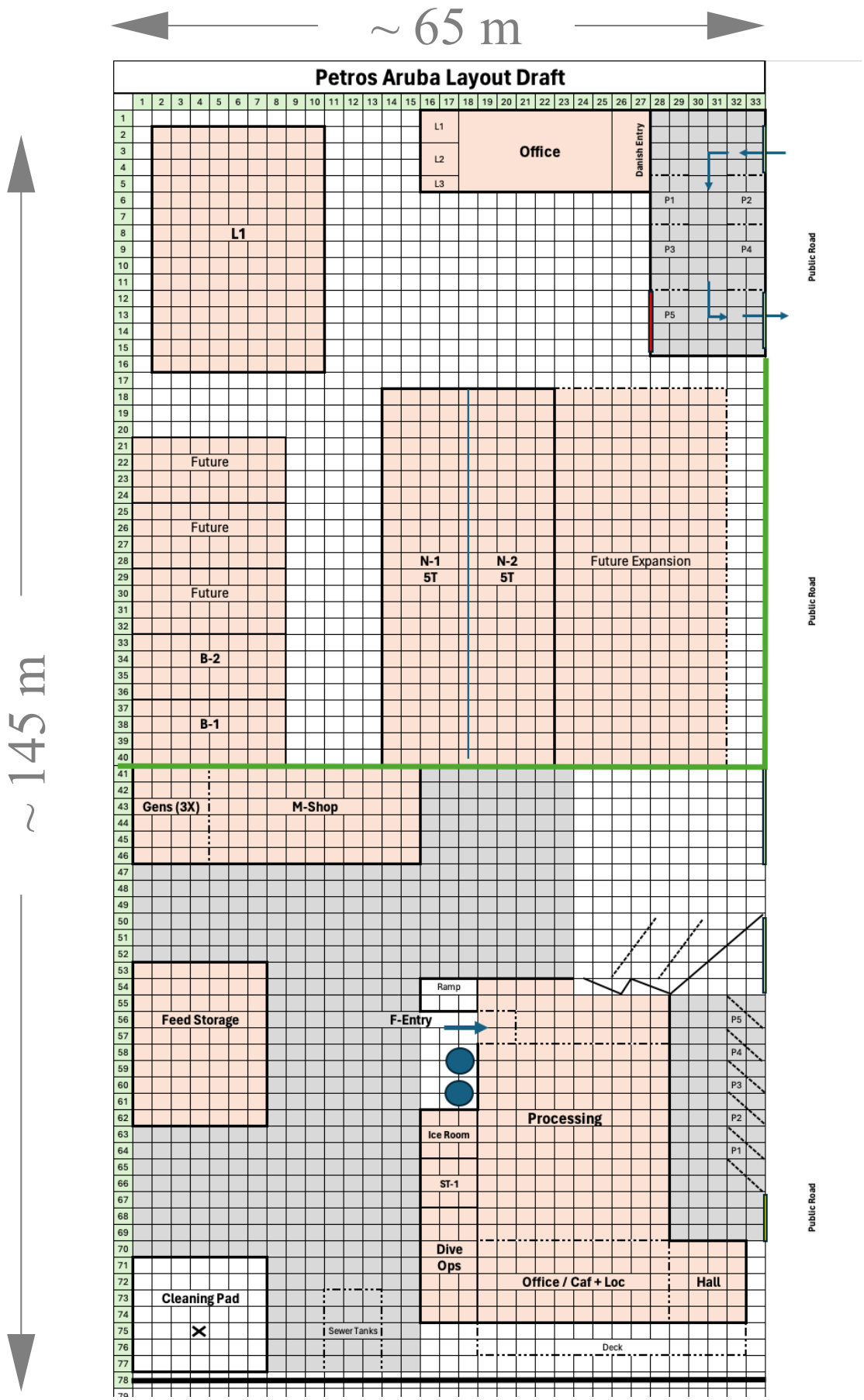


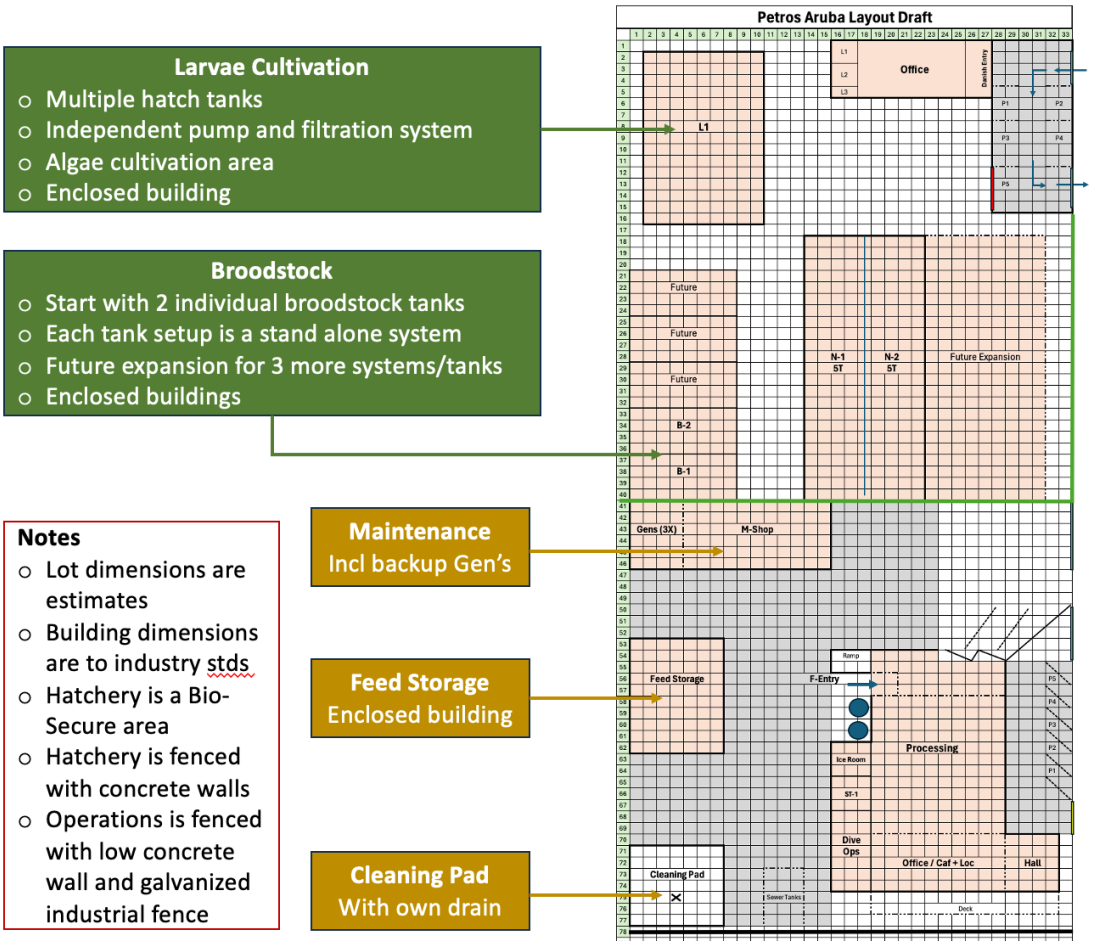
Map: Geology of Aruba with a zoomed in map of the project site. *Source:* (Rijks Geologische Dienst, 1996)

Both the hatchery and processing/operations sites will be co-located on the new targeted Barcadera site West of WEB. It is a very optimized-sized piece of land, requiring efficient and modern design that incorporates the latest sustainability architectural practices while adhering to local building codes.
The hatchery will be physically fenced in from the processing/operations areas and from the outside world. The hatchery is a bio-secure area with highly controlled access. Stringent bio-security protocols will be implemented and digitally controlled with security cameras and badge-controlled access. The processing/operations site will be fenced from the outside world and badge controlled. A full set of security cameras will be installed on both sites.

The approximate centroid of this site is 12° 28' 39.8640", -069° 59' 03.2244" (12.477740, -69.984229).

The side of the property closest to the sea will be constructed with an in-ground trench system to capture, during rainfall, any loose material inadvertently left on the property during operations. This is to avoid contaminating the Barcadera lagoon. As an added precaution, Petros will plant native shrubs in these areas to minimize any erosion potential during rain and water runoff. The sides of the property will be enclosed with concrete walls in order to avoid operation materials transferring onto the dirt road or neighboring tenants.



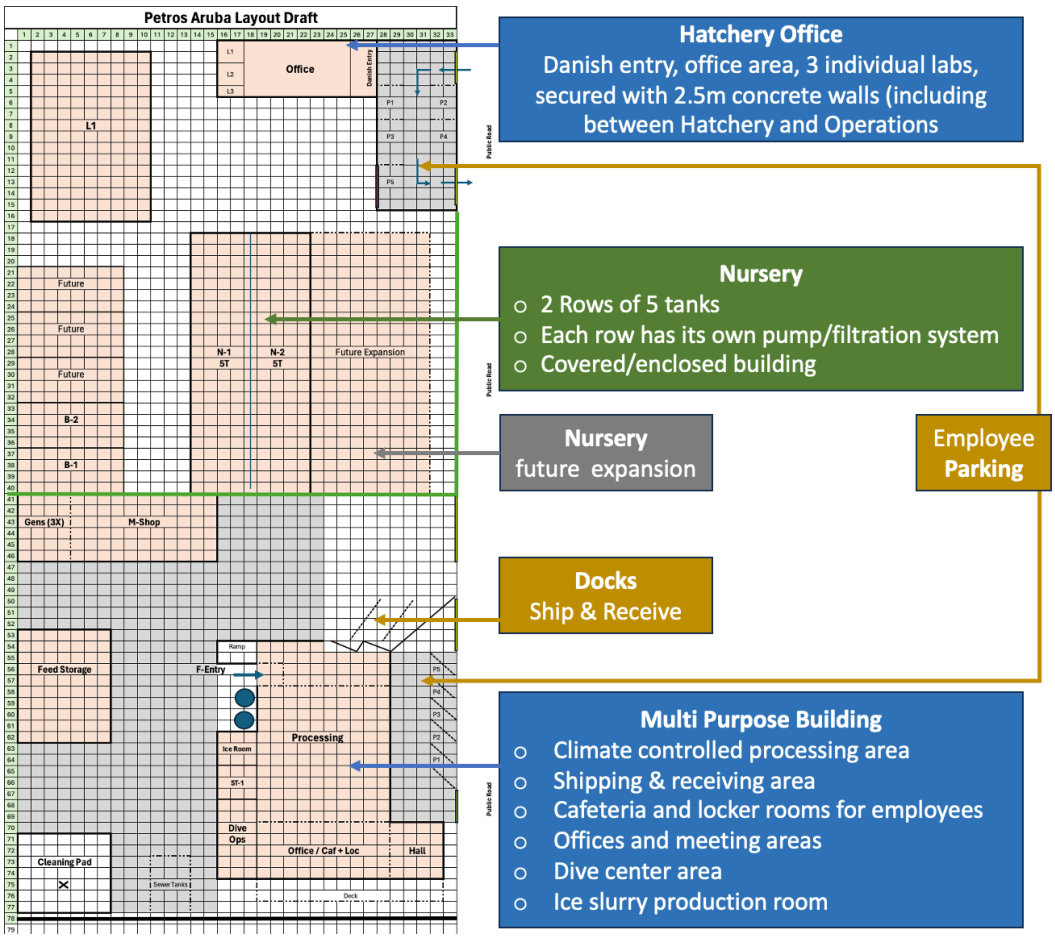


Larvae Cultivation Building is where the roe (eggs) will be hatched. The larvae will be cultivated till they are ready to be transferred to the nursery tanks. This structure will have an area to cultivate algae for the purpose of larvae feeding.

Broodstock Building will house the F1 female and male, who will lay the required roe (eggs) for ultimate grow out offshore. The broodstock will originate 100% from the local waters around Aruba, and will never be crossbred with Red Snapper that are not native to Aruba.

Maintenance Shop is a covered area where the maintenance technicians will have a workshop and secure areas for tools. Backup diesel generators will be housed next to this area.

Feed Storage Building is an enclosed building with concrete floors, designed to store fish feed in a dry and clean area. The building will be secured with doors in order to eliminate critter intrusion and protect this valuable feed.



Hatchery Office will be designed with an industry standard Danish entry. It will consist of office space, small laboratories to conduct hatchery work, a break area for the hatchery employees, and sanitary facilities.

Nursery Building will house pumps, filters, and large tanks to grow healthy fingerlings and juveniles. It will be a covered building with adequate air flow.

Parking will be available for hatchery, processing, and other operational employees. The hatchery parking will be access controlled and secured.

Multi-Purpose Building is where numerous activities happen during a traditional workday. The offices will be located on the 2nd floor with all required amenities like meeting rooms, sanitary, desk areas. An elevator will be considered to facilitate possible team members with disabilities. Located under the offices will be locker rooms, cafeteria/break area, and sanitary facilities, including showers for the employees. At the other end is where the shipping and receiving docks will be located. The center of this building is where the processing area will be housed. It will be a climate-controlled area, with the latest food processing standards meeting local (DVG) and international standards. The ice making mechanical room and dive center will also be part of this building.

Summary

The target land site has been made available by DIP. Petros must design and operate within these spatial constraints. While this parcel is smaller than typical sites for operations with similar production targets, Petros and its team of local and international experts have optimized the space usage by combining functions into multi-use areas.

Unlike other operations that typically locate their hatchery, operations center, and processing facility on separate properties, Petros has integrated all these functions onto a single property. This innovative approach to spatial efficiency may well become the industry standard in the future. It demonstrates how a small island can achieve great things by maximizing its limited resources.

North end of the main road – Project site is on the right side of this view

SouthWest corner of the Barcadera sites, looking towards the West. WEB in the background (Smoke stacks).

Construction aggregate from AWM.

Water's edge – Bacadera lagoon.

Water's edge – Bacadera lagoon. Construction aggregate from AWM.

South end of the main road, facing North. Project site is located on the left of the road.

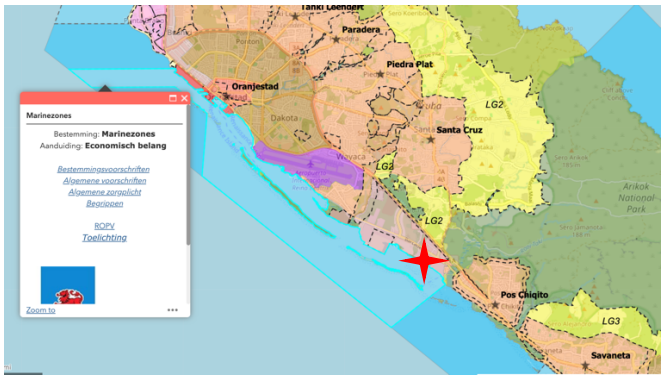
Area covered with 'Calichi' Stone

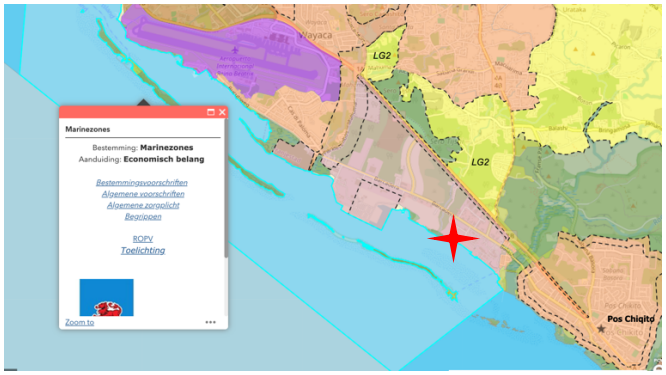
Site access to ocean

Sand Hills of Arubaanse Wegen-bouw

Littering on Site

The Barcadera site is located within an area designated as Industrial by the Aruban ROP (Ruimtelijk Ontwikkelingsplan). The lagoon adjacent to the targeted Barcadera site is designated as a marine area with economic importance. The Ports of Aruba is part of this same area specified in the ROP, as is WEB.





The current ROP is up for a refresh in 2025/26 and allowances to consider a pier in this area of the Ports, will be considered and reviewed with all stakeholders working with DIP.

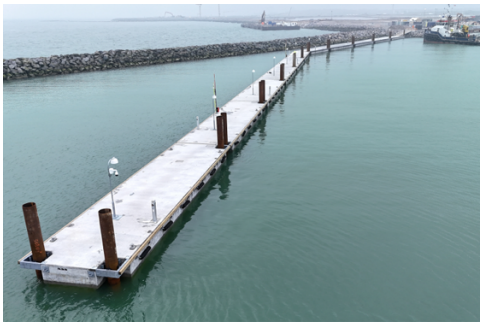
Pier System Proposal

Petros is considering two construction options for an industrial pier. The primary option is an industrial floating concrete pier, and the second option is an industrial fixed pilings concrete deck pier.

The floating concrete pier option consists of two sections of 20 m by 8 m. The sections will be plumbed with water lines, compressed air lines, and navigational aid lights for night hours. The pier will be anchored by 5 helix anchors on the leeward side of the pier (downwind side). Helix anchors are installed by screwing them into the seabed, with metal pilings extending above the water. The helical plates, screwed into the seabed, create a strong and reliable grip, offering superior holding power compared to traditional mooring methods like concrete blocks or deadweight anchors. Helix anchors minimize seabed disturbance, making them a preferred choice for environmentally sensitive areas. The minimal disturbance is because this system does not require metal chains that drag on the seabed. Its impacted area is

where the helix will be embedded into the seabed. This floating pier approach also minimizes any potential alteration of the natural current flow in the Barcadera lagoon, as it will remain open for the current to flow below the floating pier. Both the helix pilings/anchors and the floating pier are removable, if the long-term plans change, thus returning this lagoon area to its original baseline state.

Source: SF Marina



These pictures represent industrial applications. The lower picture is the best representation of Petros' intended 40 m long pier with Helix pilings on the leeward side. The pilings will be of lesser height, since the Caribbean experiences less variations between tidal phases. What will be considered are historical sea level surge during storms. A safety factor will be considered during design and implementation.

A pier with fixed pilings and a concrete deck (option 2), also has similar advantages of the floating pier, except it will require a higher number of helix anchors embedded into the seabed. This approach also has the concern of the shadow effect on the seabed. Petros believes detrimental effects will be minimal.

Location

The pier system will be located on the Southeast end of the targeted land site. Please refer to the picture below. Final orientation will be determined during the final design phase, in order to maximize water depth for Petros' vessels. The intent is to be the furthest away from the mangroves at the end of Rooi Bosal. This mangrove system is estimated to be at a minimum distance of 160 m from the pier system.

Environmental impacts and mitigation - Floating Pier

A pier system consisting of 40 m by 8 m floating concrete pontoons (2x), fixed in place with up to 5 helix pilings that are embedded into the seabed.

- Floating pier systems are less environmentally intrusive. They do not alter the seawater current flow inside the lagoon. Healthy seawater can pass below the pier. There is no downstream impact of the seabed due to reduced currents and lack of natural nutrients and oxygen.
- The helix pilings impact a very small seabed surface area. Furthermore, the helix system does not use heavy metal chains that drag over the seabed, affecting a much larger area.
- Floating pier systems are not considered permanent structures. They can be removed or recycled at the end of their life. Or they can be repurposed for other use if the business plans change.
- A minor impact can come from the shadow cast by the pier surface area. Petros proposes establishing a baseline for the benthic state prior to installation. If measurable impacts are noted due to Petros' operation, Petros proposes to support programs to improve other seagrass areas or mangrove improvement projects on Aruba. Close cooperation is expected with established organizations such as ACF (Aruba Conservation Foundation).

Environmental impacts and mitigation – Fixed Pilings Pier

A pier system built on fixed helix pilings embedded into the seabed, with a concrete top. The length will be 40 m long and 8 m wide.

- Fixed pilings pier systems are less environmentally intrusive when compared to a solid wharf. They do not alter the seawater current flow inside the lagoon. Healthy seawater can pass below the pier. There is no downstream impact of the seabed due to reduced currents and lack of natural nutrients and oxygen.
- The helix pilings impact a very small seabed surface area. Furthermore, the helix system does not use heavy metal chains that drag over the seabed, affecting a much larger area.
- Fixed pilings pier systems are not considered semi-permanent structures. They can be removed or recycled at the end of their life, but will require more work when compared to a floating pier as described above.
- A minor impact can come from the shadow casted by the pier surface area. Petros proposes establishing a baseline for the benthic state prior to installation. If measurable impacts are noted due to Petros' operation, Petros proposes to support and actively participate in programs to improve seagrass areas or mangrove improvement projects in Aruba. Close cooperation is expected with established organizations such as ACF (Aruba Conservation Foundation).

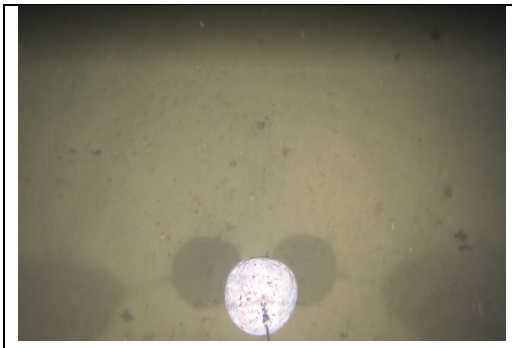
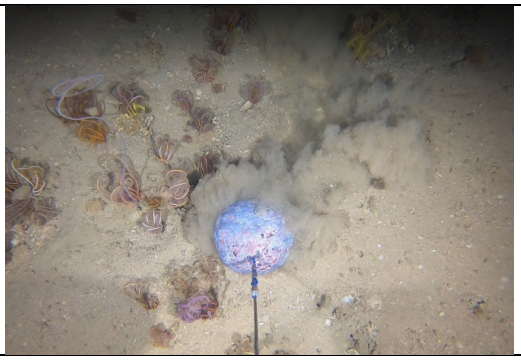
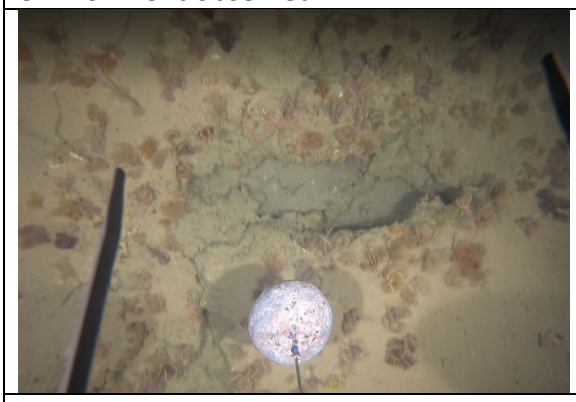
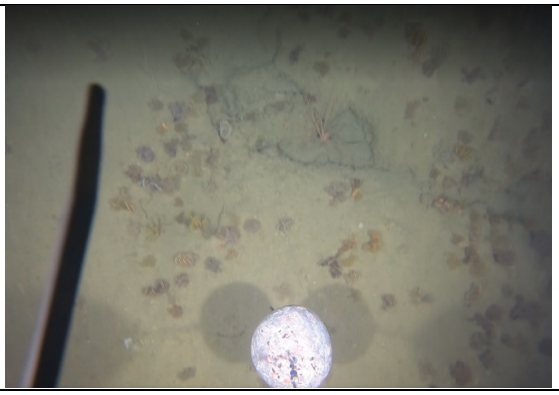
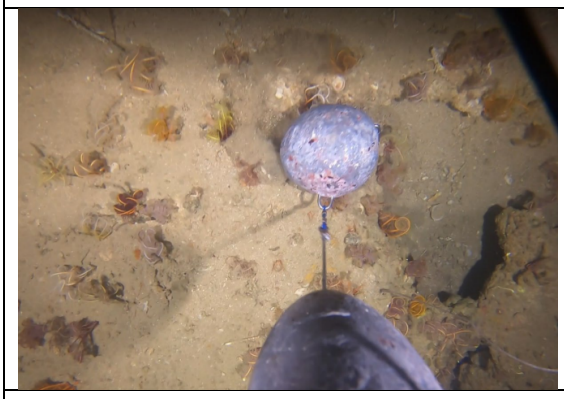
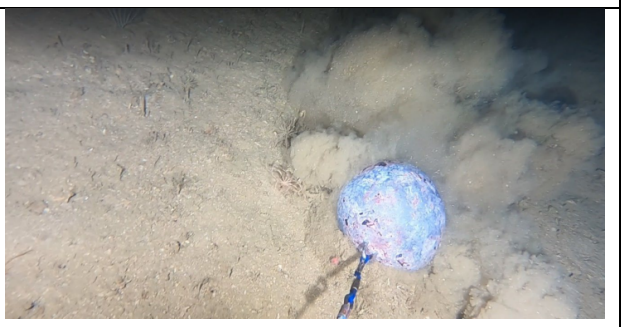
Summary

Petros is committed to minimizing environmental impact across all its operations. The floating pier system, while representing the highest capital expenditure investment, offers the least environmental impact to the Barcadera lagoon's natural ecosystem. Alternatively, the fixed pilings pier system presents a significantly lower carbon footprint during implementation, as it can be constructed on-site rather than shipped from Sweden.

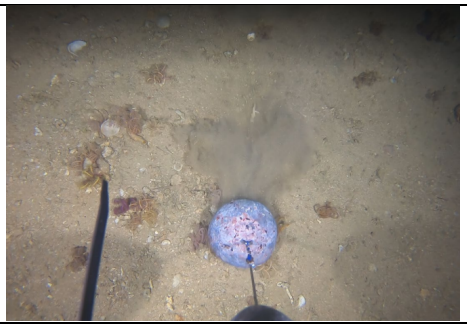
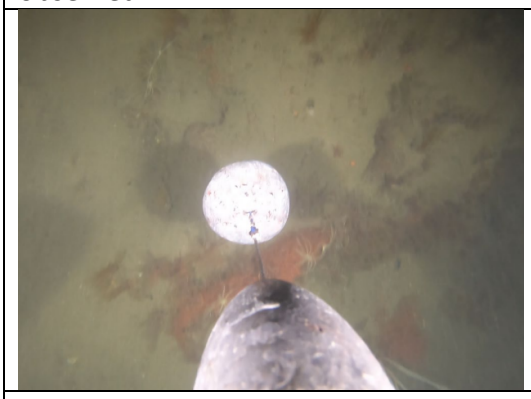
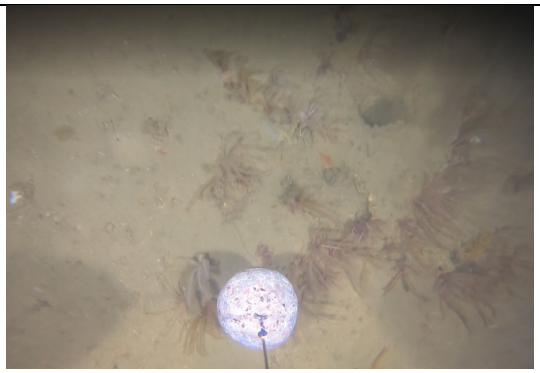
In evaluating these options, Petros will continue its collaborative efforts with key stakeholders, including DIP, DOW, DNM, ACF, and other subject matter experts. Whichever system is selected, will be fabricated to meet the highest EU and US industrial standards, ensuring quality and safety compliance.

Prior to implementation of the chosen solution, Petros will establish a comprehensive environmental baseline to monitor potential impacts. Should any effects be detected, they will work closely with DNM and other stakeholders to implement appropriate environmental improvements and mitigation measures. This proactive approach demonstrates our commitment to environmental stewardship and responsible development.

Appendix 11: Benthic images Site 1

	
Uncolonized sandy/muddy bottom which was the most common benthic environment observed	Sandy/muddy bottom with light colonization, primarily with crinoids or other small echinoderms
	
An example of a hole in the substrate where there is a break in the subsurface matric. This image also shows relatively dense colonization for the area	An example of a hole in the substrate where there is a break in the subsurface matric. This image shows moderate colonization for the area.
	
An example of a hole in the substrate where there is a break in the subsurface matric. This image shows moderate colonization for the area	Uncolonized sandy/muddy bottom which was the most common benthic environment observed

Appendix 12: Benthic images Site 2

	
Uncolonized sandy/muddy bottom which was the most common benthic environment observed	Moderate colonization with crinoids
	
An organism (observed as a red blob) which may be sponge or colonizing tunicates	Moderate colonization with crinoids
	
Relatively heavy colonization with a fish visible hiding in a hole in the substrate	A close up of the organism believed to be a sea whip

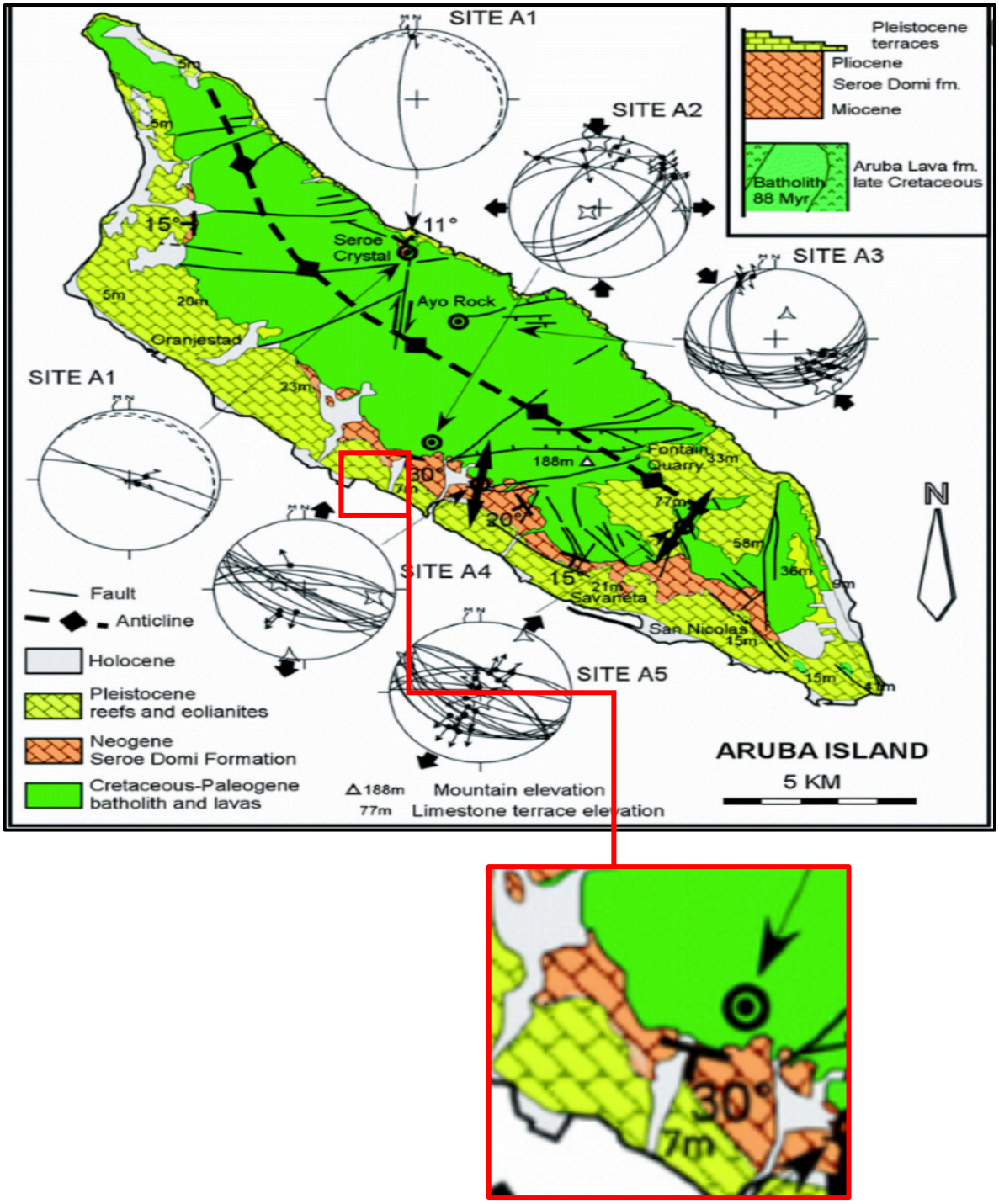
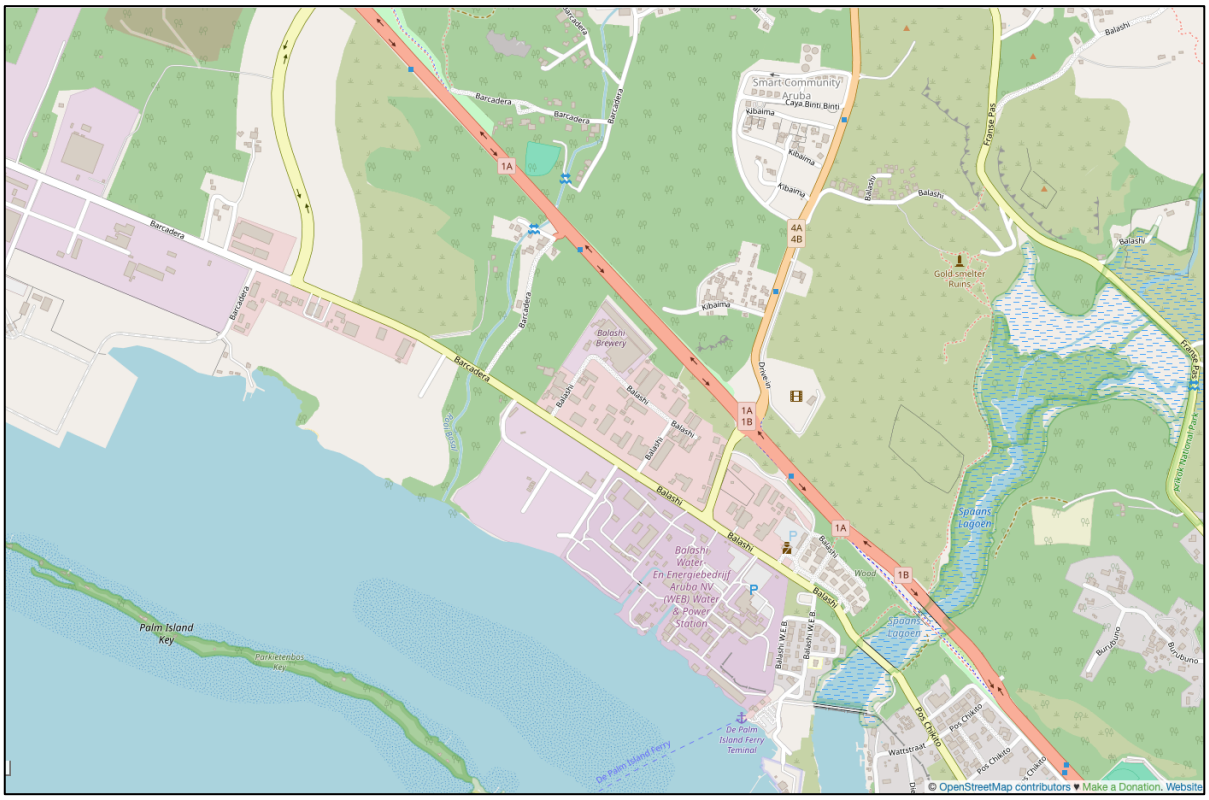


Figure: Sand movement along Balashi Area. ***Source:*** (Terwindt, Hulsbergen, & Kohsiek, 1984)

Appendix 14: Hydrology Project Site



Map: Hydrological system, Project site. *Source Data: OpenStreetMap*

Appendix 15: Water quality test (Seawater), Barcadera Aruba

Water chemistry was within normal ranges for all parameters at all sites (Table). These results are from point samples on a single day and are indicative of a healthy environment and functional ecosystem, as would be expected in these locations, but do not offer insight into seasonal fluctuations or changes from episodic events (e.g. heavy rain fall, contributions to the landfill site, uncommon environmental events).

Bacterial plates showed low bacterial activity in all samples except the coliform count for site 2 which showed 20.5 CFU/mL on the 2nd visit (Table). Open ocean environments typically have very low coliforms, so this is believed to be a contaminated sample which can happen easily in the field. The results are otherwise indicative of clean and healthy ecosystems and bacterial activity is not expected to be problematic at any location.

Table - Physio-chemical seawater quality Barcadera offshore and potential hatchery water intake sites

Site	**Site 1**	**Site 2**	**Hatchery near shore**	**Hatchery outside island**	**Near desalination plant**	**Near landfill**
Salinity (ppt)	35	35	36	36	36	35
Alkalinity (ppm)	118	122	125	129	119	129
Calcium (ppm)	443	440	447	448	369	439
Magnesium (ppm)	1478	1491	1562	1544	1574	1559
Ammonia (ppm)	0	0	0	0	0	0
Nitrite (ppm)	0	0	0	0	0	0
Nitrate (ppm)	1	2	2	2	1	2
Phosphate (ppm)	0.0	0.0	0.0	0.0	0.1	0.0
pH	8.1	8.1	8.1	8.1	8.1	8.1

Table - Bacterial activity at each site

Location	Depth (m)	Sample Size (mL)	*E. Coli* Colonies	Coliform Colonies
Site 1	85	2	0	0
Site 2	76	2	1	41
Hatchery Near Shore	2.2	2	0	3
Hatchery Outside Barrier Island	42	2	1	0
Landfill	2.3	2	4	6
Desalination Plant	5.6	2	6	2

Remarks 1: No cetaceans, pinnipeds, turtles, or other megafauna were observed during fieldwork

ETR Laboratories
Environmental Testing and Research Laboratories, Inc.
Same as Client

Report #: 715211261
Date : 7/15/2021
P.O.Number: 7-15-21 Visa

Matrix: Water
Client: Thomas Selby
Sample Location: 266 Summer Street
Boston MA 02210
Phone: (608) 698-4750

This sample taken by Thomas Selby at 5:06:00 PM on 7/8/2021. . Point of collection: Aruba/Hatch In Shore

13 Priority Pollutants Report

Analytes	Results	Description	EPA Limits
Mineral Chemistry			
Copper	Not Detected	Indicates Plumbing Corrosion	1.30 mg/L
Arsenic (Total)	Not Detected	A Naturally Occurring Toxic Element	0.010 mg/L
Lead	Not Detected	A Toxic Metal, From Plumbing Components	0.015 mg/L
Heavy Metals			
Antimony	Not Detected	A Toxic Metal if Exposed to High Amounts	0.006 mg/L
Beryllium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.004 mg/L
Cadmium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.005 mg/L
Chromium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mg/L
Mercury	Not Detected	A Toxic Metal	0.002 mg/L
Nickel	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mg/L
Selenium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.050 mg/L
Silver	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mgL
Thallium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.002 mg/L
Zinc	Not Detected	A Toxic Metal if Exposed to High Amounts	5.0 mg/L

ETR Laboratories
Environmental Testing and Research Laboratories, Inc.
Same as Client

Report #: 715211262
Date : 7/15/2021
P.O.Number: 7-15-21 Visa

Matrix: Water
Client: Thomas Selby
Sample Location: 266 Summer Street Boston MA 02210
Phone: (608) 698-4750

This sample taken by Thomas Selby at 4:26:00 PM on 7/8/2021. . Point of collection: Aruba/Hatch Off Shore

13 Priority Pollutants Report

Analytes	Results	Description	EPA Limits
Mineral Chemistry			
Copper	Not Detected	Indicates Plumbing Corrosion	1.30 mg/L
Arsenic (Total)	Not Detected	A Naturally Occurring Toxic Element	0.010 mg/L
Lead	Not Detected	A Toxic Metal, From Plumbing Components	0.015 mg/L
Heavy Metals			
Antimony	Not Detected	A Toxic Metal if Exposed to High Amounts	0.006 mg/L
Beryllium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.004 mg/L
Cadmium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.005 mg/L
Chromium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mg/L
Mercury	Not Detected	A Toxic Metal	0.002 mg/L
Nickel	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mg/L
Selenium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.050 mg/L
Silver	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mgL
Thallium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.002 mg/L
Zinc	Not Detected	A Toxic Metal if Exposed to High Amounts	5.0 mg/L

ETR Laboratories
Environmental Testing and Research Laboratories, Inc.
Same as Client

Report #: 715211263
Date : 7/15/2021
P.O.Number: 7-15-21 Visa

Matrix: Water
Client: Thomas Selby
Sample Location: 266 Summer Street Boston MA 02210
Phone: (608) 698-4750

This sample taken by Thomas Selby at 4:55:00 PM on 7/8/2021. . Point of collection: Aruba Land Fill

13 Priority Pollutants Report

Analytes	Results	Description	EPA Limits
Mineral Chemistry			
Copper	Not Detected	Indicates Plumbing Corrosion	1.30 mg/L
Arsenic (Total)	Not Detected	A Naturally Occurring Toxic Element	0.010 mg/L
Lead	Not Detected	A Toxic Metal, From Plumbing Components	0.015 mg/L
Heavy Metals			
Antimony	Not Detected	A Toxic Metal if Exposed to High Amounts	0.006 mg/L
Beryllium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.004 mg/L
Cadmium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.005 mg/L
Chromium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mg/L
Mercury	Not Detected	A Toxic Metal	0.002 mg/L
Nickel	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mg/L
Selenium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.050 mg/L
Silver	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mgL
Thallium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.002 mg/L
Zinc	Not Detected	A Toxic Metal if Exposed to High Amounts	5.0 mg/L

ETR Laboratories
Environmental Testing and Research Laboratories, Inc.
Same as Client

Report #: 715211264
Date : 7/15/2021
P.O.Number: 7-15-21 Visa

Matrix: Water
Client: Thomas Selby
Sample Location: 266 Summer Street Boston MA 02210
Phone: (608) 698-4750

This sample taken by Thomas Selby at 5:17:00 PM on 7/8/2021. . Point of collection: Aruba/Desalination

13 Priority Pollutants Report

Analytes	Results	Description	EPA Limits
Mineral Chemistry			
Copper	Not Detected	Indicates Plumbing Corrosion	1.30 mg/L
Arsenic (Total)	Not Detected	A Naturally Occurring Toxic Element	0.010 mg/L
Lead	Not Detected	A Toxic Metal, From Plumbing Components	0.015 mg/L
Heavy Metals			
Antimony	Not Detected	A Toxic Metal if Exposed to High Amounts	0.006 mg/L
Beryllium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.004 mg/L
Cadmium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.005 mg/L
Chromium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mg/L
Mercury	Not Detected	A Toxic Metal	0.002 mg/L
Nickel	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mg/L
Selenium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.050 mg/L
Silver	Not Detected	A Toxic Metal if Exposed to High Amounts	0.100 mgL
Thallium	Not Detected	A Toxic Metal if Exposed to High Amounts	0.002 mg/L
Zinc	Not Detected	A Toxic Metal if Exposed to High Amounts	5.0 mg/L

Marine Vessel Fleet

The fleet will consist of vessels made out of HDPE and Aluminum. These are the most proven materials for marine work vessels. These vessels will have one of two propulsion systems: gasoline outboard engines meeting the latest efficiency standards, and diesel inboard engines on the larger feeding/harvesting vessels.

Antifouling Paint

The HDPE vessels have the benefit of not requiring antifouling bottom paint, since this material is resistant to marine growth. This benefit also improves fuel efficiency since no extra weight from marine growth is added to the vessel. No bottom cleaning is required throughout the life of these HDPE vessels.

The aluminum vessels will require antifouling paint, but not paint containing the harmful cuprous oxide biocide. Numerous environmentally-friendly antifouling paints exist for aluminum marine vessels. These are the paints that Petros will apply to its aluminum vessels to ensure that the operation remains environmentally friendly. This approach will eliminate the use of copper-based antifouling paints. When the aluminum vessels do require new antifouling coatings as part of its established maintenance schedule, it will take place on land (vessel is hauled out of the water) and applied by local shipyard experts. No in-water marine growth removal will take place on Petros' vessels, as it will be against Petros SOP's.

Routine Maintenance

Petros' marine vessels will adhere to strict maintenance protocols. Down time due to equipment failures are costly to the farm's operation and detrimental to the fish if feeding cycles are missed. The maintenance SOP's will differ between outboard gasoline engines and inboard diesel engines.

	Vessels w/ outboard gasoline engines	Vessels w/ inboard diesel engines
On water	No activities	Oil changes, grease work, minor inboard engine repair. The engines are contained within the vessel's engine bay, which will eliminate the possibility of chemicals inadvertently making it into the lagoon
Hauled out	For oil changes, grease work, engine swaps, prop changes, hull cleaning (if not a HDPE vessel)	For major engine work, hull work, and hull cleaning.
Fueling	Fueling will take place at professional marinas possessing to the strictest operating protocols. They will be equipped with the proper pumping equipment meeting both local and international fueling standards.	Fueling will take place at professional marinas possessing the strictest operating protocols. They will be equipped with the proper pumping equipment meeting both local and international fueling standards.

Routine Deck Cleaning and Washing

Petros' strict SOP's will establish the correct method of washing the vessels while on the water. Wash down will differentiate between salt washdown and washdowns to eliminate fish biological residue and feed residue. These SOP's apply to all vessels!

	Sea salt residue	Organic residue
On water	Fresh water washdown to protect vessel and electronics. Industrial high efficiency nozzles will be used to reduce fresh water use and eliminate waste. Example: 	All biological matter from fish and feed residue will be carefully removed from the vessel prior to any traditional wash down. This will ensure that these residues do not make their way into the lagoon. The biological residue collected in totes during the harvesting process on the offshore farm will be removed from the vessel and brought on land. On land it will either be contained in the wastewater infrastructure for later transportation to one of the local RZWI facilities, or processed in the Petros' on-site wastewater treatment infrastructure (if no RZWI capacity).

Petros remains committed to protecting the marine environment throughout our operational areas, including the Barcadera lagoon, the transit route to our farm site, and the waters surrounding our offshore facility.

Summary

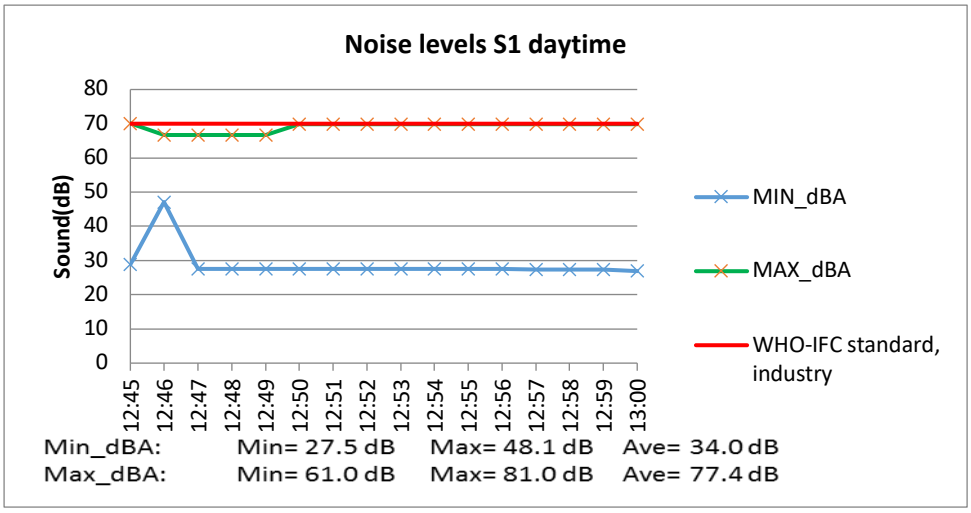
Petros will apply strict vessel maintenance protocols/SOP's to ensure environmentally sustainable activities within the Barcadera lagoon and on the open sea.

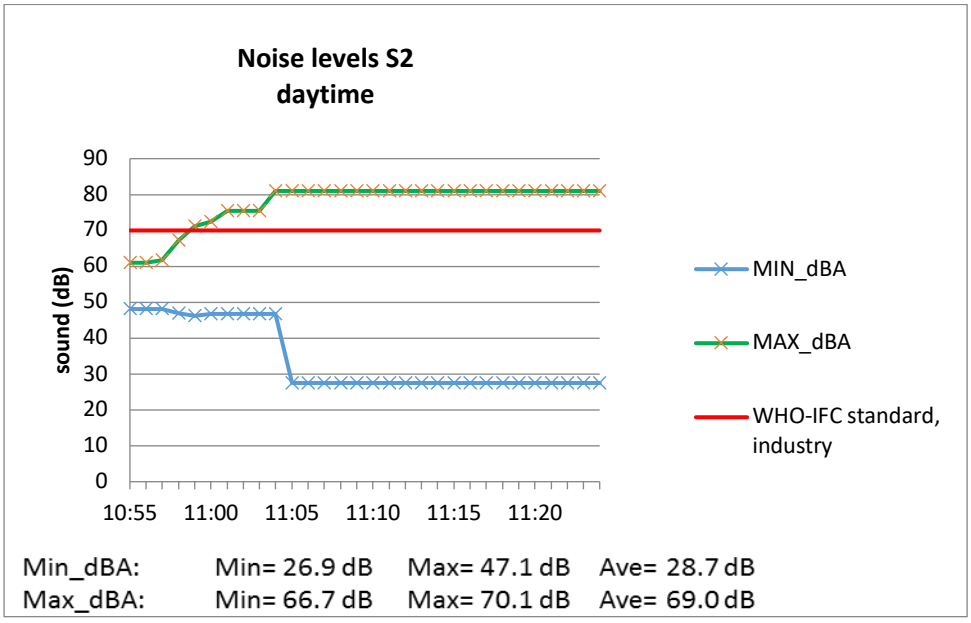
Noise levels were measured with the factory-calibrated AZ 8922 sound meter to obtain a baseline reference for noise pollution in the area. The measurements were made under acoustic conditions that are common, as judged from the expected prevailing weather conditions and expected levels of human activity. Because weather (particularly humidity and wind) affects measurements, it was attempted to survey on days with dry and low wind conditions, although this was unfortunately not possible due to prevailing strong windy conditions. Two locations were chosen for measurements: at the Project Site. Noise levels were measured during night and daytime.

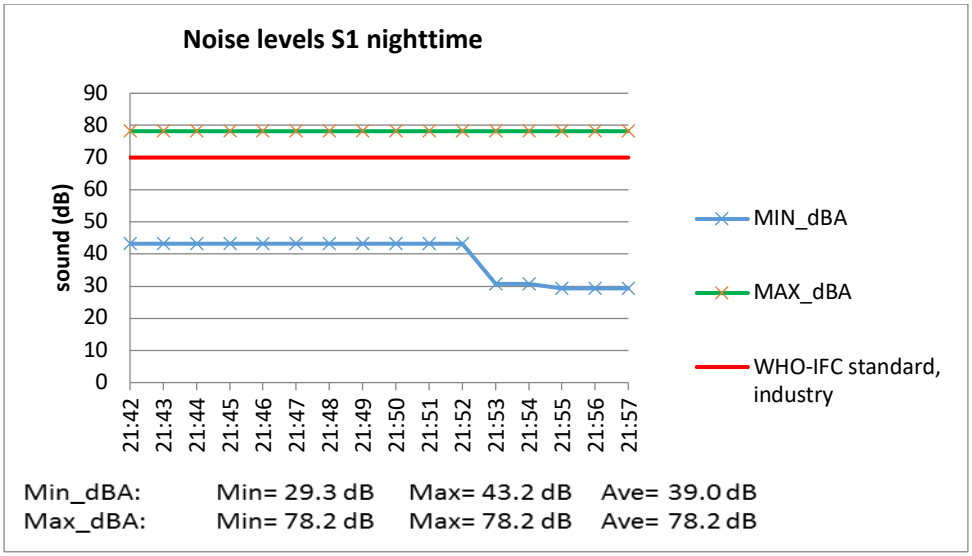
Measurements were done in A-weighted mode, with slow response time and a windscreen cover. The survey sites were located at ambient level, i.e. away from direct sources of sound and away from any vibration and obstruction (at least 10 m away from any building and at least 3.5 m from any acoustically reflective surface). The microphone was placed at about 1.5m above the ground level. The maximum and minimum sound levels were recorded for a time span of 15 minutes in dBA in 30 min at locations. Weather conditions and all observable sources of noise were reported. To compare the measured noise levels to internationals environmental noise standards for industrial noise, the IFC-Worldbank (2007) guidelines, which are partially based on WHO (1999) guidelines, were referenced. The IFC-Worldbank guidelines for industrial noise, shown as the red line in the graphs below, represent L_{AEQ} (dBA) averaged over one hour.

Table - General information and conditions

ID	LAT	LON	Date	Weather	observable noise sources
S1d	12.4781	-69.9876	21-11-18	scattered clouds, 29°C air temperature, 1012 mb air pressure, 77 % humidity, 27 km/h easterly wind	machinery from Construction Area, trucks, wind, nearby bird songs, noise from WEB
S2d	12.47885	-69.986354	12-12-18	scattered clouds, 30°C air temperature, 1015 mb air pressure, 75% humidity, 28 km/h, easterly wind	Low frequency emissions from WEB, steam pressure noise from WEB, crushers from Construction Area, truck horn, wind, nearby bird songs, overflying airplane
S1n	12.4781	-69.9876	21-11-18	scattered clouds, 28°C air temperature, 1012 mb air pressure, 79 % humidity, 20 km/h easterly wind	Noise from WEB, wind, racing car







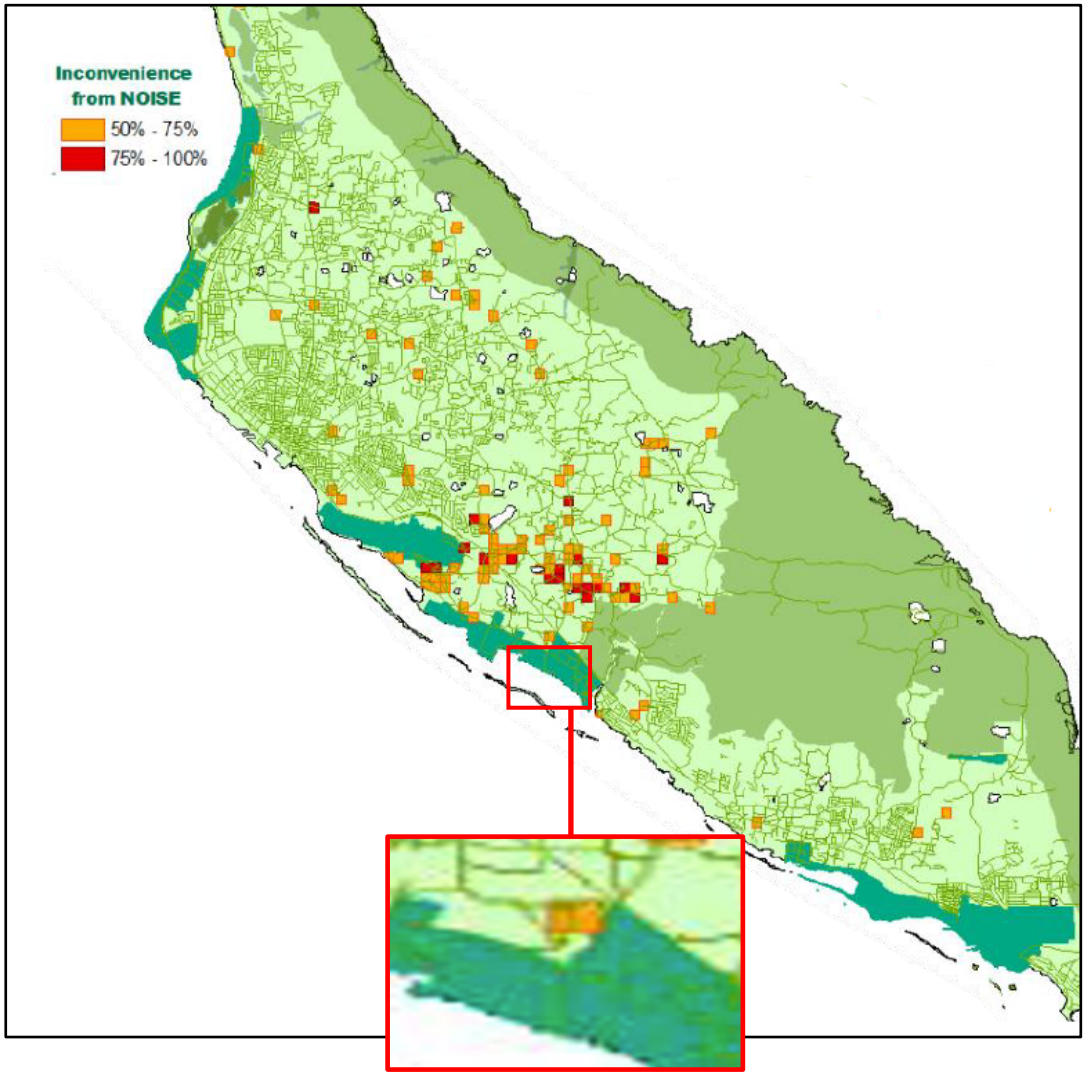
Appendix 18: Traffic Survey, Project Site, 2021

The traffic survey data reflects the traffic that passes in the road that connects the nearby Sasaki roundabout with J.E. Irausquin Boulevard.

Table - 15-minute traffic count, speed of light weight (LW) and heavy weight (HW) vehicles

Date	Latitude	Longtitude	Time of day	Time start	Time end	Tally LW	Tally HW	Average Speed LW (m/s)	Average Speed HW (m/s)
18/7/21	12.545324	-70.054724	Day	10:15	10:30	85	2	42	40
19/7/21	12.545324	-70.054724	Day	16:45	17:00	160	1	51	55
22/7/21	12.545324	-70.054724	Evening	19:10	19:25	111	1	50	46
7/8/21	12.545324	-70.054724	Night	21:48	22:03	79	1	35	27

Appendix 19: Noise Nuisance Map Aruba, (Derix, 2016)



Map: Noise Nuisance surveyed by CBS. *Source:* (Derix, 2016)

Noise Sources at the Processing Facility

The processing facility will employ modern, efficient equipment designed specifically for minimizing noise emissions in seafood processing environments. The primary noise sources within our operation include:

1. **Refrigeration systems**: These will be located outside the main facility in a designated mechanical area. The units will maintain noise levels below 70 dBA at 1 meter. If needed, additional acoustic barriers will be installed around the refrigeration units to further minimize sound propagation to neighboring areas.

2. **Electric conveyor systems**: Our facility will utilize electric-powered conveyors rather than pneumatic systems, operating at noise levels typically below 60 dBA.

3. **Hydraulic lifts**: Used for unloading and moving fish through the facility, these systems are designed to operate at noise levels not exceeding 70 dBA.

4. **Water pumps and filtration equipment**: All pumps will be enclosed in sound-insulated housings, reducing noise to ambient levels outside the immediate vicinity.

5. **Packaging equipment**: Modern vacuum packaging and labeling equipment typically generates minimal noise levels between 55-65 dBA.

For context, these noise levels are comparable to normal conversation (60 dBA) or office environment noise (50-60 dBA). Nearly all equipment will be installed and housed within the walls of the enclosed processing facility structure, which provides additional sound attenuation. The facility is located in an industrial zone where ambient noise levels are already elevated, making our contribution to the overall soundscape minimal.

Odor Control Measures

Our processing facility will operate productively and in a way that will limit the risk of odor being present in the vicinity:

1. **Controlled environment**: The entire processing operation will take place in an enclosed, temperature-controlled facility with negative air pressure systems to prevent odor escape.
2. **Rapid processing workflow**: Fish will arrive pre-bled in a low temperature ice slurry from the harvest vessels and immediately enter our processing line, with typical processing times of less than 3 hours from arrival to final packaging.
3. **Immediate byproduct management**: All fish byproducts like viscera or heads will be:

   a. Collected in sealed containers
   b. Maintained in a temperature-controlled environment
   c. Removed from the facility regularly for incinerating, conversion to agricultural inputs, or other circular economy applications
   d. No byproduct will be left outside or without proper temperature control

4. **Advanced air handling**: The facility will incorporate:
   a. HEPA filtration systems
   b. Activated carbon filters for odor adsorption
   c. Ozone treatment systems in critical areas, if needed

5. **Sanitation protocols**: The facility will maintain rigorous cleaning schedules with food-grade sanitizers and cleaning agents that neutralize odor-causing compounds.

Summary

The effectiveness of these measures is supported by our adoption of Best Aquaculture Practices (BAP) and Aquaculture Stewardship Council (ASC) certification standards, which include strict requirements for waste management and environmental impact minimization [1].

Our Mitigation Management Plan (MMP) and Environmental Monitoring Plan (EMP) will include specific monitoring protocols for both noise and odor, with clear action thresholds and remediation procedures should any issues arise.

References

Best Aquaculture Practices (BAP) Certification Standards, Processing Plant Standard (Issue 5.1). https://www.bapcertification.org/Standards

Statement

Describe the full flow of the processing area. Calculate equipment energy usage and also cooling energy usage. Provide a recap of the food safety and regulatory requirements that will be met by the facility.

Overview

Petros will establish a processing facility that can efficiently process and package Red Snapper in a way that promotes food safety, quality, as well as environmental stewardship. To do this, Petros has developed an industry-leading approach to its processing facility planning.

The high-level strategy for the processing facility with key details is summarized below:

3rd Party Food Safety Certification

The Petros processing facility will be audited and certified to the standards of the Global Food Safety Initiative's (GFSI) benchmark. This benchmark recognizes certifications that meet the most stringent global standards for food safety. A few examples of certifications within this benchmark are SQF, BRC, BAP, and more.

At the heart of the food safety strategy within the Petros facility will be effective Food Safety Management System (FSMS) like Hazard Analysis Critical Control Points (HACCP), Good Manufacturing Practices (GMP), record keeping, sanitation, microbiological testing, and more.

Local and International Governmental Licenses

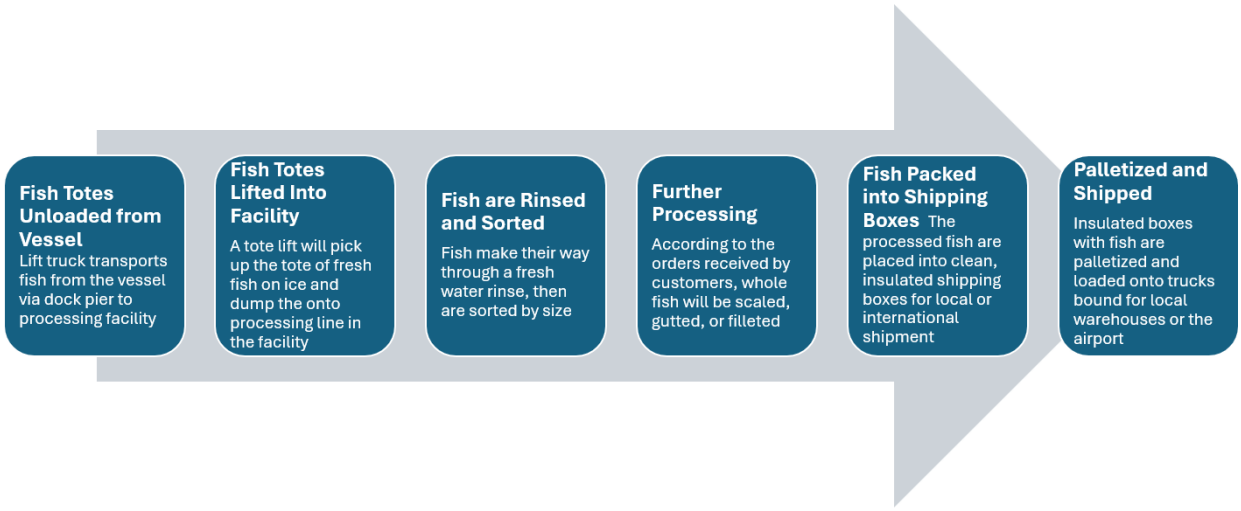
The Petros processing facility will comply with all local and international government inspections, licenses, and permitting requirements.
To comply with Aruban government requirements, the Petros processing facility will maintain an active Aruban Food & Beverage License, Health Certificate, and Declaration of Good Health. Any other regulatory requirements from the Aruban government will also be adhered to.

For the purpose of exporting to the United States, the Petros processing facility will maintain an active US Food & Drug Administration registration, which requires documentation, periodic in-person facility inspections and product inspections upon importation. Any other regulatory requirements from the US government will also be adhered to.

For the purpose of exporting to the EU market, Petros will maintain the EU Export Health Certificate, residue monitoring plan, traceability documentation and compliance with EU Hygiene Standards. Any other regulatory requirements from the EU will also be adhered to.

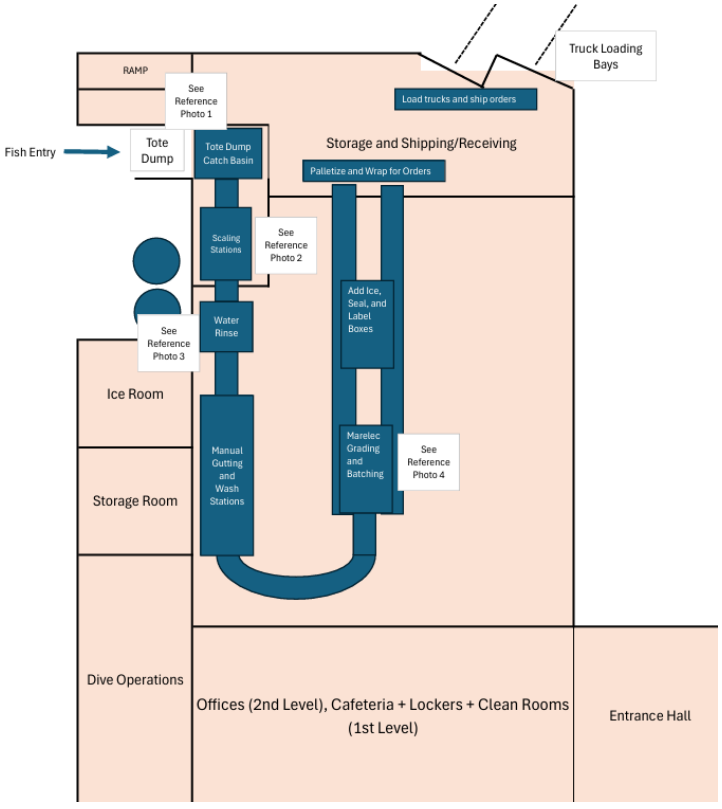
Product Flow

The flow of product through the processing facility can be seen below in 6 simple steps:



Processing Facility Floor Plan

The product flow steps identified in the previous section will be executed with a simple, but efficient processing facility layout. The processing line will be made up of a small, but carefully selected assortment of machinery and conveyors that allow for efficient processing, packing, and shipping of Red Snapper.



Reference Photo 1 – Tote Dump Example Image:

Reference Photo 2 – Scaling Station Example Image:

Reference Photo 3 – Fish Wash Example Image

Reference Photo 4 – Marelec Grading and Batching Example Image:

SUMMARY

Although the processing of the harvested fish would not occur within the next 18 months, Petros has spent a significant amount of time on the planning for this component of the operation. Petros will operate a clean, safe, and industry-leading processing facility that abides by both industry and government regulatory standards for compliance and food safety.

The processing equipment and machinery within the facility has been chosen to ensure an efficient operation, but will not require a significant amount of energy usage compared to other industrial operations.

REFERENCES LIST

- https://www.fda.gov/food/importing-food-products-united-states/imported-seafood-safety-program
- https://www.fda.gov/food/food-imports-exports/importing-food-products-united-states
- https://food.ec.europa.eu/system/files/2018-06/ia_trade_import-cond-fish_en.pdf
- https://www.wto.org/english/tratop_e/sps_e/sps_thematic_session_31120_e/2.2_gsfi_anne_gerardi.pdf
- https://openknowledge.fao.org/server/api/core/bitstreams/a56f938c-7e92-4ffe-a901-f4494a2eeb64/content
- https://www.marelec.com/industries/fish/grading-and-batching/compact-grader/

The impacts on the marine ecosystem pertaining to coral reefs, sea turtles and marine mammals, are minimal. This is based on data from farms in Panama and Hawaii, both applying similar technologies, and dealing with environmental concerns mirroring those in Aruba. Available public records and scientific papers show no measurable impacts to reefs, sea turtles, and marine mammals. Petros is also actively considering implementing the latest science on eDNA (Environmental DNA) data collection protocols to establish additional information on how well Petros is caring for the environment.

Coral Reefs

The farm site selection process was complex and intensive. It evaluated numerous inputs, such as sea currents, depth, distance to sensitive ecosystems (like coral reefs), marine traffic, local fishing grounds, areas of maritime economic value, oil and gas, telecommunication infrastructure, and others. The highest on this list of inputs were those related to coral reefs and marine fauna. During the site selection process, Petros collected hours and hours of film recordings of the targeted farm area. Numerous transects were performed with cameras filming the seabed. Based on these studies, Petros is confident that there are no coral colonies present at the depths of 80 m+ around this farm area. Additionally, the targeted location of the sea farm is approximately 8.5 km away from Aruba's coast, with a predominant Caribbean current going away from Aruba. This ensures that any possible effluent originating from the farm will be taken away from the island, not towards it, and will naturally be broken down by the micro-organism in the water column.

Concerns have been shared with Petros from local NGO's regarding the open ocean aquaculture farm's possible effluent discharge. Petros is confident that no additional stresses will be imposed on Aruba's already stressed coastal coral reefs.

The solid effluent of ocean-based fish farms is comprised of fish fecal matter and uneaten feed pellets. These particles are transported horizontally by ocean currents as they drift vertically down towards the ocean floor. Denser particles, such as fish feed, sink faster at a rate of 0.1m/s and deposit closer to the farm while finer particles are transported further, but dispersed over a wider area. The smaller particles, such as fecal fines, are faster to decompose and assimilate into the ecosystem nutrient cycle.

This nutrient transport is the primary mechanism through which fish farms can impact the surrounding benthic communities. Several different parameters are used to indicate the changes in benthic environments caused by farming activities including TOC, LOI, TON, and redox potential, as well as direct measurements of species assemblage such as Shannon-Wiener index, abundance, total biomass, and species richness. Kalantzi and Karakassis (2006) review the correlation between the various parameters and claim that TOC correlates most strongly with abundance, making it a preferable parameter to track or model in many instances. That relationship has been further validated by Hyland et al. (2005). It should be noted that most of the research on this topic is from salmon, seabass, and sea bream farms, however there are examples from tropical marine carnivores and warm water environments

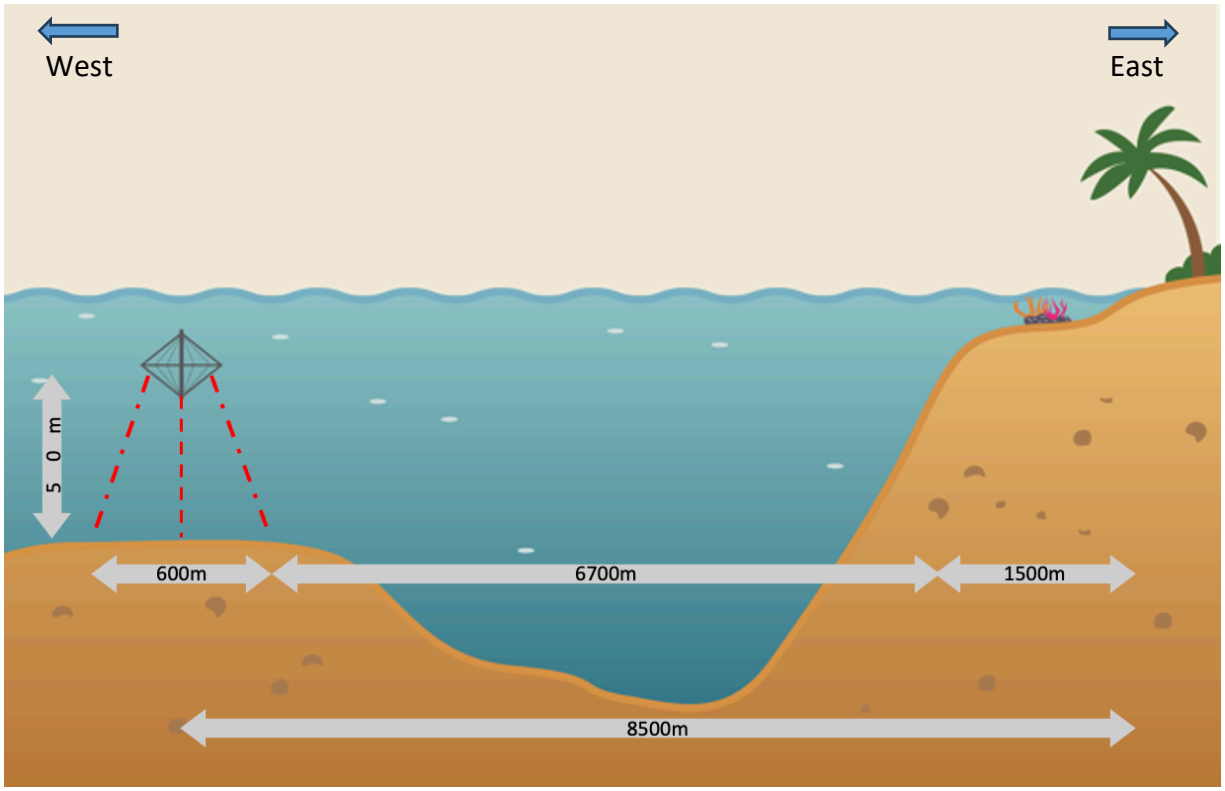
as well. The mechanisms through which nutrients are transported are the same in all environments, however the relevance of some processes can vary at different temperatures and with different sediment types. The species being farmed also affects the farm bio-load and particle size of fecal effluence, which can in turn affect the spatial distribution of nutrients.

A review of the results of deposition studies and models at oceanographically similar sites to the Petros site, provide insight into the expected magnitude and spatial extent of farm impacts. Karakassis et al. (1998) looked at a farm in Greece with mean currents ranging from 3.6 to 18 cm/s and a mean depth of 20 m and found no difference between phosphate level, organic material, or chlorophyll-α at sampling stations 25 m from the farm vs a control site. Holmer et al. (2007) deployed sediment traps at farms in Spain with mean current speeds of 9.7, 5.5, and >20 cm/s and depth ranging from 16 to 28 m and observed significant reductions in sediment rates (up to 91%) at sampling stations 5 m and 40 m away from the edge of the farm. A sample station 1, m the farm was considered indicative of background sedimentation levels.

The strength of ocean currents has a significant effect on deposition patterns. Dauvin et al. (2020) looked at a high energy salmon farm in the English Channel at a site with a depth of 20 m. The currents at the site varied between 10 cm/s at neap tide to a maximum of 70 cm/s at spring tide. The study found similar ranges of TOC, abundance, and Shannon-Weiner index, among other benthic health indicators, among five different sampling days at sites 50 m away from the farm and reference sites 500 and 600 m away.

Rensel et al. (2015) also collected samples over 7 years from Blue Ocean Mariculture, a farm in Hawaii with a mean surface current of 28 cm/s and a depth of ~60 m. This site is the most similar oceanographically to the Petros site given the tropical location, depth, and current velocity. They found a difference between the sediment total organic carbon at the center of the farm lease vs reference sites 40 to 60 m away in only 3 of the 7 years that they had data for. The mean value at the lease center was 0.16% vs 0.145% at the reference sites.

Although a nutrient contribution map cannot be created for the Petros Aquaculture site without further data and advanced spatial modeling, the benthic impacts at other farms as indicated through sediment trap studies and deposition models suggest that measurable impacts are highly localized and impacts may not be detectable beyond ~100 m from the farm site.



In the event of a 180 degrees flip of the sea current, which sporadically happens for a short period of time, what is the probability that uneaten fish feed makes it back to the Aruban coast?

- Distance from site to closest point on shore is 8.5 km.
- Distance from shore where coastal corals still enjoy the ideal depth is 1.5 km.
- Distance from pen that food can be found on the seafloor is 300 m.
- Buffer zone from extreme to extreme conditions is 6700 m.
- The Factor of Safety (FoS) based on distance alone is approximately 22:1 or 2100%.
- Note: In comparison, automotive airbags are designed to 4:1 FoS.

Feed drop rate and current speed calculations..

- Drop rate of feed pellets is 0.1 m/s.
- Current speed at 50 m (exit point below the pen) from the seabed is 0.5 m/s Figure 25 and Figure 26.
- For this calculation, assume 0.5 m/s all the way to the sea bottom.
- 500 Seconds before it reaches the seabed.
- 0.5 m/s times 500 s, equals 250 m. This is how far the feed pellet would travel under these extreme conditions before reaching the seabed.

Any feed pellet traveling through the cage, remaining uneaten by either the fish in the pens or the wild fish outside the pens, will disperse no further than 250 m from the pen. Here it will be rapidly broken down by natural micro organisms.
Petros will invest in a range of sensors and AI driven cameras to collect crucial data from within and outside of the farm area. This suite of sensor package and network of cameras will further eliminate feed waste, which is key in reducing feed washing away. The sensors will help Petros document current changes and in doing so, help Petros predict when these current changes are about to happen. This will help Petros implement new mitigation and management protocols for this potential event. The target is to collect sufficient repeatable data and in a transparent manner analyze these with the key stakeholders, such as DNM, University of Aruba, and others.

Works Cited

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Sea Mammals

Sea mammals around Aruba are primarily from the Cetacean group. Petros will be primarily managing two specific risks posed by any aquaculture operations. Entanglement and entrapment. Both will impede the mammal from reaching the surface for air. There are extensive best practices in place and many lessons learned exist on this topic that Petros will apply to the Aruba operations.

Entanglement is eliminated due to the inherent design of the pen technologies. Both the ropes and netting are engineering for taut operations. There are no loose ropes or cables, and the Kikko netting is, by design, extremely tight around the pen structure. In the event that an anchor has dragged a little over time, causing a little bit of slack in the rope, Petros' weekly maintenance inspections will detect this and follow established processes codified in our SOP to correct this situation ASAP. At strategic locations around the grid, smart sensors will be installed to collect data on the daily stresses experienced by the grid infrastructure. This data will paint a comprehensive image of the behavior of our infrastructure and guide us in creating a pre-emptive maintenance process even before a rope goes slack.

Entrapments are eliminated by strict operational procedures established by open ocean farms in Panama, Hawaii, and Mexico, who are currently using the same pen systems targeted by Petros. A sample SOP on how the farm operators avoid possible entrapment situations for the marine mammals is located at the end of this report. An example is how to keep the sea mammals from entering the pen, which impedes their ability to reach the surface. It starts by never feeding or interacting with any marine mammal while working around the pens. This is to prevent them from associating divers with food. No marine mammal feeding is allowed by any Petros employees. When divers need to enter the cage, a 2-diver protocol is applied. One diver enters as the second one stays on the lookout so that no marine mammal enters the pen inadvertently. The roles are reversed when the second diver is entering the pen. These strict protocols have been developed over time and have led to **zero entrapments** in similar setups at other established open ocean operations.

On the 17th of April 2024, Petros received an email from Mrs. Angiolina Henriquez, President of the Aruba Marine Mammal Foundation, with questions regarding the Aruban Open Ocean Aquaculture project. Listed below are the questions raised, and the answers documented following each question. The comments column has been added to this report for additional clarifications.

Initial questions	Petros' responses	Additional comments
What is the **size** of the farm: the 2D size of the total farm field (1) and per cage (2); the 3D size of the total volume field (3) and per cage (4) (metric)?	2x2 @ 85 meters depth 80m cell size = 846m x 846m ~72 Ha. 2x8 @ 85 meters depth 80m cell size = 846m x 1326m ~112 Ha. Each pen is 6400 m3 x 16 = 102,400 m3	A 2x2 means the pens are structured in a 2x2 matrix. 4 Pens total. A 2x8 will consist of 16 pens in a 2x8 matrix.

Where is the Open Sea station **located?** At which distance from shore? At which depth?	12°32'46.0"N 70°08'38.8"W 8.67KM from shore. Site depth is 85m and grid depth is 15m.	This area was identified after extensive site selection research. The grid is the network of cables and shackles holding the gages in place. The grid is attached to the sea bed.
The project fish would start with 4 cages as a phase 1 trial period, with expansion to 16 red snapper cages. Is this the limit of the **scale** of this project (to ensure financial profitability) or is possible further expansion in size and species part of your vision?	2x8 is the largest expected.	This MER is for a 500MT yearly production target. Additional tonnage growth will be added after a few years of production and detailed data collection on potential environmental impacts.
Cages are extended submerged at 10m below the surface. Correct?	Yes.	From 10m below the surface to 34m below the surface.
What is the **size** of the cage?	24m tall x 35m wide = 6400m3.	-
What is the **type of material** used for the open sea-cage netting?	Kikko netting - Polyethylene Terephthalate (PET) monofilaments.	This type of gear has many years of field data and performance.
Is the net predator rupture resistant?	The Kikko net is one of the more predator robust netting materials in the market.	-
What is your anti-fouling method for net and gear?	Desiccation of fouling on the top net when the pens are at the surface and net cleaning on the bottom with an Ideema net cleaner.	-
What is your method for removing dead fish?	Mortality trap and air lift from the vessel.	The mortality traps in each pen is checked on a daily basis.
What is the type of **cable** used for anchoring the cages?	High-tenacity polyester fiber linen - 12 strand 48mm.	-
What is the number and length of the cables per cage?	24 anchor lines 282 m each.	-
What is your **Anchoring** method?	Drag embedment anchors.	-
What is the anchor -slip mitigation measure?	Crown lines at 30m below the surface to allow vessel to adjust anchors if needed.	Slack lines are not allowed. This is to avoid potential entanglement.
Most existing open sea farms are located in sheltered areas (inner bays). What makes this project, without an inner bay - shelter, resistant to Tropical storm forces of undercurrents?	98% of the wave and surface energy is lost when the gear is submerged half the distance of the wavelength (crest to crest). 15m is well below most of the energy. This gear has been submerged below many Cat 3, 4, and 5 hurricanes/typhoons without incident because of the ocean engineering principle above.	-
Will the **feed** for the farmed fish be only "Cargill" pellets?	Other feed accredited companies (Skretting, Biomar, etc…) will be considered.	No GMO or antibiotics in any of the feed.
Does the ingredients of the red snapper feed include medications?	No.	-

What is your method to reduce/prevent red snapper feed pallet waste?	Feeding with cameras, AI machine learning feeding farming software for feed optimization. Wasting feed is expensive for a farm.	The latest tech vastly reduces feed waste into the surrounding environment.
Has this method been used before in other fish farms?	Yes - this is common on modern production sites.	-
What are the expected fish chemicals/**medications** to be used in the land based hatching and open sea stations?	Not applicable.	-
Upon my question on your **anti-poaching security,** you mentioned that you rely on the sharks circling the farm to scare off any potential nighttime poachers. Do you have additional anti-poaching security measures?	Sharks are not the method of keeping poachers away. Submerged pens make it difficult to steal from the site.	Additionally, the farm will be visited by Petros team members on a daily basis. The comm's buoy in the middle of the farm will also house a live feed camera detecting unauthorized traffic.
How do you protect the cage against **net rupture** caused by predators such as sharks (to prevent escaped farmed fish into the wild)?	Use of Kikko Nets and disciplined and efficient husbandry.	Removal of mortalities within the pens are crucial to not overstimulating any sharks present. By maintaining their natural behavior, sharks will continue on their way and refrain from "hanging" around.
What is your whale **entanglement mitigation** measure?	Taut lines.	Loose lines and netting are the main causes of entanglement. Note that the Kikko netting is also installed in a taut manner.
What is your dolphin entanglement mitigation measure?	Taut lines - 20 years of experience in Kona, Hawaii with no issues.	The Kona open ocean farm is located within a Humpback whale sanctuary. There have been zero incidents since the farm's inception.
What type of **stun method** will be used in your "stun and bleed" slaughter?	Use of latest humane commercial stunner used on the vessel.	Standard industry practices. This method also improves animal welfare.
What are the potential expected fish species **attracted** by the farm?	Local fish.	-
Have you already performed an Aruba Biodiversity Impact Study?	We have recorded videos of the sea bed prior to establishing the farm. This is our baseline data.	-
Do you plan to have a **biodiversity impact** data collecting and monitoring program of the fish farm areas (hatchery and open sea) as part of your environmental impact mitigation measures included in your Aquafarm Operations?	We will consider applying for Grants to establish such a monitoring program once the farm is operational.	This can be done with participation of DNM, University of Aruba, ACF, Carmabi, and other stakeholders.

Sea Turtles

Sea turtles are cold-blooded reptiles living in the world's oceans. Aruba, through local conservation groups such as TortugAruba Foundation, has developed an exemplary program to safeguard Aruba's turtle nesting grounds. Especially when these nesting grounds are on the most popular touristic beaches of Palm Beach and Eagle Beach. It is something each and every Aruban citizen is proud of.
One of the highest mortality rates of sea turtles in the open ocean is becoming bycatch in the wild caught fish industry. Petros will NOT be catching large quantities of fish like the commercial fishing industry. No bycatch incidents will result from Petros' operations. When it sporadically catches local Red Snappers for Broodstock in its hatchery, it will be done by local artisan fishermen with hand lines. This process will be highly supervised and fully documented.

During Petros' numerous NGO and Stakeholder communication meetings, it has been asked if the open ocean farm will use underwater lights at night. The concern is that these lights could alter the turtle's migration routes. It has been confirmed then and is now, that **Petros will not be deploying underwater light sources in or outside the open ocean pens.** The only minor light will be from the navigational lights above the water on the edges of the farm. These are only required to aid marine navigation.

Entanglement and entrapment risks are eliminated per Petros' SOPs and technology applied. Please refer to the marine mammal section above. In short, no loose or slack lines or netting will be present in the open ocean farm.

Zero human interactions with or feeding of sea turtles are allowed by Petros' team members. This is to avoid altering the sea turtle's natural behavior and patterns.
All vessels leaving port towards the farm or returning from the farm are required to extend the right of way to marina mammals, sea turtles, and other marine fauna. This is to avoid inadvertently colliding with marine animals.

The location of the open ocean farm is located approximately 8.5 km away from the closest point on land. This translates into being located even further away from the natural breeding grounds on Eagle and Palm Beach and South of the predominant currents carrying turtle hatchlings towards open ocean to the West and North of Aruba.
The design and construction of the land operation at the Barcadera industrial park, will implement external lighting specifically designed to be sustainable and with no to minimal impacts to animals like birds and sea turtles.
Petros has a commitment to being good stewards and advocates for the environment it operates in.

The Caribbean Sea

The potential to impact the Caribbean Sea beyond the territorial seas of Aruba is minimal based on the published science data and due to the application of sensors and cameras around the farm to measure DO and other key parameters. The production target of 500MT is very minimal in size. Our SOP's call for continued measurements of key environmental inputs to make sure no negative impacts are introduced by the Petros operations. Petros will go above and beyond international standards and will consider installing sensors beyond the farm boundaries to measure DO and salinity levels. Petros will also conduct additional random sampling beyond the farm boundaries to establish unambiguous data that Petros' operation has no negative effects beyond its farm. All this data will be made public, as required by international aquaculture accreditations such as ASC and BAP.
In addition to all of this, Petros is in active discussions with the University of Aruba to fully support any studies or ongoing research regarding the farm's environmental performance.

Sharks

In Aruba, concerns about sharks have been shared by some stakeholders. Petros is confident, based on scientific research and data from real case scenarios, that the presence of sharks around the farm will not be artificially increased due to the presence of these operations in the open sea. The technologies used, like the mortality trap system, will on a daily basis remove any mortalities from within the pens. The presence of decaying fish within the pens could alter a shark's behavior, but the mortality trap system eliminates this concern. By nature, sharks will target sick and dying fish. They are the keystone species in a healthy marine environment. On the Petros farm, the Red Snapper will be healthy, as will the wild fish agglomerating around the pens. With the mortalities being removed every day from each pen, the pelagic sharks living in these open water environments will carry on and not alter their natural behavior by sticking around the farm. Sharks will not become a problem around the farm or far beyond the farm area because Petros will not alter the natural behavior of the existing sharks in these waters. Well-managed operations like Petros, will not attract more sharks. This has been validated by multiple open ocean farms that operate in tropical environments today.

eDNA

Petros is strongly considering applying the latest environmental monitoring tools such as eDNA. As explained by Mrs. Eman Abo Shady in a recent post, "Environmental DNA (eDNA) is revolutionizing how we monitor and manage aquatic environments. It involves collecting genetic material shed by organisms into the environment (via skin cells, mucus, feces, etc.) from water or soil samples. This non-invasive method allows scientists to detect species without the need for direct capture or observation".

How eDNA Supports Aquaculture and Petros:

- Biodiversity and Ecosystem Monitoring

eDNA makes it possible to assess local biodiversity around aquaculture sites, ensuring that farming activities are not negatively impacting natural ecosystems (Miya et al., 2023). It provides a clearer picture of species interactions and ecosystem health.

- Invasive Species Surveillance

Aquaculture facilities face risks from invasive species. eDNA offers a sensitive method to detect non-native species at an early stage, enabling faster and more effective management responses (Sepulveda et al., 2024).

- Water Quality and Microbial Community Assessment

Recent studies highlight that eDNA can also monitor microbial community shifts, providing insights into water quality and identifying potential harmful algal blooms (Bohmann et al., 2024). This contributes to maintaining a healthier environment for farmed species. Note that algae blooms are not a common event in the Southern Caribbean Sea.

- Enhancing Farm Management Practices

The comprehensive data provided by eDNA helps improve farm practices — from optimizing stocking densities to strengthening biosecurity protocols and supporting environmental certifications (Barnes et al., 2023).

eDNA is proving to be a valuable tool in advancing sustainable aquaculture practices. Its ability to deliver rapid, accurate, and non-invasive insights makes it an essential part of modern aquaculture management.

* Credit: Eman Abo Shady – Aquaculture Researcher & Editor at Aquaculture Feed Magazine Africa

Summary

Coral reefs – The farm will be located 8.5 km from the Aruban coast where the coastal corals are. The Caribbean current flows for the majority away from Aruba and when it does "flip" a few times a year, the farm is still located so far away from the coast that no fish fecal matter or uneaten fish feed can reach the coastal corals. Additionally, Petros has 24/7 sensors to monitor current strength and direction. These will be used to develop predictive models to better understand these dynamics in the open oceans.

Marine Mammals – Entrapment and entanglement risks are reduced, if not eliminated entirely, by the taut lines applied throughout the whole farm. The Kikko netting used is also taut and of high strength to reduce intrusion by mammals or predatory species. Farm SOP's will eliminate accidental entry of marine mammals into the pens.

Sea Turtles - Entrapment and entanglement risks are reduced, if not eliminated entirely, by the taut lines applied throughout the whole farm. The farm will have no lights in or around the cages and will eliminate any alterations to the sea turtle's migration routes.

The Caribbean Sea – The environmental management system and monitoring plan, paired with high tech cameras and sensors, in addition to the smaller commercial production target of 500 MT and ASC/BAP certifications, Petros expects low to zero cumulative negative impacts to the Caribbean Sea.

Sharks – These keystone species will not be negatively impacted, and their natural behavior will remain intact. No increase in sharks will be observed closer to shore due to Petros' operations.

Standard Operating Procedures (Partial Example)

Marine Animal Interaction

Marine Mammal Interaction Reporting

1. Employees are required to report marine mammal siting on the daily biomass sheet.

Reports should include:

a. Time
b. Location
c. Species
d. Number of animals
e. Observed activity

2. Environmental Officer files a monthly marine mammal report based on the daily observations to DNM.

3. Interaction

Under the direction of the Marine Mammal Protection Act (NOAA) interaction with any marine mammal:

i) Should be avoided if possible.
ii) Vessels should move slowly on the farm and give the right of way to marine mammals to not impede their natural daily activities.
iii) Employees are not to engage with marine mammals unless the animal is in a life-threatening situation that would call upon the exemption of the marine mammal act. (16 U.S.C. 1371 Sec 101 (B)(3)(d)) Good Samaritan exemption. Operations Manual 2017 Marine Ops Manual/last update 170814 v2.0 - draft 33
iv) Employees should report any unusual behavior or interaction on the daily marine mammal observation section of the daily biomass form.

Feed according to the feed table that is provided by feed manager. Always feed with a working camera - if the camera is not working feed never more than the model and try to arrange a diving team to check the feeding, or if possible, a ROV.

All Fish should be fed to satiation. How do you know we fed 100%?

- Numbers are close to the feeding table.
- The fish go from very bundled and energetic to dispersed. The fish loose interest in the feed and start swimming to other places.
- You will see pellets "raining" around the camera.

- Ensure all materials and equipment (including the deck) are disinfected prior to carrying out procedures.
- Ensure safety protocols are being followed.
- Approach the cage - recover feed hose and camera.
- Connect camera and hose - start the feed system.
- Ensure the camera is working properly.
- Ensure there is slack on the camera cable.
- Start pump and system - run system for 1 minute before pumping the feed.
- Follow the Feed Manager's instructions for feed type and quantity.
- Stop feeding when feed response disappears and when pellets fall past the camera.
- At the end of the feeding, run the water for at least 2 minutes to ensure hose is clean.

Daily feed administration process

- The vessel should be prepared the previous afternoon.
- The feed ordering for the next day is calculated based on the number of kilos of feed left on the boat silos and the average feed consumption by each cage satiation report. Two tons of feed are included in the order to ensure enough feed at all time.
- The feed ordering is done through a request by radio, WhatsApp or phone calls to the Base operation technician.
- While loading the feed to each one of the silos, the batch number is recorder by the feed supervisor and noted on the daily feed record as well as share with the production analyst to ensure a digital record. (batches of feed loaded to the boats are also recorded in the logistics team logbook).
- In order to ensure traceability of the feed batches delivered to the cages at the farm an excel sheet with the feed given to the cage and the possible batches loaded to the silos is recorded daily and remains under the supervision of the production analyst.
- The vessel departs at 6:XX am.
- Upon arrival at first cage, measure and record temperature and DO levels:
- Measure outside the cage at 1m, 5m, & 10m.
- **If oxygen is below 4.5mg/L or 60% Saturation, feeding should be suspended and reported immediately.**
- Once a month at one nautical mile away from the farm site measure at 1m, 5m, & 10m.
- Measure and record turbidity at the farm site.
- Ensure conditions are stable for fish and personnel.
- Feeding should be delivered until feed response disappears and when pellets fall past the camera. Always observe the fish appetite/fish response. Feed rate should be initially rapid, decreasing towards the end of the ration.

- Observe distribution hoses and manifolds frequently for repairs.
- Once a month reading is also taken at one nautical mile away from the farm site.

Turbidity recording process

- Upon arrival to the farm the Secchi disk is lowered into the water on the shady side of the boat.
- Keep lowering the disk slowly until it disappears.
- Note the depth on the cord on the data sheet along with the date and time of the reading.
- Once a month reading is also taken at one nautical mile away from the farm site.

Communication & records

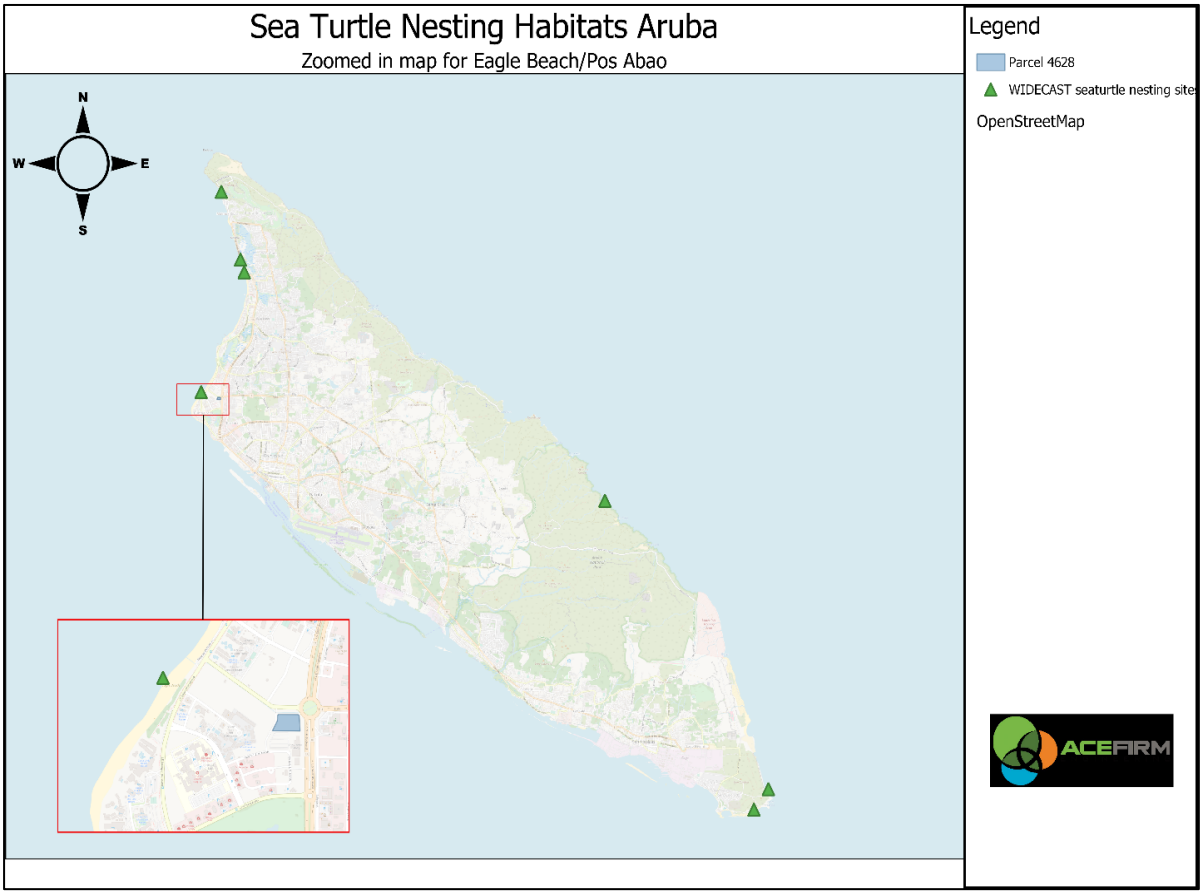
- Record all data immediately (i.e., feed, mortality, diving, and other important data).
- Report any abnormal observations to Feed Manager immediately.
- The Supervisor will then enter the data into Mercatus and send via WhatsApp.
- Submit control sheets and dive records at designated location.

Important notes

- **Starvation – fish should not be fed prior to any handling procedure, including net change, bathing, grading, stocking, towing, or harvesting.**
    - After handling, if fish behavior has returned to normal, fish can be fed. If fish do not begin to behave normally, notify the feed Manager or Marine Operations Manager.
    - Feed expiration date is verified with the log in the feed batch as well as record provided by the Base Operations Manager on the entrance of the feed at Petros' warehouse.

Table - Nesting sites summary (#Crawls/year). Source: (Dow, Eckert, Palmer, & Kramer, 2007). Original Data provider: TurtugAruba.

Beach Name	Year data collected	Green	Loggerhead	Hawksbill	Leatherback
Arashi Beach				<25	<25
Boca Grandi					<25
Dos Playa		<25			<25
Eagle					25-100
Fishermen's Huts			<25		
Palm Beach					<25
Pets Cemetary		<25			



Map: Sea Turtle Nesting Habitat Sites Aruba. *Source:* (Dow, Eckert, Palmer, & Kramer, 2007)

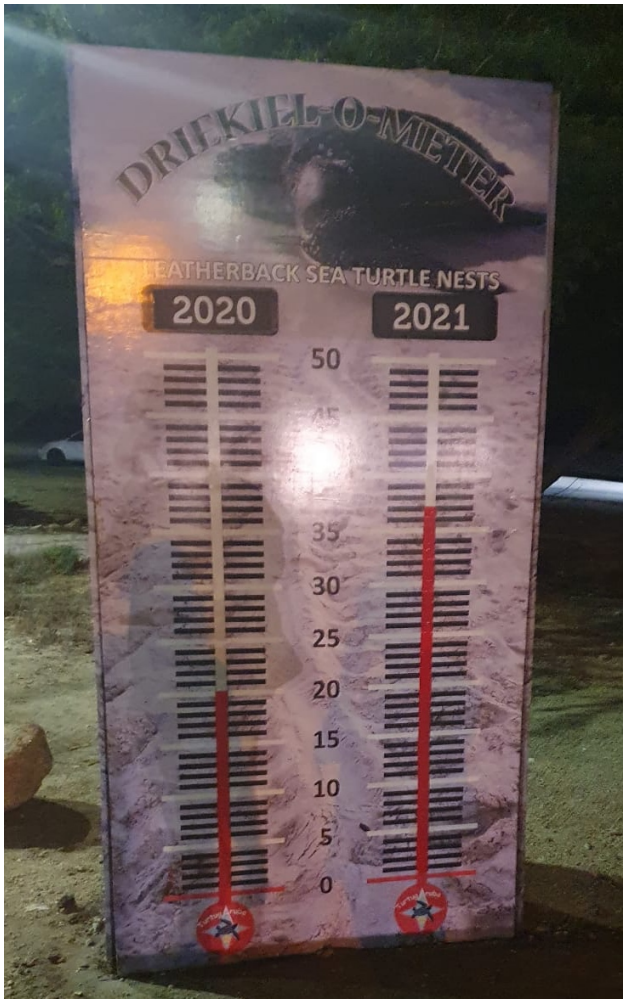
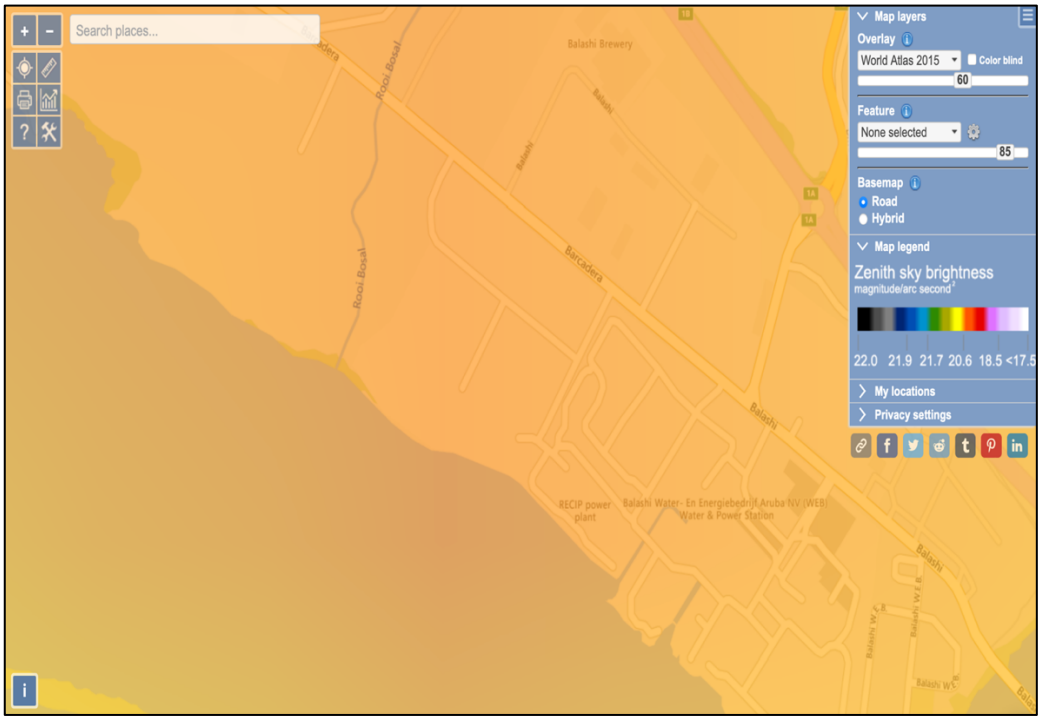


Photo: Driekiel-O-Meter: Number of Leatherback Sea Turtle nests at Eagle Beach for 2020 and for this year updated until 7th of August 2021.

Appendix 24: Light Pollution Map, Aruba

Map: Light pollution in Aruba, zoomed in for specific light pollution information regarding the project site. *Source:* *(darksite finder)*



Map: Light pollution in Aruba, zoomed in for specific light pollution information regarding the project site. *Source:* *(Stare, n.d.)*

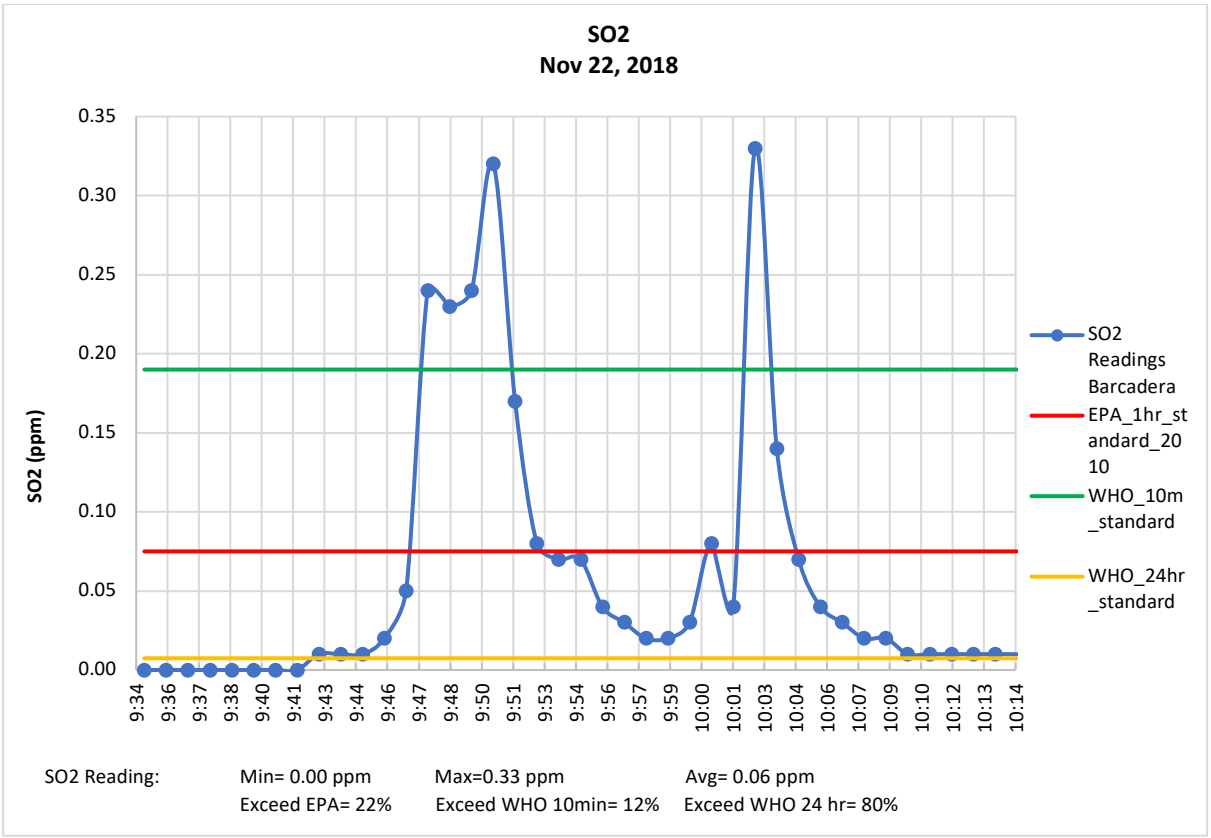
Appendix 25: Air Quality Surveys

The air quality assessment concerned particulate matter (i.e. dust) and sulfur dioxide levels. The portable Particulate Monitor, Aeroqual Series 500 with PM sensor head was used to measure PM2.5 and PM10. The Portable Desktop Sulfur Dioxide Monitor Model Z-1300 XP from Environmental Sensors Company was used for measuring sulfur dioxide levels. Both meters have been factory calibrated in 2018. The meters were placed at a height of about 1.5 meters. SO_2 levels were measured two times; for a half hour on 22 November (A1), and for almost five hours on 12 December (A2). PM levels were measured simultaneously with SO_2 levels at A2.

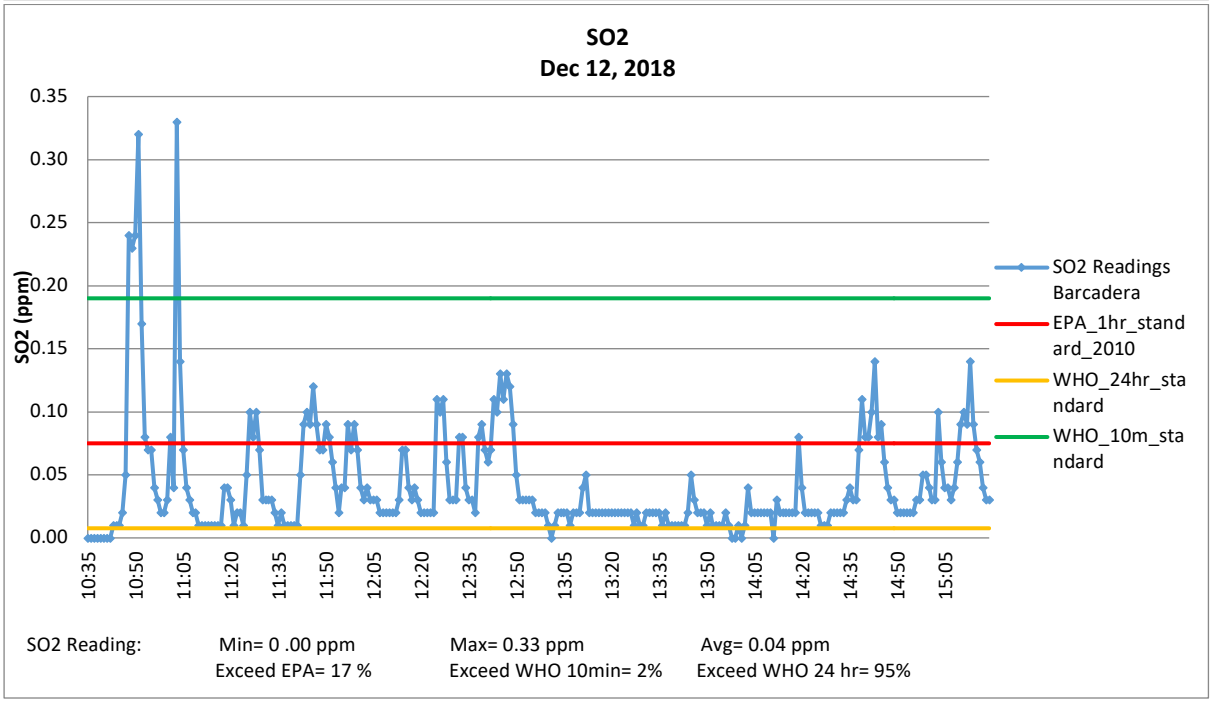
EPA's primary (public health) air quality standards and WHO air quality guidelines were referenced for comparison. The measurements of SO_2 were compared against EPA's one hour mean standard (75 ppb), WHO's 10-minute mean standard (500 µg/m^3 = 190 ppb) and WHO's 24-hour mean standard (20 µg/m^3 ≈ 8 ppb). For the PM survey, measurements were compared against WHO and EPA's 24-hour mean standard (25 and 35 ppb, respectively). The percentage of measurements that exceeded the referenced standards were calculated by counting the number of times the difference between a measurement and the reference was higher than zero and then dividing it by the duration of the survey in minutes and multiplying by 100.

ID	Parameter	LAT	LON	Date	Weather
Air 1	SO2	12.4788	-69.9866	22-11-18	Passing clouds, 29 °C, 32 km/h SE wind ,70% humidity, 1014 mbar
Air 2	SO2	12.58885	-69.986354	12-12-18	Passing clouds, 29-31°C, 28-37 km/h SE to E wind, 62-70 % humidity, 1012-1016 mbar
Air 2	PM 2.5, PM10	12.58885	-69.986354	12-12-18	" "

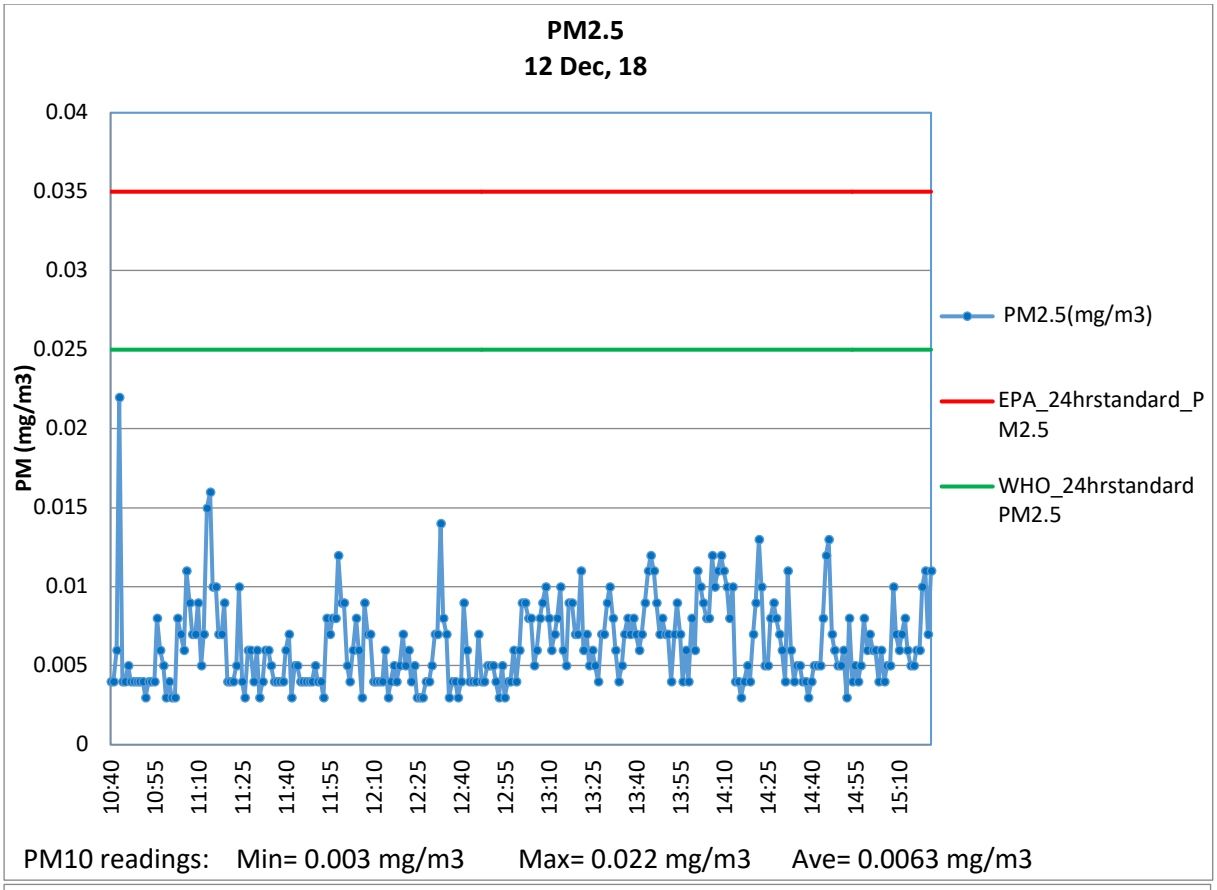
Comments: At the start of the measurements, dust clouds were formed in the nearby Construction Area. In this area heavy machinery was very active, moving aggregate materials, excavating and crushing rocks. Furthermore, a strong odor associated with the heavy fuel oil burning from WEB was observed during the setup, particularly when the wind directed the fumes from WEB directly towards the Project Site. These fumes seemed to cause a nauseous feeling.



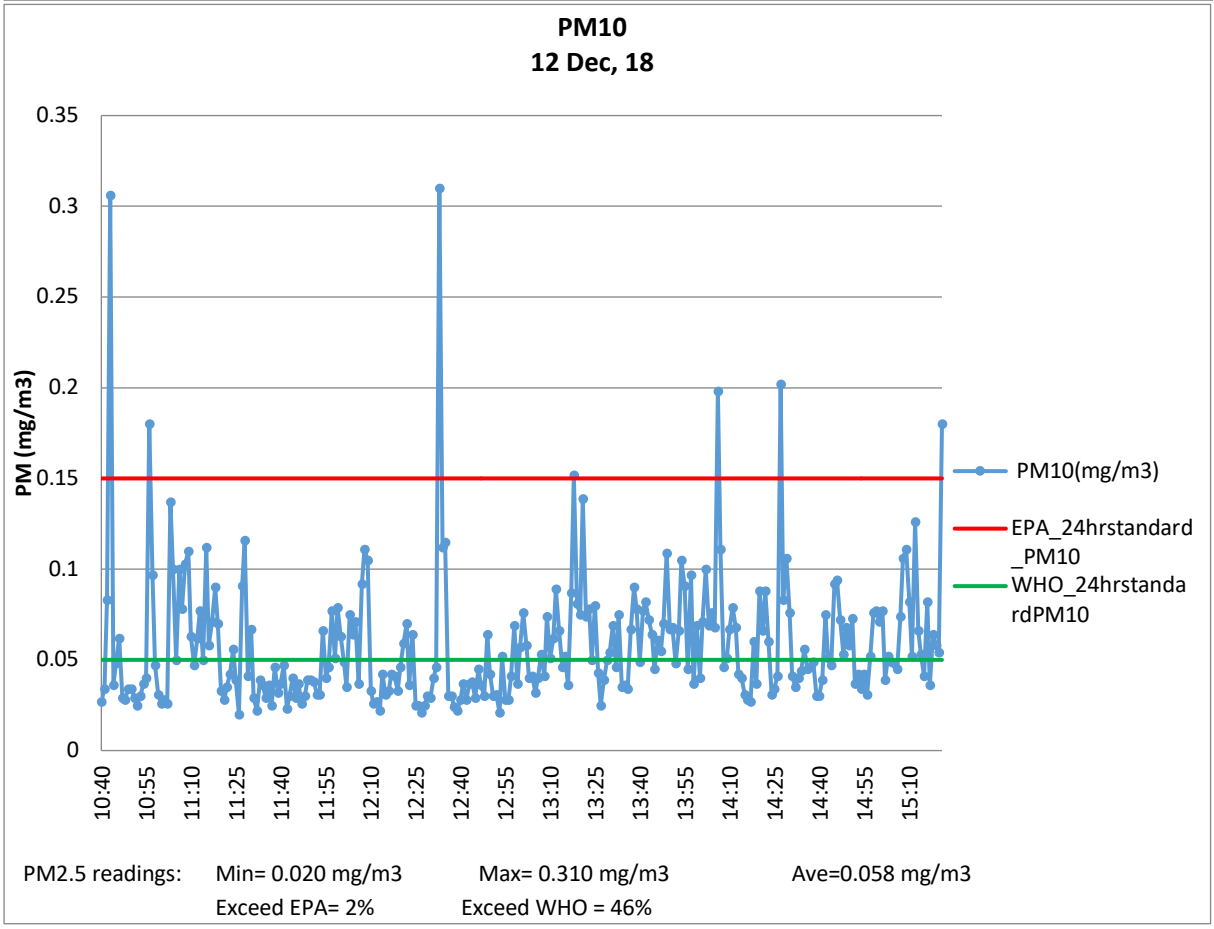
SO2 Reading: Min= 0.00 ppm Max=0.33 ppm Avg= 0.06 ppm
Exceed EPA= 22% Exceed WHO 10min= 12% Exceed WHO 24 hr= 80%



SO2 Reading: Min= 0 .00 ppm Max= 0.33 ppm Avg= 0.04 ppm
Exceed EPA= 17 % Exceed WHO 10min= 2% Exceed WHO 24 hr= 95%



PM10 readings: Min= 0.003 mg/m3 Max= 0.022 mg/m3 Ave= 0.0063 mg/m3



PM2.5 readings: Min= 0.020 mg/m3 Max= 0.310 mg/m3 Ave=0.058 mg/m3
Exceed EPA= 2% Exceed WHO = 46%

Appendix 26: Landscape Vegetation - Ecological Assessment

The Landscape Vegetation Ecological Assessment consisted of three survey points which representative two localities in the Project Site. The sampling protocol was adopted from Oosterhuis (2016), which is based on methodologies derived from the National Committee on Soil and Terrain (Australia)(2009) and from Torello-Raventos et al. (2013). At each survey point quadrats of 10 m x 10 m (100 m^2) were laid out. In these plots the height and cover of each vegetation layer (stratum) was surveyed, and all plant species identified. A number of abiotic (environmental) factors at each survey point, such as erosion signs, soil depth, geology, altitude, and slope were noted as well.

Table: LVAE data

ID	FL1	FL2	FL3
date	21-Nov	22-Nov	12- Dec
time	14:15	9:50	10:10
latitude	12.4786	12.4788	12.47978
longitude	-69.9865	-69.9866	-69.98644
geology	LS	LS	LS
landscape	xeric shrub	xeric shrub	xeric woodland
alt(m)	6.9	7.3	5.5
erosion	w	w	2
disturbance	none	none	none
soil depth(cm)	5	5	20
soil type	loamy sand	loamy sand	loamy sand
surfacecover litter (%)	5	5	20
surfacecover soil (%)	5	5	60
surfacecover rocks/gravel (%)	0	0	15
surfacecover bedrocks (%)	90	90	5
emergent species	*Stenocereus griseus*	*Cereus repandus*	*Stenocereus griseus*
emergent height (m)	3	5	5
dominant tree species	*Caesalpinia coriara*	*Caesalpinia coriara*	*Caesalpinia coriara*
dominant tree height (cm)	3	1.5	3
dominant cover(%)	s	2	3
mid layer species	*Cordia bullata, Acacia tortuosa, Passiflora foetida*	*Cordia bullata, Jatropha gossypiifolia*	*Cordia bullata*
mid layer height (cm)	120	70	50
mid layer cover(%)	4	4	2
ground species	*Cenchrus pilosus*	*Melocactus stramineus*	*Cenchrus pilosus*
ground layer height (cm)	30	30	20
ground cover(%)	NA	NA	NA
Total # species	13	19	13
Other species	*Matelea rubra, Pithecellobium unguis-cati, Jatropha gossypiifolia, Melocactus stramineus, Erithalis fruticosa, Croton flavens, Opuntia caracassana*	*Matelea rubra, Stenocereus griseus, Opuntia caracassana, Passiflora foetida, Cnidoscolus urens, Acacia tortuosa, Erithalis fruticosa, Cenchrus pilosus, Phyllanthus bothryanthus, Cyperus*	*Prosopis juliflora, Opuntia caracassana, Jatropha gossypiifolia, Acacia tortuosa, Phyllanthus bothryanthus, Passiflora foetida, Croton flavens*

		sp., Euphorbia maculata, unidentified sp. 1, unidentified sp. 2, unidentified sp. 3	
Nearby species (<10m distance)	*Lantana camara, Cnidoscolus urens*	*Croton flavens, Cordia bullata*	*Guaiacum officinale Aloe vera Cereus repandus*

Table: Code description for parameters

Cover: Braun-Blanquet scale	Codes	Erosion	Codes	Soil depth	Codes
single plant (< 5% cover)	**s**	No visible erosion	**1**	No soil	**0**
multiple (< 5% cover)	**+**	Mild erosion: some gravel or organic material piling behind barrier	**2**	Very shallow: <5 cm	**1**
many (<5%)	**1**	Severe erosion: bare roots, gullying	**3**	Shallow: 5-10 cm	**2**
5-25% cover	**2**	Weathered erosion: rock pavement visible with signs of water and wind sheered surfaces, holes in rocks, rock fragments	**w**	Moderately deep: 10-20 cm	**3**
25-50% cover	**3**	deposition	**d**	Deep: >20 cm	**4**
50-75% cover	**4**				
>75%	**5**				

Appendix 27: List of Flora recorded at Project site – Onshore

Table: Flora observed within Project site (Project Site to Barcadera)

Terrestrial**	
Latin name	**Common name**
Prosopis juliflora	Kwihi
Acacia tortuosa	Hubada
Calotropis procera	Mata di Lechi
Yellow bluestem	Yerba geel
Fetid Passsionflower	Shoshoro
Capparis Baducca	Rheed Caper

PS= Within Project Site (Parcel 1-K-4628) (C-I) (C-II) CITIES species (Appendix I /Appendix II) (S) SPAW species
*Locally protected species ** Landscaping plants are not included in this list
Becker, 2018; observed by Tatiana Becker between July and August 2018
Becker, 2021; observed by Tatiana Becker between May and August 2021

Appendix 28: Lists of Fauna recorded at Project site - Onshore

Table: Fauna observed within the Project site (Project Site to Barcadera)

Terrestrial fauna	
Latin name	**Common name**
Aedes aegypti	Asian Tiger mosquito
Ameiva bifrontata PS ***(Becker, 2018; Becker, 2021)***	Cope's Ameiva
Caelifera sp., PS (Becker, 2018; Becker, 2021)	Grasshopper sp.
Canis lupus familiaris (Becker, 2018; Becker, 2021)	Domestic dog
Cnemidophorus arubensis, PS (Becker, 2018; Becker, 2021; iNaturalist, 2021)	Aruban Whiptail Lizard
Diptera spp., PS (Becker, 2018; Becker, 2021)	Fly sp.
Columbina passerina , PS (Becker, 2018; Becker, 2021)	Common Ground-Dove
Dannaus plexxipus, ***(Becker, 2018)***	Monarch butterfly
Formicidae sp., PS (Becker, 2018; Becker, 2021)	Ant sp.
Hemidactylus frenatus ***(Becker, 2018)***	Common House gecko

Petros has studied ecosystems further downwind from its land operation. Rooi Bosal is a natural run-off which ends in the Barcadera lagoon, surrounded by natural mangrove growth. The following 2 pictures depict the area in question and the associated surroundings.

Petros is designated for the industrial park of Barcadera. Its proximity to the Rooi Bosal run-off will be detailed further in the next aerial view from this area and the location of Petros and other private operations in this area.

Petros will be tentatively located 115 meters at its closest to Rooi Bosal. It must be noted that this distance will transect another existing operation of a construction material company. This organization is crushing rocks to create aggregate materials for other construction projects and is not associated with Petros Aquaculture Operations.
Petros' land facility will be located about 100 meters from the closest mangrove growth area. Currently large mountains of aggregate material from previous operations, unknown to Petros, are located between Petros' designated land and these mangroves. Additionally, the natural slope of the area does not flow directly between these 2 areas.
The Petros pier will be located about 160 meters away from the closest mangrove growth area. This will be downwind from the pier. The vessel and pier operations mitigation plan are explained in a separate write up in this report, which focuses on the mitigation protocols to minimize/eliminate any Barcadera lagoon pollution due to vessel operations around Petros' pier.

Petros is to design and implement sustainable solutions to avoid any negative impact to the Rooi Bosal environment and its Mangrove area. The following are some of the critical solutions Petros will implement.

1. The whole property will be **secured with concrete fencing**, thus eliminating the inadvertent event that materials from the land operations leaves the Petros confines unnoticed.
2. Neither the hatchery, fish processing, or regular operation activities will generate or kick up **fine particles** (dust) into the environment beyond its property. Neither will

there be smoke or gasses generated from any regular operations on land (beyond the regular exhaust from motor boats or diesel vehicles/vans).

3. The work deck in the operations area, will apply a **recycled plastic grid**, that will be filled with **crushed aggregate**, in place of the traditional concrete or asphalt work deck. This approach does a few positive things for the environment.
    a. It uses recycled materials for the grid, which leads to a lower carbon footprint.
    b. These work decks will be permeable. Rain water will be allowed to penetrate into the ground and avoid acidification of the ground directly under the deck, and significantly limits rainwater from washing into the Barcadera lagoon.
4. **Native flora will be planted** throughout the property, especially at the end of the property closest to the lagoon. This will reduce sediment from possibly washing into the lagoon through erosion and eliminate any additional sediment washing into the properties of neighboring companies.
5. Built-in **trenched drainage system**, with industrial strainers, will be installed to capture any other items that still would have ended up in the lagoon.


Summary

Petros will go above and beyond the standard expectations to protect the environment, specially the Barcadera Lagoon and the Rooi Bosal. Petros has incorporated best-in-class design elements to minimize any loose material located on its property from inadvertently escaping into the surrounding environment. Rooi Bosal has a buffer property between itself and Petros, yet Petros will still invest capital to eliminate any possible issues from emanating from its operations.

Appendix 30: List of Locally Protected Species (AB 2017 no.48)

Table: Protected flora under Art. 1 of AB 2017 no.48

No	Species	Common Name
1	Corallinaceae	
2	Agave arubensis	Cuco di Indjan
3	Agave rutenniae	rutteniae
4	Brassavola nodosa	Orkidia di mondi
5	Bromelia humilis	Teco
6	Bursera simaruba	Palisia Cora
7	Cakile lanceolata	
8	Capparis flexueosa	Stoki / Mustard
9	Capparis indica / quadrella indica	Huliba macho
10	Castela erecta	
11	Celtis iguanaea	Beishi di Yuana
12	Ceratosanthes palmata	Batata di zumbi
13	Cissampelos pareira	Rais or Yerba di Pataka
14	Clusia rosea	
15	Condalia henriquezii	
16	Convulvus nodiflorus / jacquemontia nodiflorus	
17	Crataeva tapia	Giron
18	Cynanchum boldinghii	Mari di Palu
19	Datura stramonium	Yerba Stinki
20	Erythrina velutina	
21	Ficus brittonii	Mahawa
22	Geoffroea spinosa	Taki
23	Guaiacum sanctum	
24	Guapira fragrans	
25	Halodule wrightii	
26	Halophila baillonis	
27	Halophila decipiens	
28	Halophila engelmannii	
29	Ipomea incarnata	
30	Krugiodendron ferreum	Wayakito
31	Manihot carthaginensis	
32	Maytenus sieberiana	Palo di Colebra
33	Maytenus tetragona	
34	Metopium brownei	Manzalinja macho / Mansaniya bobo
35	Morisonia americana	Bushicuri
36	Myrmecophila humboldtii / Schomburgkia humboldtii	Banana shimaron
37	Paspalum curassavicum	
38	Pereskia guamacho	Azufro
39	Pithecellobium platylobum	
40	Pluchea carolinensis	
41	Ruppia maritima	
42	Salicornia perennis	Samphire
43	Schoepfia schreberi	Mata Combles
44	Serjania curassavica	Behuco
45	Spondias mombin	
46	Syringodium filiforme	

47	Tournefortia volubilis	
48	Trixis inula	

Table: Protected Fauna under Art. 1 of AB 2017 no.48

No	Species	Common Name
1	Class: Anthozoa	
2	Class: Hydrocorallina	
3	Order: Cetacea	Dolphins and Whales
4	Amazona barbadensis	Lora / Yellow-shouldered amazon
5	Anolis lineatus	Toteki
6	Aratinga pertinax arubensis	Prikichi
7	Athene cunicularia arubensis	Shoco
8	Buteo albicaudatus	Falc / Falki / white-tailed buzzard
9	Caretta caretta	Cawama / Loggerhead turtle
10	Chelonia mydas	Tortuga Blanco / Green turtle
11	Colinus cristatus	Patrishi
12	Columba squamosa	Blau pigeon / Paloma di baranca
13	Conus curassaviensis	
14	Cone hieroglyphus	
15	Conus wendrosi	
16	Crotalus durissus unicolor	Cascabel
17	Dermochelys coriacea	Drikil / Leatherback turtle
18	Epinephelus itajara	Djukfes / jewfish / Goliath grouper
19	Epinephelus striatus	Jakupepu / Jacupeper / Nassau grouper
20	Eretmochelys imbricata	Caret / Hawksbill turtle
21	Falco peregrinus	Falki peregrino / Peregrine Falcon / Peregrine falcon
22	Iguana iguana	Yuana
23	Lepidochelys kempii	Kemp's Ridley turtle
24	Lepidochelys olivacea	Olive Ridley turtle
25	Leptodira bakeri	Santanero / Cat-eyed snake
26	Manta birostris	Manta / Manta ray
27	Melongena melongena	Caribbean Crown conch
28	Oreaster reticulatus	Strea di lama / Red sea star cushion / West Indian sea star
29	Panulirus argus	Kreft / Caribbean Spiny Lobster
30	Pelecanus occidentalis	Rogans
31	Phoenicopterus ruber	Flamingo
32	Pleurodema brachyops	Dori
33	Poecilia vandepolli	Molly / Machuri
34	Polyborus plancus	Caracara plancus - Warawara
35	Pristis pectinata	Sawfish / Sawfish
36	Pterodroma hasitata	Black-capped petrel
37	Pteronotus davyi	Raton di anochi lomba sunu
38	Sphyrna lewini	Tribon Martieu / Scalloped Hammerhead
39	Sphyrna mokarran	Tribon Martieu / Great Hammerhead
40	Sterna antillarum	Sternchi Chikito / Least Tern
41	Sterna dougallii	Sternchi Pecho Rose
42	Strombus costatus	Calco / Milk conch
43	Strombus gallus	Calco / Rooster conch / Rooster-tail conch

44	Strombus gigas	Calco / Queen conch
45	Strombus pugilis	Calco / Fighting conch (West Indian)
46	Strombus raninus	Calco / Hawk-wing conch
47	Sylvilagus floridanus nigronuchalis	Conew / Conenchi
48	Thunnus thynnus	Buni / Tuna / Atlantic bluefin tuna

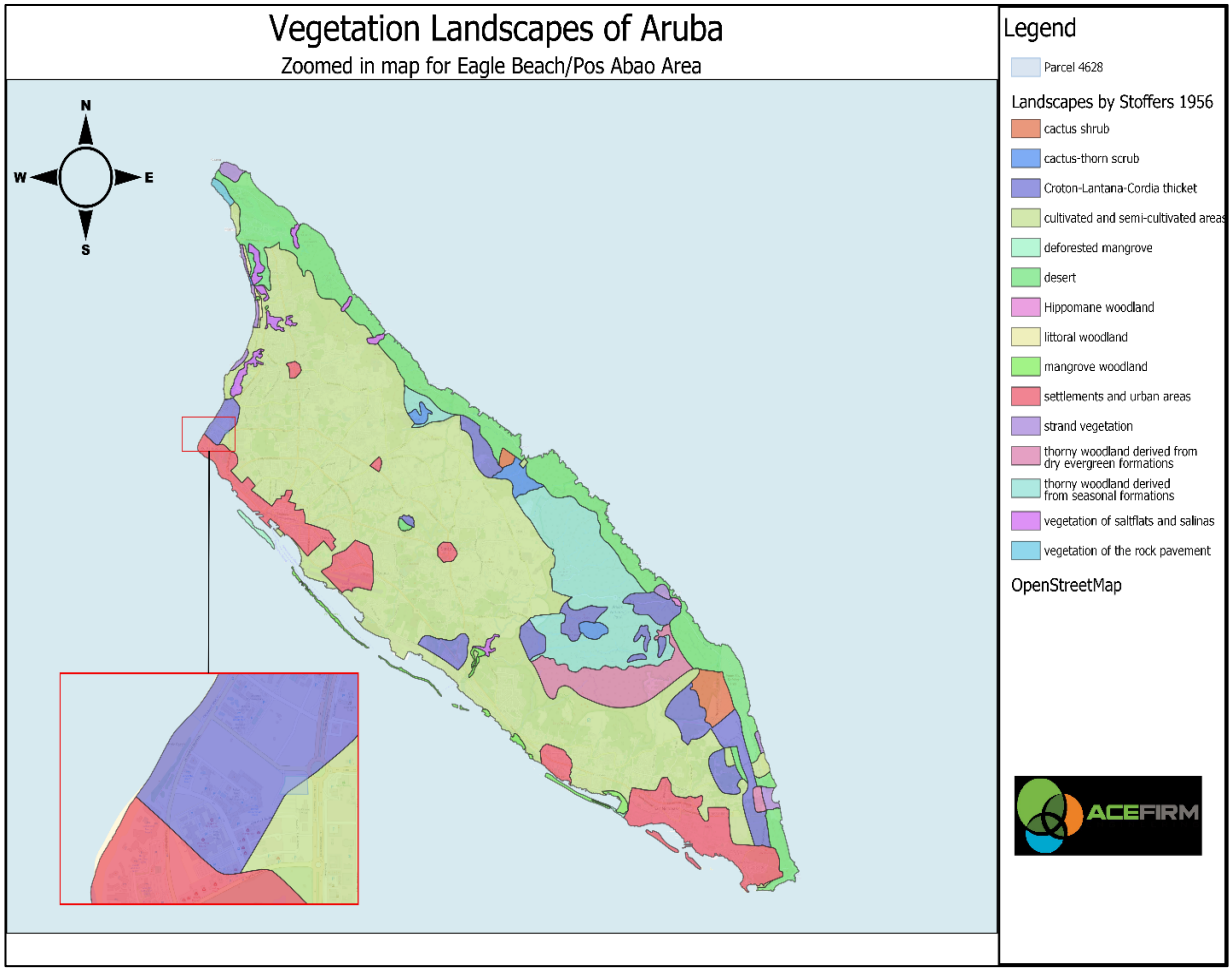
Table: Protected flora under Art. 2 of AB 2017 no.48

No	Species	Common Names
1	Acanthocereus tetragonus	Cushicuri / Cadushi di colebra
2	Avicennia germinans	Mangel Preto / Black Mangrove
3	Bursera karsteniana	
4	Bursera tomentosa	
5	Canavalia rosea	Boonchi di lama
6	Cereus repandus	Cadushi / Breba
7	Conocarpus erectus	Fofoti
8	Guapira pacurero	Macubari
9	Haematoxylum brasiletto	Mata di Brasil / Brasil / Brasia / Kam-peshi
10	Laguncularia racemosa	Mangel Shimaron / Mangel Cora / Mangel Blanco
11	Melocactus macracantus	Bushi
12	Melocactus stramineus	Bushi
13	Melocactus X Bozsingianus	Bushi
14	Opuntia caracassana	Tuna
15	Opuntia curassavica	Sumpina di colebra / Tuna di colebra
16	Pilosocereus lanuginosus / Cephalocereus lanuginosus	Cadushi pushi / Breba di pushi
17	Rhizophora mangle	Mangel Tam / Mangel / Red Mangrove
18	Sesuvium portulacastrum	
19	Stenocereus griseus	
20	Strumpfia maritima	
21	Thalassia testudinum	

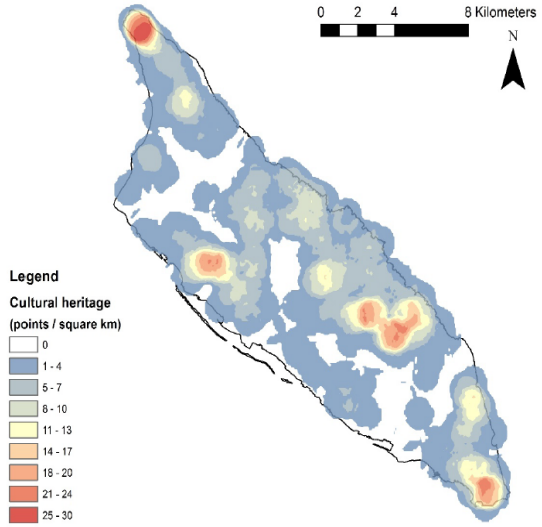
Table: Protected fauna under Art. 2 of AB 2017 no.48

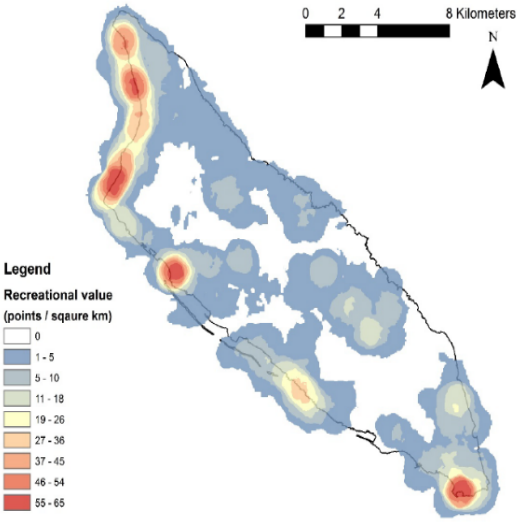
No	Species	Common Names
1	Family: Scaridae	Gutu / Parrotfish / Parrotfishes
2	Chlorostilbon mellisugus	Blenchi / Blue-tailed emerald
3	Chrysolampis mosquitus	Blenchi dornasol / Ruby-topaz hummingbird
4	Diadema antillarum	Bushi / Long-spined black sea urchin
5	Glossophaga longirostris	Raton di anochi / Leaf nosed bat
6	Leptonycteris curasoae	Raton di anochi / Curaçaoan Long-nosed Bat
7	Phyllodactylus julieni	Pega pega

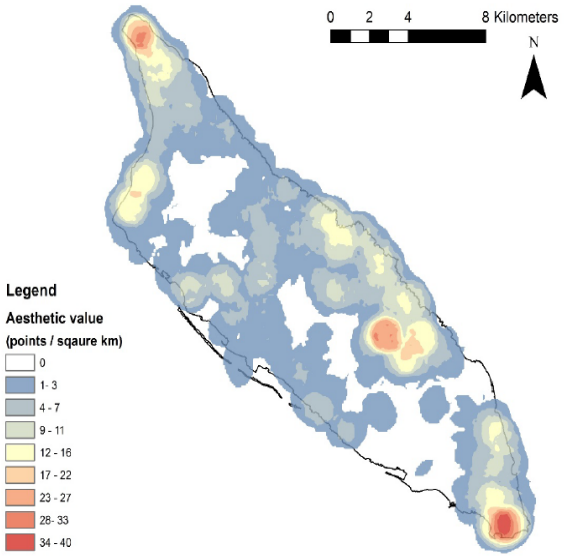
Appendix 31: Vegetation Landscapes, (Stoffers, 1956)



Map: Landscapes in Aruba categorized according to dominant vegetation, ecology and usage with a zoomed in map of project site. *Source:* (Stoffers, 1956).







MAP: Density of Cultural, Aesthetic and Recreational Value Points produced through PPGIS Hotspot Mapping in a TEEB Assessment. *Source:* (Polaszek, Lacle, van Beukering, & Wolfs, 2018)

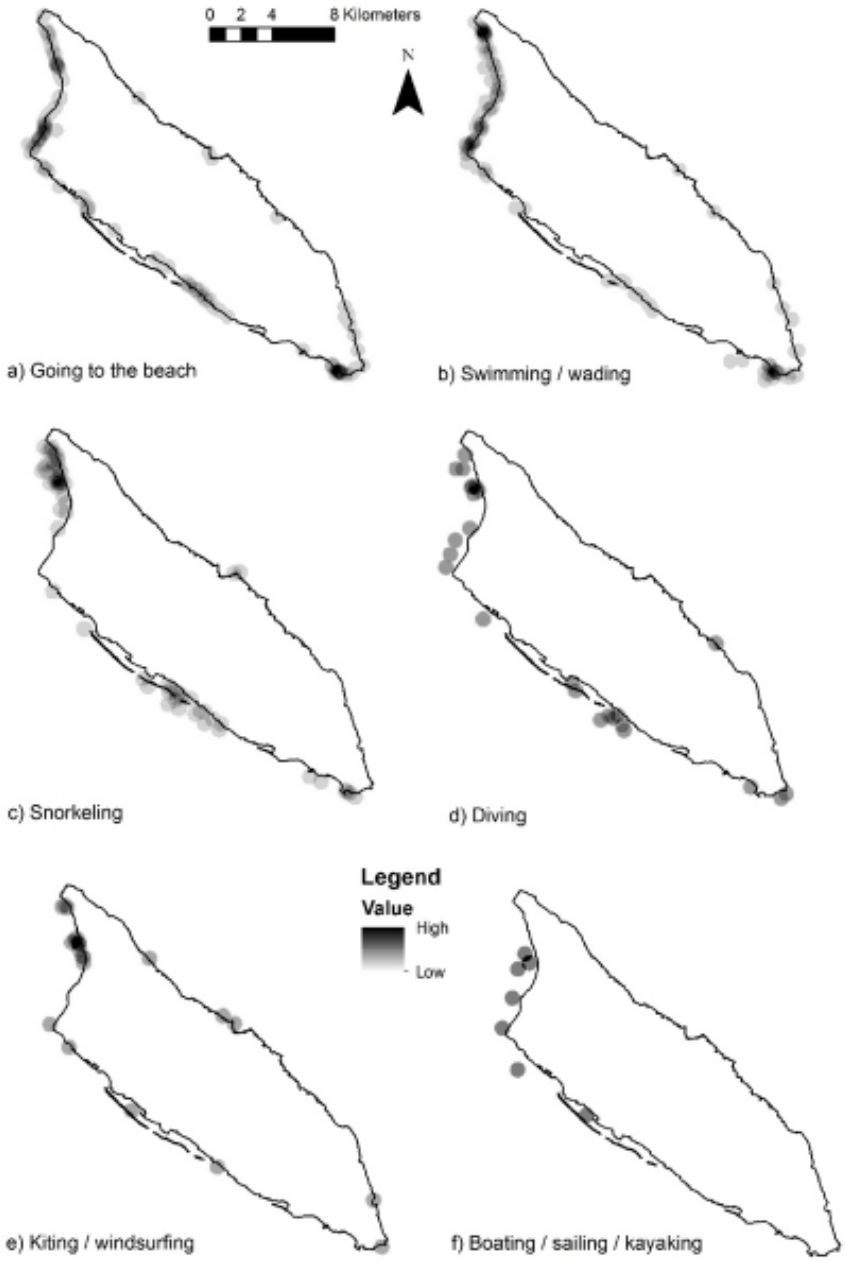


Figure: Recreational activities in the coastal zone of ARUBA, TEEB (2018)

Appendix 33: Appropriate Technologies, Design & Construction Stage, Scenario I,

Table - Design Stage BETs

Aspect	General Features	Examples of Appropriate Technologies
Natural assets (includes Flora and Fauna)	• habitat creation/preservation	• transplantation of protected cacti (Appendix 38) and high value species • planting wide variety of xeric native and non-invasive species (to determine if a species is introduced or not, refer to: the Dutch Caribbean Species Register, "De inheemse bomen van de benedenwindse Eilanden (Curacao,Bonaire en Aruba)" (1996), "Arnoldo's Zakflora, Wat in het wild groeit en bloeit op Aruba, Bonaire en Curacao"(2012) • Artificial Burrows[3] • Bathouses[4] • raised boardwalks and deck areas • fencing
	• eco-friendly and bio-degradable	• eco-certified non-toxic materials (e.g. Green Seal products, Greengard, Scientific Certification Systems, FSC)
	• hazard reduction	• non-reflective glass (e.g. fritted glass, frosted glass, dichroic glass) • screens or netting in outdoor dining areas
	• integrated pest management	• screens or netting in outdoor dining areas • enclosed waste storage spaces and containers
Nuisances	• noise attenuation	• low-noise/silent[5] and small-sized equipment • enclosed equipment (e.g. pump systems, generators, chillers, etc.) • hermetic buildings and acoustic enclosures • shelterbelt (dense trees and bushes surrounding the property) • noise absorbing materials in building (e.g. fibers, foam) and landscaping (e.g. mulch) • vibration springs and acoustic absorbents for noisy vibrating equipment (e.g. pump systems, generators, chillers, etc.) • silent plumbing system (e.g. cast-iron piping, large diameter pipes) • silent doors, windows and floors (e.g. silentguard, weatherstripping, et.c) • sound attenuating devices (for equipment) • manual landscaping tools
	• dark sky	• lighting as specified in Appendix 37 • low mounted lights • dimmers and motion sensors to reduce light • lights with color temperature below 3000 K (yellow-hued) • low intensity/wattage lighting • lights with the lowest possible glare rating BUG (backlight, up light, glare) • (down-ward) directed lights (away from natural areas) • solar (garden) lights
	• dust attenuation	• pavement or vegetation cover (non-exposed soil)
Air and Climate	• microclimate/energy saving	• fixed overhangs or awnings • ventilated roof space/void/lining • stack effect or wind-induced ventilation • natural lighting (e.g. skilights) • light dimmers • vegetated roofs, walls, terraces, parking lots • shading vegetation • tinted glass • GrassCrete • high reflectance finishing/light colored paints • ceiling isolation (radiant barrier, insulation bats/rolls with natural fibers) • insulated piping • moveable curtains or blinds • EU energy label or Energy star label equipment • high efficiency equipment for HVAC, pools and lighting

[3] FPNA have successfully installed artificial burrows for the Aruban Burrowing Owl around the island

[4] https://wiatri.net/inventory/bats/aboutBats/pdf/BuildingBatHouses.pdf

[5] https://www.quietmark.com/

		• programmable pump systems (pool and fountains) • (smart) central air system and lighting installation with automatic switches (sensors for automatic shut-off when people leave room) • consumption monitoring sensors/meters in each operation area • structural insulated panels • induction cooking and convection ovens • lights with color temperature below 3000 K • (double) insulated windows and doors (e.g. weather stripping) • ceiling fans in transition areas and common space areas • gravity-based technologies (i.e. plumbing, irrigation system, etc.)
	• pollution reduction (non-dust related)	• eco-certified materials (e.g. Green Seal products, Greenguard, Scientific Certification Systems, FSC, etc.) • non-VOC coatings (e.g. non-formaldehyde coatings) • monitoring sensors • medical waste incinerator with add-on air pollution control devices • sludge waste incinerator with add-on air pollution control devices
	• alternative energy	• solar panels and cells • solar heaters • electrical equipment as opposed to fuel-based equipment (e.g. rechargeable, etc.) • electric charging station for electric car • electric company cars • solar (garden) lights • solar attic fans • biogas from organic waste (anaerobic digester)
Waste	• waste reduction	• anaerobic digester for compostable waste • reclaimed soil and bedrock • recycled construction materials (bricks/concrete pavers/asphalt) • mulch mower (use chipped pallets or chipped reclaimed acacia wood) • soap, shampoo, toilet paper dispensers • water-bottle filling stations • medical waste incinerator with add-on air pollution control devices
	• waste separation	• labeled waste containers (organic waste, carton, household waste, plastics, medical waste)
	• litter prevention	• mesh fencing surrounding property • enclosure for waste storages
	• replaceable	• modular building designs • prefabricated materials (e.g. precast concrete, prefabricates steel)
Water	• water-saving technologies	• water efficient installations (for showers, sinks, fountains, pools, toilets); the European Water Label or watersense[6] • low-capacity to overflow, low-flow fixtures and flow regulators, faucet aerators, jet spray • low-flush or dual flush toilets • self-closing taps, especially in common use areas • on-site waste water treatment plants • smart/automated irrigation systems • sprinkler/drip irrigation systems • recirculating pumps (fountains) • channeling and rainwater collection systems • pool cover • monitoring sensors/meters in each operation area • grey and rain water collection and distribution systems
	• water quality management	• eco-certified building materials (e.g. Green Seal, Greenguard, Scientific Certification Systems, FCS, etc.) • double protected plumbing systems • spill containment products (e.g. spill kits, spill containment platforms, spill berms, spill buckets, spill trays) • selective pesticides and herbicides • plant-based repellents (e.g. Orange guard), • biological control agents (e.g. beneficial insects, diatomaceous earth) • grease traps and oil skimmers • saltwater or chlorine-free pool and fountain systems • filter systems (pools and fountains) • bioretention ponds

[6] https://www.epa.gov/watersense/watersense-products

	• storm water management	• rainwater collector and distribution systems • grassed swales • bioretention ponds • GrassCrete • vegetated roof
	• recycling/reuse	• treated wastewater and greywater irrigation systems • greywater toilet systems
Soil erosion	• storm water management	• channels, grass/vegetated swales • bioretention pond
	• soil generation	• reclaimed soil (e.g. land clearing and excavation)
Health & Safety	• sanitation	• sanitizing stations with 70% alcohol • UV air disinfection systems (HVAC)
	• hazard reduction	• exit paths and emergency plan signs • uncomplicated building layout • fire extinguishers • fire suppression systems • fire hydrants • smoke control systems • fireproofing materials • designated hazardous chemicals storage areas • designated hazardous waste storage area • refuge area • warning signs • medical waste incinerator with add-on air pollution control devices
	• ventilation	• local exhaust ventilation (extraction ventilation) in workshop areas • non-enclosed workspaces

Table - Construction Stage BETs

Aspect	General Features	Examples of Appropriate Technologies
Natural assets (includes Flora and Fauna)	• non-toxic, eco-friendly	• eco-certified products and materials (e.g. Green Seal products, Greengard, Scientific Certification Systems) • non-toxic glues, adhesives
	• hazard reduction	• small-sized, precise equipment and machinery • manual landscaping tools • geo-radar (i.e. non-intrusive survey method) if accessible as opposed to geotechnical borings
	• integrated pest management	• enclosed/covered/closed-top waste containers
Nuisances	• noise attenuation	• portable noise barriers for construction workers • low-noise/silent[7], small-sized equipment and machinery • enclosed equipment (e.g. pump systems, generators, chillers, etc.) • earth bund (from excavated soil) around construction site • vibration springs for noisy vibrating equipment (e.g. pump systems, generators, chillers, etc.) • sound attenuating devices on equipment and machinery • manual landscaping tools • geo-radar (i.e. non-intrusive survey method) as opposed to geotechnical borings
	• ear protection	• earmuffs and earplugs
	• dark sky	• low mounted lights • lights with color temperature below 3000 K (yellow-hued) • low intensity/wattage lighting • lights with the lowest possible glare rating BUG (backlight, up light, glare) • (down-ward) directed lights (away from natural areas)
	• dust attenuation	• dust screens/shrouds (higher than the height of stockpiles) around project site • pavement of access paths (e.g. open concrete grid, permeable pavers, recycled asphalt or concrete) • cover or enclosure for excavated or dust-producing material • wet suppression
	• lung protection	• respirator

[7] https://www.quietmark.com/

Air and Climate	• pollution reducing (non-dust related)	• eco-certified products (e.g. Green Seal products, Greenguard, Scientific Certification Systems, etc.) • non-VOC coatings (e.g. non-formaldehyde coatings) • electrical equipment as opposed to fuel-based equipment (e.g. rechargeable, etc.) • non-petroleum hydraulic fluids • ventilated workspace
	• local products	• local construction materials
	• energy use	• grid connection[8]
Waste	• waste separation	• labeled waste containers (organic waste, carton, household waste, construction waste, plastics)[9]
	• litter prevention	• enclosed/covered/closed-top waste containers. • enclosed/covered waste collection trucks
Water	• storm water management	• filter barrier downstream (silt fence, fiber rolls) • rainwater collection tanks
	• sanitation	• portable toilets
	• water quality management	• biodegradable (plant-based) hydraulic fluids (ISO 32, ISO 46, and ISO 68), lubricants • spill containment products (e.g. spill kits, spill containment platforms, spill berms, spill buckets, spill trays) • selective pesticides and herbicides • biological pest control (e.g. predator habitat-enhancement) as opposed to chemical pest control • precise (measuring) equipment • precise fillers
Soil erosion	• soil reuse	• storage (container) for reclaimable soil
	• soil containment	• filter barrier downstream (silt fence, fiber rolls)
Health & Safety	• protective gear	• PPE (i.e. hardhat, glasses, vest, boots, neoprene gloves, respirator, ear plugs, ear muffs, face shield, overalls) for construction workers
	• sanitation	• sanitizing stations with 70% alcohol
	• hazard reduction	• edge protection system (e.g. mesh barrier system) • low solvent adhesives • water-based paints • non-toxic glues • prefabricated materials • welding screens • barriers/boundary lines • fire extinguishers
	• ventilation	• non-enclosed workspaces • local exhaust ventilation (extraction ventilation)

[8] Consult ELMAR if this is feasible before the start of the construction process

[9] Due to Aruba's continuous development in the waste management industry it is possible that more types waste separation options will become available in the near future

Appendix 34: Appropriate Technologies, Operation Stage, Scenario I

Table - Operation Stage BETs

Aspect	General Features	Examples of Appropriate Technologies
Natural assets (includes Flora and Fauna	• eco-friendly and biodegradable	• eco-certified non-toxic products and materials (e.g. Green Seal products, Greenguard, Scientific Certification Systems, USDA Organic, FSC , MSC, etc.)
	• hazard reduction	• pool cover • screens or netting in outdoor dining areas
	• integrated pest management	• species-specific pest control (non-broad-spectrum pesticides) • plant-based repellents (e.g. Orange guard), biological control agents (e.g. beneficial insects, diatomaceous earth, larvacides with Bti or Bsp) • screens or netting in outdoor dining areas
Nuisances	• noise attenuation	• low-noise/silent[10], small-sized appliances • acoustic enclosures • noise absorbing materials (e.g. floor mats) • vibration springs and acoustic absorbents for noisy vibrating appliances • sound attenuating devices for appliances • manual landscaping tools
	• dark sky	• lights with color temperature below 3000 K (yellow-hued) • low intensity/wattage lighting • lights with the lowest possible glare rating BUG (backlight, up light, glare) • curtain/blinds
Air and Climate	• energy saving	• low-energy appliances (e.g. fans, pressure-cookers, etc...) with energy star[11] label or A+/A++/A+++ energy EU saving ratings • LED lights • induction cooking ware • pressure cookers • curtains/blinds • light colored/highly reflective finishing
	• alternative energy	• alternative energy appliances (e.g. water-powered clocks solar generators, solar chargers) • electric company cars • biogas
	• pollution reduction (non-dust related)	• eco-certified non-toxic products and materials (e.g. Green Seal products, Greenguard, Scientific Certification Systems, USDA Organic, FSC, MSC, etc.) • non-VOC coatings (e.g. non-formaldehyde coatings)
Waste	• waste separation	• labeled waste containers/bins (organic waste, carton, household waste, plastics) [12]
	• waste reduction	• worm composter bin • fabric towels • reusable bags • reusable branded water bottles • reusable keycards • reusable drink, food and silverware • beverage and food dispensers • precise measuring equipment
	• litter prevention	• enclosed/covered/closed-top waste containers • enclosed/covered waste collection trucks
	• replaceable	• modular appliances
Water	• water-saving technologies	• water efficient appliances (the European Water Label with low-capacity to overflow or Watersense[13])
	• water quality management	• spill containment products (e.g. spill buckets, spill trays) • eco-certified/non-toxic/bio-degradable products and materials (e.g. Green Seal products, Greenguard, Scientific Certification Systems, USDA Organic, FSC, MSC, etc.) • compost/fertilizer (e.g. from organic waste)

[10] https://www.quietmark.com/

[11] https://www.energystar.gov/products?s=mega

[12] Due to Aruba's continuous development in the waste management industry it is possible that more types waste separation options will become available in the near future

[13] https://www.epa.gov/watersense/watersense-products

		• selective pesticides and herbicides • plant-based repellents (e.g. Orange guard), biological control agents (e.g. beneficial insects, diatomaceous earth) • plant-based hydraulic fluids • precise measuring equipment
Soil Erosion	• soil generation	• compost • mulch mower (e.g. waste wood, woodchips, etc.) • gravel • vegetation cover
Cultural historical	• vibration attenuation	• vibration springs for vibrating equipment and machinery
Health & Safety	• protective gear	• PPE based on function (e.g. maintenance)
	• sanitation	• sanitizing stations with 70% alcohol
	• hazard reduction	• fire extinguishers

Appendix 35: Appropriate Technologies, Design & Construction Stage, Scenario II

Table - Design Stage BETs

Aspect	General Features	Examples of Appropriate Technologies
Natural assets (includes Flora and Fauna)	• habitat creation/preservation	• transplantation • proposed native species *Chrysobalanus icaco, Conocarpus erecta, Malpighia emarginata, Pithecellobium unguis-cati, Quadrella odoratissima, Coccoloba swartzii, Terminalia buceras*
	• eco-friendly	• eco-certified pragmatic materials (especially EU certified)
	• integrated pest management	• enclosed waste storage spaces and containers
Nuisances	• noise attenuation	• enclosed equipment (generators, control room) • vibration springs for noisy vibrating equipment (e.g. pump systems, generators, chillers, etc.)
	• dark sky	• lighting as specified in Appendix 37 • low mounted lights • lights with color temperature below 3000 K (yellow-hued) • low intensity/wattage lighting • lights with the lowest possible glare rating BUG (backlight, up light, glare) • (down-ward) directed lights (away from natural areas)
	• dust attenuation	• pavement and vegetation cover (non-exposed soil)
Air and Climate	• microclimate/energy saving	• fixed overhangs • wind-induced ventilation. • natural lighting (large windows, transitional spaces) • vegetated roofs, walls, terraces, parking lots, pergolas • EU energy label equipment • high efficiency equipment for HVAC, pools and lighting • programmable pump systems (pool and fountains) • (smart) central air system • lights with color temperature below 3000 K • double insulated windows and doors • transitional façade
	• pollution reduction (non-dust related)	• eco-certified pragmatic materials (especially EU certified) • medical waste incinerator
	• alternative energy	• solar panels (partly off-grid, e.g., SOLVIS SV72 E photovoltaic modules) • solar heaters
Waste	• waste reduction	• reclaimed soil and bedrock • medical waste incinerator
	• waste separation	• labeled waste containers (household waste, carton, medical waste)
	• litter prevention	• enclosure for waste storage spaces and containers
Water	• water-saving technologies	• water efficient installations with the European Water Label • on-site wastewater treatment plants (possibly AquaTec) • rainwater collection systems • grey and rainwater collection and distribution systems
	• water quality management	• eco-certified pragmatic materials (especially EU certified) • grease traps • eco-friendly pragmatic pools • filter systems (pools and fountains)
	• storm water management	• rainwater collector and distribution systems • vegetated roof
	• recycling/reuse	• treated wastewater and greywater irrigation systems • greywater toilet systems
Soil erosion	• soil generation	• reclaimed soil (e.g. land clearing and excavation)
Health & Safety	• sanitation	• sanitizing stations with 70% alcohol • UV air disinfection systems (HVAC)
	• hazard reduction	• exit paths and emergency plan signs • uncomplicated building layout • fire extinguishers • fire suppression systems • fire hydrants • warning signs

		• medical waste incinerator
	• ventilation	• local exhaust ventilation (extraction ventilation) in workshop areas • non-enclosed workspaces

Table - Construction Stage BETs

Aspect	General Features	Examples of Appropriate Technologies
Natural assets (includes Flora and Fauna)	• non-toxic, eco-friendly	• eco-certified pragmatic materials (especially EU certified)
	• integrated pest management	• enclosed/covered/closed-top waste containers
Nuisances	• ear protection	• earmuffs and earplugs
	• dark sky	• low mounted lights • lights with color temperature below 3000 K (yellow-hued) • low intensity/wattage lighting • lights with the lowest possible glare rating BUG (backlight, up light, glare) • (down-ward) directed lights (away from natural areas)
	• dust attenuation	• dust screens/shrouds around project site • pavement of access paths
	• lung protection	• respirator
Air and Climate	• pollution reducing (non-dust related)	• eco-certified pragmatic materials (especially EU certified)
Waste	• waste separation	• labeled waste containers (organic waste, carton, household waste, construction waste, plastics) [14]
	• litter prevention	• enclosed/covered/closed-top waste containers • enclosed/covered waste collection trucks
Water	• sanitation	• portable toilets
	• water quality management	• eco-certified pragmatic materials (especially EU certified)
Soil erosion	• soil reuse	• storage (container) for reclaimable soil
Health & Safety	• protective gear	• PPE (i.e. hardhat, glasses, vest, boots, neoprene gloves, respirator, ear plugs, ear muffs, face shield, overalls) for construction workers
	• sanitation	• sanitizing stations with 70% alcohol

[14] Due to Aruba's continuous development in the waste management industry it is possible that more types waste separation options will become available in the near future

Appendix 36: Appropriate Technologies, Operation Phase, Scenario II

Table - Operation Stage BETs

Aspect	General Features	Examples of Appropriate Technologies
Natural assets (includes Flora and Fauna	• eco-friendly and biodegradable	• eco-certified pragmatic products (especially EU certified)
Nuisances	• noise attenuation	• vibration springs for vibrating appliances
	• dark sky	• lights with color temperature below 3000 K (yellow-hued) • low intensity/wattage lighting • lights with the lowest possible glare rating BUG (backlight, up light, glare curtain/blinds)
Air and Climate	• energy saving	• low-energy appliances with energy EU saving ratings • LED lights • curtains/blinds
	• pollution reduction (non-dust related)	• eco-certified pragmatic products (especially EU certified)
Waste	• waste separation	• labeled waste containers/bins (organic waste, carton, household waste, plastics)
	• litter prevention	• enclosed/covered/closed-top waste containers • enclosed/covered waste collection trucks
Water	• water-saving technologies	• water efficient appliances (the European Water Label with low capacity to overflow or Watersense[15])
	• water quality management	• eco-certified pragmatic products (especially EU certified)
Soil Erosion	• soil generation	• compost • gravel • vegetation cover • mulch
Cultural historical	• vibration attenuation	• vibration springs for vibrating appliances
Health & Safety	• protective gear	• PPE based on function (e.g. maintenance)
	• sanitation	• sanitizing stations with 70% alcohol
	• hazard reduction	• fire extinguishers

[15] https://www.epa.gov/watersense/watersense-products

APPENDIX E

Diagrams of common lighting fixtures showing mounting position, light distribution, and overall suitability for use near sea turtle nesting beaches. For purposes of recommending suitable mounting distances from nesting beaches, the crest of the primary dune is considered to be the landward limit of the beach. Fixtures are assessed for their suitability in minimizing direct and indirect lighting of the beach. For all fixtures, glowing portions of luminaires (including reflectors and globes) should not be visible from the nesting beach.

WALL-MOUNTED AREA LIGHTING

MOUNTING SUITABILITY:

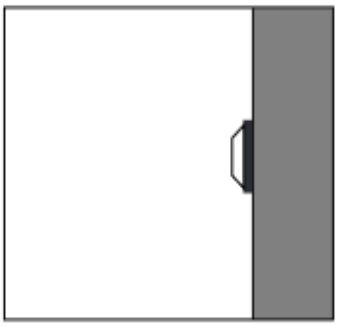
Poor. Very poor when mounted on upper stories.

DIRECTIONAL SUITABILITY:

Poor.

OVERALL SUITABILITY:

Poor. Not suitable for the beach sides of buildings.



WALL-MOUNTED AREA LIGHTING, "WALL PAK"

MOUNTING SUITABILITY:

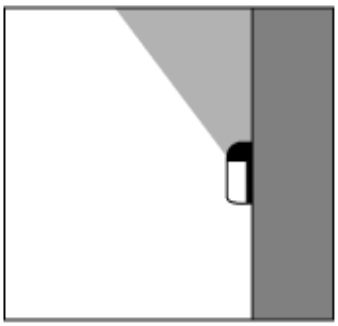
Poor. Very poor when mounted on upper stories.

DIRECTIONAL SUITABILITY:

Poor.

OVERALL SUITABILITY:

Poor. Not suitable for the beach sides of buildings.



DECORATIVE CUBE LIGHT

MOUNTING SUITABILITY:

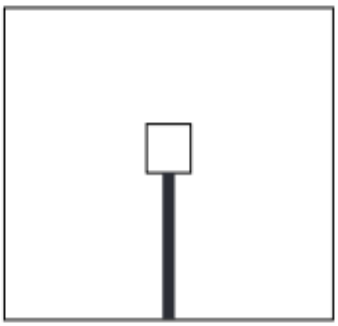
Fair if mounted at heights lower than 2 m. Poor if mounted higher.

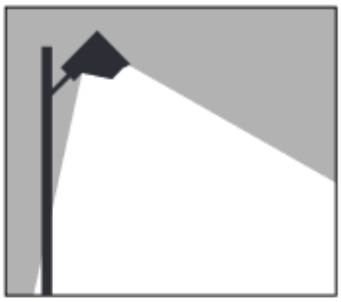
DIRECTIONAL SUITABILITY:

Very poor.

OVERALL SUITABILITY:

Very poor. This fixture is difficult to shield and should not be used near nesting beaches.





POLE-MOUNTED FLOODLIGHTING WITH FULL VISOR

MOUNTING SUITABILITY:

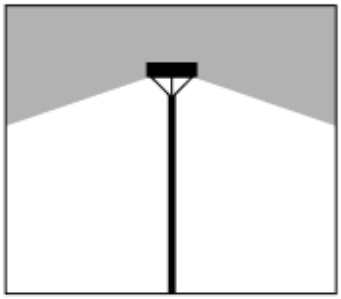
Good if directed downward and away from the beach.

DIRECTIONAL SUITABILITY:

Good.

OVERALL SUITABILITY:

Good if directed downward and away from the nesting beach and if light does not illuminate objects visible from the beach.



POLE-TOP-MOUNTED CUTOFF LIGHTING, "SHOEBOX" FIXTURE

MOUNTING SUITABILITY:

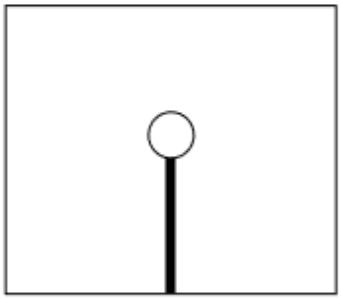
Good to poor, depending on mounting height. Mounting height should be no more than 5 m within 100 m of a nesting beach.

DIRECTIONAL SUITABILITY:

Fair to good, as determined by reflectors.

OVERALL SUITABILITY:

Fair to good when mounting heights are low.



DECORATIVE GLOBE LIGHT

MOUNTING SUITABILITY:

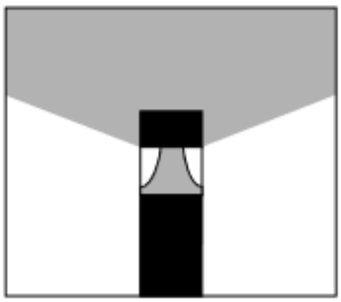
Fair if mounted at heights lower than 2 m. Poor if mounted higher.

DIRECTIONAL SUITABILITY:

Very poor.

OVERALL SUITABILITY:

Very poor. This fixture is difficult to shield and should not be used near nesting beaches.



LIGHTING BOLLARD WITH HIDDEN LAMP

MOUNTING SUITABILITY:

Good if mounting height is near 1 m.

DIRECTIONAL SUITABILITY:

Poor to fair.

OVERALL SUITABILITY:

Fair. Good if additional shields on the beach side of the fixture are used.

LOW-LEVEL "MUSHROOM" LIGHTING

MOUNTING SUITABILITY:

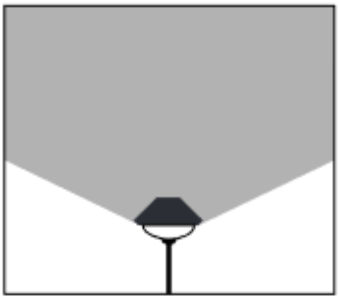
Good if mounted at foot level.

DIRECTIONAL SUITABILITY:

Poor.

OVERALL SUITABILITY:

Fair. Good to excellent if used so that vegetation and topography block its light from the beach.



LOW-LEVEL "TIER" LIGHTING

MOUNTING SUITABILITY:

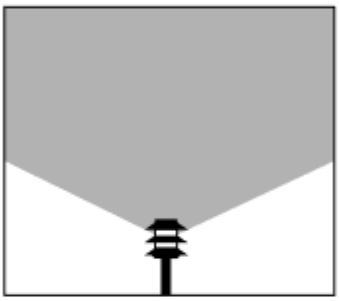
Good if mounted at foot level.

DIRECTIONAL SUITABILITY:

Poor but can be good if the fixture has louvers that eliminate lateral light.

OVERALL SUITABILITY:

Fair. Good to excellent if used so that vegetation and topography block its light from the beach.



LIGHTING BOLLARD WITH LOUVERS

MOUNTING SUITABILITY:

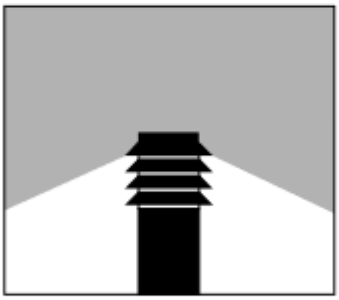
Good if mounting height is near 1 m.

DIRECTIONAL SUITABILITY:

Good.

OVERALL SUITABILITY:

Good.



GROUND-MOUNTED FLOODLIGHTING

MOUNTING SUITABILITY:

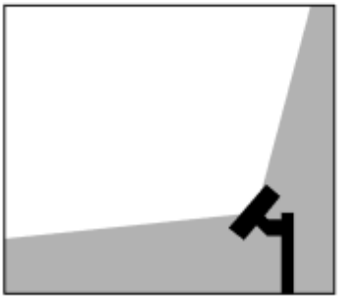
Poor, because of its upward aim.

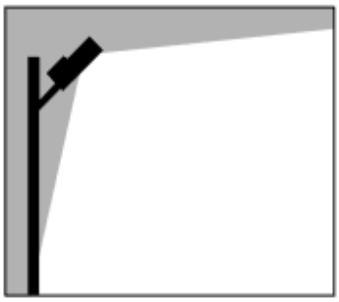
DIRECTIONAL SUITABILITY:

Fair to good.

OVERALL SUITABILITY:

Fair to poor if directed away from the beach. Very poor if directed toward the beach.





POLE-MOUNTED FLOODLIGHTING

MOUNTING SUITABILITY:

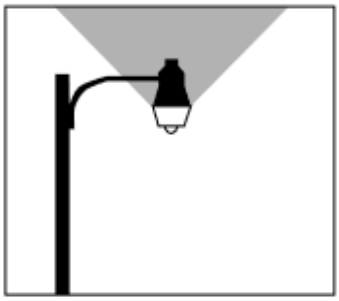
Fair if directed downward and away from the beach.

DIRECTIONAL SUITABILITY:

Fair to good.

OVERALL SUITABILITY:

Fair to good if aimed downward and directly away from the nesting beach and if light does not illuminate objects visible from the beach. Otherwise, poor to very poor.



ARM-MOUNTED AREA LIGHTING, "OPEN-BOTTOM" OR "BARN LIGHT" FIXTURE

MOUNTING SUITABILITY:

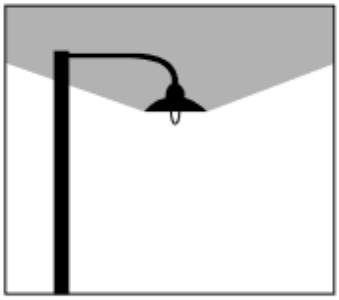
Poor to very poor, depending upon mounting height. Should not be mounted higher than 5 m within 150 m of a nesting beach.

DIRECTIONAL SUITABILITY:

Poor if unshielded. Fair if shielded.

OVERALL SUITABILITY:

Poor.



ARM-MOUNTED AREA LIGHTING, DECORATIVE "PENDANT" FIXTURE

MOUNTING SUITABILITY:

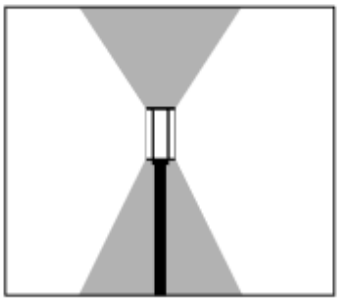
Poor to very poor, depending upon mounting height. Should not be mounted higher than 5 m within 150 m of a nesting beach.

DIRECTIONAL SUITABILITY:

Poor. Difficult to shield properly.

OVERALL SUITABILITY:

Poor.



DECORATIVE "CARRIAGE" LIGHTING

MOUNTING SUITABILITY:

Fair if mounted at heights lower than 2 m. Poor if mounted higher.

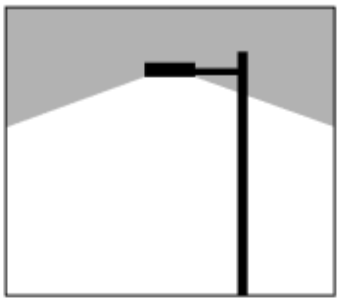
DIRECTIONAL SUITABILITY:

Very poor. Fair if properly shielded.

OVERALL SUITABILITY:

Poor.

ARM-MOUNTED CUTOFF LIGHTING, "SHOEBOX" FIXTURE



MOUNTING SUITABILITY:

Good to poor, depending on mounting height. Mounting height should be no more than 5 m within 100 m of a nesting beach.

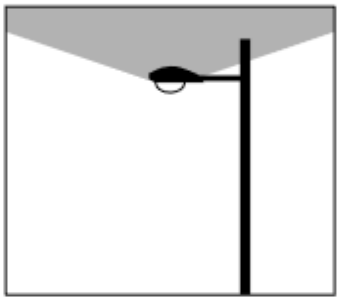
DIRECTIONAL SUITABILITY:

Fair to good, as determined by reflectors.

OVERALL SUITABILITY:

Fair to good when mounting heights are low and fixtures are aimed directly downward.

ARM-MOUNTED AREA LIGHTING, "COBRAHEAD" FIXTURE



MOUNTING SUITABILITY:

Poor to very poor, depending on mounting height. Mounting height should be no more than 5 m within 150 m of a nesting beach.

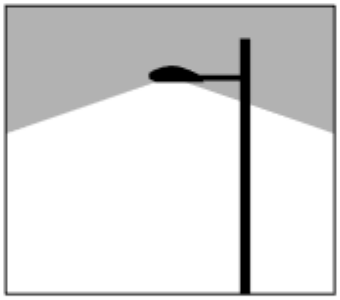
DIRECTIONAL SUITABILITY:

Poor. Difficult to shield properly.

OVERALL SUITABILITY:

Poor.

ARM-MOUNTED AREA LIGHTING, "FLAT-FACE" CUTOFF FIXTURE



MOUNTING SUITABILITY:

Good to poor, depending on pole height. Mounting height should be no more than 5 m within 100 m of a nesting beach.

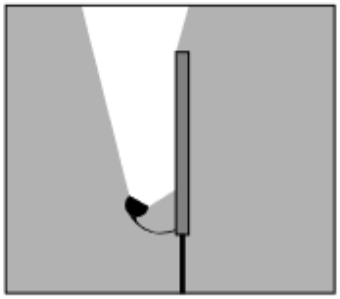
DIRECTIONAL SUITABILITY:

Fair to good, as determined by reflectors.

OVERALL SUITABILITY:

Fair to good when mounting heights are low.

SIGN LIGHTING, BOTTOM-UP STYLE



MOUNTING SUITABILITY:

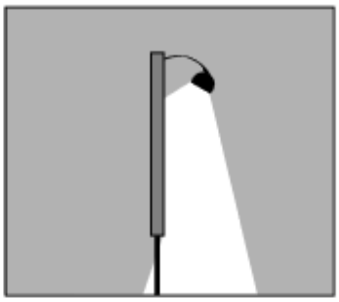
Poor, because of its potential for producing uplight scatter.

DIRECTIONAL SUITABILITY:

Poor to good.

OVERALL SUITABILITY:

Poor. Signs near nesting beaches should be lighted from the top down. In no case should lighted signs be visible from the beach.



SIGN LIGHTING, TOP-DOWN STYLE

MOUNTING SUITABILITY:

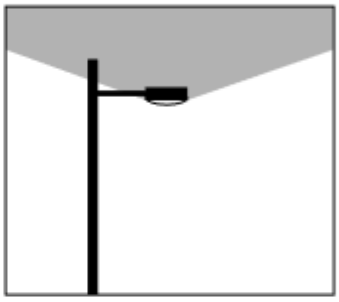
Good.

DIRECTIONAL SUITABILITY:

Poor to good.

OVERALL SUITABILITY:

Generally good if the sign is not visible from the beach and if the lighting is well aimed.



ARM-MOUNTED AREA LIGHTING, FIXTURES WITH REFRACTING GLOBES OR CONVEX LENSES

MOUNTING SUITABILITY:

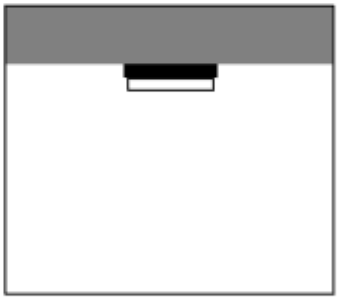
Poor to very poor, depending upon mounting height. Mounting height should be no more than 5 m within 150 m of a nesting beach.

DIRECTIONAL SUITABILITY:

Poor. Fair to good if shielded properly.

OVERALL SUITABILITY:

Poor.



CEILING-MOUNTED AREA LIGHTING, FIXTURES WITH REFRACTING GLOBES OR CONVEX LENSES

MOUNTING SUITABILITY:

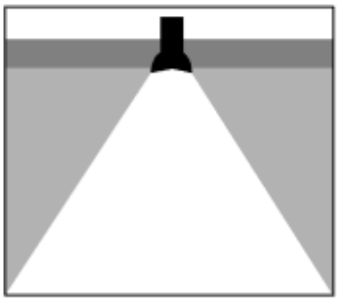
Poor if mounted on the beach sides of buildings or on upper stories. Good if shielded from the beach by buildings.

DIRECTIONAL SUITABILITY:

Poor.

OVERALL SUITABILITY:

Poor to fair, depending upon mounting location.



CEILING-RECESSED DOWNLIGHTING WITH BAFFLES TO ELIMINATE LATERAL LIGHT

MOUNTING SUITABILITY:

Good to excellent when mounted in lower-story ceilings and soffits.

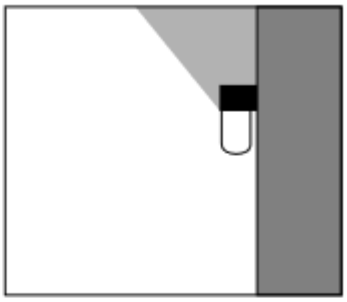
DIRECTIONAL SUITABILITY:

Excellent.

OVERALL SUITABILITY:

Good to excellent.

WALL-MOUNTED AREA LIGHTING, "JELLY-JAR" PORCH LIGHT FIXTURE



MOUNTING SUITABILITY:

Poor. Very poor when mounted on upper stories.

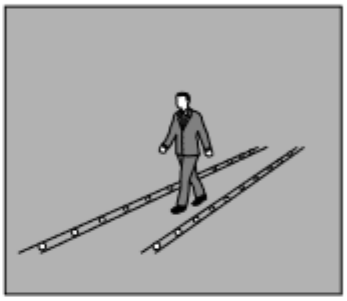
DIRECTIONAL SUITABILITY:

Poor.

OVERALL SUITABILITY:

Poor.

LINEAR TUBE LIGHTING



MOUNTING SUITABILITY:

Excellent if mounted at foot level.

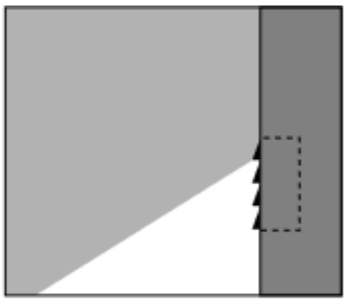
DIRECTIONAL SUITABILITY:

Fair to poor, but this lighting is of concern only if mounted high or if large numbers of high-wattage (>3 W) lamps are used.

OVERALL SUITABILITY:

Excellent if low-wattage strips are used sparingly in recessed areas.

LOUVERED STEP LIGHTING



MOUNTING SUITABILITY:

Excellent if mounted at foot level.

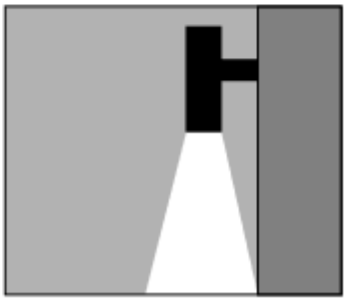
DIRECTIONAL SUITABILITY:

Excellent.

OVERALL SUITABILITY:

Excellent.

WALL-MOUNTED DOWNLIGHTING



MOUNTING SUITABILITY:

Good to excellent when mounted on lower-story walls.

DIRECTIONAL SUITABILITY:

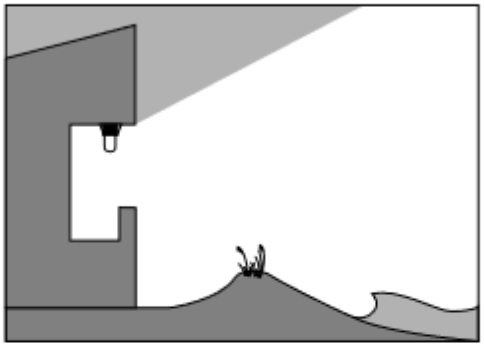
Excellent.

OVERALL SUITABILITY:

Good to excellent.

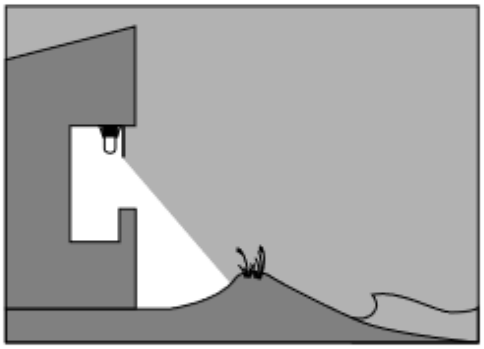
APPENDIX F

Diagrams depicting solutions to two common lighting problems near sea turtle nesting beaches: balcony or porch lighting and parking-lot lighting.



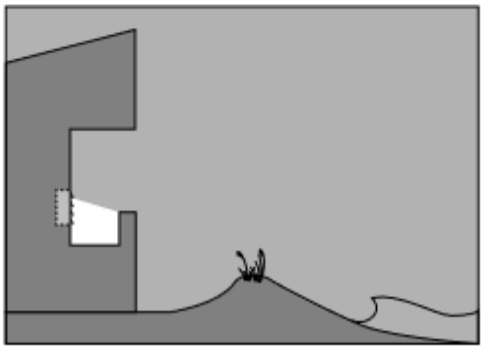
POOR

Poorly directed balcony lighting can cause problems on sea turtle nesting beaches.



BETTER

Completely shielding fixtures with a sheet of metal flashing can reduce stray light reaching the beach.



BEST

Louvered step lighting is one of the best ways to light balconies that are visible from nesting beaches.

Appendix 38: Transplanting Cacti, (Kelly, 2005)

Transplanting Heavy Or Bulky Barrel And Clustered Cacti

Step 1

Transplants will be most successful when a healthy plant is being moved (Fig. 1). Desiccated or diseased plants should be remedied in their present location before moving. Plants in less-than optimal health due to poor location can warrant a move to a more suitable site.

Figure 1

Step 2

Mark one side of the plant so you may replant the cactus facing in the same compass direction. Tie a string around the cactus, making a knot on the south side (Fig. 2). Nurseries often mark the south-facing side of containers with a paint mark, or provide other indicators of compass direction.

Figure 2

Step 3

Carefully dig out the roots about 6 inches around the plant (Fig. 3). The roots of cacti are often fleshy, brittle, and located close to the soil surface.

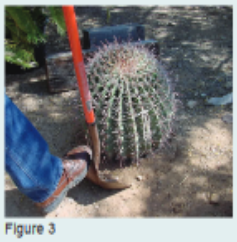


Figure 3

Step 4

Once the plant is loose, carefully remove soil from under the cactus until it can be rocked side to side, helping to access the remaining roots beneath. A section of old garden hose should be wrapped around the cactus to assist in manipulating it safely.

Step 5

Large or heavy cacti may require two people for this step. Wrap the hose section around the center of the cactus, slightly below the mid-section of the plant. Lift the freed plant from its hole (Fig. 4). The root base can also serve as a spine-free handhold. Do not lift a cactus solely by its roots. Take care not to damage spines, spine clusters or ribs – they will not grow back.

Figure 4

Step 6

Place the plant on its side, either on soft ground or on a cut section of carpet, which can later assist in moving the plant. Knock away any remaining soil from the roots. Cleanly trim away any broken or frayed roots (Fig. 5). Cacti can withstand considerable loss of roots, but it's best to not remove healthy undamaged roots.

Figure 5

Step 7

Cacti may be replanted immediately into dry soil, but allowing cut roots time to dry thoroughly before replanting can offer additional protection against root infections. Dusting sulphur may be applied to the roots to deter infection, however the effectiveness has not been studied. Cacti may also be stored for several days or weeks before replanting, as long as the cactus is kept dry and in the shade. Do not leave an uprooted cactus unattended for long. After some weeks the cactus may begin to produce uncharacteristic shade-adapted growth prone to sunburn when finally planted.

Step 8

Move larger barrel cacti using a hand dolly or a cart with adequate padding, such as a piece of carpet or moving blanket. Take care not to bruise the stem or break the spines (Fig. 6).

Figure 6

Step 9

Determine the new location for the plant. Ensure there is room for growth to maturity. The site soil must be well-draining sandy, silty or gravelly soil. If the site soil is poorly draining or is clay, consider planting the cactus on a mound built higher than the surrounding soil. If a better-draining soil mix is available in sufficient quantity, create a mound over the site soil and plant into the top of the mound. Plant in dry soil. Dig a shallow wide hole to accommodate the root spread, but no deeper.

Step 10

Place the cactus in the planting hole. Ensure that the cactus is oriented facing the same compass direction it faced at the previous site, otherwise the plant is at risk of sunburn (see step 2 above). Use a hose fragment to manipulate the cactus into position (Fig. 7). Plant the stem to the same depth it had originally grown at.

Figure 7

Step 11

Backfill with soil from the site, without amendments. Tamp the soil under the plant using the shovel handle or other blunt instrument (Fig. 8) to eliminate cavities in the soil, which could later settle.

Figure 8

Step 12

Mulch the soil surface with gravel. Do not water immediately. Wait a week for any roots damaged during transplant to dry. Establish the cactus with irrigation once every other week if transplanting was done when nighttime temperatures are above 60°F (16°C). If nighttime temperatures are cooler, do not irrigate at all unless there is an extended period (two to four weeks) without rain. Soil should dry between watering. Irrigation must be adjusted to fit the local situation (Fig. 9).

Figure 9

Step 13

Cover the plant with shade cloth blocking no more than 30% of sunlight (Fig. 10) or with cut branches of a desert shrub such as creosote bush. Leave the shade material on the plant for several weeks while acclimating to the new site. Transplants in the winter, early spring, or late fall may not require shading. If transplanting in early summer, consider leaving the shade on through the summer solstice, until days are shortening again.

Figure 10

Moving Oversized Cacti

Moving very large cacti is best left to professional cactus movers who possess the experience and tools required. Two people are needed to move cacti beyond moderate size (Fig. 11). Cacti possessing arms or forming clusters will have an uneven weight distribution which complicates the move (Fig. 12). Cacti are mostly water. Imagine the weight of a jug or barrel of water the size of the cactus. Cactus weight increases substantially with larger specimens. Don't underestimate the weight of a large cactus. A clustered barrel cactus (Fig. 12) can weight more than 200 lbs (90 kg). At a certain point the weight of the plant poses a risk of bruising or breaking sections of the cactus during transport.

The burden of the plant's own weight creates risks both to the plant and to those moving it. One could imagine that a dry and desiccated cactus would weigh less and be easier handled. While this may be true, a desiccated plant will be in a stressed condition and will lack internal water reserves to be drawn upon for reestablishment.

Figure 11

Figure 12

Moving Saguaro And Other Large Tall Cacti

Small saguaro cacti up to three feet tall can be moved with relative ease. Saguaro weight increases substantially as plants exceed five feet in height. Plants of this size or larger should be moved by experienced professionals. For small saguaros, the procedure follows that for barrel cacti outlined above. A notable difference is the usual presence of one or a few vertical tap roots on saguaro (Fig. 13).

When moving a small saguaro, first mark the south side of the plant. Begin digging about one foot out from the trunk of the cactus. Dig down and sever the lateral roots and scoop out the soil between them. A second person should hold the saguaro so it does not topple over as the roots are cut. Now cut across the bottom of the hole and sever the tap root. Carefully lie the cactus on its side, preferably on a cushioning section of carpet or blanket. Trim away any frayed or broken roots cleanly with pruners. The Arizona Game and Fish Department (2019) recommends applying both a bactericide and a fungicide to the roots as an extra precaution against root rot, for which saguaro are vulnerable. Use a carpet or blanket to carry the saguaro to a shaded site in order to air dry the roots for two to four days. Do not leave the saguaro on its side in the sun. This orientation under the sun creates a great risk of sunburn.

To replant the saguaro, dig a customized hole which will accommodate the shape of the tap root and side roots but is no deeper or wider than this. Doing so preserves the site soil in its undisturbed condition, which is less likely to shift than loose soil. This offers greater soil stability around the saguaro roots. Refill the hole with site soil or with pea gravel as recommended by the Arizona Game and Fish Department (2019). Add no fertilizer or soil amendments. Pack the fill material in tightly to support the saguaro.

Figure 13

Do not water the saguaro for several weeks. After this time, the transplanted saguaro should be provided regular irrigation. Rainfall is seldom adequate to provide for establishment. Allow soil to dry between irrigations. The amount and timing of irrigation will differ on the basis of soil type and season. Irrigate lightly and no deeper than the depth of the roots. Do not heavily saturate the soil as this could promote rot and also makes the plant prone to toppling from the softened soil.

One of the common pitfalls when transplanting saguaro occurs from planting too deep. It is tempting to do so, as deep planting would seem to offer the plant greater stability. It probably does - while usually dooming the plant. Saguaro should be transplanted to the same depth they originally grew at in the soil and no deeper. This depth is easily ascertained when observing the stem of the uprooted plant. Saguaro can only grow roots from the region where roots are already present. If planted too deeply, this root zone is placed deeper than the depths to which the desert soil is commonly saturated by rainfall. It also buries green stem tissue, which becomes vulnerable to rot. Taller saguaros may require stabilizing support provided by cables (Arizona Game and Fish Department

Figure 14

2019) or by a trio of wooden bracing supports, padded with carpet where they contact the stem (Fig. 14). Supports must remain in place for several years until a root system is formed. This emphasizes the rationale for planting much younger saguaros, which are less prone to topple. Large saguaros with arms are expensive to purchase and move, and also face greater challenges of stability and establishment.

A fallen saguaro is a poor prospect for replanting. The fall alone can fatally crack or bruise the plant. Sun exposure on a horizontal saguaro may irreparably sunburn the upturned side of the plant. The weight of a saguaro is a safety concern for its handlers, even when re-righting a plant with a partial root system remaining in the soil.

Other tall cacti such as organ pipe and cereus can be approached in the manner of saguaro. Strain on the arms of these cacti is a risk when laying down large specimens for transport. Here too, moving large plants should be left for professionals.

Legal Aspects Of Moving Cacti

All wild native cacti in Arizona are protected under provisions outlined in the Arizona Administrative Code, Chapter 3. Department of Agriculture – Environmental Services Division, Title 3, Article 11, Arizona Native Plants. In addition, several Arizona cacti are afforded additional protections by Federal Laws governing Threatened and Endangered Species.

Figure 15

Under special permits from the Arizona Department of Agriculture, certain wild cacti may be removed from designated sites, transported and sold. This has been arranged by some cactus and succulent societies and certain plant salvage operations. Typically the cacti are removed from construction sites where they would otherwise be destroyed. A protected native plant tag (Fig. 15), or a saguaro tag (for saguaro only) is affixed to these cacti and should remain with the plant through the process of initial transport, sale, transport to the new site and planting into the final location. The tag signifies that the plant is being moved legally and has not been poached from a wild population. Look for these tags when purchasing bare-root native cactus plants as an indicator of legal provenance. The tag may be removed after the cactus is planted in the landscape, but it is advisable to save tags for record keeping purposes.

If wild Arizona native cacti are to be destroyed, moved off one's property, or offered for sale, Department of Agriculture regulations will apply. Check with the Arizona Department of Agriculture for current permit regulations, as rules are subject to change. These regulations apply to wild growing cacti and cacti previously sourced from the wild in Arizona. These regulations do not apply to cacti produced under cultivation, such as those grown in containers, and to species not native to Arizona.

In addition to statewide regulations concerning the movement of native plants, Scottsdale and other Arizona cities and municipalities have local regulations. Check with your local native plant ordinance, as cacti are typically covered as protected native plants.

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Arizona Game and Fish Department. 2019. Best Management Practices for Saguaro Translocation and Replanting.

Breslin, P., Romero, R., Starr, G., and V. Watkins. 2017. Field Guide to Cacti & Other Succulents of Arizona (Second edition). Tucson Cactus and Succulent Society.

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Appendix 39: Environmental Impact Evaluation Scenario II, Construction Phase

Scenario	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II
Element/Aspect	**Flora**			**Fauna**			**Air and climate**			**Nature and Landscape**			**Water**			**Soil**			**Human health**			**Cultural-historic assets**		
Site Clearance		Y-	-		Y-	-		Y-	-		Y-	--		Y-	-		Y-	-		Y-	-		Y	-
Noise (heavy equipment)					Y-	-					Y-	-								Y	-			
Lighting					Y	-					Y	-												
Heavy Equipment Transport		Y-	-		Y-	-		Y-	-		Y-	-		Y-	-		Y-	-		Y-	-		Y-	-
Subsurface Vibrations (heavy equipment)					Y-	-					Y-	-		Y-	-								Y -	--
Excavation and Drilling		Y	-		Y-	-		Y-	-		Y-	--		Y-	--		Y-	-		Y-	-		Y -	--
Foundation and Construction Buildings					Y-	-											Y	-		Y	-			
Parking Construction								Y	-								Y	-		Y	-			
Waste Management		Y	-		Y	-		Y	-		Y	-		Y	-		Y	-		Y	-		Y	-
Hazardous Materials		Y	-		Y	-		Y	-					Y	-		Y	-		Y	-			
Waste Water Sewage		Y	-		Y	-								Y	-		Y	-		Y	-			
Ofshore work Activities		Y+	±		Y++	±		Y++	+		Y+	±		Y -	-		Y--	±						

- -	major negative impact	++	major positive impact
-	minor negative impact	+	minor positive impact
	no impact	±	both positive and negative impacts
Y	mitigation measure		
	negative impact, even with BMP's		
	possitive impact, with BMP's		

Appendix 40: Environmental Impact Evaluation Scenario II, Operation Phase

Scenario	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II
Element/Aspect	**Flora**			**Fauna**			**Air and climate**			**Nature and Landscape**			**Water**			**Soil**			**Human health**			**Cultural-historic assets**		
Noise				-	Y-	-				-	Y-	-												
Lighting				-	Y-	-				-	Y-	-												
Movement of people	-	Y-	-	-	Y-	-				-	Y-	-				-	Y	-						
Cleaning Activities					Y	-		Y	-					Y	-		Y	-		Y	-			
Plumbing					Y	-								Y	-		Y	-		Y	-			
Other Maintenance (electrical, refinishing, etc)					Y	-		Y	-					Y	-		Y	-		Y	-			
Parking and Traffic	-	Y-	-	-	Y-	-	-	Y-	-	-	Y	-	-	Y-	-	-	Y-	-	-	Y-	-			
Waste Management		Y	-		Y	-					Y	-		Y	-		Y+	-		Y	-			
Hazardous Materials		Y	-		Y	-		Y	-					Y	-		Y	-		Y	-			
Waste Water Management		Y++	-		Y++	-								Y+	-		Y+	-		Y	-			
Smell		Y-	-		Y-	-		Y-	-					Y-	-		Y-	-		Y	-			
Fish Farming Onshore RAS System & Ofshore proven techniligy		Y++	±		Y++	±		Y++	+					Y- -	-		Y+	±		Y	-			

- -	major negative impact	++	major positive impact
-	minor negative impact	+	minor positive impact
	no impact	±	both positive and negative impacts
Y	mitigation measure		
	negative impact, even with BMP's		
	possitive impact, with BMP's		

Appendix 41: Mitigation Management Plan

Main Impact (s)	Mitigation Measure	When	Responsibility	Main Indicator(s)
Pre- construction Phase				
- loss of flora/habitat - soil erosion	incorporate established protected and high-value species (excl. Acacia trees) into architectural plans, preferably maintain in the same location and where not possible determine new location for translocation; determine which protected and high-value species (e.g., Lignum Vitae, Divi-Divi) are not (easily) transplantable and purchase plants from local vendors for reintroduction in landscaping. Avoid unnecessary removal of the topsoil layer where possible and provide opportunities for small fauna to freely move from one area to another by incorporating raised boardwalks and decks in the design of the outdoor facilities and landscaping	design, preconstruction	Project Developers, Architects, Landscape contractors, Plant expert	plant species and cover
- loss of flora/ fauna/habitat	create a proper Site Clearance Plan; incorporate a transplanting handling procedure/restoration plan; mark plants that will be transplanted, choose cacti, trees and tall shrubs, refer to Appendix 38 ; incorporate an artificial habitat for the burrowing owl and cottontail rabbit (e.g. hidden brush piles) in the landscaping plans; consider incorporating bird and bat houses;	design, preconstruction	Landscape contractors, Plant expert, Contractors, Sustainability officer, FPNA	plant species and cover
- light pollution - disturbance to sensitive fauna - sea turtle disorientation	create a protocol for minimalizing lighting of workplaces and exterior lighting installations (refer to European standard: EN 12464-2:2014)	design, preconstruction	Sustainability officer	light pollution level, sea turtle nesting frequency
- loss of flora - water consumption - pollution - introduction invasive species	develop environmentally responsible xeriscaping plan	design	Landscaping, Project Developers, Sustainability Officer	plant species and cover, water consumption, groundwater quality
- heat island effect	incorporate shade producing plants in parking area and other areas receiving high sun exposure	design	Project Developers, Landscaping	
- soil erosion	ditches should be designed for the bottom slope in cut sections with gutters or drainage chutes designed to carry water down-slope (i.e. west of project site), but not directed towards the existing culvert, incorporate a bio retention pond and bioswales in the landscaping and parking area to filter run-off from stormwater	design	Project Developers, Landscapers, Architects	coastal water quality
- impair health - chemical pollution	create a separate waste storage room for hazardous waste with a sloped floor, equipped with spill collectors for proper disposal	design	Project Developers	groundwater quality coastal water quality
- greenhouse gas emissions	Go electric; install electric charger stations for electric company cars,	design	Project developers,	- energy consumption

	electric stoves, electric landscaping equipment; install electricity meters in each department		Operating managers	
- water consumption	shelter fountains and pools to reduce evaporation; install water meters in each department	design	Project Developers, Architects	water consumption
- nutrient enrichment	Incorporate oligotrophic (low nutrient requiring) plants for landscaping to avoid using fertilizers; incorporate bioretention ponds and bioswales into the parking lot and landscaping;	design	Project Developers, Landscapers	groundwater quality, coastal waterquality
- loss of fauna - loss of aesthetic value	Incorporate mesh netting along the parameter of the project site (similar to Divi Village Golf) rather than a concrete wall in order to prevent accidental littering of the surrounding areas, while still allowing the passage of small animals moving between natural areas	design	Project Developers, Architects, Landscaping	debris count
range of impacts	apply for LEED (environmental building certification program)	design, preconstruction	Project Developers	range of indicators
- damage flora - damage cultural historical assets -introduction invasive species - soil erosion	mark boundaries beyond which personnel, vehicles and machinery may not move, clearly mark trails; communicate the exact location of the cultural-historical remains to construction crew, mark and fence-off sites, search for potential other historical remains	preconstruction	Contractors, NAMA	plant species and cover, cultural historical asset quality
- impacts to structures - hydrological changes	execute a geophysical survey (e.g. using georadar)	preconstruction	Project Developers, Geotechnical crew	groundwater level, cultural historical asset quality
- chemical pollution - loss in aesthetic value	preplan ways of material transportation and unloading to avoid litter and spills; develop a chemical handling procedure;	preconstruction	Contractors, Sustainability officer	groundwater quality
- chemical pollution - waste production - loss in aesthetic value	create a Solid Waste Management Plan; incorporate policies to keep grounds and adjoining areas clean; preplan an area specific for resting and consumption-related activities	preconstruction	Sustainability Officer, Contractors	waste production, debris counts
- soil erosion	Install silt fencing, fiber rolls and/or other products to prevent sediment run-off (they should have loose-weave netting that is made of natural fiber materials with movable joints between the vertical and horizontal twines)	preconstruction (before any land disturbing activity)	Contractors	coastal water quality
- loss of fauna	schedule site clearance in non-migratory bird season (June-September, December-March)	preconstruction	Project Developers, Contractors	bird counts
- loss of fauna - loss of flora - chemical pollution - impair human health or safety	create an emergency response plan which will cover containment of hazardous materials, oil spills, and work-site accidents and provide detail on the process for handling, and subsequently reporting, emergencies, and specifications of the organizational structure (including responsibilities of nominated personnel)	preconstruction	Sustainability officer	groundwater quality, coastal quality

- introduction of invasive species	(steam) clean heavy machinery off-site to remove potential invasive agents;	preconstruction (before use, when off-site)	Contractors	plant species and cover
- loss of fauna - loss of flora	provide detailed signs with detailed information of the existing Flora and Fauna, together with precaution measures as provided in this MMP	Just before construction phase	Sustainability officer	bird counts, plant species and cover
- chemical pollution - pest proliferation	create an Integrated Pest Management (IPM) plan including the following guidelines (avoid the use of chemicals where possible, avoid broad-spectrum and persistent pesticides, only apply pest abatement if needed; decide where is the best place to solve the problem; check when are the optimal times in the pest's life cycle for treatment; keep records of pest control management for evaluation; apply Bti or Bsp to combat mosquito infestations; remove or drain still standing water; remove illegally dumped waste in the surroundings that can become mosquito breeding areas	pre-operation	Sustainability officer, Pest Control	groundwater quality coastal water quality
Construction Phase				
- range of impacts	organize training sessions for construction workers (incl. environmental behavior); supervise and inspect compliance; provide basic medical training, safety and contingency measures to specified work staff and basic medical service and supplies to workers; provide layout plan for construction camp: firefighting equipment, safe storage of hazardous material, first aid, security, fencing	especially before land clearing, before excavation, before building structures and while doing finishing work	Sustainability officer	range of indicators
- damage flora -introduction invasive species	discourage parking/driving/walking outside project site, use of existing parking, roads and access; fence-off construction site	throughout construction phase	Project Developers, Contractors	plant species and cover,
- waste production - chemical pollution	keep an inventory of all the chemicals and products purchased	Throughout construction	Contractors	Waste production
- impair human safety	Only authorized and well-experienced personnel should be allowed to use heavy machinery	Throughout construction	Contractors	NA
- pollution - loss in aesthetic value	remove potential sources of litter (e.g. light plastics, waste containers) as timely as possible; plastic packaging materials should be immediately placed in closed waste containers	throughout construction phase	Contractors, Waste Collection Company	debris counts
- loss of fauna	search for bird nests in trees and carefully move them to trees located in the west of the project site; carry out a slow-paced site clearance; give animals time to flee; ensure animals are flushed before land clearing	site clearance	Contractors	bird counts
- loss in aesthetic value - chemical pollution	Before clearing vegetation and soil manually remove as much as possible plastic debris (e.g. bottles, containers, etc.) in order to separate it from the organic debris (vegetation, soil and	site clearance	Contractors	Groundwater quality, debris count

	rock) that will be reused; store the oil contaminated bedrock and antropogenic debris in a separate waste container			
- chemical pollution	execute precision work when applying chemicals/materials, store all chemicals with lids closed, remove as many potential sources of spills as possible from the site when not working, avoid pouring/ dropping inert/fill materials (e.g. cement, asphalt) from heights; limit the use of hazardous chemicals wherever possible; avoid pouring fuels on-site in the fuel tanks; make sure to fill tanks before; if leaks/spills occur remediation and or restoration should be immediately applied; evaluate remedial/restoration methods	throughout construction phase	Project developers, Contractors	groundwater quality, coastal water quality
- noise pollution - disturbance to sensitive fauna - hearing loss	schedule all construction works during daytime: 8 AM -5 PM; wherever possible avoid using mechanical equipment/machinery that are noisy or cause high vibrations; wherever possible manually perform activities (removal debris, landscaping, etc.) or use portable small equipment rather than heavy machinery (especially during land clearing); cover metal tables, hoppers, wheels and other metal pieces with elastic material (e.g. hard rubber or cork) to reduce noise vibrations; operate noisy machinery during times when fewer people are on-site; ensure that suitable mufflers are installed on engine exhaust and compressor components	throughout construction phase	Contractors	noise level, bird counts
- light pollution - disturbance to sensitive fauna - sea turtle disorientation	minimal lighting at night, only directed lighting	throughout construction phase	Contractors, Security	light pollution level, sea turtle nesting frequency
- soil erosion	regularly inspect erosion control measures throughout duration of use	throughout construction-phase	Contractors	coastal waterquality
- fecal pathogens - loss in aesthetic value - impair human health	clean & maintain sanitary portable toilets	throughout construction phase	Toilet supplier	groundwater quality
- greenhouse gas emissions - noise pollution - chemical pollution	periodically inspect and perform (preventative) maintenance on equipment (e.g. worn hoses, lubricate) to avoid accidental oil and grease leaks, lower emissions and unnecessary noise production; use and maintain equipment according to the user manual and maintenance procedure; avoid maintenance of equipment/machinery on-site	throughout construction phase	Contractors	noise level, PM levels, groundwater quality, bird counts
- range of impacts	where harm is done to the environment restoration should take place promptly;	ASAP	Contractors	depends on impact

- greenhouse gas emissions - noise pollution	discourage idling of engines; switch off machinery/equipment when not used;	throughout construction phase	Contractors	noise level; bird counts
- impair human health	use of PPE (especially gloves and respiratory masks); avoid skin contact	When hazardous chemicals are handled (e.g. oil debris removal, finishing) or in dust-generating activities	Contractors	NA
- smothering plants - respiratory health issues - soil erosion	locate material stockpiles in sheltered areas and cover with tarp to prevent material becoming airborne; limit on-site vehicle speed to 20 km/h; during periods of high wind dust generating activities should be avoided; water unpaved dirt soil (if it has not rained a while); If surrounding vegetation is covered in dust, dust off with clean water as timely as possible; ensure that all vehicles transporting potentially dust-producing material are not overloaded, are provided with adequate tailboards and side- boards, and are adequately covered with a tarp (covering the entire load and secured at the sides and tail of the vehicle) during transportation	throughout construction phase, but especially after groundworks	Contractors	PM level, plant species and cover
- soil erosion - waste production	reuse/redistribute soil, limestone rocks and natural debris as erosion control (e.g. for filling, riprap, pavements)	after site clearance and excavation	Project Developers, Contractors	waste production
- introduction of invasive species	(steam) clean heavy machinery to remove potential invasive agents, but do this above a tarp and collect waste water to prevent pollution;	Whenever heavy machinery needs to leave the construction place	Contractors	NA
- greenhouse gas emissions - pest proliferation	carry out a final inspection for holes or cracks in building and fill/seal them for insulation and pest management	Finishing	Contractors	Energy consumption (operation phase)
Operation Phase				
- chemical pollution	execute precision work when applying chemicals/materials, store all chemicals with lids closed, remove as many potential sources of spills as possible from the site when not working, avoid pouring/ dropping materials from heights; if leaks/spills occur remediation and or restoration should immediately be applied; evaluate remedial/restoration methods	operation	Project developers, Operators	groundwater quality, coastal water quality
NA	collaborate and partner with environmental NGO's (Turtugaruba, Ban lanta y planta); participate in environmental initiatives (e.g. planting trees, clean-ups, earth-hour, etc.)	operation	Project developers, Sustainability officer	NA
- range of impacts	organize training sessions for staff (incl. environmental behavior & health & safety); supervise and inspect compliance; raise awareness about environmental issues and policies of the Fish farming to staff; place signs to	operation	Sustainability officer	range of indicators

	request understanding and helping to lower carbon footprint; establish environmental guidelines and policies for each department			
- greenhouse gas emissions - noise pollution	discourage idling mode; switch off machinery/equipment when not used;	operation	Staff handling equipment/ machinery, Suppliers	noise level; bird counts
- waste production - chemical pollution	keep an inventory of all the chemicals and products purchased; avoid the use of agrochemicals in landscaping	operation	Operators, landscaping	Product inventory, Waste production
- damage flora - introduction invasive species	discourage parking/driving/walking outside project site, use of existing parking and roads ; security personnel should be tasked with monitoring vehicles that might harm the surrounding flora or fauna; fence-off the Fish Farm, but do not restrict movement of small fauna (e.g. rabbits, lizards, crabs,)	operation	Project Developers, Operators	plant species and cover,
- greenhouse gas emissions	avoid lowering cooling temperatures below 24˚C, especially in offices; refrigerators should have unobstructed air-flow and located away from heat-generating devices	operation	Operators	Energy consumption
- chemical pollution	limit the use of hazardous chemicals wherever possible; implement minimum-dose application policy; use phosphate free-detergents and soaps; avoid the use of bleach in pools and fountains	operation	Maintenance, Pest control	groundwater quality, coastal water quality
- range of impacts	where harm is done to the environment restoration should take place promptly;	asap	Operators	depends on impact
- light pollution - disturbance to sensitive fauna - sea turtle disorientation - greenhouse gas emissions	minimalize lighting at night (especially outdoor lighting)	operation (night time)	Operators, Security	light pollution level, sea turtle nesting frequency
- disturbance to sensitive fauna - fecal pathogens	(service) animals should not be walked or allowed to roam free in the surrounding landscape	operation	Operational managers	bird count
- greenhouse gas emissions	seal cracks and holes; turn of appliances, computers and lights when not in use	operation	Maintenance	Energy consumption
- greenhouse gas emissions - noise pollution - chemical pollution - fecal pathogens - nutrient enrichment	periodically inspect and perform (preventative) maintenance on equipment (e.g. worn hoses, clogged pipes and filters) to avoid accidental leaks, lower emissions and unnecessary noise production; use a maintenance log in each department to keep track of necessary maintenance tasks; use and maintain equipment according to the user manual and maintenance procedure	operation	Maintenance	noise level, PM levels, groundwater quality, bird counts, coastal quality
- greenhouse gas emissions	where possible, encourage night time ventilation for cooling building	operation	Operators	Energy consumption

- waste production	buy in bulk and buy products with little or no packaging or reusable packaging; eliminate the use of plastic where possible; reusable items (tourniquets, bicarbonate cartridges, medical scrubs, aprons, etc.) should be personalized and reused; avoid disposable items; reuse paper and go digital where possible; remain updated on recycling options on the island (e.g. Plastic Beach Party recycles plastic for a monthly fee); no- single use plastics (refer to national decree: AB 2019 no. 73); separate waste at source using labeled waste containers and transparent bag casings to showcase correct waste separation; donate items that have reached their final use, but are still in good condition (e.g. furniture, kitchenware); use garden waste shredder to create mulch and or compost; where feasible, the principle of repaired or refurbished should be applied, rather than purchasing new products (unless it leads to much lower efficiencies)	operation	Operators	waste production and composition
- range of impacts	participate in regional and international audit/certificate programs that evaluate or assist in the environmental responsibility of the company's policies and operations (e.g. ISO 14001, Caribbean Action for Sustainable Tourism, EarthCheck, Green Globe)	operation	Project Developers, Operators	- range of indicators
- greenhouse gas emissions	provide communal transport for staff members and encourage staff to use this service	operation	Operators	NA
- loss of fauna - loss of habitat - loss of flora	CITES and endangered species, or products thereof, or products deriving from unsustainable practices, should not be displayed or sold	operation	Operators (particularly gift shop)	NA
- loss of aesthetic value - chemical pollution	preplan ways of material transportation and unloading; avoid litter and spills	operation	Operators	- debris count - ground water quality - coastal water quality

Petros Aquaculture Operations is committed to developing a sustainable open ocean aquaculture operation for Lutjanus Campechanus off the coast of Aruba. Petros is committed in achieving global accreditation of both ASC and BAP. In response to the MER Commission report dated March 25, 2025, we are sharing parts of our comprehensive Environmental Management Strategy that addresses the Commission's concerns and aligns with the Aquaculture Stewardship Council (ASC) Farm Standard.

Our strategy is built on the principles of environmental stewardship, transparency, scientific rigor, and continuous improvement. We recognize the importance of systematic monitoring, clear decision-making frameworks, and meaningful stakeholder engagement to ensure our operations contribute positively to Aruba's economy while safeguarding its marine ecosystem.

This document outlines our approach to environmental management, monitoring, and decision-making processes that will be implemented throughout all phases of our project, with particular attention to the Commission's recommendations for SMART (Specific, Measurable, Achievable, Relevant, Time-bound) monitoring and the ASC certification requirements.

1. Addressing MER Commission Concerns

The MER Commission report identified several key areas for improvement. Our strategy addresses each of these directly:

1.1 Environmental Management System

The Commission noted the need for a more comprehensive environmental management system with clear processes and accountabilities. Our response includes:

- **Systematic Approach**: Implementation of a structured environmental management system following the ASC Farm Standard (Criterion 1.2) and ISO 14001 principles.
- **Clear Accountability**: Designation of specific roles and responsibilities for environmental management, led by a senior management representative (per ASC Indicator 1.2.2).
- **Documentation and Policies**: Development of comprehensive environmental policies, procedures, and work instructions covering all aspects of our operations
- **Regular Review**: Implementation of a management review process to ensure continuous improvement (per ASC Indicator 1.2.6).

1.2 SMART Monitoring Plan

The Commission emphasized the need for more robust monitoring of environmental impacts that is SMART (Specific, Measurable, Achievable, Relevant, Time-bound). Our strategy includes:

- **SMART Monitoring Approach**: Implementation of a monitoring program that meets all SMART criteria as specified in the MER Commission report.
- **Comprehensive Coverage**: Implementation of the full ASC Benthic Monitoring Program (Appendix 7 of ASC Farm Standard) and Water Quality monitoring (Appendix 8).
- **Baseline Studies**: Completion of thorough baseline studies of water quality, benthic conditions, and marine biodiversity before commencing operations.
- **Scientific Rigor**: Utilization of scientifically valid methodologies for all environmental monitoring, following ASC protocols.
- **Independent Verification**: Engagement of third-party experts to conduct monitoring where appropriate.

2. ASC-Aligned Environmental Management System

Our Environmental Management System (EMS) will be fully aligned with the ASC Farm Standard requirements and structured to provide systematic oversight of all environmental aspects of our operations.

2.1 Management System Structure (ASC Criterion 1.2)

Our EMS will include:

- **Environmental Policy**: A comprehensive policy signed by senior management that commits to environmental protection, legal compliance, and continuous improvement.
- **Organizational Structure**: Clear definition of roles, responsibilities, and authorities for environmental management.
- **Competency Requirements**: Identification of necessary skills and knowledge for environmental management roles and provision of appropriate training (per ASC Indicator 1.2.3).
- **Document Control**: Procedures for creating, reviewing, approving, and updating EMS documentation.
- **Operational Controls**: Procedures and work instructions for activities with potential environmental impacts.
- **Emergency Preparedness**: Plans and procedures for identifying and responding to potential emergency situations.
- **Monitoring and Measurement**: Systems for tracking key environmental parameters and performance indicators.

- **Internal Audit**: Regular assessment of EMS implementation and effectiveness (per ASC Indicator 1.2.4).
- **Management Review**: Periodic evaluation of the EMS by senior management to ensure its continuing suitability, adequacy, and effectiveness (per ASC Indicator 1.2.6).

2.2 Risk Management Approach (ASC Appendix 4)

Our EMS will incorporate a comprehensive risk management approach that:

- **Identifies Environmental Risks**: Uses the standardized methodology in ASC Appendix 4.1 to identify potential environmental impacts.
- **Assesses Likelihood and Severity**: Evaluates the probability and potential consequences of each impact.
- **Implements Controls**: Establishes preventive and mitigative measures proportionate to the level of risk.
- **Regularly Reviews and Updates**: Ensures that risk assessments remain current as conditions change.

2.3 Legal Compliance Management (ASC Criterion 1.1)

Our system will ensure full compliance with all applicable laws and regulations through:

- **Legal Register**: Maintenance of a comprehensive register of all applicable legal requirements.
- **Compliance Evaluation**: Regular assessment of compliance status.
- **Corrective Action**: Prompt addressing of any non-compliance issues.
- **Regulatory Relationship**: Proactive engagement with regulatory authorities.

3. SMART Environmental Monitoring Plan

Our monitoring plan will provide a systematic approach to tracking environmental parameters, assessing impacts, and informing management decisions. All monitoring activities will follow SMART principles, as recommended by the MER Commission:

3.1 SMART Monitoring Principles

All our monitoring programs will adhere to SMART principles:

- **Specific**: Clearly defined parameters and indicators that directly relate to potential environmental impacts.
- **Measurable**: Quantifiable metrics with established methodologies and units of measurement.
- **Achievable**: Realistic monitoring protocols that can be consistently implemented with available resources.
- **Relevant**: Focused on parameters that are directly related to our operations and potential impacts.

- **Time-bound**: Defined monitoring frequencies and reporting schedules with clear deadlines.

3.2 Benthic Monitoring (ASC Criterion 2.5 and ASC Appendix 7)

Our SMART benthic monitoring program will:

- **Specific**:
  - Monitor precise locations at 30 m, 100 m, and 150 m from cage edge in multiple directions.
  - Measure specific parameters including total free sulphide (S^{2-}), redox potential (Eh), and benthic macrofauna.
- **Measurable**:
  - Use quantitative thresholds for Environmental Quality Standards categories as defined in ASC Appendix 7, Table 2.
  - Employ standard methodologies for all measurements (e.g., using calibrated probes for redox potential).
- **Achievable**:
  - Use established sampling techniques proven effective in similar environments.
  - Engage qualified personnel and laboratories for analysis.
- **Relevant**:
  - Focus on indicators directly related to organic enrichment from aquaculture
  - Include reference sites to distinguish farm impacts from background conditions.
- **Time-bound**:
  - Conduct sampling during period of highest expected impact (30 days after peak feeding/biomass).
  - Complete sample analysis within 2 weeks of collection.
  - Report results within 1 month of analysis.

3.3 Water Quality Monitoring (ASC Criterion 2.6 and ASC Appendix 8)

Our SMART water quality monitoring program will:

- **Specific**:
  - Measure dissolved oxygen (DO), Secchi disk (SD) depth, chlorophyll-a (Chl-a), total nitrogen (TN), and total phosphorus (TP).
  - Establish specific sampling locations for farm and Waterbody Unit of Management (WUM) level monitoring.
- **Measurable**:
  - Use standard analytical methods for all parameters (as specified in ASC Appendix 8, Section 2.3.5).
  - Compare results against quantitative thresholds for trophic status.
- **Achievable**:

  - Employ sampling methods appropriate for local conditions and available equipment.
  - Utilize accredited laboratories for sample analysis.
- **Relevant**:
  - Focus on parameters that indicate potential eutrophication impacts.
  - Compare farm and reference sites to isolate farm effects.
- **Time-bound**:
  - Conduct quarterly monitoring with specific sampling dates.
  - Complete 24-month baseline monitoring before scaling up production.
  - Report results to authorities and ASC annually.

3.4 Wildlife Interactions Monitoring (ASC Criterion 2.3)

Our SMART wildlife monitoring program will:

- **Specific**:
  - Record all interactions with wildlife, particularly Threatened and Protected Species.
  - Document exact species, location, type of interaction, and outcome.
- **Measurable**:
  - Count and categorize all wildlife mortality incidents.
  - Track trends in interaction rates over time.
- **Achievable**:
  - Train staff in species identification and reporting procedures.
  - Implement standardized recording protocols.
- **Relevant**:
  - Focus on species known to occur in the farm area.
  - Analyze interaction patterns to identify potential causes.
- **Time-bound**:
  - Conduct daily observations during operational hours.
  - Report wildlife mortalities publicly within 30 days of incidents.
  - Provide annual reports to ASC.

3.5 Escape Monitoring (ASC Criterion 2.4 and ASC Appendix 6)

Our SMART escape monitoring program will:

- **Specific**:
  - Monitor exact inventory through precise counting during stocking and harvest.
  - Document any observed escapes, including estimated numbers and circumstances.
- **Measurable**:
  - Maintain count accuracy of ≥98% as required by ASC standards.
  - Calculate Total Escape Count following ASC methodology.
- **Achievable**:

  - Implement proven counting technologies appropriate for Red Snapper.
  - Establish realistic protocols for escape detection and reporting.
- **Relevant**:
  - Consider the EICAT Category for potential impacts of escapees.
  - Focus monitoring on highest risk points (e.g., during transfers).
- **Time-bound**:
  - Conduct inventory counts at defined intervals and during all fish transfers.
  - Report any escape incidents to authorities within 24 hours.
  - Submit annual escape data to ASC.

3.6 Additional SMART Monitoring Programs

In response to specific MER Commission concerns, Petros will implement additional monitoring:

3.6.1 Marine Mammal and Sea Turtle Monitoring

- **Specific**: Document all sightings with species, location, and behavior.
- **Measurable**: Record frequency, proximity to farm, and any changes in behavior patterns.
- **Achievable**: Train staff in identification and use standardized observation protocols.
- **Relevant**: Focus on protected species identified in the area during EIA studies.
- **Time-bound**: Conduct weekly dedicated observation periods and compile quarterly reports.

3.6.2 Fisheries Interaction Studies

- **Specific**: Monitor catch composition, abundance, and size in areas near the farm.
- **Measurable**: Compare with historical data and control sites to detect changes.
- **Achievable**: Partner with local fisheries organizations using their existing methods.
- **Relevant**: Focus on commercially important species and those of ecological significance.
- **Time-bound**: Conduct seasonal sampling and produce annual comparative reports.

4. Traffic Light Monitoring System and Corrective Actions

As recommended by the MER Commission and aligned with ASC requirements, Petros will implement a traffic light system for key environmental parameters:

4.2 Traffic Light Approach

For each key parameter in our SMART monitoring plan, Petros will establish:

- **Green Range (Acceptable)**: Parameter values indicate no significant environmental impact.

- **Amber Range (Warning)**: Parameter values suggest potential developing impacts requiring increased vigilance.
- **Red Range (Unacceptable)**: Parameter values indicate potential significant impacts requiring immediate action.

4.2 Documentation and Reporting

All monitoring results and responses will be:

- Documented in standardized formats.
- Analyzed for trends over time.
- Reported to relevant authorities.
- Shared with stakeholders through appropriate channels.
- Used to inform adaptive management decisions.

5. Local EMP Requirements

Below is the table covering additional local EMP requirements from the Aruban Law perspective.

Monitoring indicator	General requirements	
Noise levels	**Methodology:** noise logging with class 1 sound meter, refer to Appendix 17	
	Sample location(s): Project Site	
	Timing (minimal frequency): Preconstruction (1x), Construction (daily), Operation (semi-annually)	
Dust levels	**Methodology:** PM2.5 and PM10 logging, refer to Appendix 25	
	Sample location(s): Project Site)	
	Timing (minimal frequency): Preconstruction (1x), Construction (weekly), Operation (semi-annually)	
Groundwater levels	**Methodology:** piezometer in three auger boring holes as requested by DNM in Appendix 1. Note: auger boring requires a Construction Permit, according to ROPV 2021.	
	Sample location(s): Project Site (highest elevation, intermediate elevation and lowest elevation)	
	Timing (minimal frequency): Preconstruction (1x), Construction (1x before and 1x after excavation), Operation phase (semiannual)	
Groundwater quality	**Methodology:** 1) In-situ measurements of temperature, salinity, dissolved oxygen, pH 2) Analysis of NO_4 and PO_4 within 4 hours after sampling 3) Analysis of pathogens (e.g. *Escherichia coli* and *Enterococcus faecalis*) 4) inspection of surface pollutants (oils, flocculates)	
	Sample location(s): Project Site if required	
	Timing (minimal frequency): if required *(Preconstruction (1x), Construction (monthly and after spill/leakage), Operation (quarterly and after spills/leakage))*	
Plant species and cover	**Methodology 1:** To measure impacts on surrounding vegetation: identification of species and their cover inside plot; if die-off is taking place in surrounding vegetation, take measures to restore habitat and continue with method 2	**Methodology 2:** To measure success of habitat restoration: drone imagery mapping of vegetation cover of protected and high-valued species (in m^2)
	Location: Vegetated landscape west of project site	**Location:** Project Site

	Timing (minimal frequency): Construction (start and end) Operation (bi-annually)	**Timing (minimal frequency):** Operation (semi-annually)
Water quality (as BMP)	**Methodology:** Sampling. In-situ measurements of temperature, salinity, dissolved oxygen, pH and analysis of NO_4, PO_4 within 4 hours after sampling. Obtain results from DVG's monthly inspection of bathing water: *Escherichia coli* and *Enterococcus faecalis*.	
	Sample location(s): Onshore Pier Area and Offshore location	
	Timing (minimal frequency): Preconstruction (1x), Construction (monthly), Operation (quarterly). Also refer to the full EMP based on ASC specifications.	
Light pollution (as BMP)	**Methodology:** A sky quality meter (UNIHEDRON: SQM-L) shall be used to measure the levels of light (mag arcsec^{-2})	
	Sample location(s): directly at project site	
	Timing: Construction (1x), Operation (yearly)	

Table – Environmental Monitoring Plan – Partial

5. Summary

Petros Aquaculture Operations is committed to implementing an environmental management strategy that directly addresses the concerns raised by the MER Commission, including the requirement for SMART monitoring. Our approach exceeds regulatory requirements and fully aligns with ASC standards, emphasizing:

- A comprehensive environmental management system.
- Rigorous, science-based SMART monitoring with clear indicators and thresholds.
- Traffic light system for monitoring parameters with defined response protocols.
- Transparent stakeholder engagement.
- Precautionary and adaptive management.
- Continuous improvement.

By implementing this strategy, Petros aims to develop an aquaculture operation that contributes positively to Aruba's economy while protecting its precious marine environment. Petros believes its phased approach, with careful SMART monitoring and clear decision criteria, provides the appropriate balance between development and environmental protection that the MER Commission has recommended.
Petros welcomes ongoing dialogue with the Commission, regulatory authorities, and all stakeholders as it moves forward with this important project for Aruba's sustainable development.

Additional details on the ASC Tropical Marine Finish Standard can be found here: https://asc-aqua.org/producers/asc-standards/tropical-marine-finfish/

Appendix 43: Monitoring for the Facility[16]

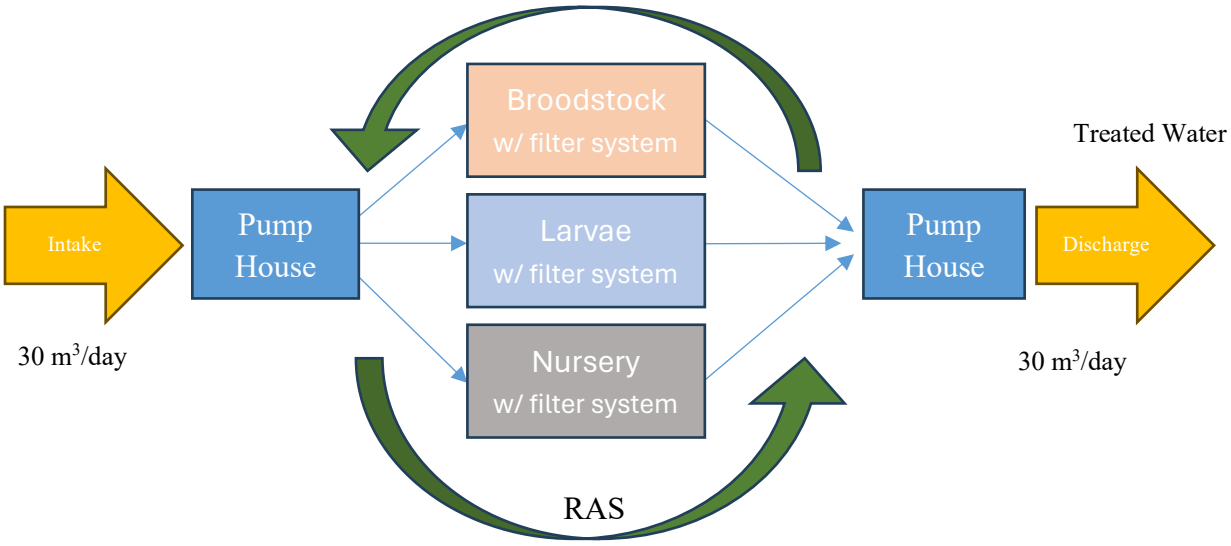
Table - Environmental and Health & Safety Monitoring Plan for the Facility

Monitoring Indicator	General requirements
Water Consumption	**Methodology:** WEB bills should contain data on total consumption levels. For in-depth evaluation of water efficiency and savings, install water meters in each type of operation and use EnergyStar Portfolio Manager for Commercial Buildings.
	Timing (minimal frequency): Operation (yearly)
Energy Consumption	**Methodology:** ELMAR, AruGas, Fuel, Propane bills/receipts should contain data on total consumption levels. For in-depth evaluation of energy efficiency and savings, install meters in each type of operation and use EnergyStar Portfolio Manager for Commercial Buildings.
	Timing (minimal frequency): Operation (yearly)
Energy Production	**Methodology:** use smart meters to track daily, monthly or year energy production from solar power
	Timing (minimal frequency): Operation (yearly)
Solid Waste Production	**Methodology:** Waste-collection bills (including those of medical waste and plastic waste) should contain data on tonnage waste collected from facilities.
	Timing (minimal frequency): Construction (after land clearing and final stage), Operation (yearly)
Solid Waste Composition	**Methodology:** In-depth analysis of waste production using EnergyStar Portfolio Manager for Commercial Buildings. Include a category for medical waste.
	Timing (minimal frequency): Operation (yearly)
Maintenance log and inspection	**Methodology:** create daily monthly and yearly maintenance logs where staff checkmarks all the completed tasks and randomly do inspections on HVAC, Electrical, Lighting, Plumbing, Fire Prevention systems, Hatchery and processing Equipment/Devices
	Timing (minimal frequency): Operation and following complaints
Housekeeping log and inspection	**Methodology:** create daily monthly and yearly housekeeping logs where staff checkmarks all the completed tasks and randomly do housekeeping inspections
	Timing (minimal frequency): Operation and following complaints
Effluent quality (for reuse)	**Methodology:** inquire at RWZI/DOW/DNM/DLVVM. For parameters and standards refer to Appendix 45
	Sample location(s): effluent outlet
	Timing (minimal frequency): Operation (inquire at RWZI/DOW)
Irrigation water quality	**Methodology:** inquire at DOW/DNM/DLVVM. For parameters and standards refer to Appendix 45
	Sample location(s): irrigation water outlets
	Timing (minimal frequency): Operation (inquire at DOW/DNM/DLVVM)
Occupational Noise Exposure	**Methodology:** ISO 9612:2009 or OSHA 1910.95
	Sample location(s): according to ISO 9612:2009, but should provide measurements in locations
	Timing (minimal frequency): Operation (inquire about frequency at DVG) and following complaints

[16] Inquire at DVG and the Department of Technical Inspections (DTI) which tests should be performed regularly to monitor safety and health. Note that requirements are subject to change as a result of continuous updates or production of new legislation.

500 MT/Yr Production Target.

The total water volume of the complete RAS hatchery is 600 m^3. This includes broodstock, larvae, and nursery tanks.



Once the system is filled, the daily water intake from the Barcadera lagoon and discharge into the lagoon, is estimated at 5% (each) at peak times of the total 600 m^3 volume.

On a daily basis, 30 m^3 of new sea water is taken from the Barcadera lagoon. This water will be treated and filtered before it goes into the hatchery systems. Each specific area has its own filtration system prior to the new water making it into the tanks. Subsequently these systems will continuously filter and treat the water from each tank. Additionally, 30 m^3 of this recirculated water within the hatchery systems, is filtered and treated before being returned to the sea (over 24 hours). The below table shows monthly averages of discharge water into the body of water, as stipulated in the Cartagena Protocol. Specifically, the Land Based Sources (LBS) component of the protocol. Both the ASC and BAP align with these targets and are part of Petros' environmental management protocols.

Discharges into Class I Waters Each Contracting Party shall ensure that domestic wastewater that discharges into, or adversely affects, Class I waters is treated by a new or existing domestic wastewater system whose effluent achieves the following effluent limitations based on a monthly average:

Parameter	Effluent Limit
Total Suspended Solids	30 mg/l*
Biochemical Oxygen Demand (BOD5)	30 mg/l
pH	5-10 pH units
Fats, Oil and Grease	15 mg/l
Faecal Coliform (Parties may meet effluent limitations either for faecal coliform or for E. coli (freshwater) and enterococci (saline water).)	Faecal Coliform: 200 mpn/100 ml; or a. E. coli: 126 organisms/100 ml; b. enterococci: 35 organisms/100 ml
Floatables	not visible
* Does not include algae from treatment ponds	

*Source: Cartagena Protocol LBS Page #26.

The following targets/limits are from the Best Aquaculture Practices Standard. In order to obtain this international certification, Petros will need to meet these standards. BAP is more stringent than the Cartagena Protocol (table above).

Appendix B – Effluent Water Quality Criteria - Ponds, Non-Coastal Flow-through Systems and Recirculating Aquaculture Systems

Petros

BAP Effluent Water Quality Criteria

Variable (units)	Ponds and Non-Coastal Flow through Systems	RAS*	Minimum Collection Frequency
pH (unit)	6.0 – 9.5	6.0 – 9.5	Monthly
Total Suspended Solids (mg/L)	Less than 50	Less than 25	Quarterly
Soluble Phosphorus (mg/L)	Less than 0.5	N/A	Monthly
Total Phosphorus (mg/L)	N/A	Less than 10	Quarterly
Total Ammonia Nitrogen (mg/L)	Less than 5	Less than 5	Monthly
Nitrate – N (mg/L)	N/A	Less than 50	Quarterly
5-day biochemical oxygen demand (mg/L)	Less than 50	Less than 25	Quarterly
Dissolved oxygen	More than 5 (mg/L) or ≥ 70% saturation**	More than 5 (mg/L) or ≥ 70% saturation**	Monthly
Chloride	No discharge above 800 mg/L chloride into freshwater***	No discharge above 800 mg/L chloride into freshwater***	Monthly

* Here RAS are defined as systems 1) with a recirculating flow that is >90% of total water flow and 2) with greater than 1% new water per day of total system volume. Recirculating systems with less than 1% new water per day of total system volume are exempt from effluent monitoring.

** Percent saturation of dissolved oxygen shall be calculated based on temperature and altitude of the facility. Online calculators can be used for the calculations: http://www.waterontheweb.org/under/waterquality/DOSatCalc.html*** Water with less than 1 ppt salinity, specific conductance below 1,500 µmhos/cm or chloride less than 550 mg/L is considered fresh

Sampling

- Samples shall be collected just prior to locations where effluents enter natural water bodies or exit the hatchery property. Samples shall be collected so that mixing of effluent and water from the receiving body is prevented.
- For hatcheries with multiple effluent outfalls, all or several outfalls shall be sampled to prepare a composite sample for analysis. Where there are four or more outfalls, three outfalls shall be selected as sampling locations.

Best Aquaculture Practices	Hatchery Standard	Issue Number 2.1	Effective Date 30-January-2023
Group Program Integrity	Status Active - External	Page 65 of 75	

Source: BAP Hatchery Standard Page # 65

The intake system extracting sea water in the Barcadera lagoon, located in front of the land site, consists of the following high-level details.

Intake
Two 6” diameter HDPE pipes.
One of the 2 pipes is for redundancy.

Discharge
Two 6” diameter HDPE pipes.
One of the 2 pipes is for redundancy.

Both intake and discharge pipes will be anchored to the seabed with concrete blocks. Petros will consider drilling a test well on land, a few meters away from the sea edge, to investigate making this well the intake source. But water quality tests are needed prior to proceeding with this option. The well will extract saline water, but the goal is to have the natural limestone filter out naturally occurring bacteria in the sea water from the lagoon.

The current plan of action is an intake system and a discharge system from the Barcadera lagoon.

Summary

Petros is committed to minimizing the environmental impact of its hatchery operations on the Barcadera lagoon and surrounding coastal waters. The hatchery will use a Recirculating Aquaculture System (RAS) which significantly reduces water usage. New seawater intake will be limited to 30 m^3 per day to replenish losses from evaporation and periodic flushing. The same volume, 30 m^3 per day, will be discharged after thorough treatment to exceed the effluent water quality standards set by the Cartagena Protocol, which Aruba has ratified into law. Petros will also adhere to the strict discharge requirements of the international Aquaculture Stewardship Council (ASC) and Best Aquaculture Practices (BAP) certification programs. By utilizing RAS technology, treating effluent to high standards, and limiting daily discharge volumes, Petros will ensure that its hatchery operations have minimal impact on the water quality and marine life of the Barcadera lagoon and surrounding coastal ecosystems. Petros is fully committed to sustainable aquaculture practices and environmental stewardship.

Appendix 45: Parameters and standards for reuse of Effluent and for Irrigation water

The tables below are details on water reuse on Aruba.

Parameter	Kwaliteitseis
Fecale colibacteriën	< 1000 /100 ml
Geleidbaarheid	< 2.250 µS/cm
CZV	< 100 mg/L
BOD	< 20 mg/L
Kj-N	< 30 mg/L
TSS (Gesuspendeerde stof)	< 50 mg/L

Tabel 4: Kwaliteitseisen voor effluent hergebruik op Aruba (Afvalwaterstruktuurplan Aruba 1997-2010)

Parameter t.b.v. beoordeling irrigatiewater	Kwaliteitsrichtlijn:
parasieten	< 1 /L
Fecale colibacteriën	< 1000 kve/100ml
Legionella bacteriën	< 1000 kve/L

Tabel 5. Microbiologische parameters bij irrigatiewater

		Richtlijn	opmerkingen
Zuurgraad	pH	6,5 – 8,4	
Gesuspendeerde stof		50 mg/l	Kan drip systemen verstoppen
Geleidbaarheid		< 2.250 µS/cm	
Aluminium	Al	5,0 mg/l	Toxisch indien pH < 5,5
Arseen	As	0,1 mg/l	
Beryllium	Be	0,1 mg/l	
Cadmium	Cd	0,01 mg/l	
Cobalt	Co	0,05 mg/l	
Chroom	Cr	0,1 mg/l	
Koper	Cu	0,2 mg/l	
Lithium	Li	2,5 mg/l	Toxisch bij citrus fruit
Mangaan	Mn	0,2 mg/l	
Nikkel	Ni	0,2 mg/l	Toxisch indien pH < 7,0
Lood	Pb	5,0 mg/l	
Selenium	Se	0,02 mg/l	
Vanadium	V	0,1 mg/l	
Zink	Zn	2,0 mg/l	Toxisch indien pH < 7,0

Tabel 6: Chemisch / Fysische parameters bij irrigatiewater (FAO, 1992)

Appendix 46: Solid Waste Re-Use Potential

Statement

Detail the kind of solid waste, the origins of this waste, and how to turn this waste into a value-add product for re-use.

Overview

In an aquaculture operation like that of Petros, there are a few defined solid waste streams. The processing facility will generate by-product of fish guts, scales and wastewater. From the hatchery production of fingerlings, sludge byproduct will also be a solid waste stream. In addition to these clearly defined waste streams, Petros also applies a waste avoidance protocol to its daily operation. This could include the reduction and/or elimination of wooden pallets in fish feed storage, and reusable/recyclable fish packaging solutions in place of the polystyrene boxes traditionally used in the seafood industry.

Waste Re-Use			
Waste Stream	**Image**	**Possibilities**	**Reference**
Fish guts		1. Convert to pig feed 2. Convert to fertilizer 3. Convert to fish meal	1. https://www.iffo.com/system/files/downloads/85.pdf 2. https://www.accessagriculture.org/turning-fish-waste-fertilizer 3. https://www.researchgate.net/publication/372991279_Fish_Waste_to_Fish_Meal_Potential_Sustainability_and_Emerging_Issues_Related_to_Microplastics_and_Regulations
Scales		1. Bio degradable food wrapping 2. Convert to Ferilizer 3. Bio absorbant	1. https://www.smithsonianmag.com/innovation/bioplastic-made-from-fish-scales-just-won-james-dyson-award-180973550/ 2. https://www.accessagriculture.org/turning-fish-waste-fertilizer 3. https://news.nus.edu.sg/upcycling-fish-scales-pollution-control-encryption/#:~:text=A%20research%20team%2C%20led%20by,and%20water%20flow%20tracing%20agents.
Sludge		1. Convert to fertilizer	1. https://www.rastechmagazine.com/waste-not-converting-ras-fish-waste-to-fertilizer-biocoal-other-opportunities/ 2. https://businessnorway.com/solutions/bioretur-converts-fish-waste-to-fertiliser
Waste water	No Image	Limited	Limited

Table 1: Waste Re-Use Opportunity

Most of these solutions are best practices within the seafood industry and in other adjacent industries. The next table explains in some detail what is being considered by Petros. They are considered Waste Avoidance practices.

Waste Avoidance			
Waste Stream	**Image**	**Possibilities**	**Reference**
Wooden pallets		Request fish feed bags to arrive without pallets. Bags are specially made with rings in order to be hung from the forklift.	Best practice at some existing farms. Cargill is already able to supply their fish feed bags in this method. Significant reduction in wooden pallet waste, that will not make it to the landfill.
Office paper	No Image	Minimal print outs allowed. All data stored in and shared from the cloud.	Zero Waste Principles and Aspirations
Cardboard	No Image	Cardboard compactors will be on site to recycle all incoming cardboard boxes.	Zero Waste Principles and Aspirations
Sea trash		Since Petros will have multiple vessels traveling daily to and from the off shore fish farm, Petros will implement a floating trash removal program for its fleet. Trash that is too large or dangerous, will be documented and the data stored.	1. https://oceanliteracy.unesco.org/ocean-clean/ 2. https://www.healthyseas.org/ 3. https://www.eea.europa.eu/highlights/marine-litter-2013-a-growing 4. https://sdgs.un.org/partnerships/cleanup-90-floating-ocean-plastic-2040

Table 2: Waste Avoidance Opportunity

Summary

Petros is a steward of the environment, especially the marine environment. Petros is considering all the different waste stream re-use opportunities as it grows its operating footprint. Petros will remain open and welcoming to any local entrepreneur who is driven to utilize any of these waste streams for the creation of new green/blue business opportunities for Aruba. Petros will continue to encourage and foster this mindset into the general population and the entrepreneur community.

Reference List

- https://www.iffo.com/system/files/downloads/85.pdf
- https://www.accessagriculture.org/turning-fish-waste-fertilizer
- https://www.researchgate.net/publication/372991279_Fish_Waste_to_Fish_Meal_Potential_Sustainability_and_Emerging_Issues_Related_to_Microplastics_and_Regulations
- https://www.smithsonianmag.com/innovation/bioplastic-made-from-fish-scales-just-won-james-dyson-award-180973550/
- https://www.accessagriculture.org/turning-fish-waste-fertilizer
- https://news.nus.edu.sg/upcycling-fish-scales-pollution-control-encryption/#:~:text=A%20research%20team%2C%20led%20by,and%20water%20flow%20tracing%20agents.
- https://www.rastechmagazine.com/waste-not-converting-ras-fish-waste-to-fertilizer-biocoal-other-opportunities/
- https://businessnorway.com/solutions/bioretur-converts-fish-waste-to-fertiliser
- https://oceanliteracy.unesco.org/ocean-clean/
- https://www.healthyseas.org/
- https://www.eea.europa.eu/highlights/marine-litter-2013-a-growing
- https://sdgs.un.org/partnerships/cleanup-90-floating-ocean-plastic-2040

Petros Aquaculture has developed a comprehensive wastewater management strategy that addresses any potential concerns by developing two viable options for wastewater management. Petros understands the importance of protecting Aruba's sensitive marine environment and share this commitment to environmental stewardship.

Wastewater Assumptions

Our previous estimated wastewater usage included fillet processing of Red Snapper. After further market analysis, Petros has determined that all substantial processing at the facility would simply be the conversion of whole fish to whole gutted fish, with miniscule processing of fillets. This determination is based on market expectations for product form.

For whole-to-gutted processing, the wastewater loads are typically lower than filleting operations since:

- Less mechanical processing is involved
- Fewer cutting operations means less blood and organic matter in the water
- The processing line is simpler with fewer washing steps

In addition to the processing facility, Petros will also be using water for conducting equipment cleaning, dive gear cleaning, and showers. Wastewater load is minimal for this, but the load estimates are included in the numbers below.

Recycled water that is approved for reuse will be utilized for sanitary flushing, Tote rinsing, vessel salt washdowns, building maintenance, etc.

BOD and TSS Generation Rates

Based on industry standards for gutting operations rather than filleting:

1. **BOD Production Range:** For gutting operations, the BOD load is typically on the lower end of the seafood processing spectrum, around 8-15 kg of BOD per MT of product processed compared to the wider range of 1-72.5 kg of BOD per MT for more intricate seafood processing operations (https://www.environmentalpollution.in/waste-management/seafood-industry/how-to-treat-waste-water-in-seafood-industry/5205).

2. **TSS Production:** Gutting operations typically generate 150-400 mg/L of TSS compared to higher concentrations seen in more intensive processing that can reach 1,100 mg/L or more (https://www.frontiersin.org/journals/environmental-science/articles/10.3389/fenvs.2021.689580/full).

3. **Wastewater Volume:** Gutting requires less water than filleting, approximately 10-15 m^3 per MT of fish rather than the 20 m^3 typical for full processing operations

(https://www.frontiersin.org/journals/environmental-science/articles/10.3389/fenvs.2021.689580/full)

Utilizing the above data, operational wastewater metrics are calculated below.

Projected Wastewater Metrics for Petros Aquaculture Project

Wastewater during processing Phase – 500 MT/year

Parameter	Per MT of Fish	Phase 1 Total (500 MT)	Daily Average
Wastewater Volume	12 m^3	6,000 m^3/year	16.4 m^3/day
BOD Load	12 kg	6,000 kg/year	16.4 kg/day
TSS Load	300 mg/L	1,800 kg/year	4.9 kg/day

Daily Average

Source	Water Volume (L/day)	BOD Load (kg/day)	TSS Load (kg/day)
Equipment Washing	321-643	0.13-0.51	0.10-0.39
Dive Gear Rinsing	200-300	0.01-0.02	0.02-0.06
Personnel Showers	359	0.05-0.07	0.04-0.05
Total Additional	**880-1,302**	**0.19-0.60**	**0.16-0.50**

Wastewater Treatment Option 1: Utilization of Existing RWZI Infrastructure with Confirmed Capacity

Petros primary approach leverages Aruba's existing wastewater treatment infrastructure, specifically the RWZI at Parkietenbos. It has conducted a thorough analysis of the current and planned capacity of this facility in coordination with Aruba Waste Water Sustainable Solutions (AWSS).

Detailed Capacity Assessment

Recent written communications with AWSS have confirmed that their planned upgrades will provide sufficient capacity to accommodate our project's wastewater, including during the scaling of production beyond 500 MT annually. The following specifics were provided:

- STP Parkietenbos facility is receiving 1200 m^3/day of the 1500 m^3/day of capacity with expansion capacity to 3000 m^3 by 2030
- STP Zeewijk is receiving 500 m^3/day of its 5000 m^3/day capacity. This facility also has upgrades and refurbishments planned in 2025/2026.
- Anticipated wastewater volume from our operations at 500 MT production: approximately 500m^3/month
- AWSS's formal commitment to capacity increases over the next 24 months that will exceed our requirements, even with expansion beyond 500 MT

Documentation and Agreements

To address the Commission's concerns about formal establishment of this capacity, Petros has:

- Secured a formal letter of intent from AWSS detailing their commitment to our project's needs
- Obtained certification from AWSS regarding the technical specifications of their planned upgrades
- Established a monitoring protocol to track actual wastewater volumes during operations of 500 MT

The utilization of the AWSS wastewater infrastructure remains our primary option for wastewater treatment and disposal from the facility. To ensure Petros has a firm solution in place if AWSS cannot meet our demand, Option 2 has been developed as a part of their contingency planning.

Option 2: On-Site Modular Wastewater Treatment System

As a complementary strategy that demonstrates our commitment to environmental protection, Petros has developed a comprehensive plan for implementing its own on-site wastewater treatment facility using proven modular technology.

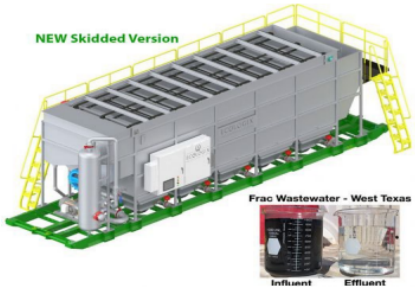
Technical Specifications

Petros has engaged Ecologix Environmental Systems, from Atlanta Georgia, to design a customized modular wastewater treatment solution specifically engineered for aquaculture processing facilities. This DAF system would:

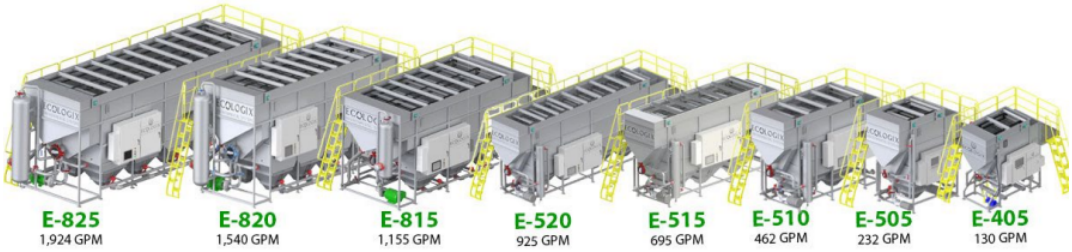
- Process 100% of our wastewater on-site
- Utilize a multi-stage treatment process including solids separation, biological treatment, and final polishing
- Meet or exceed all Aruban and international water quality standards for discharge
- Be scalable to accommodate growth

- **ITS 1500** : Frac Water Recycling Platform

- **E-DAF** : Enhanced Dissolved Air Flotation System



The Complete Primary (phys/chem) Treatment System
Max Flow Rates: 130 - 3.700 US GPM



Features

- Reduced footprint
- High efficiency
- Air scouring – for automatic tube cleaning
- Whitewater pumps
- Countercurrent scraping
- Sludge grating/thickening
- Fewer moving parts
- Full movable SKID

Industries

- Meat processing / slaughterhouse
- Dairy processing (milk, cheese, yogurt)
- Confectionary/Candy manufacturing
- Bakery / baked goods
- Automotive industry
- Printing
- Cereal and snack foods
- Food processing and packaging
- Beverage factories (breweries, juice, soda)

Environmental and Sustainability Benefits

This on-site treatment approach offers several advantages that align with both Petros' and Aruba's sustainability goals:

- Water recirculation capability, allowing us to reuse approximately 60-70% of our processed water
- Significant reduction in freshwater demands, a critical consideration for an island with limited resources
- Elimination of transportation-related environmental impacts associated with trucking wastewater
- Recovery of nutrient-rich solids that can be repurposed as agricultural inputs
- Complete control over water quality parameters ensuring no negative impacts to the surrounding environment
- Energy-efficient operation with options for renewable energy integration

The treated wastewater, after being tested for purity and passing all wastewater disposal requirements, will first be made available for agriculture operations on the island (ex. The AgriPark project on Aruba). This strategy encourages growth across the circular economy of Aruba. Any remaining treated water will be released into the Barcadera lagoon upon completion of quality testing and compliance to Aruban law and international accreditations.

Implementation Timeline

Should this option be selected, Petros would:

- Finalize system specifications during the construction phase of our processing facility
- Install and commission the treatment system prior to the start of operations
- Conduct extensive testing and optimization before full-scale production begins
- Maintain regular monitoring and reporting to relevant authorities

Comparative Analysis and Decision Framework

To ensure a responsible approach to wastewater management, Petros proposes implementing a staged decision-making process:

1. Begin with Option 1 (RWZI utilization) during initial operations with careful monitoring of volumes and treatment efficacy.
2. Concurrently finalize designs for the Option 2 modular system.
3. Establish clear performance metrics and environmental KPIs for both approaches.
4. Make a final determination on the optimal long-term solution prior to scaling to full production.

This adaptive approach ensures a response to operational realities while maintaining our commitment to environmental protection.

Summary

Petros Aquaculture Operations takes its environmental responsibilities seriously, particularly regarding wastewater management. Through either the confirmed capacity arrangements with AWSS or the implementation of our own state-of-the-art treatment facility, Petros is confident that it will address the Commission's points of comment while maintaining the highest standards of environmental stewardship.

The on-site treatment facility option particularly aligns with the broader sustainability vision, allowing the creation of a closed-loop system that minimizes the environmental footprint while maximizing resource efficiency — an approach particularly valuable in Aruba's island context.

Detail the process followed to identify the best site location for the fish farm. Key requirement points have been evaluated and considered.

Overview

The site selection process was rooted in a data-backed approach that required both remote and in-situ deliverables. Initially a comprehensive remote site selection process took place. Some of the KPI's included, but were not limited to, depth targets, telecommunication infrastructure, marine traffic patterns, ocean current and wave height models, and other economic interest areas for Aruba.
Innovasea performed a site selection study for Sustimar/Petros, which examined four potential farm sites on the South and Western sites of Aruba. Sites to the North and East of the island were not considered as these areas are more exposed to ocean energy (waves and currents) which were identified early on as primary drivers of site suitability. A report describing the methodology and results of that study is attached to this appendix.

The study recommended pursuing on-site studies at 2 sites. Site A located at 12.5461°N x 070.1441°W and site B located at 12.4613°N x 070.0955°W. In-Situ site characterization studies were completed for both sites in 2021, however the Innovasea personnel who deployed the sensors reported conditions to be more favorable at site A. The results of the Site Characterization Study are also attached to this appendix for more detail.

Based on the available remote, modeled, and in-situ measured data, site A was deemed to be the best available site. This decision was not only driven by bathymetry, wave height, and ocean current velocity, but also considered the proximity to Petro's shore-based site, benthic ecology, user conflict analysis, and critical approvals extended by the Department of Infrastructure & Planning (DIP) and Aruba Maritime Authority (DSA).

Summary

Multiple levels of research and studies have been conducted in order to arrive at the best suitable site for fish farming. The initial remote study was to assess which areas were suitable for open ocean aquaculture in and around Aruba. The next and more detailed remote study identified the best target sites for further in-situ study. From this report, 2 sites were identified as promising areas. Post extensive in-situ field work, the data was compiled and analyzed. The current site discussed is the best area for Aruba's first open ocean farm site.

Statement

Establish the risk profile for nutrient pollution from the open ocean aquaculture operations.

Overview

Nutrient inputs from feed waste and fish excretions can influence water quality and benthic ecosystems, but effective monitoring and site selection strategies help ensure aquaculture remains environmentally responsible. Understanding the extent of nutrient loading and the ability of the environment to disperse and assimilate those nutrients is critical for developing a responsible farm plan and a monitoring plan to minimize ecological impacts while maintaining productivity.

As part of an in-situ baseline assessment of the proposed farm area, sediment samples and benthic video transects were carried out to assess the bottom type and benthic community structure. The primary benthic habitat was characterized by exposed sandy and muddy bottom with sparse colonies of invertebrates, suggesting an environment with low sensitivity and low biodiversity (Innovasea, 2021). These observations suggest that the benthic environment can tolerate some level of nutrient input without significant changes to biodiversity or ecosystem function. The images serve as critical baseline information to draw upon once the farm enters the production phase in order to compare findings to future environmental monitoring assessments.

Existing offshore aquaculture farms provide insights into the environmental impacts of commercial-scale sites. In Panama, Open Blue Sea Farms (OBSF) operates a commercial cobia (*Rachycentron Canadum*) farm using the same submersible pen technology and was the subject of a study in 2019, which examined the nutrient footprint of the farm. Organic waste from the farm, including uneaten feed and feces, led to small, localized increases in sediment total organic carbon (TOC) and shifts in benthic species composition (Welch et al., 2019). However, strong offshore currents helped disperse waste, preventing severe oxygen depletion or biodiversity loss beyond a defined impact zone. Similarly, while ammonia levels increased downstream of the cages, rapid dilution prevented harmful eutrophication or algal blooms, unlike near-shore farms where restricted water flow can exacerbate nutrient accumulation (Welch et al., 2019). These findings highlight the importance of site selection to mitigate against potential impacts of nutrient loading.

The Panama farm is certified by the Aquaculture Stewardship Council (ASC) and demonstrates that increased nutrient loading from the farm can result in localized impacts, but the high-energy environment helps to dilute nutrients over a larger area. The Panama site is oceanographically similar to the proposed area, being sited in a deep, oligotrophic,

high-energy environment with current speeds regularly above 0.2 m/s, therefore, the impacts from the proposed farm are anticipated to be similar. Regular monitoring of ecosystem indicators will help early detection of environmental changes and guide adaptive management. Sustainable practices such as optimized feeding, and strategic siting are essential in minimizing ecological disruption while supporting the farm's long-term viability.

The ASC standards for a tropical marine finfish farm (ASC, 2023) outline the best practices for benthic monitoring which include redox potential, sulfide levels in sediments, and comparison between these parameters at the allowable zone of effect (AZE) and to control sites. Farms must conduct benthic faunal index assessments using approved methods (e.g., AMBI, Shannon-Wiener Index) and maintain scores within set thresholds to indicate healthy benthic biodiversity. At least three sediment samples must be collected at peak biomass, downstream of the predominant current, and analyzed by an accredited laboratory using approved methodologies (ISO 12878, 2022). ASC and other certification bodies outline trusted management practices that enable farmers to minimize nutrient loss, maintain ecosystem balance, and enhance the long-term sustainability of aquaculture operations while supporting healthy aquatic environments. Given the certification of the Panama farm, and the similarities between that site and the one being proposed, it is expected that the proposed farm will also fall within the allowable targets outlined above.

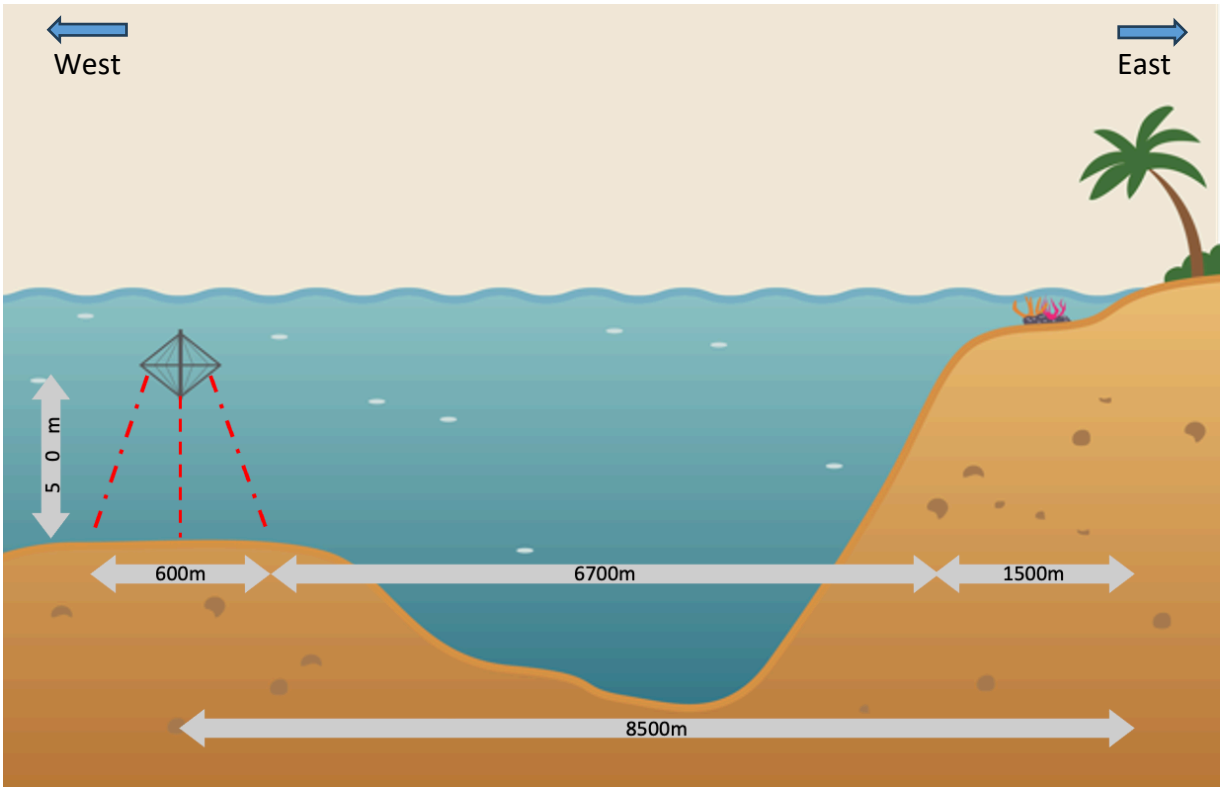


Figure is a not-to-scale representation from Manchebo Beach Aruba to the farm site.

In the event of a 180 degrees flip of the sea current, which sporadically happens for a short period of time, what is the probability that uneaten fish feed makes it back to the Aruban coast?

- Distance from site to closest point on shore is 8.5 km.
- Distance from shore where coastal corals still enjoy the ideal depth is 1.5 km.
- Distance from pen that food can be found on the seafloor is 300 m.
- Buffer zone from extreme to extreme conditions is 6700 m.
- The Factor of Safety (FoS) based on distance alone is approximately 22:1 or 2100%.
- Note: In comparison, automotive airbags are designed to 4:1 FoS.

Feed drop rate and current speed calculations.

- Drop rate of feed pellets is 0.1 m/s.
- Current speed at 50 m (exit point below the pen) from the seabed is 0.5 m/s Figure 25 and Figure 26.
- For this calculation, assume 0.5 m/s all the way to the sea bottom.
- 500 Seconds before it reaches the seabed.
- 0.5 m/s times 500 s, equals 250 m. This is how far the feed pellet would travel under these extreme conditions before reaching the seabed.

Any feed pellet traveling through the cage, remaining uneaten by either the fish in the pens or the wild fish outside the pens, will disperse no further than 250 m from the pen. Here it will be rapidly broken down by natural micro-organisms.
Petros will invest in a range of sensors and AI driven cameras to collect crucial data from within and outside of the farm area. This suite of sensor package and network of cameras will further eliminate feed waste, which is key in reducing feed washing away. The sensors will help us document current changes and in doing so, help Petros predict when these current changes are about to happen. This will help Petros implement new mitigation and management protocols for this potential event. The target is to collect sufficient repeatable data and in a transparent manner analyze these with the key stakeholders, such as DNM, University of Aruba, and others.

Summary

The monitoring plan for the proposed farm will adhere to the best practices outlined by the ASC & BAP, and will draw on the successful strategies employed by existing farms like OBSF, which have achieved ASC certification. By following these established guidelines, this farm aims to ensure environmentally responsible aquaculture operations. The full monitoring plan, detailing these practices and more, can be found in Section 5.0.

References

- Aquaculture Stewardship Council (ASC). (2023). *ASC Tropical Marine Finfish Standard. Version 1.1.* *https://asc-aqua.org/wp-content/uploads/2023/07/ASC-Tropical-Marine-Finfish-Standard-v1.1-Final.pdf*
- Innovasea. (2021). *Sustimar Site Characterization Report.*
- International Organization for Standardization. (2022). *Environmental monitoring of the impacts from marine finfish farms on soft bottom* (ISO Standard No. 12878:2022). https://www.iso.org/standard/52086.html
- Welch, A. W., Knapp, A. N., El Tourky, S., Daughtery, Z., Hitchcock, G., & Benetti, D. (2019). The nutrient footprint of a submerged-cage offshore aquaculture facility located in the tropical Caribbean. *Journal of the World Aquaculture Society*, *50*(2), 299–316. https://doi.org/10.1111/jwas.12593

MGMSource-2025-1108
Social Economic Impact Assessment (SEIA)
Introduction, Output expectation, Context (SEIA report not yet available)
Aquaculture Project Aruba – Lutjanus Campechanus – Petros Aquaculture Operations February 2025

INTRODUCTION

The Social Economic Impact Assessment (SEIA) report aims to develop an understanding of all the different potential social and economic impacts this new project could have on the population of Aruba. These impacts could result in being assessed as positive, neutral or negative, thus resulting in matters that may need to be mitigated or addressed and offering tools/ methods that could be applied to minimize these.

OVERVIEW

MGM Source, an Aruban boutique firm, has been tasked with conducting the SEIA report for this aquaculture project scheduled to commence once the option of the properties has been obtained from the authorities. MGM Source's services range from business plans, feasibility studies, capital raising, M&A support, market assessments, investment support, and social economic impact studies.

The sourcing of data used for all projects includes a series of methods, as displayed in the following pictographs.

In Aruba, the Social Economic Impact Assessment (SEIA) is part of a series of requirements from the Government of Aruba, via an option agreement related to a designated property, to be able to obtain the granting of the designated lease property.

Source: MGM Source

This requirement is alongside the Environmental Impact Study, the Feasibility Study, proof of financing/funding and various others.

MGM Source team has been conducting these types of studies for over 2 decades which comply with the requirements as stipulated by the local authorities as well as compliant to international best practices. MGM Source recognizes that it is a dynamic process and therefore aims to improve the products and services on an ongoing basis, as requirements may change and all on a best effort basis.

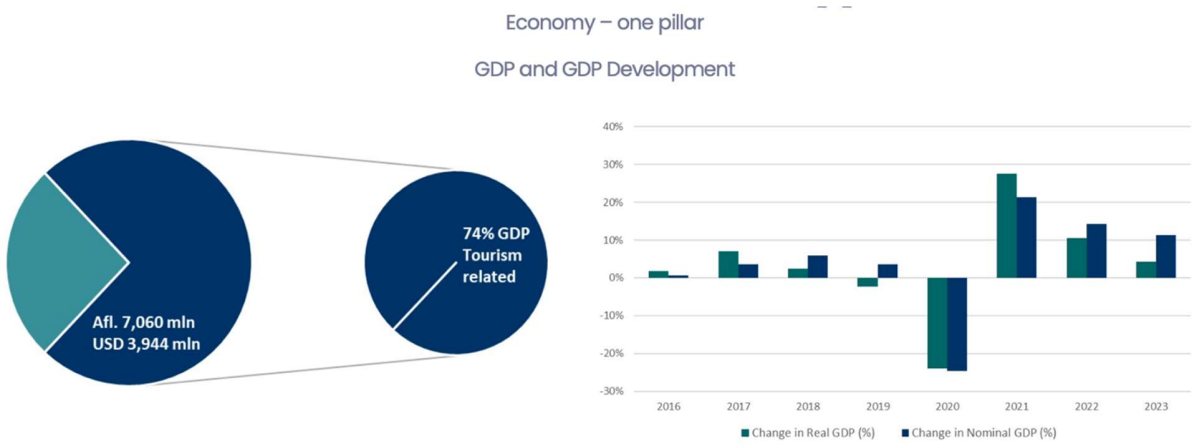
MGM Source was approached and engaged by the Client, now through Petros Aquaculture Operations VBA (formerly through Sustimar LLC), to conduct a Feasibility Study in 2020 for the aquaculture endeavor to have submergible pens that grow Lutjanus Campechanus in Aruba's Territorial Sea, far from shore, and then to harvest these and distribute regionally as well as internationally through export. This endeavor is further referred to as "The Project". The Feasibility Study for the Project was then prepared by MGM Source for the Client. Various scenarios and adaptations have been prepared since to accommodate for the changing times, needs and the dynamic process of any project.

As of the current date of February 14th, 2025, MGM Source is contracted to execute the SEIA as soon as Petros receives an option for the intended land and sea locations from the Government of Aruba. Client was asked by the Government of Aruba to conduct the Environmental Impact Study, despite not having a valid current option from the Government, to gain traction and counter various of the negative assumptions that may have risen in some sectors/departments of the Government or outside to eventually lead to a valid option for the assignment/ granting of the territories needed onshore and offshore. The process of the intended SEIA will be further elaborated herein, including the matters that have already been conducted for this study in a pre-phase and the ones aligned to be taken once a "go ahead" is provided for the initiation of the SEIA.

Even though the SEIA has not initiated, various engagements with GO's, NGO's, environmental groups, local fishermen groups, and private sector representatives have been held for the pre-phase of the SEIA. Additional engagements are still required for the SEIA.

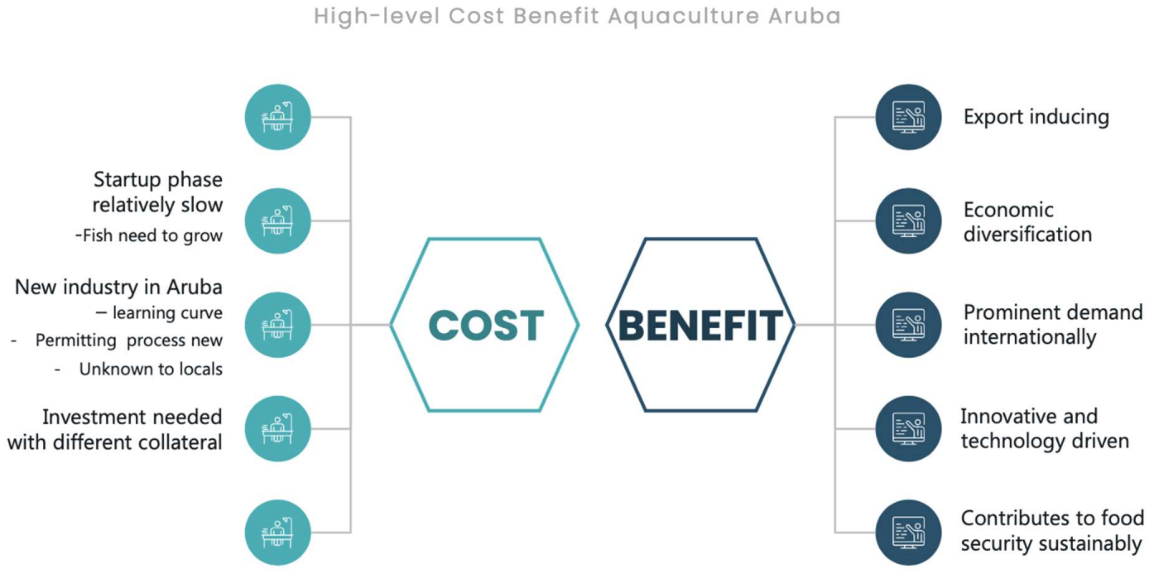
CONTEXT

As stated below from CBA data, Aruba's economy is dependent mainly on the tourism industry. A diversification of this economy is highly needed for Aruba's own economic security, while not competing with nor replacing the Tourism industry.



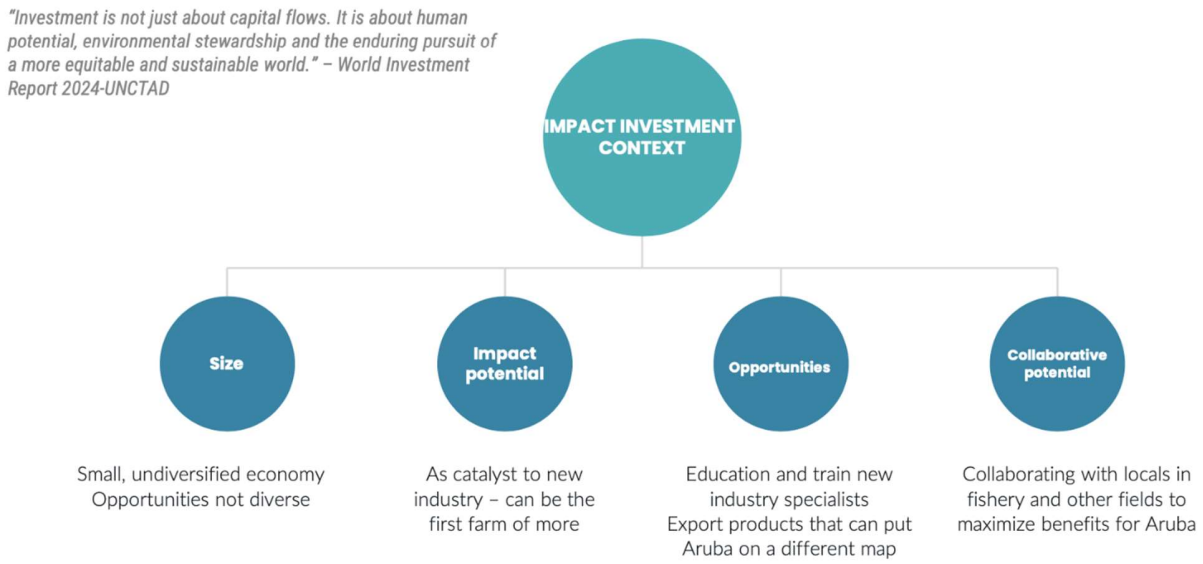
Source: Central Bank Aruba (CBA)

The picture below illustrates a high-level preliminary cost benefit overview of such an offshore aquaculture industry for Aruba. In-depth assessment is still required to be able to present an all-inclusive cost benefit assessment.



Source: MGM Source

The illustration below shows the ambitions of the Project's investment within the Aruban context and as observed during the feasibility trajectory.



Source: MGM Source

NEXT STEPS

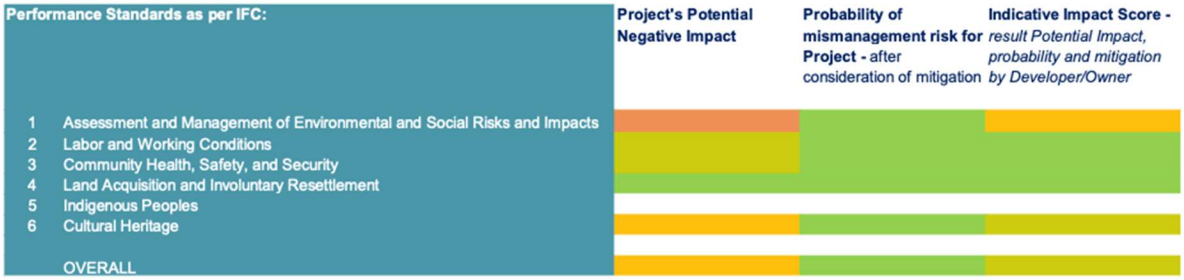
Next activities to complete the SEIA will include a series of interviews with stakeholders and developer's key persons, (formal and informal) conversations, research, and analysis of all the various aspects and data to be covered in the SEIA. The tables below are samples of some output tables that are generated by MGM Source once the exercises are conducted and included in the SEIA report to be issued. Stakeholders include, but are not limited to, NGO's, private businesses and organizations, fishermen and the general public.

Outline Social Economic Impact Assessment by MGM Source

Outline output report SEIA	Tasks and assessment described concisely	Status
Concise description of the Project;	The description of the report is already known to MGM Source through the excercises for the Feasibility Study and from that report and update conversations with Client the description that fits the SEIA will be described	Existing
The possible consequences for the population;	An assessment on various aspects is included to deduct the impact on the population. This includes the impact from a quantity standpoint, from a nuissance standpoint, from a development view, educationally, added value, and any other impact that can be related. Interviews and benchmarking will support and substantiate the assessment.	To be initiated still pending option process Client
The economic impact of the Project;	MGM Source has an economic model which it adapts per Project and sector to include all the variables of the economic sectors and their impact quantification in it. Besides the quantitative model approach, the qualitative aspects including diversification, added value, opportunities, etc, are observed and assessed.	To be initiated still pending option process Client
The employment opportunity and related education-program;	The direct and indirect employment opportunities are viewed next to project specific information. Same goes for the training and educational aspects that are project specific in the context of Aruba.	To be initiated still pending option process Client
The possible impact on the public transportation and traffic;	Depending on sizing of the Project the impact (if any) is assessed and brought forward and quantified where possible, while also taking into account qualitative impacts if these are present, either positive or negative, whichever may be applicable.	To be initiated still pending option process Client
The possible impact of the Project on the surrounding real estate.	Depending on sizing of the Project the impact (if any) is assessed and brought forward and quantified where possible, while also taking into account qualitative impacts if these are present, either positive or negative, whichever may be applicable.	To be initiated still pending option process Client
Review of Project based on International Finance Corporation (IFS) Performance Standards (not required by standard option agreements, but included as part of international standards). Other considerations also included	MGM Source has customized models that take into account various international best practices including IFC performance standards, FDI cost benefit assessments, engagement plan related to the various aspects. Impact on the SDGs are also considered and assessed. To subtantiate all the above extensive sessions are held with Client and stakeholders.	Some sessions held with stakeholders were attended by MGM Source as the early stage of assignment

Source: MGM Source

The assessed items will be displayed in the following sample table outputs within the SEIA report, where applicable. Note that per project, some items are added or omitted, depending on context and applicability.



Source: MGM Source

Performance Standards as per IFC:	Relation to a Project and related activities and main objectives
1 Assessment and Management of Environmental and Social Risks and Impacts	This standard is applicable for projects with environmental and/or social risks and/or impacts. "Project" refers to defined set of business activities intended or present. To adopt a mitigation hierarchy to anticipate and avoid or where avoidance is not possible, minimize and where necessary compensate/ offset for risks and impacts to workers, affected communities and the environment. To promote improved environmental and social performance of clients through management systems.
2 Labor and Working Conditions	The pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. To include promotion of equal opportunity to workers, improve worker-management relationship, compliance with national employment and labor laws and promote safe and healthy working conditions.
3 Community Health, Safety, and Security	To anticipate and avoid adverse impacts on the health and safety of the affected community during the project life and to ensure the safeguarding of personnel and property in accordance with relevant human rights principles
4 Land Acquisition and Involuntary Resettlement	To avoid and when avoidance is not possible to minimize displacement by exploring alternative project designs, to avoid forced eviction and to minimize adverse social economic impacts from land acquisition
5 Cultural Heritage	To protect cultural heritage from the adverse impacts of project activities and support its preservation and to promote the equitable sharing of benefits from the use of cultural heritage

Source: MGM Source

	Principle social elements reviewed, requested by GOA	Possible negative Impact	Possible positive Impact	Probability Negative Impact	Probability Positive Impact	Result after mitigation
1)	*Possible impact on population (permanent and transient)*	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be: Semi negatively affected - negatively affected - neutral - positively affected - semi positively
2)	*Economic Impact*	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be: Semi negatively affected - negatively affected - neutral - positively affected - semi positively
3)	*The impact on the surrounding real estate*	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be: Semi negatively affected - negatively affected - neutral - positively affected - semi positively
4)	*The possible impact on social and physical infrastructure*	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be: Semi negatively affected - negatively affected - neutral - positively affected - semi positively
5)	*The impact on employment and related training programs*	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be: Semi negatively affected - negatively affected - neutral - positively affected - semi positively
6)	*The social alienation, culture and identity "vervaging"*	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be low - medium - high	Outcome could be: Semi negatively affected - negatively affected - neutral - positively affected - semi positively

Source: MGM Source

DURING CONSTRUCTION/IMPLEMENTATION (.. months) - yearly				Potential Impact	
Unit: amount in million USD	Aruba*	Project**	% share	Degree Impact	Type Impact
GDP	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Construction Sector	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Import	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
FDI through direct investment	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Government Tax Revenue	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Wage taxes	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Taxes on property	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Import duties	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Export	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Labour force - Total	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Labour force - Construction Sector	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Population	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
DURING OPERATIONS - Year 3, 2021					
Unit: amount in million USD (unless stated otherwise)	**Aruba***	**Project****	**% share**		
GDP	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Tourism receipts	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Government Tax Revenue	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Wage taxes	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Taxes on property	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Import duties	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Export receipts	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Turnover tax	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Taxes on profit	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Labour force - Total	XXX	XXX	%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Labour force - Lodging industry			%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Population (+average added experts per day)			%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative
Population (+ additional persons fixed)			%	MINOR/MODERATE/HIGH	Positive/Neutral/Negative

Source: MGM Source

SUMMARY

Some steps to prepare the SEIA have already taken place in the pre-phase, including the numerous engagements with Aruban stakeholders. The MER and SEIA in the context of Aruba, are two separate reports and issued by two different entities in this case, while stakeholder consultations have been held jointly in the pre-phase.
As is required for any other new project in Aruba, this aquaculture project will also complete the SEIA report, which will adhere to the applicable requirements. MGM Source will conduct such in an independent manner and will consider any advice received which is project specific from the authorities or the "Commissie mer" for the fulfillment of its duties thereunder, on a best effort basis.

Native Range and Presence in Aruban Waters

The Lutjanus Campechanus has long been observed and caught in the waters of the ABC islands. According to fisheries data from the IUCN Red List assessment and regional surveys, Lutjanus Campechanus has a distribution that extends throughout the Gulf of Mexico, into the Southern Caribbean (Officially a native species in Trinidad & Tobago), and has been observed as far South as Brazil.

There is also mixed consensus on the taxonomic identification and spatial distribution of Lutjanus Campechanus and Lutjanus Purpureus. For example, Marval-Rodriguez et al. (2022) concluded, based on genetic analyses, that these are not two separate species, while da Silva et al. (2020) found that they were, although both species share a significant number of haplotypes, indicating important gene flow between the two.

When Petros begins the work of capturing broodstock for its hatchery, it will work with local fishermen to catch numerous live Red Snapper (Lutjanus Campechanus) and will conduct genetic testing with a 3rd party lab to validate it is indeed Lutjanus Campechanus. The location of each caught Red Snapper will be documented accordingly. By following this process, Petros is ensuring that no non-native species will be introduced to Aruban waters.

In partnership with local and/or international universities, Petros will support the academic work required to ensure that this species is recognized scientifically as a native species in Aruba. Our initial data of capture broodstock data can be used for this process. Petros will also support additional field work with these scientists to facilitate the required data collection. Petros recognizes that this is a multi-year international scientific process.

References Related to Section

- https://link.springer.com/article/10.1007/s12526-016-0575-1
- https://www.dutchcaribbeanspecies.org/linnaeus_ng/app/views/species/nsr_taxon.php?id=182120&cat=163
- https://www.fishingtnt.com/red-snapper
- Marval-Rodriquez et al. (2022) Assessing the Speciation of Lutjanus Campechanus and Lutjanus Purpureus through Otolith Shape and Genetic Analyses: "[..] L. Campechanus and L. Purpureus exhibit some otolith shape and genetic differentiation between populations in the Gulf of Mexico, the Caribbean, and the southwestern Atlantic, but not enough to consider them as two distinct species."'
- Da Silva et al. (2020) New insights about species delimitation in red snappers (Lutjanus Purpureus and L. Campechanus) using multilocus data: "The molecular delimitation of species supported the discrimination of L. Purpureus and L. Campechanus as distinct evolutionary units. Nevertheless, a unidirectional gene flow was found from L. Campechanus towards L. Purpureus. Therefore, it seems plausible to infer that L. Campechanus and L. Purpureus are two evolutionary units in which the apparent sharing of haplotypes should be driven by introgression."

Aquaculture Science and Research Background

The selection of Lutjanus Campechanus for our aquaculture operation is strongly supported by extensive scientific research:

1. **Research Foundation**: The University of Miami's Aquaculture Program has conducted over 15 years of pioneering research on Lutjanus Campechanus cultivation, developing comprehensive protocols for spawning, larval rearing, and grow-out phases.
    a. https://scholarship.miami.edu/esploro/outputs/doctoral/Physiology-and-Development-of-Northern-Red/991031965318502976
    b. https://scholarship.miami.edu/esploro/outputs/graduate/Advances-in-Hatchery-Technology-of-Red/991031524284102976
    c. https://www.sciencedirect.com/science/article/pii/S235251342300220X

2. **Proven Success in Similar Environments**: Data from Tropic Seafood's pilot project in the Bahamas demonstrated exceptional results with L. Campechanus, including:
    a. Nearly 100% survival rate from fingerling stage
    b. Excellent Food Conversion Ratios (FCRs)
    c. Phenomenal growth rates

3. **Knowledge Transfer**: Our partnership with the University of Miami provides direct access to this scientific expertise, dramatically reducing the technical risks associated with farming a less-studied species. Petros has a strong working relationship with the University of Miami on this subject.

Economic Viability and Market Considerations

The Lutjanus Campechanus represents the strongest business case for sustainable aquaculture in Aruba:

1. **Premium Market Recognition**: L. Campechanus is the only species legally marketable as "Red Snapper" in the United States, our primary export market. This designation commands premium pricing in the US market (30-40% higher than other snapper species).
2. **Market Demand**: The U.S. market demonstrates consistent demand for Red Snapper, with imports valued at over $22 billion annually for all seafood. Specific demand for Red Snapper continues to exceed wild-caught supply.
3. **Export Potential**: Our economic model benefits from access to premium export markets. The Red Snapper's established brand recognition and market value in North American and European markets is unmatched by other snapper species.
4. **Price Stability**: Historical price data shows L. Campechanus maintains more stable pricing compared to other snapper species, providing greater business predictability.

Risk Mitigation for Potential Fauna Distortion

Petros will implement multiple safeguards to prevent fauna distortion in Aruban waters:

1. **Native Species Confirmation**: As documented above, L. Campechanus is naturally present in Aruban waters and genetic testing will be conducted to eliminate any concerns that a non-native species is being introduced. Petros' broodstock will be captured in Aruba's Territorial Seas.
2. **Escape Prevention Systems**: The Innovasea SeaStation™ submersible pens incorporate:
    a. Kikko netting with exceptional strength and durability.
    b. Regular integrity inspections and maintenance protocols.
    c. Submersible capability to avoid storm damage.
3. **Genetic Management**: The broodstock will consist of F1 specimens. Future breeding will be based on these F1 cohorts. Petros will maintain genetic diversity similar to wild populations, minimizing genetic divergence that could impact wild stocks in the unlikely event of escapes.
4. **Certification Standards**: Both BAP and ASC certification programs require strict adherence to escape prevention protocols, which Petros will fully implement.

Summary

The selection of Lutjanus Campechanus for this aquaculture operation represents a carefully considered balance between ecological compatibility, scientific foundation, and economic viability. This species naturally occurs in Aruban waters, has well-developed aquaculture science behind it, and presents the strongest business case for a sustainable economic development in Aruba.

Petros is committed, in close collaboration with local stakeholders and partners, to the monitoring and mitigating of any potential risks through its comprehensive environmental management system and are prepared to adapt its approach based on ongoing assessment results during the initial phase of operations.

Statement

What is really in fish feed? Has the industry improved its FIFO (Fish In Fish Out) ratio over the years? Is the current fish feed truly sourced from sustainable origins?

Overview

Petros has been working with industry leading fish feed companies like **Cargill** and **Biomar**. The table below captures the main points of concern voiced by NGO's and the general public.

Sustainable Fish Feed in Aquaculture (2025) What's in the feed that Petros will use?	
Use of GMO (Genetically Modified)	No
Antibiotics and/or Medication	No
Fish oil/meal from illegal fisheries (IUU)	No
Fish oil/meal from forage fish	No
Fish oil/meal from fish **trimmings**	Yes
Vegetable oils/proteins	Yes
ASC & BAP Accredited	Yes
Periodically feed sustainability assessments	Yes
Supplier quality assurances	Yes
Full value stream traceability	Yes
Carbon, Nitrogen & Phosphorus report	Yes
Produced for warm water species	Yes
Circular economy programs	Yes

Aquaculture Stewardship Council Feed Certificate For:

EWOS Canada Ltd

Scope of Certificate:

Production and storage of aquaculture Hatchery, Pre-grow out & Grow out feed for Salmon, Trout, Seabass, Seabream, Tilapia, Seriola, Totoaba, & Cobia using the Mass Balance Production Model.

This independent certification assessment was conducted on behalf of:

EWOS Canada Ltd
7721-132 St, Surrey, BC V3W 4M8, Canada

Certification Code: ASC02659
Original Certification Date: 09 December 2024
Valid from: 09 December 2024
Valid to: 08 December 2027
ASC Standard: ASC Feed Standard V1.01

Please consult www.asc-aqua.org for descriptions of product from this and other ASC certified feed mills.

SCSglobal SERVICES

Adam Daddino

Adam Daddino, Program Manager, Aquaculture
SCS Global Services
2000 Powell Street, Ste. 600, Emeryville, CA 94608 USA

NSF

Best Aquaculture Practices

ANAB ANSI National Accreditation Board ACCREDITED ISO/IEC 17065 PRODUCT CERTIFICATION BODY #1181

EWOS Canada Ltd.

7721 132 Street
Surrey, British Columbia V3W 4M8 Canada

was evaluated by NSF Certification, LLC and found to meet the requirements of Global Seafood Alliance

Feed Mill Standard

Issue 3.1 - 31-May-2022

Product Species: Aquaculture Feed

Facility #: M10028

Registration #: NSF SF 24544

Announced Evaluation Date: 03 - 04 September 2024

Certificate Issue Date: 30 September 2024

Certificate Expiration Date: 22 October 2025

Sarah Krol

NSF Certification, LLC
789 N. Dixboro Road
Ann Arbor, Michigan 48105 USA
www.nsf.org

Certificate not valid unless the facility is listed on BAP website: www.bapcertification.org. This certificate was executed in accordance to the requirements of ISO/IEC 17065 and is issued after initial assessment and is validated through periodic assessment. This certificate remains the property of NSF Certification, LLC and must be returned immediately upon request. 12249-15.

EWOS Cargill www.ewos.com

January 6, 2025 *(Reviewed and updated)*

To whom it may concern:

RE: **EWOS Canada Parasite Free Feed Statement**

This letter summarizes the segments of the fish feed process which contribute to a parasite free product physical fish feed, which is supplied by EWOS Canada for the feeding of various fish species.

EWOS Canada's fish feeds are comprised only of dry feed ingredients and oils which are permitted for use by the C.F.I.A. and the U.S.F.D.A. There is no use of raw, uncooked marine ingredients. Specifically, no meals of raw wild fish are used. Meals of farmed fish are not used in our feeds.

The feed is heat-treated via extrusion at ≈ 80ºC - 100ºC for 1.0 - 1.5 minutes and drying at 70ºC -130ºC for ≈ 40 to 60 minutes.

Based on this information, we assert our fish feed does not contain live parasites.

Best regards,

Jing Li
FSQR Site Lead
Cargill EWOS Canada Ltd.

EWOS® Canada Ltd. 7721 – 132 Street Surrey BC V3W 4M8 Canada Telephone: 604.591.6368 ▪ Toll Free: 1.888.492.7722 ▪ Facsimile: 604.591.7232

CONTROLUNION

PRODUCTS RvA C 412

GGN: 4052852616218

CERTIFICATE No: CU 829268-01.2024

GLOBALG.A.P. REGISTRATION No: CU 829268

GLOBALG.A.P.

GLOBALG.A.P.

CERTIFICATE

According to

GLOBALG.A.P. Compound Feed Manufacturing General Regulation version2.2_Aug2016

Issued to:

EWOS Canada Ltd.
7721 - 132nd Street
V3W 4M8 Surrey
49.143514, -122.85966
CANADA

The Annex contains details of the feed-manufacturing units included in the scope of this certificate.
Control Union Certifications declares that the manufacturing of the products mentioned on this certificate has been found to be compliant in accordance with the standard:

GLOBALG.A.P. Control Points and Compliance Criteria Compound Feed Manufacturing Version 2.2_Aug2016

Product	GLOBALG.A.P. Product Certificate Number	No. of manufacturing units	Assessed sub-sections of section C
Compound Feed for Aquaculture	00137-NVKPH-0002	1	

Valid from: 08 November 2024
Valid to: 27 August 2025

☑ Announced
☑ On-site audit

Declared by:
On behalf of the Managing Director

CONTROLUNION
Control Union Certifications B.V.

Authorized by: Szabo, Mr. CS. (Csaba)

Control Union Certifications B.V.
Meeuwenlaan 4-6
8011 BZ ZWOLLE
The Netherlands
http://www.controlunion.com
tel.: +31(0)38-4260100

Date of approval decision: 08 November 2024
Printed on: 11 November 2024

The current status of this certificate is always displayed at: https://www.database.globalgap.org/search

Control Union Certifications B.V., P.O.Box 161 8000, AD Zwolle, The Netherlands, certifications@controlunion.com

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SOURCE OF TRIMMING MARINE INGREDIENTS

August 9, 2024

SNo.	Origin	Fish Name	Type
Fish Meal :			
1	Pacific Ocean (FAO Zone 67)	North Pacific Hake / Pacific Whiting (*Merluccius productus*)	Trimmings
2	Bering Sea and Pacific Northeast Ocean (FAO Zone 67)	Alaskan Pollock (*Gadus chalcogramma*)	Trimmings
Fish Oil:			
1	Bering Sea and Pacific Northeast Ocean (FAO Zone 67)	Alaskan Pollock (*Gadus chalcogramma*)	Trimmings
2	Pacific Ocean (FAO Zone 67)	North Pacific Hake / Pacific Whiting (*Merluccius productus*)	Trimmings

Note :

No fishmeal or fish oil originating from IUU (illegal, unregulated, unreported) catches or from species categorized as vulnerable, endangered or critically endangered according to the IUCN Red List of threatened species are used in EWOS Canada feeds.

Summary

Feed is one of the most important components of a successful aquaculture operation. In the past the aquaculture industry committed many sins in their feed sourcing. But with transparency, ethical corporate culture, and public pressure, have transformed the industry into a shining beacon of hope and good governance. Aquaculture leaders driven to understand all aspects of the feed composition, how it was manufactured, and the reduction of the FIFO ratio to zero. Advances are made on a regular basis and the outlook is very positive.

New research is ongoing in new sustainable feed sources like seaweed and BSF (Black Soldier Flies). These researches are in their early phases and much more is still to be learned.

Note

FIFO, which stands for Fish-In-Fish-Out, is a metric used to assess the sustainability of aquaculture. It measures the amount of wild-caught fish used to produce a unit of farmed fish, essentially indicating how much wild fish is needed to produce the farmed fish used in feed. A lower FIFO ratio is generally considered more sustainable, indicating less reliance on wild-caught fish.

FFDR stands for Forage Fish Dependency Ratio. **Petros will always demand a FFDR of zero.**

Perceptions exist that limited amount of project information has been shared with the public and key stakeholders.

Overview

Since March of 2020, all of the key government organizations of Aruba have been introduced and informed on the vision of economic diversification and improved food security for Aruba through this Open Ocean Aquaculture project. In addition, many Non-Government Organizations (NGO's) and stakeholders have been engaged on the project. Continuous engagement and discussions have occurred not just once, but throughout the multi-year period. The table below highlights the main informative engagement sessions held throughout the last few years. This list does not include the many single contact points throughout the years.

Date	Subject	Attendee Groups
Sep 2023	Project Intro	Public interview w/ local paper. 2 separate articles.
Feb 2024	Project Intro & MER Data	Fishermen orgs, numerous marine focused NGO's, mixed sessions w/ GO's, DOW and future AWSS members, multiple Minister representatives, local fishermen, and charter boat captains.
Mar 2024	Project Intro & MER Data	Presentation to Parliament.
Jan 2025	Project Intro & MER Data	Additional NGO's who were not able to attend previous events (1-on-1 sessions).
Feb 2025	Project Intro & MER Data	Aruba Zero Waste community, University of Aruba SISSTEM group (Students & Faculty).

The following list of future communication and engagement events can be found below. Note that some of these events are in combination with those needed to complete the SEIA report as required by the Optie process from DIP.

1. Open public sessions held at MFA locations around Aruba. A minimum of 2 major sessions are to be held for the general public. They will be announced in traditional news publication as well as social media. Flexibility exists to schedule additional sessions if interest so dictates.
2. Key leaders within the fishing community have advised Petros to hold 1 big session focused on their community. This will also be scheduled and published through local papers, social media, and personal visits to fishing hubs throughout the island.
3. Numerous sessions required by the SEIA process. These will be managed by the 3rd party MGM Source.
4. Continuous social media presence and information sharing on the Petros project.
5. Petros leadership team will be open and transparent with local and international media, and will remain available to share the vision of Aruba's 1st open ocean aquaculture project.

Once the project is in full operation, continued efforts will be made to keep the dialogue active with the public. Mainly through social media, local media interviews, seafood industry

articles, and others. Also concerted efforts have been made to ensure engagement with the local school system, the University of Aruba, NGO engagements, and social community participation.

Summary

The Petros project is complex and innovative, which will require continuous dialogue with the public and stakeholders. Petros will remain transparent and on point. Many engagements have taken place over the last few years, more will take place throughout 2025, and additional one's post start of production.

Below are previous examples of sessions already held with stakeholders. More is still required and planned.

February 2024 GO Session

February 2024 Fishermen Group Session

April 2024 Aruban Parliament Session

Petros Open Ocean Aquaculture Project Environmental Protection Summary

Executive Summary

Petros plans to build Aruba's first offshore fish farm. The farm will grow Red Snapper (*Lutjanus Campechanus)* fish far from shore where it won't hurt the environment or tourism. The submergible cages will be 8.5 kilometers (5.3 miles) away from land and not visible from the island.

This project will help Aruba in three important ways:

- **Create jobs** for local people
- **Grow fresh fish** instead of importing it from other countries
- **Diversify the economy** by establishing a new sustainable industry

The fish farm uses safe technology that has worked in other regions for over 20 years without issue.

Project Description

What We're Building

A fish farm in deep ocean water that grows Red Snapper, a fish that already lives naturally around Aruba. The farm will be completely underwater and invisible from shore.

Why Red Snapper?

- People like to eat it
- It is a native fish in Aruba's warm water and grows well in it

Where It Will Be Located

- 8.5 Kilometers offshore (very far from land)
- In water that is 85-90 meters deep (deeper than a 30-floor building)
- Away from coral reefs, beaches, leisure and commercial use areas
- In strong ocean currents that keep water oxygenated

Protecting Aruba's Environment

Keeping Coral Reefs Safe

Safe Distance: The farm is 8.5 km away from all coastal coral reefs.

Ocean Currents Help: Strong currents carry any fish waste away from shore. Even if currents drastically change directions, waste naturally breaks down well before the reefs that are about 8 km away and is not detectable beyond 250 m from the pens.

Proven Safe: The same technology used in Panama and Hawaii showed no harm to coral reefs.

No Impact on Sea Turtles and Other Marine Life

No Lights Underwater: The farm has no lights that could confuse turtles trying to find beaches.

No Loose Ropes: All nets and ropes are tight so turtles and marine mammals can't get tangled.

Far from Nesting Beaches: The farm is over 8.5 km from turtle nesting areas like Eagle Beach.

Daily Monitoring: Workers will watch for turtles and report any interaction to the authorities.

Impact on Fish Population

No Extra Food for Sharks: Dead fish inside the pens are removed every day to prevent behavioral change in sharks.

Strong Nets: Farmed fish can't escape into the wild because of the strong nets and stringent protocols.

Helps Local Fishing: The farm becomes a Fish Attracting Device, giving local fishermen new places to catch wild fish.

Safe and Clean Operations

Sustainable Fish Feed

The fish food contains:

- **No medicine or antibiotics**
- **No GMO ingredients**
- **No fish meal from forage fish**
- **Only plant proteins and fish scraps** from fish processing

ASC & BAP Certified: All fish feed is certified to meet all global sustainability requirements.

Smart Feeding: Underwater cameras watch the fish eat. When fish stop eating, feeding stops automatically so minimal food makes it into the surrounding environment.

Clean Water Systems

On Land: All wastewater from the shore facility will be treated properly, either at Aruba's treatment plant or with a new on-site system.

Hatchery: The facility recycles between 95% and 98% of its water and needs 30 m^3/day of new water.

Strict Rules: All water released will be cleaner than what the law requires. This is to meet international accreditations

Native Fish

Local Parents: All parent fish will be caught by Aruban fishermen from Aruba's waters using fishing lines (not nets).

DNA Testing: Every parent fish will be tested to make sure it's the right type of Red Snapper from Aruba.

Small Numbers: Only about 50 parent fish are needed - a very small number compared to all the Red Snappers in Aruba's waters.

Minimal Impact Promise

Tiny Ocean Footprint

The entire farm is only 0.03% of Aruba's territorial seas.

Proven Technology

The underwater pens have worked safely in Hawaii's whale sanctuary (20+ years) with zero problems.

Constant Monitoring

- Sensors check water quality 24 hours a day
- Environmental data is shared with fishermen and the public
- Wildlife sightings are reported to the government
- Independent inspectors check the farm regularly

Oversight

Multiple Agencies Watching

Multiple government departments will monitor the farm:

▪ DNM (Nature and Environment) ▪ DVG (Health) ▪ DIP (Planning)	▪ DTI (Technical) ▪ DLVV (Fisheries) ▪ DOW (Public Works)

International Standards

The farm must meet the highest international standards (ASC and BAP) for responsible fish farming.

Public Reports

Every three months, the farm will publish reports about environmental monitoring.

Benefits for Aruba

Economic Benefits

- Create dozens of direct jobs in fish farming, boat operations, and fish processing
- Reduce dependence on imported fish (currently 95% of fish is imported)
- Provide fresh, local fish for local markets, restaurants, and for export

Environmental Benefits

- No impact on coral reefs or tourism
- Use sustainable fish feed
- Create new fishing areas for local fishermen
- Monitor ocean conditions and share data publicly

Community Benefits

- Hire local fishermen to help with the project
- Share ocean monitoring data with the community
- Support Aruba's goal of economic diversification
- Actively engage and support local scientific community focusing on Aruba’s marine ecosystem

Conclusion

The Petros fish farm is designed to strengthen Aruba's economy while protecting the ocean environment. By using proven technology, following strict environmental rules, and locating far from sensitive areas, the project will create jobs and fresh fish without harming Aruba's precious coral reefs, sea turtles, or tourism industry.

The farm represents a careful balance between economic development and environmental protection, using the best science and technology to minimize impacts while maximizing benefits for Aruba's people.

Appendix 55: Professional Biography of Experts

Personal Information	
First name(s) & Surname:	Eleomar Mateo
Work Experience	
Period:	2020- to present
Occupation:	Electrical/ Environmental Support
Name of Employer:	ACE Firm Engineering
Education	
Titles:	B. Eng Electrical Engineering
Name of Organization:	UNA Curacao

Personal Information	
First name(s) & Surname:	Rubiëla Lampe Chiquito
Work Experience	
Period:	2013 – to present
Occupation:	Managing Director
Name of Employer:	ACE Firm Engineering
Period:	2003 – 2012
Occupation:	Process Engineer
Name of Employer:	Valero Aruba Refinery
Education	
Period:	1997 – 2003
Titles:	MSc. Chemical Engineering
Name of Organization:	University of Groningen

Personal Information	
First name(s) & Surname:	Reigene Aldrick Geerman
Work Experience	
Period:	2013 – to present
Occupation:	Project Leader
Name of Employer:	ACE Firm Engineering
Period:	Jan 2004 – Nov 2012
Occupation:	Process Engineer, & Refinery Energy Coordinator,
Name of Employer:	Valero Aruba Refinery
Education	
Titles:	B. Eng. Chemical Engineering
Name of Organization:	Hogeschool Rotterdam, Rotterdam