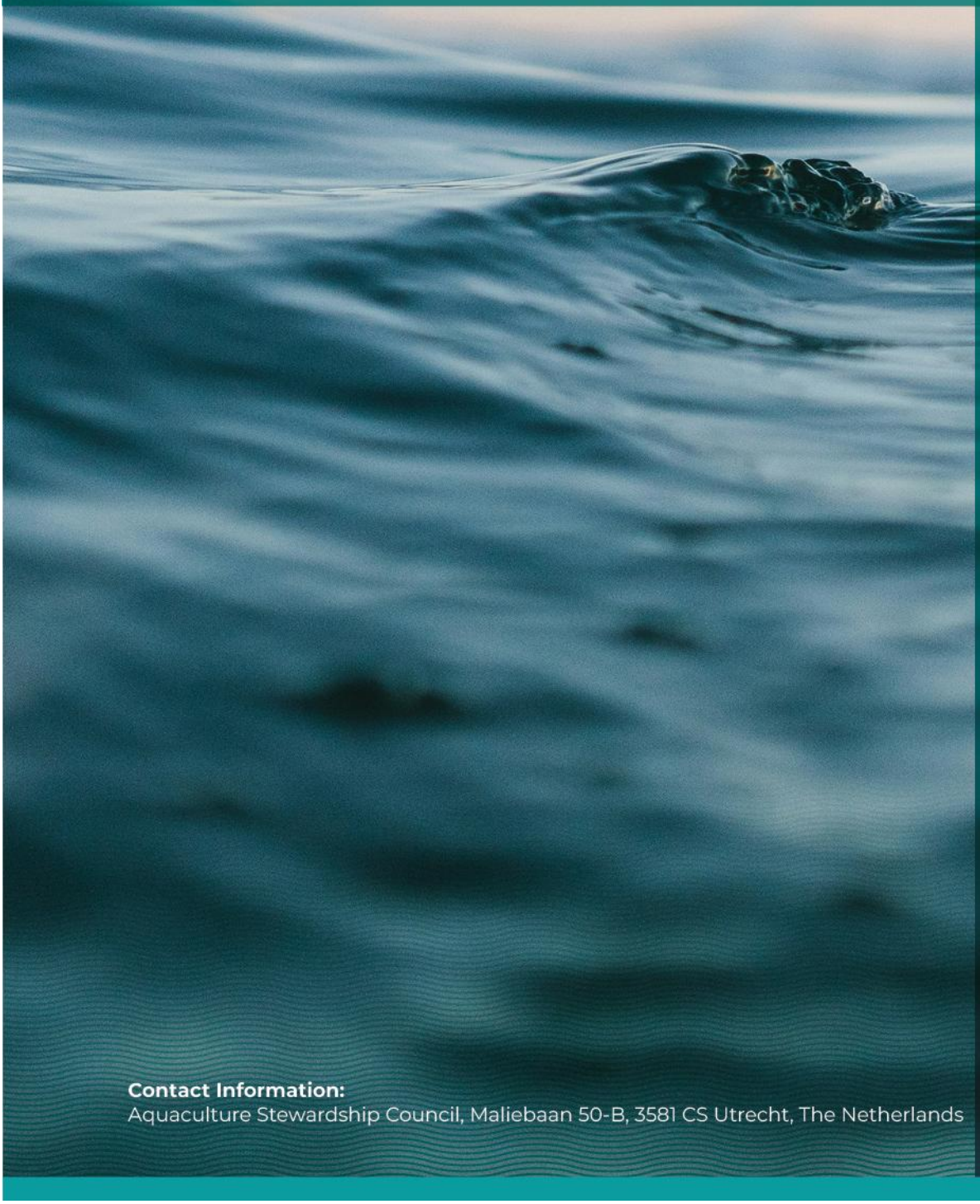
ASC Farm Standard

Version: 1.1 - Issue Date: 1 November 2026













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Version control, available language(s), and copyright notice

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For feedback or questions regarding the content of this document, please contact ASC via standards@asc-aqua.org.

Document ID: ASC-STD-001

Version control

Document version history:

Version:	Issue Date:	Effective date:	Mandatory date:	Remarks/changes
V1.0	1 May 2025	1 August 2025	1 May 2027	New document
V1.0.1	1 August 2025	1 August 2025	1 May 2027	Non-substantive corrections and clarifications only – full details can be found here: https://programme-centre.asc-aqua.org/app/uploads/2025/08/ASC-Farm-Standard-V1.0.1-Non-substantive-corrections-and-clarifications.pdf
V1.0.1A	1 July 2026	1 July 2026	1 May 2028	Interim amendment. Indicators and sections of the appendices that will be updated or removed in the upcoming V1.1 marked as 'not in use' (greyed out and crossed out) - full details can be found here: https://programme-centre.asc-aqua.org/app/uploads/2026/06/ASC-Farm-Standard-V1.0.1A-Interim-amendment-with-Indicators-'not-in-use.pdf
V1.0.1A2	5 August 2026	5 August 2026	1 May 2028	Updated interim amendment - full details can be found here:

				https://programme-centre.asc-aqua.org/app/uploads/2026/08/ASC-Farm-Standard-V1.0.1A2-Interim-amendment-with-Indicators-'not-in-use.pdf
V1.1	1 Nov 2026	1 February 2027	1 May 2028	Substantive, non-substantive and editorial changes made across the whole document. Substantive changes made to the following sections: **Criterion 1.5: Supply Chain - Indicator 1.5.2** Requirements focus on direct suppliers for most applicable species, aligning responsibility with producer influence. **Criterion 2.1: Environmental Risk Assessment - Appendix 3 (3.3)** Clearer guidance and decision-making tools. **Criterion 2.4: Escapes and Native Biodiversity - Appendix 6 (6.2)** EICAT Contextualisation Decision Tree removed. **Criterion 2.5: Benthic Impact - Indicators 2.5.1-2.5.6** Equivalent regulatory requirements can be recognised to avoid farms duplicating environmental monitoring efforts. **Criterion 2.6: Water Quality - Indicators 2.6.1-2.6.22** Equivalent regulatory requirements can be recognised and removal of specific depth/current siting requirement. **Criterion 3.2: Forced Labour; Criterion 3.7: Transparent Contracts - Indicators 3.2.3-3.2.14 and Indicators 3.7.43-3.7.6** Requirements strengthened on protections for workers supplied through third parties (subcontractors), applicability and wording clarified. **Criterion 3.5: Health and Safety - Indicators 3.5.7 and 3.5.21-3.5.24** Additional requirements introduced, strengthening health and safety provisions relating to diving operations. **Criterion 3.9: Working Hours - Indicator 3.9.9**

				More flexibility in how rest periods are scheduled, allowing two periods of 24 consecutive hours rather than requiring one 48-hour consecutive period per 14-day period. **Criterion 4.4: Veterinary Therapeutants - Indicator 4.4.18** Market-specific Maximum Residue Limits indicator removed. **Criterion 4.4: Veterinary Therapeutants - Indicator 4.4.19** Public disclosure requirement removed. **Appendix 12.4: Eyestalk Ablation** Timeline adjusted for *P. monodon* to reflect implementation realities.

V1.0 of the ASC Farm Standard became effective on August 1st 2025. From this date, ASC started accepting audit announcements against the ASC Farm Standard. Recognising the need for farms to transition to the new ASC Farm Standard, it will only become mandatory on May 1st 2028. From this date, all audits must be against the ASC Farm Standard.

It is the responsibility of the user of the document to use the latest version as published on the ASC website.

Review and revision

ASC shall review this Standard at least once every five years according to the requirements of the ISEAL Code of Good Practice, considering its continued relevance against ASC's intended outcomes and impacts, and its effectiveness in meeting ASC's objectives.

If review determines that revision is necessary, ASC shall revise the Standard accordingly, publishing the new version on the ASC website with the issue date, effective date and date of next review.

If review determines that revision is not necessary, ASC shall reaffirm the standard, communicate publicly about the decision and rationale, and establish the date of next review.

Available language(s)

The ASC Farm Standard document is available in the following language(s):

Version:	Available languages
V1.0	English (official language) Japanese Korean Spanish Turkish Vietnamese

In case of any inconsistencies and/or discrepancies between available translation(s) and the English version, the online English version (PDF format) will prevail.

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About ASC

The Power of Seafood

A nutritious protein source and a key component of global food security, 3.3 billion people rely on seafood for at least 20% of their animal protein consumption, and between 400 – 600 million people are directly and indirectly involved with the industry[1].

With population estimates of 10 billion by 2050, and with wild caught fisheries at capacity, farmed seafood comprises almost 60% of seafood consumed as its numbers and importance continues to grow[1]. Care must be taken immediately to limit the industry's negative impacts.

Responsible seafood farming eases pressure on natural resources, protects precious ecosystems, promotes economic opportunities and addresses food security challenges, caring for seafood, people and the planet. A crucial link in the circular economy, it upcycles multiple by-product streams into much needed high-quality protein.



Our Vision

A world where seafood farming plays a major role in supplying food and social benefits for humanity whilst minimising negative impacts on the environment



Our Mission

To transform seafood farming towards environmental sustainability and social responsibility, creating value across the chain using market mechanisms, improvement incentives and delivering value-added services from farm to fork

[1] *UN Fisheries Panel (COFI36):* Aquaculture as a solution to food insecurity, malnutrition and poverty

Transforming Seafood Farming

ASC is accelerating the transformation of the farmed seafood industry by:

- **Championing Change** – raising awareness of what needs to change and collaborating to create pathways for the change required to accelerate positive impact on people and planet, fish and farms.
- **Making Change** – developing and implementing the world's leading independent certification and improver programmes for responsibly farmed seafood.

Our supply chain partners choose ASC certification for the most robust standards and the highest assurance ensuring traceability and transparency throughout the supply chain. By choosing ASC-labelled seafood, consumers in over 100 countries are contributing to a sustainable future.

Making an Impact

The impact of the ASC programmes in the seafood farming industry is substantiated across multiple Sustainable Development Goals (SDGs)[2].



Simplifying this target framework, ASC contributes specifically to the following areas:

- Conserving Biodiversity
- Addressing Climate Change
- Fostering Fish Health and Welfare
- Improving Lives, Livelihoods and Communities

In addition to the focus of ASC programmes on these key SDGs, the ASC standards contribute to a broader range of SDGs at different levels to address the impacts of seafood farming on fish health and welfare, people and planet.

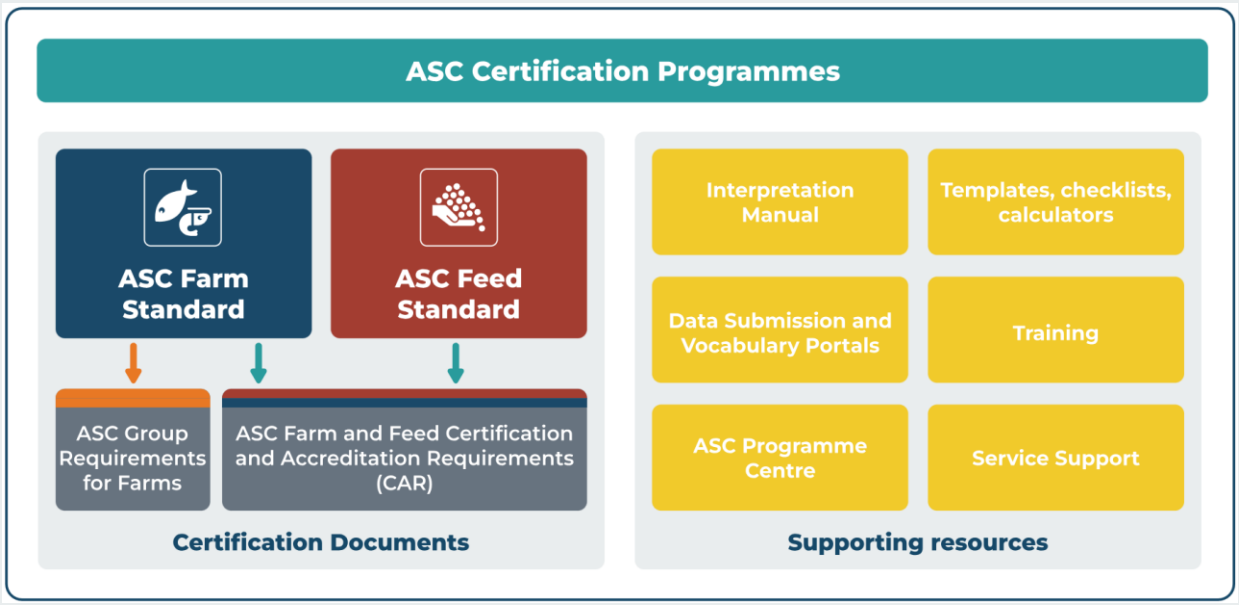
[2] For more information on ASC's SDG work, see https://www.asc-aqua.org/wp-content/uploads/2022/12/ASC-SDG-Report-2022-1.pdf

Throughout the ASC Farm Standard, there are SDG icons showing which are contributed to at both Principle and Criterion levels.

Note that the extent to which any ASC-certified farm contributes to these SDGs will depend on its specific circumstances, including its scope, the species farmed, the nature of its operations, workforce, geography and neighbouring stakeholders.



ASC Certification Programmes



ASC Certification

ISEAL Community Membership

ISEAL is a global membership organisation for ambitious, collaborative and transparent sustainability systems, that drives collective efforts to tackle the most pressing sustainability issues and create a world where markets are a force for good.

The ASC Certification Programme is ISEAL Code Compliant. The ISEAL Code is a globally recognised framework that defines best practices for effective and credible sustainability systems.

Normative Documents and Tools

The documents and tools listed below are a normative part of the ASC Certification Programme:

- ASC Farm Standard
- ASC Farm and Feed Certification and Accreditation Requirements (CAR)
- ASC Group Requirements for Farms
- ASC Vocabulary Portal
- ASC Data Submission Procedure
- ASC Variance Request (VR) Procedure
- ASC Question for Interpretation (QA) Procedure

Additional documents are referred to in Indicators and Appendices of this standard in such a way that some or all of their content constitutes requirements of this document.

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Supporting Documents and Tools

The documents and tools listed below support the implementation of the ASC Certification Programme:

- ASC Farm Standard Interpretation Manual
- ASC Programme Centre
- ASC Calculators to support calculations for Criterion 2.6 (Water Quality), 2.10 (GHG Emissions) and 3.8 (Living Wage)

Certification Programme

The ASC Certification Programme is a voluntary third-party certification programme consisting of the following independent actors:

Scheme Owner: Aquaculture Stewardship Council

As scheme owner, ASC sets and maintains standards and associated assurance documents and their underpinning procedures, as well documents and resources that support the implementation of the Certification Programme.

An overview of all documents and the latest version can be found on the ASC Controlled Document Master List.

Conformity Assessment Body: Provide certification services in accordance with the requirements of this scheme.

The legal entity responsible for the **Unit of Certification** (UoC), contracts a Conformity Assessment Body (CAB) which employs auditor(s) that conduct an independent conformity assessment (hereafter 'audit') of the UoC against the relevant ASC standard.

The management requirements for CABs as well as auditor competency requirements are described in the CAR and are assured through accreditation.

Integrity Services Provider and Accreditation Body:

The Integrity Services Provider is appointed by ASC to oversee the integrity of the programme.

Integrity services and accreditation are currently provided by Assurance Services International (ASI). Findings of ASI assessments and an overview of currently accredited CABs are available on the ASI website.[3]

Audit Process

An ASC audit follows strict process requirements. These requirements are detailed in the CAR. Only ASC accredited CABs are allowed to audit and certify a UoC against ASC standards.

As scheme owner, ASC is not involved in the audit or certification decision of a UoC.

As part of the ASC commitment to transparency, all audit reports, findings and certificates are publicly available on the ASC website. These include audit findings that result in a negative certification decision.

Certificate

All ASC certificates are available on the ASC website for verification. Issued certificates are the property of the CAB.

[3] http://www.asi-assurance.org/s/

Each certificate specifies the scope (i.e. ASC Farm Standard) and the sub-scope of the certified UoC (i.e. animal group and species name). Examples are listed below:

- ASC Farm Standard, Sub-scope: Finfish, Atlantic Salmon (*Salmo salar*)
- ASC Farm Standard, Sub-scope: Crustaceans, White leg shrimp (*Penaeus vannamei*)
- ASC Farm Standard, Sub-scope: Molluscs, Pacific oyster (*Crassostrea gigas*)

ASC Chain of Custody (CoC) Certification

Once ASC-certified seafood is produced by a certified UoC, every company that owns or handles the ASC-certified products must be covered by valid ASC Chain of Custody (CoC) certification. This includes any processing or packing conducted while the product is owned by the UoC. This assures consumers and seafood buyers that ASC-labelled products come from certified farms. ASC uses the Marine Stewardship Council's (MSC) Chain of Custody (CoC) Standard, plus the ASC-owned CoC Module, to verify the origin of seafood sold as ASC-certified. This process benefits companies that handle both ASC and MSC certified seafood by allowing them to do a combined audit. CoC certification covers activities beyond farm production, such as processing and packing. For more information see Chain of Custody Standard - ASC International or contact info@asc-aqua.org.

ASC Label and Claims

ASC-certified entities shall only use the ASC label, claim, and trademarks if authorised through a signed ASC Licensing Agreement.

Unauthorised label display or use of trademarks is prohibited and will be treated as a trademark infringement. For more information see ASC's Label User Guide or contact licensing@asc-aqua.org.

ASC Assurance Net

The independent actors and processes described above are interlinked to provide the most robust and reliable assurance system, supported by ASC's transparent processes and stakeholder participation. CABs conduct strict audits to verify conformity against the ASC standards. ASI assesses CABs to confirm that certification was granted following the requirements and with integrity. Both CABs and ASI may conduct these activities unannounced, and all the evaluation results are publicly available for interested stakeholders who may provide additional information to the certification process.

Working closely with assurance partners, ASC monitors conformance across the supply chain.

ASC adds another layer of assurance by designing tailored tools that support additional verification of conformity. These tools evaluate the conformance of ASC products in different stages, for example, antibiotic residues and provenance (TestASC), verification of production cycles and remote sensing (MapASC), and complete tracking of products in the supply chain (TraceASC).

Group Certification

ASC Group certification provides a more efficient option to certify multiple sites where there is a centralised internal management system in place which assures conformity across all sites. The internal

management system requirements are described in the ASC Group Requirements for Farms document.

One of the key benefits of this type of certification is that a sample of sites is selected for the CAB audits, thereby reducing the audit time compared to auditing and certifying each site individually. The CABs also assess the robustness of the internal management system and can increase or decrease the sample size based on risk.

Variance Request Process

UoCs may encounter circumstances in which ASC standards' requirements need to be adapted to the local context while maintaining their original intent. To address this need, ASC has developed a Variance Request (VR) Process.

The ASC Variance Request (VR) Procedure sets out the steps for submitting, processing and publishing VRs, including stakeholder engagement. The procedure ensures that VRs are processed consistently and that outcomes are clear and replicable.

All VRs are evaluated for inclusion during the development or revision of ASC standards. To ensure transparency, all VRs and related procedural documents are publicly available on the ASC's Variance Request and Interpretation Platform.

Question for Interpretation Process

UoCs, CABs, ASI and stakeholders may encounter circumstances in which the language or intent of an Indicator or requirement requires interpretation or clarification. To address this need, ASC has developed the Question for Interpretation (QA) process. In contrast to VRs, QAs provide temporary additional guidance, interpretation and information between revisions of ASC standards.

The ASC Question for Interpretation (QA) Procedure sets out the steps for submitting, processing, and publishing QAs. The procedure ensures that QAs are processed consistently and that the outcomes are clear and replicable.

All QAs are evaluated for inclusion during the development or revision of ASC standards. To ensure transparency, all QAs and related procedural documents are publicly available on the ASC Variance Request and Interpretation Platform.

ASC Data Submission Requirements

ASC collects data as part of the ASC Certification Programme and related services. These data are essential for demonstrating ASC's impacts, supporting assurance and programme development, transparency, delivering client and partner services, and meeting research needs. ASC establishes data submission requirements based on clear, justified needs and adheres to a strict data sharing policy. The data to be submitted are specified in the ASC Data Submission Procedure.



Document Structure and Vocabulary

Document Structure

The ASC Farm Standard is structured as follows:

- Four **Principles** – each Principle defines a high-level outcome which, collectively, contributes to the ASC Vision.
- A Principle consists of multiple **Criteria** - each Criterion addresses an impact that is relevant to the aquaculture industry.
- A Criterion consists of a **Rationale**, **Intent** and multiple **Indicators**.
    - The Rationale describes why the issue is of relevance to the aquaculture industry;
    - The Intent describes the long-term outcome of the Criteria;
    - Each Indicator describes a requirement. Audits are conducted to determine conformity to Indicators, including any referenced appendices, footnotes or terms.

The ASC Farm Standard also contains:

- **Appendices** – included to provide detail on acronyms, performance metrics, methodologies, formulas or requirements.
- **Footnotes** – used to detail **exemptions** to an Indicator and for references.
- **Terms** – defined terms are highlighted in **bold** when used for the first time. Definitions are listed in the ASC Vocabulary Portal.

Vocabulary Use

Intentional language is used in the ASC Farm Standard to ensure clarity:

- **Shall vs. Should**
    - 'Shall' denotes a requirement;
    - 'Should' denotes a recommendation.
- **May vs. Can**
    - 'May' denotes a permitted course of action;
    - 'Can' denotes a possible course of action.
- **Exceptions vs. Exemptions**
    - 'Exception' an alternative requirement for a specific circumstance, referenced in the Indicator;
    - 'Exemption' an exclusion from an Indicator, referenced in a Footnote.
- **Appropriate vs. Adequate**
    - 'Appropriate' refers to what is suitable or proper for a particular need;

- ‘Adequate’ refers to what is sufficient to meet a need.

- **And vs. Or (in lists)**
  - ‘And’ implies inclusiveness i.e. all items are required;
  - ‘Or’ implies exclusiveness i.e. only one of the items is required.
- **Indications of time**
  - ‘Day’ refers to calendar days unless working days are explicitly specified.
  - ‘Week’ refers to a period of seven consecutive calendar days unless otherwise specified.
  - ‘Month’ refers to a calendar month unless otherwise specified.
  - ‘Year’ refers to a calendar year unless otherwise specified.
- **As necessary**
  - Refers to a situation where something shall be done if, and to the extent that, it is needed.
- **Where relevant**
  - Refers to a situation where something shall be done if it is applicable to the specific situation or circumstances.

Scope of the Standard

The ASC Farm Standard applies to aquaculture grow out farms (hereafter 'grow out sites'). The Standard does not apply to pre-grow out sites, for example, nurseries and hatcheries.

The scope of the Standard is defined by the following elements:

- Focus Areas;
- Unit of Certification (UoC);
- Supply chain and associated activities; and
- Applicability across culture systems, water types and species.

Focus Areas

The following focus areas are within scope of the ASC Farm Standard:

- Legal compliance
- Environmental stewardship
- Human rights
- Animal health and welfare

Unit of Certification (UoC)

The UoC may be a single aquaculture grow out site or consist of multiple aquaculture grow out sites.

The following components of the UoC are within scope of the ASC Farm Standard:

- The farmed species, including any co-habitant species, and the associated culture units (e.g. marine cages);
- Operational processes and activities;
- Workers; and
- Facilities (e.g. storage facilities, offices and accommodation).

Supply Chain and Associated Activities

- ### Upstream Supply Chain
  - For some species, the UoC shall demonstrate that upstream supplier sites conform with the requirements outlined in Appendix 14 of the Standard (see Indicator 1.5.2).
  - For marine salmonid species, any cage culture site in the UoC's upstream supply chain shall be certified against the ASC Farm Standard (see Indicator 1.5.2).
- ### Downstream Supply Chain
  - Slaughter:

- Where the slaughter activity is conducted within the UoC, it is within the scope of the ASC Farm Standard.
- Where the slaughter activity is conducted outside the UoC, it is not within the scope of the ASC Farm Standard and is instead within the scope of the ASC Chain of Custody (CoC) Certification.

- Processing and Packing:
  - Processing and packing activities are not within the scope of the ASC Farm Standard and are instead within the scope of the ASC Chain of Custody (CoC) Certification.

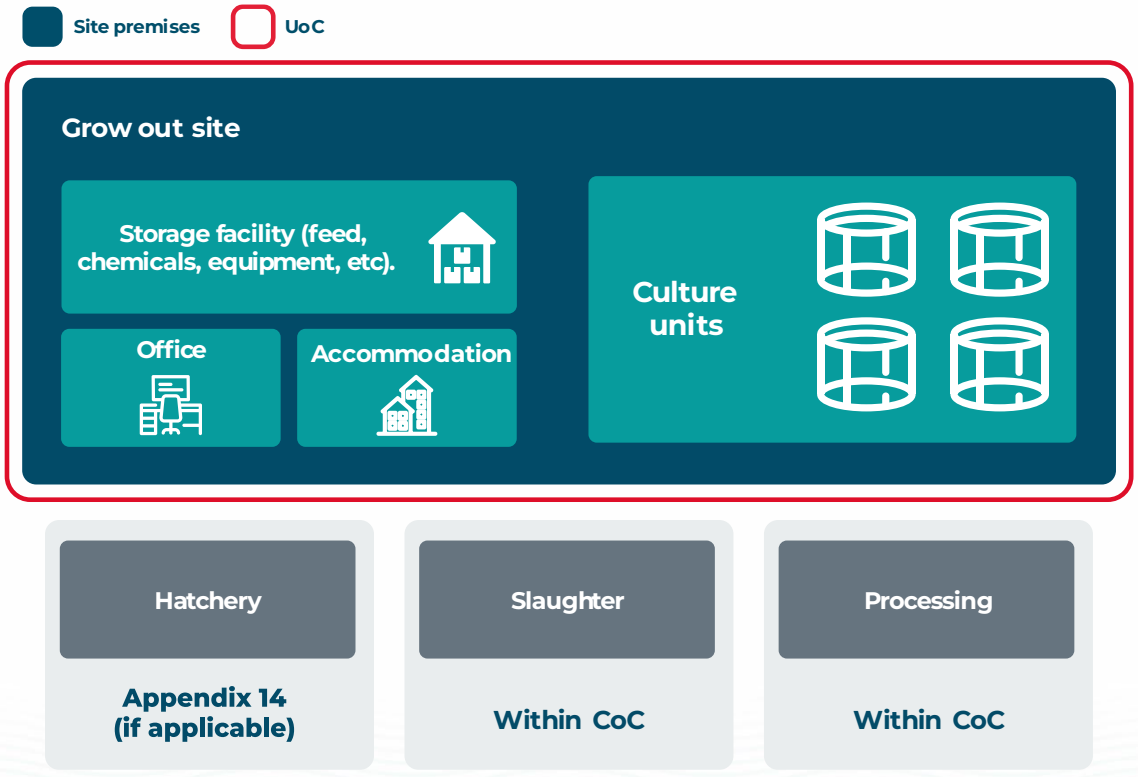
- **Transport**
  - Where the live aquaculture product remains under the ownership of the UoC during transport to or from the UoC, the transport activity is within the scope of the ASC Farm Standard.

Examples of UoC Configurations

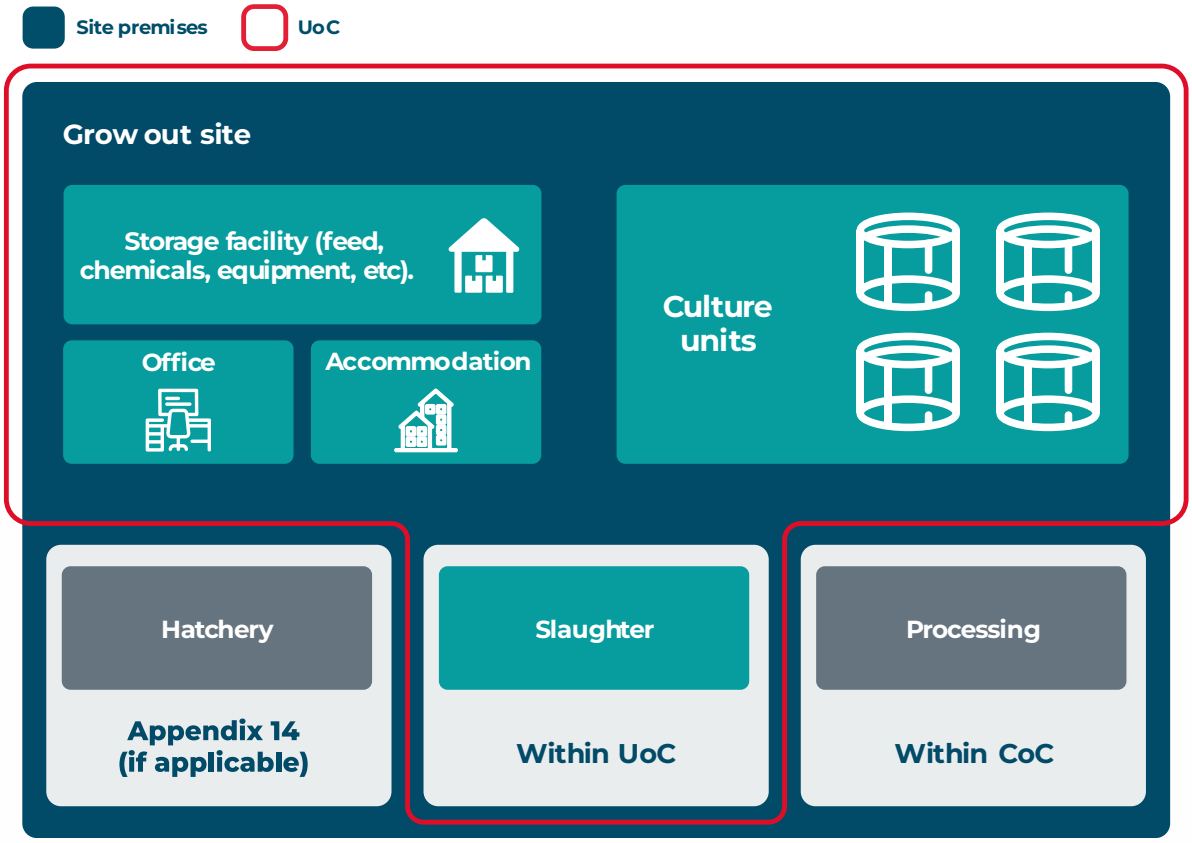
Culture units and facilities of the UoC might not always be located within the premises of the grow out site. For example, marine cage units, chemical and feed storage facilities, offices and employee accommodation may be located at separate physical locations. Where these components form part of the grow out site's operations, they are considered part of the UoC.

The following are illustrative, non-normative examples of different UoC configurations.

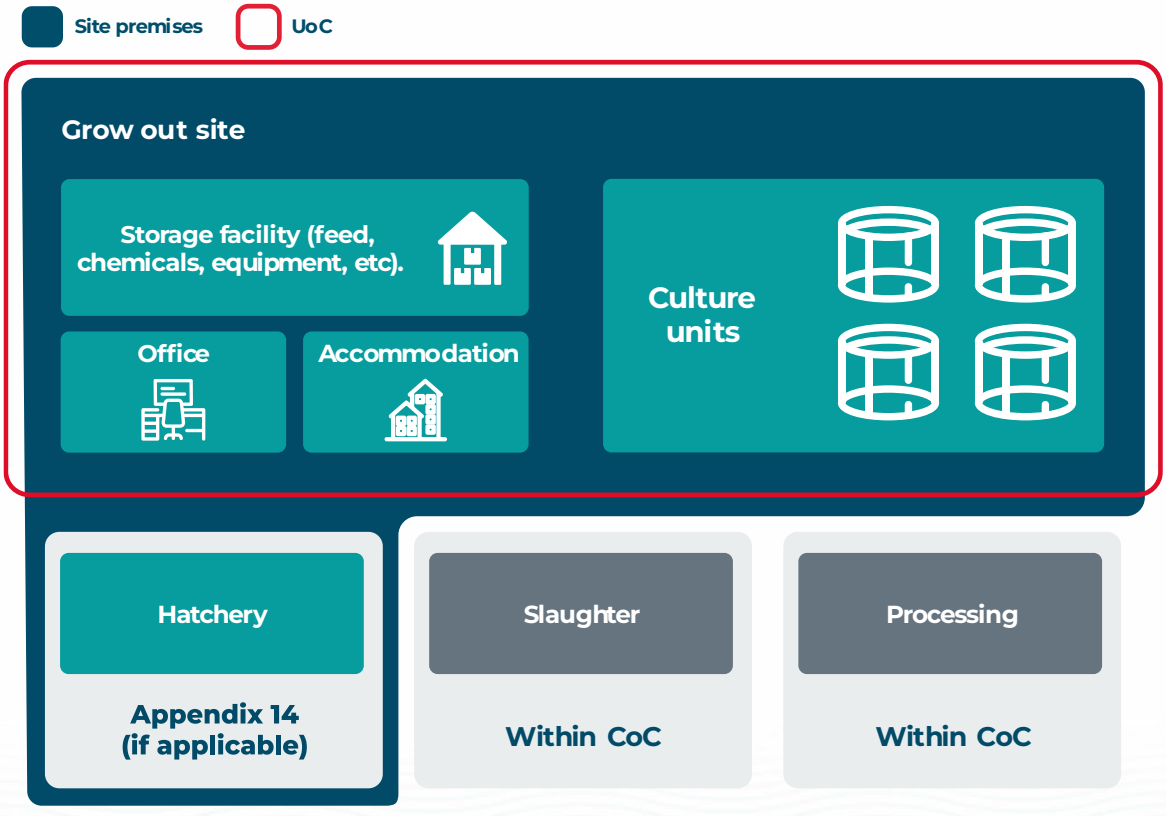
Example 1 UoC with off-site hatchery, slaughter and processing



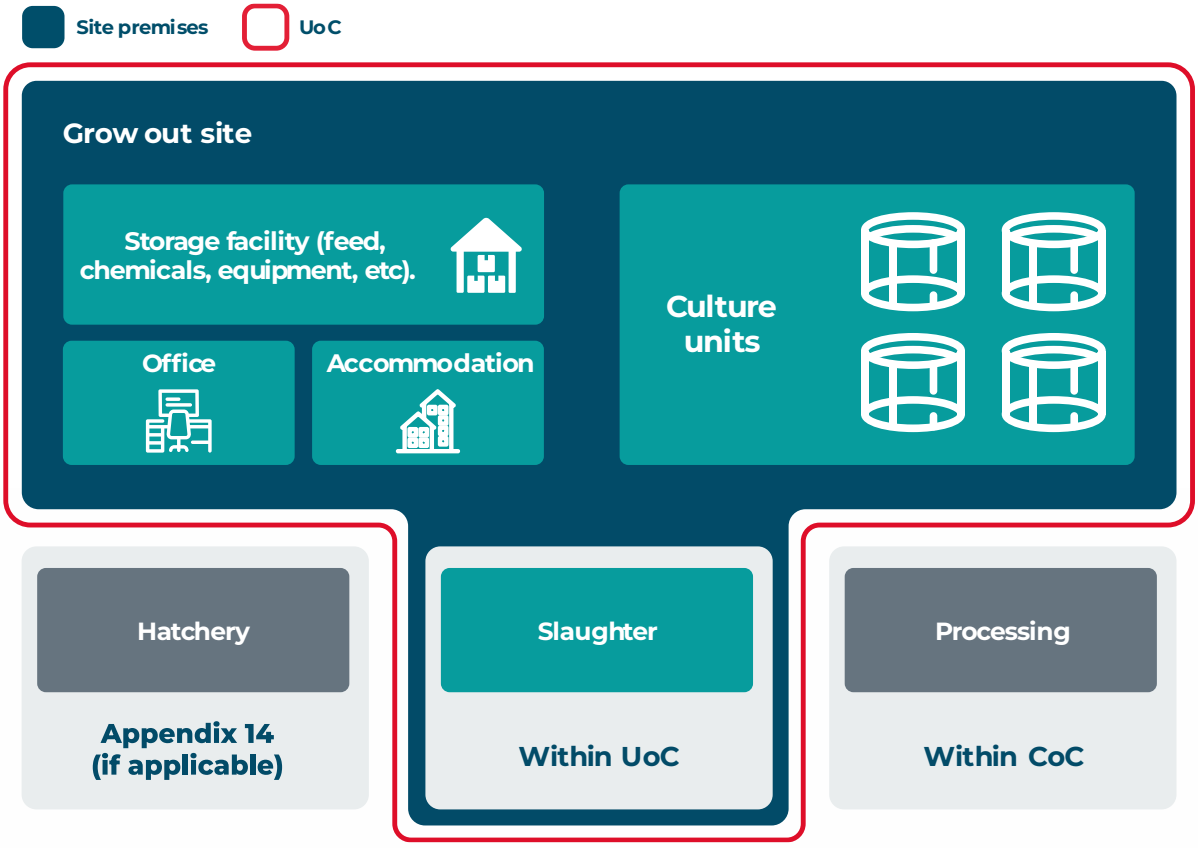
Example 2 UoC with on-site hatchery, slaughter and processing



Example 3 UoC with on-site hatchery and off-site slaughter and processing



Example 4 UoC with on-site slaughter and off-site hatchery and processing



Applicability Across Culture Systems, Water Types and Species

The ASC Farm Standard applies to the main aquaculture **Culture Systems** and **Water types** for eligible **species**.

All Indicators are applicable unless explicitly stated otherwise in the Criterion, Indicator, or Appendices.

For the applicability of the Indicators, the following is considered:

- **Applicable Laws and Regulations**
  - Where a Law or Regulation is more stringent than an Indicator, the UoC shall comply with the Law or Regulation.
  - Where a Law or Regulation is less stringent than an Indicator, the UoC shall conform with the Indicator unless conformance with the Indicator is prohibited by that Law or Regulation.
- **Applicable Culture System**
  - Water-based (all have Diffuse Source Effluent Discharge):
    - **Cage culture systems**
    - **Suspended culture systems**
    - **Other water-based culture systems**

- Land-based (all have **Point Source** Effluent Discharge):
  - **Flowthrough/Raceway culture systems**
  - **Pond culture systems**
  - **Recirculating Aquaculture System (RAS) culture systems**
  - **Other land-based culture systems**

- **Applicable Water Type**
  - Freshwater (salinity <0.5 ppt)
  - Brackish Water (salinity 0.5-29.9 ppt)
  - Marine Water (salinity > 29.9 ppt)
- **Applicable Species**
  - All species listed under 'Eligible Species' below are eligible for certification. Applicability can be assigned at various levels:
    - Animal Group (e.g. Fish)
    - Species Group (e.g. Salmonids)
    - Genus (e.g. *Salmo*)
    - Species (e.g. *S. salar*)
- **Applicability Defined Otherwise**
  - Certain Indicators apply only to specific circumstances, which are detailed in the Indicator itself.

Additionally, the Standard differentiates between:

- Fed species and non-fed species.

Eligible Species

The species and genera listed below are eligible for certification. Whenever possible, the naming of species, genera, families and orders adhere to the Aquatic Sciences and Fisheries Information System (ASFIS) list of species maintained by the Food and Agriculture Organisation (FAO). Only hybrid species of two separately eligible species are eligible for certification.

Fish:

- Catfish – all the species in the genera *Clarias*, *Heterobranchus*, *Ictalurus*, *Ameiurus* and *Silurus*
- Cod – *Gadus morhua*
- Flatfish
  - Flounders – all species in the genera *Paralichthys* and *Pseudopleuronectes*
  - Halibut – all species in the genus *Hippoglossus*
  - Turbot – all species in the genus *Scophthalmus*

- Pangasius - all species in the family *Pangasiidae*
- Pike-perch – all species in the genus *Sander*
- Salmonids - freshwater
  - Salmon, trout and char – all species in the genera *Salmo*, *Oncorhynchus* and *Salvelinus*
  - Greyling – all species in the genus *Thymallus*
  - Whitefish – all species in the genus *Coregonus*
- Salmonids – marine
  - Salmon, trout and char – all species in the genera *Salmo*, *Oncorhynchus* and *Salvelinus*
- Seabass, Seabream, Meagre
  - Seabass - all species in the genus *Dicentrarchus*
  - Seabream - all species in the genera *Sparus* and *Pagrus*
  - Meagre - all species in the genus *Argyrosomus*
- Seriola and Cobia
  - Seriola - all species in the genus *Seriola*
  - Cobia - *Rachycentron canadum*
- Tilapia - all species in the genera *Oreochromis, Coptodon* and *Tilapia*
- Tropical Marine Fish
  - Groupers – all species in the genera *Epinephelus*, *Cromileptes*, *Plectropomus* and *Cephalopholis*
  - Snappers – all species in the genera *Lutjanus* and *Ocyurus*
  - Pompano – all species in the genus *Trachinotus*
  - Barramundi – all species in the genus *Lates*
  - Croaker – all species in the genus *Larimichthys*

Molluscs:

- Abalone – all species in the genus *Haliotis*
- Bivalve – all (filter-feeding) species in the class *Bivalvia*, except the (non-filter-feeding) families *Nuculanidae, Nuculidae* and *Solemyidae*

Crustaceans:

- Shrimp – all species in the genus *Penaeus*
- Freshwater prawn – all species in the genus *Macrobrachium*
- Crayfish – all species in the genera *Cherax*, *Procambarus and Astacus*

Principle 1

The aquaculture industry ensures legal compliance and effective business management



Principle 1

The aquaculture industry ensures legal compliance and effective business management

Rationale

The aquaculture industry plays a vital role in global food production and economic growth, however its rapid expansion has raised concerns about the social and environmental impacts driven by irresponsible practices.

With rising consumer awareness and demand for responsibly produced food, businesses must be able to trace the origins of their seafood to verify that it is produced responsibly and ethically.

As the industry continues to develop, it is important to comply with law, uphold business ethics and ensure supply chain traceability and transparency as a framework to build a long-lasting industry. This benefits producers, the communities that depend on aquaculture and consumers.

This principle's criteria address the shortfall that occurs in some regions between national legislation, enforcement and good practice, due to the rapid growth of seafood farming. This ensures that ASC-certified farms are well-managed and legally compliant, thereby contributing to the development of a sustainable seafood farming industry.

1.1 Legal Compliance

Rationale

A legal business complies with applicable laws, licensing, and permit requirements.

A wide variety of laws and regulations apply to aquaculture. Ensuring national laws are followed, and necessary permits and licences are acquired helps to promote a socially and environmentally responsible aquaculture industry. Compliance also benefits a business by enhancing customer trust, increasing revenue, strengthening reputation, and avoiding legal sanctions and fines[4].

This criterion focuses on the legal compliance of ASC-certified farms as the basis of a well-managed business.

Intent – The aquaculture industry complies with all applicable legal requirements.

Indicators:	
1.1.1	The UoC shall hold all applicable legal licences and permits.
1.1.2	The UoC shall comply with all applicable legal requirements, including those relevant to the Criteria within the ASC Farm Standard.

[4] Widjaja, G. (2024). Managing Legal and Corporate Compliance to Induce and Enhance Business. Law and Humanities Quarterly Reviews, 3(2). https://doi.org/10.31014/aior.1996.03.02.115

1.2 Management Systems

Rationale

A management system supports an organisation to manage the interrelated parts of the business to achieve its objectives. Management systems include policies, processes and procedures, and vary in complexity depending on the organisation's context. They can support compliance with laws and regulations, detection and resolution of issues, and monitoring of essential operational activities.

This Criterion focuses on the development of a management system for the implementation and maintenance of **ASC Requirements** on ASC-certified farms.

Intent – The aquaculture industry continuously manages and improves processes to deliver consistent performance against the ASC requirements.

Indicators:	
1.2.1	The UoC shall develop, implement and maintain a management system to support the implementation of the ASC Requirements that is appropriate to the size and complexity of the UoC.
1.2.2	The UoC shall appoint at least one member of management responsible for the implementation of the ASC Requirements.
1.2.3	The UoC shall ensure that relevant[5] **employees** have the necessary skills and training to implement ASC Requirements.
1.2.4	The UoC shall annually review the management system and revise it where necessary to ensure its continued suitability, adequacy and effectiveness in implementing the ASC Requirements.

[5] Relevant employees are those who carry out tasks or activities within the scope of the ASC Farm Standard and whose work affects the implementation of, or conformance with, the ASC Requirements.

1.3 Business Ethics

Rationale

Business ethics are defined as the application of ethical values to business behaviour by the Institute of Business Ethics (IBE) and range from the behaviour of an individual, to sales and accounting practices and how companies treat their employees. The benefits of running a business ethically include stronger teams, increased employee loyalty, a strengthened reputation and competitive advantage[6]. However, businesses often operate in environments that can make operating ethically a challenge, and many businesses can face problems with fraud.

This Criterion focuses on ASC farms operating in a legally-compliant and ethical manner to reduce the risk of **corruption** and fraud.

Intent – The aquaculture industry upholds ethical business practices.

Indicators:	
1.3.1	The UoC shall discourage all forms of corruption and shall encourage ethical behaviour and integrity in their business operations.
1.3.2	The UoC shall ensure that information provided as evidence of conformance to the ASC Requirements is not falsified or misrepresented.

[6] Ferrell, O. C., Fraedrich, J., Ferrell, L. (2011). Business Ethics – Ethical Decisions Making and Cases (8th Edition). Mason, OH, USA: South-Western Cengage Learning.

1.4 Traceability and Disclosure



Rationale

Traceability plays a crucial role in seafood sustainability certification as it ensures that claims are properly transferred through the supply chain to the end consumer.

As one of the most internationally traded commodities – often through complex supply chains – seafood is highly vulnerable to food fraud, especially product mislabelling, species substitution and provenance misrepresentation[7].

This Criterion focuses on ASC-certified products being correctly differentiated from non-ASC-certified products, and traceability systems being in place on ASC-certified farms to maintain the integrity of products traded and sold under the ASC label.

Intent – The aquaculture industry supplies food that is traceable through the supply chain.

Indicators:	
1.4.1	The UoC shall identify, evaluate and mitigate risks of mixing and substituting ASC-certified products with non-ASC-certified products at all sites.
1.4.2	The UoC shall develop, implement and maintain a traceability system, covering all sites, to ensure that the following conditions are met: a. all stocked animals are traceable back to the direct supplier; and b. all **batches** of ASC-certified product and, where applicable, non-ASC-certified product, are identifiable and segregated at all sites and at all times; and c. all batches of ASC-certified product are traceable at all times to: i. the site(s) used; and ii. the production unit(s) used; and d. corrective actions are taken if **non-conforming product** is identified, sold or dispatched; and

[7] Lawrence, S. J., Elliott, C., Huisman, W., Dean, M., & van Ruth, S. (2022). The 11 sins of seafood: Assessing a decade of food fraud reports in the global supply chain. Comprehensive Reviews in Food Science and Food Safety, 21, 3746–3769. https://doi.org/10.1111/1541-4337.12998

e. accompanying documentation shall identify product sold or dispatched as ASC-certified and, where applicable, as non-ASC-certified.

1.4.3 *Indicator applicability: every UoC using compound feed*

The UoC shall demonstrate that feed products, subject to conformance with Indicator 2.12.1, are accompanied by the following information:

a. the originating feed mill holds valid certification against the ASC Feed Standard with the appropriate scope of certification in relation to the ASC Production Model (i.e. Mass Balance Production Model or Segregation Production Model product); and

b. feed is traceable as ASC-conforming throughout all steps between the feed mill and site; and

c. documentation accompanying the feed identifies the feed as ASC-conforming; and

d. documentation accompanying the feed identifies the production model applied (i.e. Mass Balance Production Model or Segregation Production Model); and

e. for ASC-conforming Segregation Production Model feed, the product is identifiable by a distinct feed name in formal documentation accompanying the product.

1.4.4 *Indicator applicability: every UoC using compound feed*

The UoC shall disclose to all buyers of their ASC-certified product when a product's feed contains >0.9%[8] Genetically Modified Organisms (GMO) or macro ingredients[8] produced from GMO.

1.4.5 The UoC shall not identify, sell or dispatch the following as ASC-certified:

a. any product treated with **antimicrobials** listed as Authorised for use in Humans Only (Indicator 4.4.12), Highest Priority Critically Important Antimicrobials (HPCIA) or Critically Important Antimicrobials (CIA) (Indicator 4.4.13) by the World Health Organisation (WHO)[9], at any stage in the lifecycle of the product; or

b. crustaceans treated with any antibiotic at the UoC (Indicator 4.4.14).

1.4.6 The UoC shall disclose to buyers of their ASC-certified product, upon request, a list of all veterinary **therapeutants** applied to the product.

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[8] European Council. (2003). Regulation (EC) No 1830/2003 concerning the traceability and labelling of genetically modified organisms and the traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC. European Parliament, Council of the European Union.
[9] https://cdn.who.int/media/docs/default-source/gcp/who-mia-list-2024-lv.pdf?sfvrsn=3320dd3d_2

1.4.7 The UoC shall report the related data for production volumes and sales/dispatch volumes of ASC-certified and non-ASC-certified products originating from each site and the specified traceability data (when requested), in accordance with the ASC Data Submission Procedure.



1.5 Upstream Supply Chain

Rationale

The impacts of aquaculture extend beyond the final grow out site, as the production of many species relies on upstream supply chain stages, such as hatchery and nursery production, which often occur across multiple sites. A key challenge in addressing these impacts is the diversity of production practices, both between and within species, together with the need for effective information sharing between the various sites. Managing these impacts throughout the upstream supply chain and enabling the transfer of batch-specific information is essential to ensuring that the industry operates responsibly as a whole.

This Criterion requires ASC-certified sites to source aquatic animals from supplier sites that address key impacts at the relevant production stages.

Intent – The aquaculture industry sources from responsibly operated suppliers.

Indicators:

1.5.1 The UoC shall maintain an up-to-date list of all supplier sites in its upstream supply chain[10], in accordance with the ASC Data Submission Procedure.

1.5.2 *Indicator applicability: cod, flatfish, salmonids, seabass, seabream and meagre*

The UoC shall only stock fish from direct supplier sites that conform with the requirements in **Appendix 14**[11].

An exception applies to UoCs stocking marine salmonids, in which case:

a. all land-based sites[12] in the upstream supply chain shall conform with the requirements in **Appendix 14** at the time of stocking at the UoC; and

b. all cage culture sites[12] in the upstream supply chain shall:

   i. hold valid ASC certification at the time of stocking at the UoC[13]; and

[10] The upstream supply chain to be listed includes all supplier sites involved in the production chain from which the fish originate (e.g., eggs, spats, nauplii, alevin, fry, fingerlings, post-larvae, juveniles and smolts production sites).
[11] An exemption applies to supplier sites that hold valid ASC certification. These sites do not need to conform with the requirements in Appendix 14.
[12] An exemption applies to broodstock sites.
[13] Exception *b.i.* applies from the start of the production cycle following the cycle ongoing at the time of the first certification to the ASC Farm Standard. However, where the UoC is supplied with smolts produced in freshwater cage culture, exception *b.i.* applies from the production cycle ongoing at the time of the first certification to the ASC Farm Standard.

ii. if producing smolts in freshwater cage culture, operate in regions where native salmonids of the same species are present.



Principle 2

The aquaculture industry demonstrates environmental stewardship



Principle 2

The aquaculture industry demonstrates environmental stewardship

Rationale

The aquaculture industry is ideally positioned to help provide the food needed to support a growing global population due to its smaller environmental footprint than many land-based animal sources. Maintaining this advantage requires ongoing stewardship of the environmental impacts. Through the initiatives outlined in this principle, ASC supports the industry to develop in an environmentally responsible manner to meet this challenge.

Aquaculture relies on ecosystems to provide resources, including water, as well as the absorption of its outputs, including waste from farm processes, to operate.[14] Without proper management, the environment's capacity to keep providing these resources and assuming these outputs can be exceeded, leading to concerns about biodiversity loss, **greenhouse gas emissions** that drive climate change, and inefficient resource use.

This principle's criteria focus on effective resource management, efficient feed use, safe waste disposal – including handling hazardous materials and plastics – and re-use of **biosolids**. Through these means, ASC-certified farms manage their inputs from, and outputs into, the ecosystem responsibly and contribute to a circular economy (**recycling** and reusing existing materials to extend their life cycle[15]).

Aquaculture farms affect nearby habitats and species through both siting and operational activities. Choosing farm sites carefully is crucial to protect ecologically sensitive areas and managing farm practices is equally important. This includes managing benthic impacts, controlling nutrient release into open waters, reducing wildlife conflict, and preventing farmed animals from escaping and affecting native biodiversity. Addressing these challenges is key to tackling global biodiversity loss[16].

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[14] Gephart, J. A., Henriksson, P. J., Parker, R. W., Shepon, A., Gorospe, K. D., Bergman, K., ... & Troell, M. (2021). Environmental performance of blue foods. *Nature*, *597*(7876), 360-365.

[15] Chary, K., van Riel, A. J., Muscat, A., Wilfart, A., Harchaoui, S., Verdegem, M., ... & Wiegertjes, G. F. (2024). Transforming sustainable aquaculture by applying circularity principles. *Reviews in Aquaculture*, *16*(2), 656-673.

[16] Aguilar-Manjarrez, J., Soto, D., & Brummett, R. (2017) *Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture. A handbook*. Rome, Italy: FAO.

2.1 Environmental Risk Assessment



Rationale

All human activities can have negative impacts on the surrounding environment. Understanding the likelihood of negative impacts occurring from an activity, and the magnitude of that impact, requires a risk-based approach. An **Environmental Risk Assessment (ERA)** is a useful tool to help identify the environmental risks associated with an activity along with actions to help mitigate those risks.

Aquaculture operations take place in a wide variety of environments and contexts. Defining a farm's particular risks and environmental impacts requires a site-specific evaluation that considers the context-relevant risks for that farm.[17]

This Criterion requires that ASC-certified farms identify their potential environmental impacts by conducting an ERA and mitigating identified risks accordingly.

Intent – The aquaculture industry performs comprehensive environmental assessments to address site-specific risks.

Indicators:	
2.1.1	The UoC shall conduct an Environmental Risk Assessment (ERA) per site, following the method outlined in **Appendix 3 (3.3)**.
2.1.2	The UoC shall ensure that the ERA (see Indicator 2.1.1) is conducted by a person with the necessary competencies, experience and training, following the method in **Appendix 3 (3.3)**. Where applicable regulatory competency requirements exist, the UoC shall ensure that the person conducting the ERA complies with these requirements.

[17] Andersen, L. B., Grefsrud, E. S., Svåsand, T., & Sandlund, N. (2022). Risk understanding and risk acknowledgement: a new approach to environmental risk assessment in marine aquaculture. ICES Journal of Marine Science, 79(4), 987-996. https://doi.org/10.1093/icesjms/fsac028

2.2 Ecologically Important Habitats



Rationale

Conversion and fragmentation of habitats is a leading driver of biodiversity loss.[18] Wetlands are particularly important in promoting biodiversity, as they provide breeding and nursery grounds for native species, supporting ecological services like water purification, and increasing environmental resilience to threats like storms, floods and climate change.[19]

Aquaculture production can drive conversion and fragmentation of ecologically important habitats if improperly sited. Farms sited in protected or sensitive habitats can affect local biodiversity and the ecological services these environments provide. Loss of wetlands has been historically linked to expansion of aquaculture in tropical regions. Sited and operated with consideration paid to important habitats, aquaculture can benefit from the many services that suitable sites provide while minimising these negative impacts.[20]

This Criterion focuses on requirements for where ASC-certified farms can be situated to reduce impacts on local biodiversity, restricts conversion of ecologically important habitats and requires rehabilitation of previously converted wetlands.

Intent – The aquaculture industry preserves habitat that is important for biodiversity.

Indicators:

2.2.1 *Indicator applicability: all species except bivalves, abalone, pangasius and tilapia.*

The UoC shall ensure that the site is not located in **Protected Areas** (PA). An exception applies where conditional siting is allowed according to **Appendix 4 (4.2)**.

[18] Crooks, K. R., Burdett, C. L., Theobald, D. M., King, S. R., Di Marco, M., Rondinini, C., & Quantification of habitat fragmentation reveals extinction risk in terrestrial mammals. *Proceedings of the national Academy of Sciences*, *114*(29), 7635-7640. Boitani, L. (2017).

[19] Liquete, C., Piroddi, C., Drakou, E. G., Gurney, L., Katsanevakis, S., Charef, A., & Egoh, B. (2013). Current status and future prospects for the assessment of marine and coastal ecosystem services: A systematic review. *PloS one*, *8*(7), e67737.

[17] Aguilar-Manjarrez, J., Soto, D., & Brummett, R. (2017). Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture. A handbook. Rome, Italy: FAO.

2.2.2 The UoC shall ensure that the site has a low risk of negative impact on **critical habitats**, as determined through the ERA (see Indicator 2.1.1).

2.2.3 The UoC shall preserve any critical habitat identified within the site.

2.2.4 The UoC shall ensure that the site has a low risk of negative impact on **sensitive habitats**, as determined through the ERA (see Indicator 2.1.1).

2.2.5 *Indicator applicability: seabass, seabream and meagre*

The UoC shall maintain a buffer between the Zone 1 boundary and the nearest edge of seagrass habitat, following the method outlined in **Appendix 7 (7.6)**, with a minimum distance of either 500m or as determined through the ERA (see Indicator 2.1.1), whichever is stricter.

2.2.6 *Indicator applicability: land-based systems*

The UoC shall maintain any natural **wildlife corridors** within the site, as determined through the ERA (see Indicator 2.1.1).

2.2.7 *Indicator applicability: land-based systems producing catfish, crustaceans, freshwater salmonids or pike-perch*

The UoC shall[21] maintain a **riparian zone** between the site and any confined or linear waterbody, with a minimum width of either 15m or as determined through the ERA (see Indicator 2.1.1), whichever is stricter.

2.2.8 *Indicator applicability: land-based systems producing catfish or crustaceans*

The UoC shall maintain a **coastal barrier** between the site and any large or open waterbody, with a minimum width of either 100m or as determined through the ERA (see Indicator 2.1.1), whichever is stricter.

2.2.9 *Indicator applicability: land-based and suspended systems located in natural wetlands*

The UoC shall have successfully **restored** a minimum of 50% of **natural wetland** converted before May 1999.

[21] An exemption applies to: (i) the site's inflow and outflow systems; (ii) sites adjacent to artificial canals or natural waterways that have undergone considerable man-made modification; and, (iii) sites producing pike-perch and salmonids in freshwater that were installed before February 2013. Exemption (iii) does not apply to sites that were installed before this date but have subsequently undergone significant expansion.

2.2.10

Indicator applicability: land-based and suspended systems

The UoC shall not convert natural wetland after May 1999. An exception applies where conversion is needed for establishing and maintaining pumping stations, water pipes or canals, in which case the UoC shall successfully restore 100% of the converted area.

2.2.11

Indicator applicability: all bivalve species

The UoC shall[22] ensure that total bivalve culture in a waterbody does not result in phytoplankton depletion either by:

a. demonstrating that the waterbody has a ratio of **Clearance Time** (CT) over **Retention Time** (RT) > 1, following the method outlined in **Appendix 5 (5.2)**. Where CT over RT is <1, demonstrate that the waterbody has a ratio of CT over **Primary Production Time** (PPT) > 3, following the method outlined in **Appendix 5 (5.3)**; or

b. conducting a modelling study that demonstrates that the carrying capacity of the waterbody is not exceeded.

[22] An exemption to Indicator 2.2.11 applies for situations where the total surface area of aquaculture within a waterbody is less than 10% of the total surface area of the waterbody.

2.3 Wildlife Interactions

Rationale

Over 45,000 wildlife species are at risk of extinction, many of them occurring in environments suitable for aquaculture.[23] Human-wildlife interactions can occur in numerous ways, from direct **Human-Wildlife Conflict** with animals to disruption of migration routes, disturbance to diurnal cycles or alteration of local food availability.

Aquaculture operations may result in human-wildlife interactions and conflict in many ways. Farms may rely on wildlife directly for collection of larvae, juveniles, or breeding stock. Their vessels, infrastructure, or equipment may disturb or interact with wildlife. They may also use deterrent devices to discourage predators or pests from approaching pens or cages. Risk to wildlife from these interactions should be assessed and mitigated and, when injuries or mortalities do occur, corrective measures need to be put into place to avoid similar future occurrences.

This Criterion focuses on the minimisation of ASC-certified farms' interaction with wildlife to reduce injury and mortalities, especially interactions involving threatened or endangered species.

Intent – The aquaculture industry prioritises the protection of threatened species by minimising negative interactions with wildlife.

Indicators:

2.3.1 The UoC shall ensure the site has a low risk of Human-Wildlife Conflict within the site and in the area surrounding the site, as determined through the ERA (see Indicator 2.1.1).

2.3.2 The UoC shall not cause the mortality of any **Threatened Species**.

An exception applies for occasional incidents that do not affect the population status, and where a written statement from a **registered veterinarian** or the responsible authorities is available to confirm that:

a. injured animals are unlikely to recover; or

b. immediate human safety is threatened; or

c. legal requirements mandate emergency euthanasia.

[23] IUCN. (2024). The IUCN Red List of Threatened Species. Version 2024-1. https://www.iucnredlist.org

2.3.3 The UoC shall not injure or cause mortality of mammals, elasmobranchs or reptiles (excluding **vermin**).

An exception applies for occasional incidents where:

a. injured animals are unlikely to recover; or

b. immediate human safety is threatened; or

c. legal requirements mandate emergency euthanasia.

2.3.4 The UoC shall investigate all wildlife mortality incidents to determine the root cause and shall implement appropriate corrective actions to prevent recurrence.

2.3.5 The UoC shall only use **aquatic acoustic deterrence** where peer-reviewed or otherwise scientifically robust evidence demonstrates that its use does not result in significant stress, injury to, or mortality of, affected species or their population(s).

2.3.6 *Indicator applicability: all fish species*

The UoC shall only stock fish that is hatchery-raised.

An exception applies where the UoC can demonstrate the following for Seriola/Cobia, in which case wild caught fish are permitted to be stocked:

a. the species is not listed as a Threatened Species; and

b. the originating fishery is certified under the Marine Stewardship Council (MSC) standard, or equivalent to an ASC-recognised fisheries certification scheme[24]; and

c. traceability back to the originating fishery is provided.

2.3.7 The UoC shall not use Threatened Species for wild broodstock.

2.3.8 *Indicator applicability: all crustacean species*

The UoC shall only stock larvae that are hatchery-raised.

An exception applies where the UoC can demonstrate the following for extensive crustacean production, in which case wild larvae are permitted to be stocked:

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[24] Equivalence to the MSC standard shall be determined by ASC based on an assessment of compliance with the ISEAL Code of Good Practice, and consideration of sustainability criteria referenced in the MSC Principles and Criteria. Equivalent standards shall be set in accordance with the ISEAL Code of Good Practice and shall be recognised by, or meet the requirements of, the Global Sustainable Seafood Initiative (GSSI) Global Benchmark Tool. The standard shall be based on a full ecosystem approach, including specific provisions for the management of low trophic level species and the protection of populations of dependent predators. Recognition of equivalent standards shall be made publicly available by ASC.

a. the larvae are collected passively; and

b. the production system is a non-fed, low-intensive pond production system; and

c. inflow of larvae occurs through natural tidal flow into the ponds.

2.3.9 *Indicator applicability: hatchery-raised bivalve seed*

The UoC shall only source from hatcheries that have procedures to address genetic concerns specific to the species and geographical region where the seed will be stocked.

2.3.10 *Indicator applicability: all bivalve species*

The UoC shall[25] only use wild caught seed if:

a. the species is not listed as a Threatened Species; and

b. the seed is **harvested** from a regulated source.

2.3.11 *Indicator applicability: all abalone farming in regions where the farmed species is Threatened*

The UoC shall only use seed originating from wild broodstock (not selectively bred animals).

2.3.12 The UoC shall publicly disclose all wildlife mortalities per site within 30 days of each incident.

2.3.13 The UoC shall report wildlife mortality related data in accordance with the ASC Data Submission Procedure.



[25] An exemption applies to wild caught larvae.

2.4 Escapes and Native Biodiversity



Rationale

The introduction of non-native (or alien) species, often driven by human activities, poses significant concerns for natural ecosystems. Their impacts can vary widely, from negligible effects to severe ecological disruptions. These consequences often emerge after extended periods and can vary significantly based on the biological traits of the species and the characteristics of the receiving ecosystem[26].

The global aquaculture industry is a key contributor to the spread of **alien species**. Many of these species have escaped into the wild, establishing populations that can cause ecological harm. Risks to native biodiversity may also arise where farmed animals become reproductively mature and spawn in culture systems, creating a risk of genetic interaction, hybridisation or introgression with wild populations, even where no physical escape of live animals is confirmed. This underscores the need for effective management strategies and scientifically sound evaluation tools.

To address these challenges, the International Union for Conservation of Nature (IUCN) developed the Environmental Impact Classification for Alien Taxa[27] (EICAT). EICAT is a globally recognised framework that classifies alien species based on the magnitude and mechanisms of their environmental impact. It provides a transparent basis for identifying and prioritising species of concern and for informing appropriate management responses. ASC conducts EICAT assessments and makes the outcomes publicly available.

ASC-certified farms are required to implement robust escape management practices and mitigation measures aligned with the relevant EICAT classification(s), where applicable, to minimise the risks posed by alien species and their impacts.

Intent – The aquaculture industry cultivates species in a manner that poses minimal risk to native biodiversity.

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[26] Blackburn, T. M., Essl, F., Evans, T., Hulme, P. E., Jeschke, J. M., Kühn, I., ... & Bacher, S. (2014). A unified classification of alien species based on the magnitude of their environmental impacts. PLoS biology, 12(5), e1001850. https://doi.org/10.1371/journal.pbio.1001850

[27] International Union for Conservation of Nature (IUCN). (2020). IUCN EICAT Categories and Criteria. The Environmental Impact Classification for Alien Taxa. Gland, Switzerland and Cambridge, UK: IUCN. https://doi.org/10.2305/IUCN.CH.2020.05.en

Indicators:

2.4.1 The UoC shall not stock **transgenic** animals.

2.4.2 *Indicator applicability: all species except **sessile** bivalves*

The UoC shall implement escape prevention measures that include the installation, inspection and maintenance of containment structures suitable for the species, life stages and environmental conditions under which the site is operating.

2.4.3 *Indicator applicability: all species except sessile bivalves*

The UoC shall carry out a site-specific handling and containment risk assessment, approved by a member of management, following the method outlined in **Appendix 3 (3.2)**.

2.4.4 *Indicator applicability: all species except sessile bivalves*

The UoC shall ensure that any person involved in handling activities is trained on handling procedures to minimise escapes.

2.4.5 *Indicator applicability: all species except sessile bivalves*

The UoC shall log all handling and containment incidents.

2.4.6 *Indicator applicability: land-based systems producing flatfish, pangasius, seabass, seabream, meagre, tilapia or tropical marine finfish*

The UoC shall maintain a bund or equivalent physical barrier between the site and the waterbody and shall demonstrate that the barrier is higher than the maximum recorded water level at the site during the previous ten years.

2.4.7 *Indicator applicability: all bivalve species*

The UoC shall make efforts to address genetic concerns specific to the species and geographic region where hatchery-raised seed will be out-planted.

Indicators 2.4.8 - 2.4.13
Additional requirements for fish species with a published ASC EICAT evaluation[28]

2.4.8

Indicator applicability: fish species with an EICAT Category MO

The UoC shall[29] calculate the number of **known escapes** per site following the method outlined in **Appendix 6 (6.2)**, the maximum number of which shall not exceed:

a. cod and marine salmonids: 300 individuals per production cycle

b. other fish species: 6% in the last 12 months

If the maximum number of known escapes is exceeded more than once in a six-year period, the UoC shall:

c. by the next working day:

i. submit a formal request to the CAB for cancellation of the certificate or site under the certificate; and

ii. notify ASC of the exceedance of known escapes in accordance with the ASC Data Submission Procedure.

d. not identify, sell or dispatch the fish as ASC-certified[30].

2.4.9

Indicator applicability: fish species with an EICAT Category MO

The UoC shall[29] not exceed one mass escape event per site in a six-year period, defined as:

a. cod and marine salmonids: >5000 individuals per production cycle

b. other fish species: >6%

If a mass escape event occurs more than once in a six-year period, the UoC shall:

c. by the next working day:

i. submit a formal request to the CAB for cancellation of the certificate or site under the certificate; and

ii. notify ASC of the exceedance of known escapes in accordance with the ASC Data Submission Procedure.

d. not identify, sell or dispatch the fish as ASC-certified[30].

[28] Species-specific EICAT evaluations are published on the ASC Website.
[29] An exemption applies where no species-specific EICAT evaluation is available at the time of audit. Where an evaluation becomes available during the certification cycle, the Indicator applies from the next audit.
[30] This applies to all fish present at the site at the time the UoC submits the formal notification of cancellation of certification to the CAB, including any fish recovery thereafter.

2.4.10

Indicator applicability: fish species with an EICAT Category MR/MV

The UoC shall[29] calculate the number of known escapes per site following the method outlined in **Appendix 6 (6.2)**, the maximum number of which shall not exceed:

a. cod and marine salmonids: 300 individuals per production cycle

b. other fish species: 6% in the last 12 months

If the maximum number of known escapes is exceeded, the UoC shall:

c. by the next working day:

i. submit a formal request to the CAB for cancellation of the certificate or site under the certificate; and

ii. notify ASC of the exceedance of known escapes in accordance with the ASC Data Submission Procedure.



d. not identify, sell or dispatch the fish as ASC-certified[30].

2.4.11

Indicator applicability: fish species with an EICAT Category MR/MV

The UoC shall[29] not have any mass escape events, defined as:

a. cod and marine salmonids: >5000 individuals per production cycle

b. other fish species: >6%

If a mass escape event occurs, the UoC shall:

c. by the next working day:

i. submit a formal request to the CAB for cancellation of the certificate or site under the certificate; and

ii. notify ASC of the mass escape event in accordance with the ASC Data Submission Procedure.



d. not identify, sell or dispatch the fish as ASC-certified[3029].

2.4.12

Indicator applicability: fish species with an EICAT Category MO or MR/MV

The UoC shall[29] count fish with a minimum of 98% accuracy.

2.4.13

Indicator applicability: tilapia with an EICAT Category MO or MR/MV

The UoC shall use all-male stock.

Indicators 2.4.14 – 2.4.17
Additional requirements for cage culture sites producing smolts in freshwater

2.4.14 The UoC shall communicate each **escape incident** to the local fishery trust(s).

2.4.15 The UoC shall collaborate with fishery trust(s) in conducting native salmonid monitoring programme(s) in the waterbody where it operates.

2.4.16 The UoC shall conduct, in collaboration with the local fishery trust(s) and/or competent authority, a scientific baseline study to determine the genetic composition of the contemporary native and farmed salmonid population(s) in the waterbody where it operates. The baseline study shall:

a. use credible methodologies and analysis and undergo peer review; and

b. include known historical farmed and native salmonid genetic profiles; and

c. determine if changes in the genetic composition of the contemporary native salmonid population(s) have occurred; and

d. if changes in the genetic composition of the contemporary native salmonid population(s) are detected, seek to determine if these have occurred through introgression of farmed salmon or through other mechanisms; and

e. be updated every three years.

An exception applies where the UoC can demonstrate that the local competent authority has undertaken or commissioned an equivalent assessment for the waterbody where the UoC operates, in which case the UoC shall provide evidence that the assessment:

f. determines the genetic composition of the relevant contemporary native and farmed salmonid population(s); and

g. considers known historical farmed and native salmonid genetic profiles, where available; and

h. determines whether changes in the genetic composition of the contemporary native salmonid population(s) have occurred; and

i. where changes are detected, seeks to determine whether these have occurred through introgression of farmed salmon or through other mechanisms; and

j. is updated at least every three years.

2.4.17 The UoC shall publicly disclose the scientific baseline study (see Indicator 2.4.16).

2.5 Benthic Impact

Scope – Every UoC using cage culture, suspended marine mollusc systems and freshwater systems discharging into rivers.

Rationale

The benthic zone ('bottom') of a waterbody often supports a rich biodiversity and provides critical ecological functions such as assimilation of **organic waste** (e.g. faeces, uneaten feed), provision of food for species and protection of coastal sediment from erosion. Human activities interacting with the benthic zone can negatively impact the functioning of these ecosystems.

Aquaculture can interact with the benthic zone through deposition of organic waste and release of heavy metals.[31] When this deposition exceeds the environment's ability to handle it, harmful changes to the ecosystem can occur.[32] The severity of these impacts depends on factors such as the amount of waste released, waterbody characteristics and the ability of the benthic microbial community to break down waste.[33]

This Criterion focuses on effective management by ASC-certified farms to monitor the local benthic zone and limit these impacts by ensuring waste deposition is lower than the natural decomposition rate.

Intent – The aquaculture industry maintains healthy benthic ecosystems.

Indicators:

2.5.1

Indicator applicability: cage culture and suspended marine mollusc systems

The UoC shall[34] determine benthic status, following the method outlined in **Appendix 7 (7.2.1, 7.3.1, 7.4.1, 7.8)**.

[31] González-Gaya, B., García-Bueno, N., Buelow, E., Marin, A., & Rico, A. (2022). Effects of aquaculture waste feeds and antibiotics on marine benthic ecosystems in the Mediterranean Sea. Science of the Total Environment, 806, 151190.

[32] Hargrave, B. T., Phillips, G. A., Doucette, L. I., White, M. J., Milligan, T. G., Wildish, D. J., & Cranston, R. E. (1997). Assessing benthic impacts of organic enrichment from marine aquaculture. In The Interactions Between Sediments and Water: Proceedings of the 7th International Symposium, Baveno, Italy 22–25 September 1996 (pp. 641-650). Springer Netherlands.

[33] Kalantzi, I., & Karakassis, I. (2006). Benthic impacts of fish farming: meta-analysis of community and geochemical data. Marine Pollution Bulletin, 52(5), 484-493.

[34] An exemption applies to sites situated in areas classified as having a “hard bottom”. Evidence is required to support the classification “hard bottom”.

2.5.2 *Indicator applicability: cage culture and suspended marine mollusc systems*

The UoC shall demonstrate an 'Acceptable' benthic status[35], following the method outlined in **Appendix 7 (7.2.2, 7.3.2, 7.4.2).**

2.5.3 *Indicator applicability: cage culture and suspended marine mollusc systems*

The UoC shall ensure that the person conducting sediment sampling and analysis (see Indicator 2.5.1) is independent and has the necessary competencies, experience and training.

Where applicable regulatory competency requirements exist, the UoC shall ensure that the person conducting the sampling and analysis complies with these requirements.

2.5.4 *Indicator applicability: freshwater systems discharging into rivers producing freshwater salmonids or pike-perch*

The UoC shall demonstrate that the benthic status does not deteriorate downstream from the site's effluent point, following the method outlined in **Appendix 7 (7.5)**.

2.5.5 *Indicator applicability: freshwater systems discharging into rivers producing freshwater salmonids or pike-perch*

The UoC shall ensure that:

a. the person conducting sediment sampling (see Indicator 2.5.3) has the necessary competencies, experience and training; and

b. the laboratory conducting the analysis of the samples is accredited and has approved the sampling methodology.

Where applicable regulatory competency requirements exist, the UoC shall ensure that the person conducting the sampling and/or the laboratory conducting the analysis complies with these requirements.

2.5.6 *Indicator applicability: cage culture systems in freshwater lakes/reservoirs*

The UoC shall report benthic related data in accordance with the ASC Data Submission Procedure.

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[35] An exemption applies to cage sites situated in lakes and reservoirs, where determination of benthic status is required (Indicator 2.5.1) but demonstration that the status is 'Acceptable' is not required for the first three years of the ASC Farm Standard being mandatory.

2.6 Water Quality

Scope – Sites using feed or fertilisers and releasing effluents[36].

Rationale

Eutrophication is caused by excessive nutrient inputs (especially nitrogen and phosphorus) to water bodies and is a major environmental issue. It disrupts freshwater and marine ecosystems, contributes to algal blooms and oxygen depletion, and affects the quality of water available to local communities and other resource users.[37]

Nutrient releases from aquaculture in the form of faeces and uneaten feed can lead to eutrophication and negatively impact oxygen availability and other water quality parameters.[38] The severity of these effects depends on factors like water depth and current velocity, location and sensitivity of the waterbody to nutrient loading.

This Criterion focuses on ASC-certified farms minimising their contribution to eutrophication by monitoring water quality, managing nutrient releases, and engaging in collaborative information sharing in at-risk waterbodies.

Intent – The aquaculture industry minimises its contribution to eutrophication and the trophic status shift of waterbodies.

Indicators:

2.6.1 *Indicator applicability: fed systems*

The UoC shall calculate Total Nitrogen (TN) and Total Phosphorus (TP) release, following the method outlined in **Appendix 8 (8.2)**.

2.6.2 *Indicator applicability: crustaceans, freshwater salmonids, pangasius and tilapia*

The UoC shall adhere to species-specific limits on TN and TP release, according to **Appendix 2 (2.1)[39].**

[36] An exemption to this Criterion applies to sites that never release effluents.

[37] Akinnawo, S. O. (2023). Eutrophication: Causes, consequences, physical, chemical and biological techniques for mitigation strategies. Environmental Challenges, 12, 100733.

[38] Chislock, M. F., Doster, E., Zitomer, R. A., & Wilson, A. E. (2013). Eutrophication: causes, consequences, and controls in aquatic ecosystems. Nature Education Knowledge, 4(4), 10.

[39] An exemption applies where there is no species-specific metric listed in Appendix 2.

2.6.3 *Indicator applicability: cage-fed systems with feed of a diameter ≥3mm*

The UoC shall ensure that feed used contains <1% fines, following the method outlined in **Appendix 8 (8.3)**.

2.6.4 The UoC shall ensure that the **Receiving Waterbody (RW)** has been classified per site as Type A, B or C, following the method outlined in **Appendix 8 (8.4)**.

Indicators 2.6.5 - 2.6.14
Scope: Type A waterbodies

2.6.5 The UoC shall define the **Waterbody Unit of Management (WUM)**, following the method outlined in **Appendix 8 (8.5)**.

An exception applies where a WUM is already defined, in which case the UoC shall provide evidence of the defined WUM.

2.6.6 The UoC shall ensure that the person conducting water quality monitoring has the necessary competencies, experience and training.

Where applicable regulatory competency requirements exist, the UoC shall ensure that the person conducting water quality monitoring complies with these requirements.

2.6.7 The UoC shall establish a Water Quality Monitoring Network (WQMN), following the method outlined in **Appendix 8 (8.6)**.

An exception applies where a WQMN is already established, in which case the UoC shall participate in the WQMN.

2.6.8 The UoC shall conduct a water quality survey and determine the water quality baseline, including the trophic status, following the method outlined in **Appendix 8 (8.7)**.

2.6.9 The UoC shall, after the determination of the water quality baseline, conduct monitoring of the water quality parameters listed below, following the method outlined in **Appendix 8 (8.7)**:

a. Total Nitrogen (TN) concentration; and

b. Total Phosphorous (TP) concentration; and

c. Dissolved Oxygen (DO); and

d. Secchi Disk (SD) depth[40]; and

e. Chlorophyll-a (Chl-a).

2.6.10 The UoC shall, based on the monitoring of the water quality parameters, ensure that there is no decline in trophic status compared to the water quality baseline determined, following the method outlined in **Appendix 8 (8.7)**.

2.6.11 The UoC shall, based on the monitoring of the water quality parameters, ensure that there is no upward rate of change >25% over the past 24 months, for any of the water quality parameters listed below, following the method outlined in **Appendix 8 (8.7)**:

a. TN concentration; and

b. TP concentration; and

c. Chl-a; and

d. Biological Oxygen Demand (BOD).

2.6.12 The UoC shall implement a nutrient reduction plan when at least one of the following is identified:

a. TN concentration, TP concentration or Chl-a has increased by ≥5 index points according to Table 2 in **Appendix 8 (8.7)**, compared to the water quality baseline; or

b. TN, TP or Chl-a has increased by ≥15% over the past 24 months; or

c. the distance from the surface to the **zone of oxygen depletion** or to the **zone of anoxia** has decreased by ≥25% over the past 24 months; or

d. BOD has increased by ≥15% over the past 24 months; or

e. ≥1 **adverse turnover event (ATE)** or ≥1 **harmful algal bloom (HAB)** within the past 10 years.

2.6.13 The UoC shall report WUM related data in accordance with the ASC Data Submission Procedure.



2.6.14 The UoC shall report water quality monitoring related data, including BOD values in accordance with the ASC Data Submission Procedure.



[40] An exemption applies if the mean of Secchi Disk (SD) depth calculated over any rolling two-year period remains ≥10m.

Indicators 2.6.15 - 2.6.17
Scope: Point source systems

2.6.15 The UoC shall use a treatment system prior to the discharge of effluent water[41] that ensures:

a. ≥65% of **Total Suspended Solids (TSS)** are captured; and

b. concentration of **settleable solids** in effluent water is <3.3ml/L

2.6.16 *Indicator applicability: waterbody Type B*

The UoC shall conduct monitoring of TN concentration, TP concentration and TSS upstream from the inflow point and downstream from the outflow point, following the method outlined in **Appendix 8 (8.8)**, if one of the following conditions applies:

a. the site effluent flow contribution to the receiving water flow is >10%, as calculated following the method outlined in **Appendix 8 (8.9)**; or

b. the site effluent enters a river or channel <1km upstream of a Type A waterbody.

2.6.17 *Indicator applicability: waterbody Type B*

The UoC shall, if Indicator 2.6.16 applies, ensure there is <25% increase in TN concentration, TP concentration and TSS concentrations between the measured upstream concentration and the calculated downstream concentration.

Indicators 2.6.18 – 2.6.21
Dissolved oxygen requirements

2.6.18 The UoC shall conduct monitoring of DO concentration and DO saturation, following the method outlined in **Appendix 8 (8.10)**.

2.6.19 The UoC shall demonstrate that the weekly average of daily DO saturation is ≥65% in freshwater or ≥70% in marine waterbodies.

An exception applies if the UoC cannot demonstrate this, in which case the UoC shall ensure the weekly average of daily DO percentage saturation at a 'downstream, near-field'

[41] An exemption applies when the Receiving Waterbody has a higher or equal level of Total Suspended Solids and concentration of settleable solids than in the effluent water.

impacted location is equal to, or higher than, results from an 'upstream, far-field' non-impacted reference location, at least 500m upstream of the site.

2.6.20 The UoC shall demonstrate that ≤5% of the weekly averages of daily DO concentrations are <2mg/L.[42] An exception applies if the UoC cannot demonstrate this, in which case the UoC shall:

a. demonstrate ≥70% saturation by conducting continuous monitoring using an electronic probe and recorder with a 15-minute sampling frequency for at least one week; or

b. ensure percentage saturation at a 'downstream, near-field' impacted location is equal to, or higher than, results from an 'upstream, far-field' non-impacted reference location, at least 500m upstream of the site.

2.6.21 *Indicator applicability: point-source systems in waterbody Types A and B*

The UoC shall conduct DO monitoring downstream from the outflow point and shall demonstrate that daily diurnal DO (DDDO) fluctuation is ≤65% saturation, following the method outlined in **Appendix 8 (8.10)**.

[42] This is demonstrated annually using the DO measurements from Indicator 2.6.18.

2.7 Salinisation



Rationale

Salinisation occurs when salt concentration rises in soil or freshwater, either naturally or due to human activities. It affects agricultural land, contributing to crop failures and reduces yields. It also affects local ecosystems, leading to habitat loss and biodiversity decline. With a growing global population, addressing salinisation is crucial for food security.[43]

Aquaculture activities can cause salinisation through seepage from saline waterbodies, saline water discharge into freshwater, the intrusion of saline water into groundwater or the dumping of biosolids.[44] In coastal regions, the effects of the dumping of biosolids can be amplified by rising sea-levels and land subsidence as a result of climate change.

This Criterion focuses on ASC-certified farms implementing best practices, such as pond liners, and regulating discharge of saline water to minimise contribution towards salinisation of soil and freshwater.

Intent – The aquaculture industry does not contribute to salinisation of soil or freshwater.

Indicators:	
2.7.1	*Indicator applicability: brackish or saltwater pond culture* The UoC shall[45] use low permeable liners.
2.7.2	The UoC shall not discharge brackish or saltwater effluent over land.
2.7.3	The UoC shall only discharge effluent water of a salinity level equal to or lower than the salinity level of the receiving waterbody or natural wetland.

[43] Kumar, P., & Sharma, P. K. (2020). Soil salinity and food security in India. Frontiers in sustainable food systems, 4, 533781.

[44] Rajarshi, M., & Santra, S. C. (2011). Influence of Brackish water aquaculture on soil salinisation. Int J Res Chem Environ, 1, 60-65.

[45] An exemption applies where ponds are located in naturally brackish or saline environments.

An exception applies to waterbodies and natural wetlands that have naturally periodic varying salinity levels, in which case the salinity level of the effluent water shall be within range of the natural variation.

2.7.4 The UoC shall ensure that freshwater-wells used for freshwater culture do not exceed a conductivity of 1,500 micro-mhos per centimetre (µmho/cm) or chloride concentration of 300mg/L.

An exception applies where well-monitoring is not permitted by applicable law, in which case regulatory records shall be obtained to provide evidence of conductivity levels.

2.8 Biosolids



Scope – Land-based sites.

Rationale

Farming activities, such as aquaculture, accumulate biological waste. Discharge and unregulated disposal of biosolids into the environment can cause negative impacts, including eutrophication, salinisation, spreading of disease and residues, and sedimentation of aquatic habitats.

Biosolids or sludge from aquaculture are often nutrient-rich and can be re-used, for example for fertilisation, if treated appropriately.[46] This provides an opportunity for the industry to contribute to building more circular economies.

This Criterion focuses on the on-site containment of biosolids by ASC-certified farms and potential for their re-use.

Intent – The aquaculture industry contributes to the circular economy by improving biosolids management.

Indicators:	
2.8.1	The UoC shall ensure that **biosolids** are appropriately contained.
2.8.2	The UoC shall ensure that biosolids are not disposed or released into receiving waterbodies, natural wetlands or other ecosystems.
2.8.3	The UoC shall only re-use uncontaminated biosolids.
2.8.4	The UoC shall dispose of biosolids responsibly if they cannot be re-used.

[46] Campanati, C., Willer, D., Schubert, J., Aldridge, D.C. (2021) Sustainable Intensification of Aquaculture through Nutrient Recycling and Circular Econoies: More Fish, Less Waste, Blue Growth. Review in Fisheries Science & Aquaculture (30) 143-169. https://doi.org/10.1080/23308249.2021.1897520

2.9 Freshwater Use

Rationale

Freshwater is a vitally important global resource. As a result of increasing demand, water scarcity is increasing, leading to regional 'water stress'. The source of freshwater, the local conditions, and the intensity of extraction determine whether the utilisation of resources is detrimental to the natural environment and to humans. Global freshwater resource depletion is driven primarily by food production systems.[47]

Water use in aquaculture has direct impacts on the availability of water for other users and biological processes[48], making it important that aquaculture operations in sensitive regions are aware of their water use and act to improve the water efficiency of their farming processes.

This Criterion focuses on ASC-certified farms appropriately monitoring and using water responsibly.

Intent – The aquaculture industry conserves freshwater.

Indicators:	
2.9.1	The UoC shall develop, implement and maintain a Water Efficiency Management Plan (WEMP) in areas identified as having 'high' or 'extremely high' water stress according to the Aqueduct 'Water Risk Atlas'[49], with the intent to reduce water consumption.
2.9.2	*Indicator applicability: areas identified as having 'high' or 'extremely high' water stress* The UoC shall ensure the WEMP is annually reviewed and revised as necessary.
2.9.3	*Indicator applicability: areas identified as having 'high' or 'extremely high' water stress*

[47] Food and Agriculture Organization of the United Nations (FAO). (2022). The State of the World's Land and Water Resources for Food and Agriculture 2021—Systems at a Breaking Point. Rome, Italy: FAO. https://doi.org/10.4060/cb9910en

[48] For the purpose of this Criterion, water use refers only to freshwater used as part of the culture (production) process in land-based aquaculture systems. It does not include water use in non-production activities.

[49] https://www.wri.org/applications/aqueduct/water-risk-atlas/#/?advanced=false&basemap=hydro&indicator=w_awr_def_tot_cat&lat=-14.445396942837744&lng=-142.85354599620152&mapMode=view&month=1&opacity=0.5&ponderation=DEF&predefined=false&projection=absolute&scenario=optimistic&scope=baseline&timeScale=annual&year=baseline&zoom=2

The UoC shall monitor and record water levels in groundwater wells, and shall include the results in the WEMP.

An exception applies where monitoring is not permitted by applicable law, in which case regulatory records shall be obtained to provide evidence of recording of water levels.

2.9.4 The UoC shall not use freshwater to reduce the salinity of culture water. An exception applies if discharged effluent water is desalinated.

2.9.5 The UoC shall not use salt to increase the salinity of freshwater for culture purposes. An exception applies if discharged effluent water is desalinated.

2.9.6 The UoC shall not divert >50% volume of **surface water**. An exception applies if the UoC can demonstrate that the diversion of water is based on a minimum **Vital Flow** determined by a regulatory permit or scientific study.

2.9.7 The UoC shall return >90% of the diverted surface water volume to its source.

2.10 Energy Use and Greenhouse Gas (GHG) Emissions



Rationale

Climate change is one of the most pressing environmental challenges globally with wide-ranging environmental and socio-economic implications. Food systems account for roughly a third of anthropogenic **greenhouse gas (GHG) emissions**[50] making the transforming of food systems towards lower-emission production and taking action to reduce emissions from food supply chains, critically important in combatting climate change.

Aquaculture contributes to GHG emissions through the use of fossil fuel-derived energy, production of feed ingredients, deforestation for feed crops or farm siting, and numerous other activities. While aquaculture products typically have a lower GHG impact than land-based alternatives[51,52] the GHG performance of aquaculture production varies widely.

The Criterion focuses on the measurement, reporting, and management of GHG emissions by ASC-certified farms to encourage climate-responsible aquaculture production.

Intent – The aquaculture industry measures and reduces greenhouse gas emissions so it remains a producer of climate-friendly food.

Indicators:	
2.10.1	The UoC shall calculate the energy use of production following the method outlined in **Appendix 9 (9.3).**
2.10.2	The UoC shall calculate the feed and farm-related GHG emissions of production following the method outlined in **Appendix 9 (9.4)**.

[50] Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F. N., & Leip, A. J. N. F. (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. Nature Food, 2(3), 198-209. https://doi.org/10.1038/s43016-021-00225-9

[51] Gephart, J. A., Henriksson, P. J., Parker, R. W., Shepon, A., Gorospe, K. D., Bergman, K., ... & Troell, M. (2021). Environmental performance of blue foods. Nature, 597(7876), 360-365. https://doi.org/10.1038/s41586-021-03889-2

[52] Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science, 360(6392), 987-992. https://www.doi.org/10.1126/science.aaq0216

2.10.3 The UoC shall develop, implement and maintain a GHG Management Plan, and shall ensure the plan is annually reviewed, and revised as necessary, following the targets set out in **Appendix 9 (9.5)**.

2.10.4 The UoC shall report energy use and GHG emissions related data in accordance with the ASC Data Submission Procedure.



2.10.5 *Indicator applicability: marine salmonids*

The UoC shall provide GHG emissions data to any subsequent ASC-certified site to which it supplies fish for grow out.

2.11 Material Use, Waste and Pollution Control



Rationale

Waste is generated through human activities such as agriculture, construction and demolition, industrial or commercial operations, the healthcare sector and domestic refuse. Improper material use and disposal can cause long-term pollution of terrestrial and aquatic environments, and have a direct effect on biodiversity loss, pollution and climate change.[53]

From construction, to operation and decommissioning, aquaculture farms use materials and generate waste that can be hazardous. Copper-based antifoulants can leach into the water and cause harm to marine life in the water column and to the sediments below the farm. Therapeutants and chemicals used to treat farmed animals can also create unintended impacts on the animals themselves, the ecosystem and their handling staff.

Aquaculture gear or infrastructure can contribute to plastic pollution in aquatic environments, particularly where materials are lost, damaged or degraded. Plastic pollution can persist in the environment, affect habitats and wildlife, and create long-term risks for aquatic ecosystems. Responsible material use and management practices can reduce the likelihood of plastic loss, leakage and pollution from aquaculture operations.

This Criterion focuses on ASC-certified farms using, and re-using, resources responsibly, minimising generated waste, and preventing pollution and harm to communities and the environment.

Intent – The aquaculture industry prevents pollution by responsibly managing and disposing of waste and chemicals.

Indicators:	
2.11.1	The UoC shall assess and, where feasible, implement measures to reduce, **reuse** and recycle waste materials.
2.11.2	*Indicator applicability: point-source discharge*

[53] UN Environment Programme (2024). Beyond an age of waste – Turning rubbish into a resource. DOI: LXXTW:HSMSVK10911720000118224499

The UoC shall capture non-biological solid waste, including plastics, prior to effluent discharge.

2.11.3 The UoC shall dispose of waste[54] responsibly.

2.11.4 The UoC shall not use pesticides that are banned or restricted by any of the following conventions or organisations:

- The Rotterdam Convention on Prior Informed Consent (PIC)[55]
- The Stockholm Convention on Persistent Organic Pollutants (POPs)[56]
- The World Health Organisation (WHO), for products classed as 'extremely hazardous' or 'highly hazardous' (classes Ia and Ib).[57]

2.11.5 The UoC shall only use net antifouling agents containing biocides that are approved by local regulations in either Australia, the European Union, Japan or the United States of America.

2.11.6 The UoC shall hold water containing hormones for at least 48 hours or as per product specifications, whichever is greater, prior to discharge.

2.11.7 *Indicator applicability: every UoC with a processing facility on site*

The UoC shall ensure that all processing effluent is treated to minimise biosecurity and environmental risks.

2.11.8 *Indicator applicability: cage culture and suspended culture not using copper-treated gear or infrastructure*

The UoC shall clean **aquaculture gear or infrastructure** in land-based facilities only if the facility treats effluents.

2.11.9 *Indicator applicability: cage culture and suspended culture using copper-treated gear or infrastructure*

The UoC shall not treat or clean aquaculture gear or infrastructure in situ.

[54] Including human waste and production mortalities.
[55] http://www.pic.int/TheConvention/Chemicals/AnnexIIIChemicals
[56] http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx
[57] https://www.who.int/publications/i/item/9789240005662

2.11.10 *Indicator applicability: cage culture and suspended culture using copper-treated gear or infrastructure*

The UoC shall clean aquaculture gear or infrastructure in land-based facilities that treat effluents, including the capturing of copper.

2.11.11 *Indicator applicability: cage culture in marine/brackish waters using copper-treated gear or infrastructure*

The UoC shall demonstrate that copper levels in the sediment are ≤ 34 mg Cu/kg dry sediment weight, following the method outlined in **Appendix 7 (7.7)**[58].

An exception applies where copper levels in sediment > 34 mg Cu/kg dry sediment weight, in which case the UoC shall demonstrate that the levels fall within the range of background concentrations measured following the method outlined in **Appendix 7 (7.7)**.

2.11.12 The UoC shall handle, use, store and dispose of chemicals according to the Safety Data Sheets (SDS) provided by the supplier.

2.11.13 The UoC shall not discharge effluent containing chemicals without adequate treatment.

2.11.14 The UoC shall adequately contain **hazardous materials** to prevent spillage, contamination and pollution.

2.11.15 The UoC shall implement spill prevention and emergency response procedures for hazardous materials.

2.11.16 The UoC shall adequately store perishable materials to minimise spoilage, spillage, contamination or pest damage.

2.11.17 The UoC shall adequately maintain machinery, aquaculture gear and infrastructure to minimise performance degradation and failure.

2.11.18 *Indicator applicability: water-based UoC*

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[58] An exemption applies to sites situated in areas classified as having a “hard bottom”. Evidence is required to support the classification “hard bottom”

The UoC shall mark and record substantial aquaculture gear.

2.11.19 *Indicator applicability: water-based UoC*

The UoC shall retrieve lost aquaculture gear.

2.11.20 The UoC shall clean up waste from the receiving shoreline or land surrounding the site.

2.11.21 *Indicator applicability: water-based UoC*

The UoC shall not use any floats made from polystyrene foam.

An exception applies where:

- Floats made from polystyrene foam are fully enclosed; and
- Floats are inspected monthly and following storm or collision events; and
- Floats are replaced when damaged or visibly deteriorated, as determined upon inspection.

2.11.22 *Indicator applicability: water-based UoC*

The UoC shall ensure that visible aquaculture infrastructure is uniform in positioning and orientation.

2.11.23 *Indicator applicability: all bivalve species*

The UoC shall ensure that surface floats are uniform in colour.

2.12 Feed



Rationale

Most farmed animals require feed. Although feed must meet the nutritional and welfare needs of the animal, it can have a negative environmental impact in how it is produced and utilised.

More than 70% of animal aquaculture is fed.[59] Life cycle assessments indicate that feed can account for up to 90% of environmental impacts of fed aquaculture production.[60] Although most of those impacts typically occur during the production, harvesting, and processing of raw materials, environmental impacts can also occur during on-farm use through nutrient pollution and inefficient use of feed.

This Criterion addresses the environmental impacts resulting from feed usage on farm, as well as efficient use of feed raw materials. In addition, ASC-certified farms need to source feed from mills certified to the ASC Feed Standard, through which responsible sourcing of ingredients is assured.

Intent – The aquaculture industry uses responsibly produced feed efficiently.

Indicators:	
2.12.1	*Indicator applicability: every UoC using **compound feed*** The UoC shall only use ASC-conforming compound feed.
2.12.2	*Indicator applicability: every UoC using seaweed as a direct feed source* The UoC shall only use seaweed from regulated sources.
2.12.3	The UoC shall not use feed containing protein derived from the same genus as the species being farmed. An exception applies:

[59] Food and Agriculture Organization of the United Nations (FAO). (2024). The State of World Fisheries and Aquaculture 2024—Blue transformation in action. Rome, Italy: FAO. https://doi.org/10.4060/cd0683en

[60] Little, D. C., Young, J. A., Zhang, W., Newton, R. W., Al Mamun, A., & Murray, F. J. (2018). Sustainable intensification of aquaculture value chains between Asia and Europe: A framework for understanding impacts and challenges. Aquaculture, 493, 338-354. https://doi.org/10.1016/j.aquaculture.2017.12.033

a. where it can be demonstrated that same-species protein hydrolysates have a molecular weight of <10,000 daltons, in which case their use is allowed.

b. for cod, in which case the use of protein derived from wild-caught cod is allowed.

2.12.4 The UoC shall not feed **wet feedstuffs, moist pellets, or uncooked/ unprocessed marine raw materials.**

2.12.5 The UoC shall calculate feed efficiency, according to **Appendix 15**, and shall adhere to the species-specific limits on feed efficiency, according to **Appendix 2 (2.2)**[61].

2.12.6 The UoC shall report feed related data in accordance with the ASC Data Submission Procedure.



[61] An exemption applies where there is no species-specific metric listed in Appendix 2.

Principle 3

The aquaculture industry is committed to respecting and promoting human rights



Principle 3

The aquaculture industry is committed to respecting and promoting human rights

Rationale

More than 22 million people are employed in the aquaculture industry globally[62]. The industry is a major contributor to people's livelihoods and communities. As with any industry, if not carried out with proper care and attention, seafood farming can have negative impacts on people's wellbeing such as through poor working conditions, social exclusion and land grabbing.

This principle addresses key topics related to the rights of employees, Indigenous people and communities, aiming to protect the human rights of those who work in aquaculture and live in surrounding communities, while acting as a catalyst for broader industry-wide change.

The criteria in this principle draw upon International Labour Organisation Conventions and Recommendations, and are aligned with the Universal Declaration of Human Rights (UDHR)[63], the ILO Declaration on Fundamental Principles and Rights at Work[64] and the United Nations Guiding Principles (UNGPs) on Business and Human Rights[65]. Alignment with these important international instruments places the respect of human rights and social responsibility at the forefront of ASC's certification system.

Details of applicable ILO Conventions and other resources can be found in **Appendix 1.**

[62] FAO SOFIA 2024
[63] https://www.un.org/en/about-us/universal-declaration-of-human-rights
[64] https://www.ilo.org/ilo-declaration-fundamental-principles-and-rights-work
[65] https://www.ohchr.org/sites/default/files/documents/publications/guidingprinciplesbusinesshr_en.pdf

3.1 Rights Awareness



Rationale

The Universal Declaration of Human Rights (UDHR) is a list of thirty rights and freedoms that belong to every human being.[66] A critical first step is **employers**, employees and neighbouring communities being aware of, and understanding, these rights in order to access them.

Aquaculture employees and people living in communities where aquaculture occurs need to be able to access all of these rights – from the right to a safe and healthy environment to freedom from forced and compulsory labour. Aquaculture producers share a responsibility to ensure that their employees and surrounding communities are aware of their rights so that the wellbeing of all these groups can be preserved and improved.

This Criterion focuses on the development and implementation of a human rights policy so that ASC-certified farms set out their intentions, with employees and communities being aware of – and able to advocate for – their rights and improve their working conditions and wellbeing.

Intent – The aquaculture industry respects and promotes the human rights of all employees and surrounding communities.

Indicators:

3.1.1 The UoC shall have a written human rights policy, approved by senior management, with the intent of publicly demonstrating its commitment to at least the following:

a. freedom of association and the effective recognition of the right to collective bargaining; and

b. the elimination of all forms of forced or compulsory labour; and

c. the effective abolition of **child labour**; and

d. the elimination of discrimination in respect of employment and occupation; and

e. a safe and healthy working environment; and

f. being a good neighbour and respecting the rights of surrounding communities.

[66] United Nations. (1948). *Universal Declaration of Human Rights*. United Nations General Assembly.

3.1.2 The UoC shall have at least one named member of management who is responsible for the implementation and maintenance of the human rights policy.

3.1.3 The UoC shall ensure that employees are engaged in the implementation and maintenance of the human rights policy.

3.1.4 The UoC shall ensure that all employees are trained on the human rights policy.

3.1.5 The UoC shall publicly disclose the human rights policy and actively communicate it to suppliers, buyers and other relevant stakeholders.

3.2 Forced Labour



Rationale

According to recent estimates, 28 million people are victims of human trafficking, debt bondage, and more subtle forms of **forced labour** that force employees to remain in their jobs against their will through other means of threat.[67]

These practices persist globally across many industries, including seafood production and processing This may take the form of threats or coercion, barring access to legal protections, withholding of identification by employers or high recruitment fees to secure jobs. Risk of some of these practices may be particularly high due to the presence of migrant worker populations.

This Criterion focuses on the prevention of all forms of forced labour by ASC-certified farms, during recruitment and employment. Rather than disengaging from any abuses identified, as part of ASC's approach to respect human rights and work on improvements in aquaculture, this Criterion requires that effective remediation is conducted.

Intent – The aquaculture industry does not engage in the use of forced labour and provides effective remediation for affected individuals.

Indicators:

3.2.1 The UoC shall not engage in, or support, forced labour[68].

3.2.2 *Indicator applicability: Every UoC where forced labour has been identified*

If forced labour is identified, the UoC shall implement remediation processes that prioritise the best interest of the person, following the method outlined in **Appendix 10**.

3.2.3 The UoC shall ensure that original identity documents are not retained, including by any recruitment agencies used. If a storage option for identity documents is provided, the UoC shall ensure that:

a. the storage is secure; and

b. it is the choice of the employee to use the storage; and

[67] Walk Free. (2023). The Global Slavery Index 2023. Perth, Australia: Minderoo Foundation.

[68] If forced labour is identified, a critical non-conformity shall be raised by the CAB.

c. stored items are logged; and

d. employees have free access to the storage.

3.2.4 The UoC shall ensure that employees, whether employed directly or through a recruitment agency, are allowed to terminate their employment according to their employment terms and conditions.

3.2.5 The UoC shall ensure that employees, whether employed directly or through a recruitment agency, do not have any part of their salary, property, or benefits unlawfully withheld.

3.2.6 The UoC shall ensure that employees, whether employed directly or through a recruitment agency, are not charged any fees associated with recruitment, employment or travel and repatriation.

3.2.7 The UoC shall not engage in **prison labour**, including where any recruitment agencies are used.

3.2.8 *Indicator applicability: Every UoC that provides loans and advances*

The UoC shall have a policy if providing loans and advances, in which the terms and conditions are not used to bind employees to employment. The policy shall be communicated to employees in an understandable manner.

3.2.9 The UoC shall allow employees to move around the workplace to freely access sanitary facilities and drinking water during their **shift**.

3.2.10 The UoC shall not keep employees involuntarily at the site outside of a shift, including confining them in employee accommodation.

3.2.11 *Indicator applicability: Every UoC that has a site that is not easily accessible*

The UoC shall offer free-of-charge and safe transportation for employees to leave the site when it is not easily accessible.

3.2.12 *Indicator applicability: Every UoC that has a site that is easily accessible*

The UoC shall not require employees to reside in employee accommodation as a condition of employment for easily accessible sites.

3.2.13 The UoC shall not require family members of owners or employees to work. Where family members have the opportunity to work, the UoC shall ensure they are separately and voluntarily contracted.

3.2.14 *Indicator applicability: Every UoC that operates a store or service*

The UoC shall not require employees to purchase from employer-operated stores or services as a condition of employment. Where alternative stores or services are not available due to the remote location, the UoC shall ensure that goods and services are sold at fair prices.

3.3 Child Labour



Rationale

All children have the right to be protected from work that is dangerous or harmful to their health, development or education.[69] [70] Employment and exploitation of children and young workers occurs globally across many sectors and is driven by economic and cultural pressures on the poorest, most vulnerable people.[71] However, limited and non-harmful forms of participation in the workforce can contribute to a **child**'s development in some contexts, providing them with skills for their adult life and supporting the welfare of their families.

More than two-thirds of global child labour is attributed to agriculture, forestry, fisheries, and aquaculture, making it a priority issue to address.[72]

This Criterion focuses on the prevention of child labour and the provision of safe working conditions for **young employees** on ASC-certified farms. Rather than disengaging from any abuses identified, as part of ASC's approach to respect human rights and work on improvements in aquaculture, this Criterion requires that effective remediation is conducted.

Intent – The aquaculture industry does not engage in the use of child labour and provides effective remediation for affected individuals.

Indicators:

3.3.1 The UoC shall not engage in child labour[73]. **Child labour** is work that:

- is mentally, physically, socially or morally dangerous and harmful to children; or
- interferes with their schooling.

3.3.2 *Indicator applicability: Every UoC where child labour has been identified*

[69] International Labour Organization (ILO). (1999). Worst Forms of Child Labour Convention, 1999 (No. 182). Geneva, Switzerland: ILO.

[70] International Labour Organization (ILO). (1973). Minimum Age Convention, 1973 (No. 138). Geneva, Switzerland: ILO.

[71] International Labour Office and United Nations Children's Fund. (2021). Child labour: Global estimates 2020, trends and the road forward. New York, USA: ILO and UNICEF.

[72] FAO (2021) Tackling child labour in fisheries and aquaculture. Background Paper. Rome. https://doi.org/10.4060/cb7159en

[73] If child labour is identified, a critical non-conformity shall be raised by the CAB.

If child labour is identified, the UoC shall implement remediation processes that prioritise the best interest of the child, following the method outlined in **Appendix 10**.

3.3.3 The UoC shall implement an age verification mechanism for all employees and shall maintain records of verified ages.

3.3.4 The UoC shall not employ children under the age of 13 under any circumstances.

3.3.5 *Indicator applicability: Every UoC employing children aged 13 or 14, or below the age of completion of mandatory schooling*

The UoC shall ensure any child employed aged 13 and 14, or below the age of completion of mandatory schooling, only conducts **light work** if permitted by applicable law and where the following conditions are met:

a. a risk assessment is conducted to determine that the work is non-hazardous; and

b. the child receives appropriate training prior to work; and

c. the child receives appropriate supervision; and

d. parental/guardian consent is given; and

e. the work does not interfere with schooling; and

f. the work is for limited hours (see Indicators 3.3.8- 3.3.13).

3.3.6 *Indicator applicability: Every UoC employing young employees aged 15 or above and above the age of completion of mandatory schooling*

The UoC shall ensure any young employees only conduct work where the following conditions are met:

a. a risk assessment is conducted to determine that the work is non-hazardous; and

b. the young employee receives appropriate training prior to work; and

c. the young employee receives appropriate supervision; and

d. parental/guardian consent is given; and

e. work is for limited hours (see Indicators 3.3.8, 3.3.9, 3.3.14-3.3.17).

3.3.7 *Indicator applicability: Every UoC with children living at the site*

The UoC shall facilitate school attendance for any children living at the site.

3.3.8 *Indicator applicability: Every UoC employing people under the age of 18*

The UoC shall ensure that all employees under the age of 18 have at least 48 consecutive hours of rest within a seven-day period.

3.3.9 *Indicator applicability: Every UoC employing people under the age of 18*

The UoC shall not allow overtime hours for employees under the age of 18.

3.3.10 *Indicator applicability: Every UoC employing children aged 13 or 14, or below the age of completion of mandatory schooling*

The UoC shall ensure that children conducting light work:

a. do not work more than 14 hours per week (excluding breaks); and

b. do not work more than 2 hours per day on a school day (excluding breaks); and

c. do not work more than 3 hours per day on a non-school day (excluding breaks); and

d. have a combined time for school, work and transportation to and from school and work totalling less than 8 hours per day (excluding breaks).

3.3.11 *Indicator applicability: Every UoC employing children aged 13 or 14, or below the age of completion of mandatory schooling*

The UoC shall ensure that where children conduct light work for more than 2 hours on a non-school day, an additional 0.5-hour break period is included within the shift.

3.3.12 *Indicator applicability: Every UoC employing children aged 13 or 14, or below the age of completion of mandatory schooling*

The UoC shall ensure that children conducting light work have a daily rest period of at least 14 consecutive hours within a 24-hour period.

3.3.13 *Indicator applicability: Every UoC employing children aged 13 or 14, or below the age of completion of mandatory schooling*

The UoC shall ensure that children conducting light work do not work between 8pm and 6am.

3.3.14 *Indicator applicability: Every UoC employing young employees aged 15 or above and above the age of completion of mandatory schooling*

The UoC shall ensure that young employees:

a. do not work more than 40 hours per week; and

b. do not work more than 8 hours per day; and

c. have a combined time for school, work and transportation to and from school and work totalling less than 10 hours per day.

3.3.15 *Indicator applicability: Every UoC employing young employees aged 15 or above and above the age of completion of mandatory schooling*

The UoC shall ensure that young employees have a total break time of at least 1 hour within 8 consecutive hours of work, with at least 0.5 hours break within any 4.5 consecutive hours of work.

3.3.16 *Indicator applicability: Every UoC employing young employees aged 15 or above and above the age of completion of mandatory schooling*

The UoC shall ensure that young employees have a daily rest period of at least 12 consecutive hours within a 24-hour period.

3.3.17 *Indicator applicability: Every UoC employing young employees aged 15 or above and above the age of completion of mandatory schooling*

The UoC shall ensure that young employees do not work between 10pm and 6am.

3.4 Discrimination and Harassment



Rationale

Discrimination is a pervasive problem that affects millions of people globally. It causes negative impacts for individuals at home, in the workplace, or within wider society which can perpetuate poverty, stifle development, productivity and competitiveness, and, on a larger scale, instigate political instability. To promote a peaceful, just, and effective society, discrimination must be addressed in all its forms – visible and invisible.

This Criterion focuses on the prevention of discrimination on ASC-certified farms.

Intent – The aquaculture industry prevents discrimination and ensures equal opportunity for all employees.

Indicators:	
3.4.1	The UoC shall not engage in or tolerate any form of discrimination, and shall ensure that all employees and applicants receive equal treatment and opportunities in all employment and recruitment practices.
3.4.2	The UoC shall not engage in or tolerate any form of violence or **harassment**.
3.4.3	The UoC shall ensure that employees, whether employed directly or through a recruitment agency, are not tested for pregnancy or virginity and are not forced or coerced into involuntary contraception.
3.4.4	The UoC shall ensure that medical tests are only conducted during the recruitment process if required for the function of the job or by applicable law, including where any recruitment agencies are used.
3.4.5	The UoC shall only require medical tests during employment if justified by a health and safety or food safety risk assessment or if required by law.
3.4.6	*Indicator applicability: Every UoC that requires medical tests* The UoC shall, when requiring medical tests (see Indicators 3.4.4 and 3.4.5), ensure that: a. employees understand the reasons for the tests; and b. employees' medical information is confidential; and

c. employees have access to their test results; and

d. employees are not charged for the tests.

3.5 Health and Safety



Rationale

A safe and healthy work environment ensures that workers are protected from accidents, injuries and illness arising from their employment. Despite this basic right, unsafe work is a reality for many people globally.

An estimated 22 million people are employed worldwide in aquaculture production.[74] These workers regularly contend with hazardous conditions and suffer injuries relating to the use of machinery, tools, boats, vehicles, drowning, falling and electrocution. The risks of accidents or incidents typically remain unaddressed due to gaps in knowledge, limited independent analyses of prevention measures or a lack of investment in risk reduction strategies. With adequate health and safety management, many of these incidents can be prevented and additional costs can be avoided.

This Criterion focuses on all aspects of creating a safe, healthy and secure workplace, including training for all employees, on ASC-certified farms.

Intent – The aquaculture industry provides safe and healthy workplaces.

Indicators:	
3.5.1	The UoC shall carry out a site-specific health and safety risk assessment, approved by a member of senior management, following the method outlined in **Appendix 3 (3.4)**.
3.5.2	The UoC shall ensure that the person conducting the site-specific health and safety risk assessment has the necessary competencies, experience and training. Where applicable regulatory competency requirements exist, the UoC shall ensure that the person conducting the site-specific health and safety risk assessment complies with these requirements.
3.5.3	The UoC shall allow any person the freedom to remove themselves from an unsafe situation without seeking permission and without fear of retribution.

[74] Food and Agriculture Organization of the United Nations (FAO). (2024). The State of World Fisheries and Aquaculture 2024—Blue transformation in action. Rome, Italy: FAO. https://doi.org/10.4060/cd0683en

3.5.4 The UoC shall ensure that any person with a medical condition, or who is pregnant, does not conduct hazardous work as determined by a personalised health and safety risk assessment (see also Indicator 3.5.1).

3.5.5 The UoC shall ensure that any person working on the site receives health and safety training as required to carry out their job. The UoC shall ensure that training is:

a. free of charge; and

b. provided in a timely manner; and

c. repeated on a regular basis; and

d. conducted during regularly remunerated working hours, or the person is compensated for their time; and

e. updated as necessary based on new procedures or equipment; and

f. documented, and records maintained.

3.5.6 The UoC shall maintain written records of health and safety accidents and near misses, determine the root cause and implement appropriate corrective actions to prevent recurrence.

3.5.7 *Indicator applicability: Any UoC where a fatal incident has occurred*

The UoC shall notify ASC of any fatal workplace accident. The notification shall be made within 14 days of the incident in accordance with the ASC Data Submission Procedure.



3.5.8 The UoC shall ensure that appropriate and understandable health and safety notices, instructions, and warning signs are visibly displayed.

3.5.9 The UoC shall ensure that clear and understandable emergency and fire safety procedures are in place.

3.5.10 The UoC shall ensure that escape routes, fire exits, firefighting equipment and fire alarms are clearly marked and maintained in good working order.

3.5.11 The UoC shall ensure that escape routes, fire exits and firefighting equipment are accessible and clear of obstacles.

3.5.12 The UoC shall provide and maintain appropriate Personal Protective Equipment (PPE) free of charge and monitor its proper use.

3.5.13 The UoC shall provide appropriate First Aid in the event of a work-related injury, including access to professional medical assistance.

3.5.14 *Indicator applicability: Every UoC located in a region where healthcare is not provided by a state or national social security or health system*

The UoC shall, where not provided by a state or national social security or health system, provide and pay for insurance or have a system to cover costs for all employees for all work-related accidents or injuries. This shall include at least the following:

a. the cost for transport and medical treatment and medication needed to treat the accident or injury; and

b. the cost for transport and medical treatment and medication needed for recovery; and

c. compensation for lost working hours; and

d. cost for any required repatriation in case of migrant workers.

3.5.15 The UoC shall ensure that any person who handles or comes into contact with hazardous substances has access to appropriate changing and washing facilities.

3.5.16 The UoC shall provide access to appropriate sanitary facilities that:

a. are clean and hygienic; and

b. include adequate privacy measures; and

c. include separation by gender if required; and

d. are sufficient for the number of people using them.

3.5.17 The UoC shall provide access to free, clearly labelled, drinking water.

3.5.18 The UoC shall provide access to an appropriate and clean area to prepare food and eat during breaks.

3.5.19 The UoC shall ensure that all buildings and structures on the site are safe to use through adequate construction, maintenance, and repair.

3.5.20 The UoC shall ensure that machinery and equipment:

a. is compliant with applicable legal requirements or other recognised standards; and

b. is safely installed, maintained, and safeguarded; and

c. is only operated by trained employees.

3.5.21 *Indicator applicability: Every UoC where diving activities are taking place*

The UoC shall log all commercial diving activities and maintain records, which shall include, at a minimum:

a. divers names and roles; and

b. breathing apparatus and gas mixture per diver; and

c. exact departure time / return time from atmospheric pressure; and

d. bottom time; and

e. maximum depth reached; and

f. full decompression schedule used (pressures, depths, times); and

g. pre-dive plant inspection results (condition, functionality and safety status of a diver's life support equipment); and

h. any decompression illness incidents and treatment given; and

i. environmental conditions; and

j. associated dive table records.

3.5.22 *Indicator applicability: Every UoC where diving activities are taking place*

The UoC shall ensure that any person involved in commercial diving activities holds commercial diver certification through an accredited organisation.

3.5.23 *Indicator applicability: Every UoC where diving activities are taking place*

The UoC shall ensure that commercial divers undergo annual medical tests to confirm they are fit to dive.

3.5.24 *Indicator applicability: Every UoC where diving activities are taking place*

The UoC shall ensure that every dive operation is supervised by a Diving Supervisor who is:

a. appointed in writing before diving begins; and

b. holds a recognised supervisor qualification; and

c. is present at the site and in continuous communication with divers; and

d. has authority to abort any dive on safety grounds without prior approval.

3.6 Collective Bargaining and Freedom of Association



Rationale

The rights to **freedom of association** and **collective bargaining** are key mechanisms of worker engagement. These rights, and the pathways that they create, enable workers to come together, articulate their needs to employers and engage in a dialogue regarding the realisation of decent working conditions.

This Criterion focuses on ASC-certified farms upholding employees' rights to freedom of association and collective bargaining – and where national law does not permit these rights, how farms can provide alternatives for employees.

Intent – The aquaculture industry respects and supports the rights to collective bargaining and freedom of association.

Indicators:

3.6.1 The UoC shall allow all employees to join or form a trade union or worker organisation. An exception applies where this is restricted by applicable law, in which case the UoC shall allow alternative lawful mechanisms for employee engagement.

3.6.2 The UoC shall allow all employees to engage in collective bargaining. An exception applies where this is restricted by applicable law, in which case the UoC shall allow alternative lawful mechanisms for employee engagement.

3.6.3 The UoC shall not interfere with collective bargaining processes or the establishment, operation, or administration of trade unions or worker organisations.

3.6.4 *Indicator applicability: Every UoC with collective bargaining agreements in place*

The UoC shall uphold any **collective bargaining agreements** developed.

3.7 Transparent Contracts



Rationale

Employment contracts consist of terms and conditions that address aspects of the employment such as the respective responsibilities of employer and employee. They are designed to give both parties clarity, trust, assurance and protection, through clear and understandable explanation of the obligations for both sides. If these agreements are not clearly understood by the employee, confusion and disagreements may result. Contracting employees in a transparent manner increases accountability in the workplace, helping to build a positive relationship between employer and employee. This Criterion focuses on employers committing to, and employees clearly understanding the terms and conditions of, their employment – contributing to transparency and accountability on ASC-certified farms.

Intent – The aquaculture industry contracts on clear terms for all employees, including migrant workers.

Indicators:

3.7.1 The UoC shall ensure that all employees have received, understood and agreed upon, written information about their employment terms and conditions before starting employment and, where applicable, prior to migration. This information shall include at least the following:

a. a description of the role and any responsibilities; and

b. the type of contract (e.g. permanent, fixed-term, contractor); and

c. working hours, including allowance for breaks, paid annual leave, allowance for days off on public holidays, and sick leave; and

d. wages, any agreed wage deductions (e.g. accommodation, meals), compensation for overtime, and loans and advances; and

e. social benefits (e.g. insurances); and

f. termination terms and conditions, notice period; and

g. relevant human rights and labour-related policies (see Indicator 3.1.1); and

h. information on labour rights (see Indicator 1.1.2).

3.7.2 The UoC shall ensure that if **family members** are working on the site they are either subject to Indicator 3.7.1 or they receive compensation or benefits for work done that is proportional to the productivity or profit of the site.

3.7.3 *Indicator applicability: Every UoC that uses recruitment agencies, employment agencies, or subcontractors*

The UoC shall establish and implement a process for the screening and oversight of third parties that supply workers, to ensure that the rights of everyone who works at the UoC are respected. The process shall include:

a. verification of legal compliance and any required licences or registrations; and

b. communication of the UoC's expectations regarding workers' rights; and

c. maintaining documentation on workers supplied to the UoC; and

d. periodic review of the third party's practices with regards to workers' rights; and

e. investigation and remediation of concerns related to third party workers' rights

3.7.4 The UoC shall not engage in **false-apprenticeships**.

3.7.5 The UoC shall ensure that no employment arrangements are used to avoid obligations to employees under applicable labour and social security laws, and social security for all employees is paid according to applicable legal requirements.

3.7.6 The UoC shall report employee composition related data in accordance with the ASC Data Submission Procedure.



3.8 Wages

Rationale

Every employee deserves to be fairly compensated for their efforts. In many countries, this compensation is insufficient to maintain a decent standard of living, leaving employees and their families in a cycle of poverty which is difficult to escape from. Across many industries, efforts are being made to progress compensation up to the level of a **living wage**, defined as "the remuneration received for a standard workweek by a worker in a particular place sufficient to afford a decent standard of living for the worker and her or his family. Elements of a decent standard of living include food, water, housing, education, health care, transportation, clothing, and other essential needs including provision for unexpected event."[75]

Intent – The aquaculture industry provides salaries at or above the legal **minimum wage** and improves towards payment of a living wage.

Indicators:

3.8.1 The UoC shall set wages, before overtime and bonuses, at or above the legal minimum wage. An exception applies where a minimum wage has not been established by applicable law, in which case the UoC shall calculate wages in consultation with employees or their representative organisations.

3.8.2 The UoC shall annually identify any living wage gap, following the method outlined in **Appendix 11**.

3.8.3 The UoC shall report living wage related data, including the living wage gap, in accordance with the ASC Data Submission Procedure.

3.8.4 *Indicator applicability: Every UoC that has identified a living wage gap*

The UoC shall, where a living wage gap has been identified (see Indicator 3.8.2), develop and implement a wage improvement plan towards payment of a living wage.

[75] https://www.globallivingwage.org/about/what-is-a-living-wage/

3.8.5 The UoC shall pay wages in full directly to employees in **legal tender** or into a bank account in their name at regular intervals, at least monthly. Wages shall not be delayed, deferred or in any way withheld.

3.8.6 The UoC shall document wage payment and receipt by all employees.

Documentation shall be understandable and made available to the employees and shall include information on at least the following:

a. wages; and

b. advances; and

c. loans; and

d. hours worked including overtime; and

e. details of any withholdings.

3.8.7 The UoC shall ensure that employees are entitled to maternity leave of a minimum of 14 weeks that includes a guarantee of return to the job.

3.9 Working Hours



Rationale

With many global standards and local regulations in place, working time is one of the oldest labour concerns.[76] Excessive working hours are a widespread issue – including within the aquaculture industry – and in some regions are driven by low hourly wages.[77] An inability to decline excessive overtime, due to wage pressures or fear of dismissal, can result in forced labour and higher levels of fatigue-related accidents.

This Criterion focuses on ASC-certified farms having a framework for regulating hours of work, rest periods and annual holidays – serving also to promote higher productivity while safeguarding employees' physical and mental health.

Intent – The aquaculture industry implements reasonable working hours that encourage a healthy work-life balance.

Indicators:	
3.9.1	The UoC shall ensure that working hours comply with applicable legal requirements and any collective bargaining agreements in place on premium rates, working hours, shift patterns, breaks, daily rest, weekly rest and annual leave.
3.9.2	The UoC shall maintain records of the hours worked by every employee.
3.9.3	*Indicator applicability: Every UoC employing people aged 18 and above* The UoC shall ensure that normal working hours, excluding overtime, do not exceed 8 hours per day and 48 hours in a week. An exception applies where the operations of the UoC require a different working pattern, in which case the UoC may use averaging of working hours if permitted by applicable legal requirements, calculated over a maximum 17-week reference period[78].

[76] International Labour Organization (ILO). (1919). Hours of Work (Industry) Convention, 1919 (No. 1). Geneva, Switzerland: ILO.

[77] Messenger, J. (2018). Working time and the future of work. Geneva, Switzerland: International Labour Organization.

[78] https://www.gov.uk/maximum-weekly-working-hours

When more than 48 hours are worked in a week as a result of averaging, the UoC shall ensure that the following conditions are met:

a. it is in line with applicable legal requirements; and

b. it is in line with collective bargaining agreements; and

c. terms are clearly set out and agreed to by employees in their contracts; and

d. appropriate safeguards are put in place to protect the employee's health and safety.

3.9.4 The UoC shall ensure that overtime hours:

a. are voluntary; and

b. are not requested regularly; and

c. have appropriate safeguards in place to protect the employee's health and safety.

3.9.5 The UoC shall ensure that total working hours, including normal and overtime hours, do not exceed 60 hours in a week.

3.9.6 The UoC shall ensure that overtime hours are paid at a premium rate of at least 125%[79] of the agreed wages, or as defined by applicable legal requirements or any collective bargaining agreements in place, whichever is higher.

3.9.7 *Indicator applicability: Every UoC employing people aged 18 and above*

The UoC shall ensure that all employees are granted breaks during work shifts. Where this is defined by applicable legal requirements or any collective bargaining agreements in place, these shall be followed.

3.9.8 *Indicator applicability: Every UoC employing people aged 18 and above*

The UoC shall ensure that all employees are granted at least 11 consecutive hours of rest within a 24-hour period.

3.9.9 *Indicator applicability: Every UoC employing people aged 18 and above*

[79] https://normlex.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C030

The UoC shall ensure that all employees are granted at least 24 consecutive hours of rest within a 7-day period[80], or at least two periods of 24 consecutive hours of rest within a 14-day period[81] if allowed by applicable law.

3.9.10 *Indicator applicability: Every UoC with employees who are pregnant or breastfeeding*

The UoC shall ensure that additional breaks are granted for employees who are pregnant or breastfeeding. These breaks shall be counted as working time and appropriate facilities shall be provided.

3.9.11 The UoC shall ensure that all employees are granted paid leave as defined by applicable legal requirements or any collective bargaining agreements in place. An exception applies where paid leave has not been defined by applicable law or a collective bargaining agreement, in which case the UoC shall determine paid leave in consultation with employees or their representative organisations.

[80] https://normlex.ilo.org/dyn/normlex/en/f?p=1000:12100:::12100:P12100_INSTRUMENT_ID:312159
[81] https://www.ethicaltrade.org/eti-base-code/6-working-hours-are-not-excessive

3.10 Disciplinary Practices



Rationale

Professional behaviour in the workplace benefits both the employer and employee as it strengthens the effectiveness of operational processes, contributing to business productivity and wider industry reputation. However, when employee behaviours are not in line with expectations, the employer may decide to intervene. Although these interventions are intended to benefit both parties, there is a risk that this could be done in an unfair or degrading manner towards the employee.

This Criterion focuses on establishing an effective and consistent way to deal with performance matters, while protecting the dignity, and physical and mental wellbeing of employees on ASC-certified farms.

Intent – The aquaculture industry implements fair and transparent disciplinary practices, fostering a culture of respect and accountability.

Indicators:	
3.10.1	The UoC shall have a written disciplinary policy with the intent of setting out the process to respond to breaches of company rules. The policy shall define clear levels of escalation and shall ensure that the employee's dignity is upheld at all times.
3.10.2	The UoC shall ensure that all employees are aware of, and understand, the disciplinary policy.
3.10.3	The UoC shall maintain records of responses to breaches of company rules.
3.10.4	The UoC shall not deduct from wages or benefits as part of any response to breaches of company rules.

3.11 Employee Accommodation



Rationale

Aquaculture sites are often located in remote areas, including offshore operations. Daily commutes between shifts are usually difficult under these circumstances, and as a result, employees may reside for a duration in accommodation provided by their employer. In certain regions and particular industries, employees might decide to live with their families on the site. Where employee accommodation is provided, there can be a risk that the living conditions are poor, with limited freedom of movement or access to sanitary facilities – posing a physical and mental health risk. Poor accommodation is strongly linked to forced labour.[82]

This Criterion focuses on housing provided by employers meeting the needs of employees and forming a suitable living environment on ASC-certified farms.

Intent – The aquaculture industry provides safe, decent and hygienic employee accommodation where this is needed.

Indicators:

3.11.1

Indicator applicability: Every UoC that provides accommodation

The UoC shall ensure that any accommodation provided for employees or their family:

a. is according to applicable legal requirements; and

b. has adequate safety provisions; and

c. is regularly maintained and kept in good working order; and

d. is clean and hygienic; and

e. allows for adequate privacy, including separation by gender if required; and

f. meets the basic needs of the employees and their families; and

g. is sufficient for the number of people using them.

3.11.2

Indicator applicability: Every UoC that provides accommodation

[82] International Labour Organization (ILO). (1961). Workers' Housing Recommendation, 1961 (No. 115). Geneva, Switzerland: ILO.

The UoC shall ensure that any rent for accommodation is reasonable and is in line with average local rental rates.

3.11.3 *Indicator applicability: Every UoC that provides accommodation*

The UoC shall provide access to appropriate sanitary facilities that:

a. are clean and hygienic; and

b. include adequate privacy measures; and

c. include separation by gender if required; and

d. are sufficient for the number of people using them.

3.11.4 *Indicator applicability: Every UoC that provides accommodation*

The UoC shall arrange for an annual meeting with employees or their representatives to discuss any reasonable improvements required to accommodation. The UoC shall maintain records of these meetings and shall take actions where necessary.

3.11.5 *Indicator applicability: Every UoC that has employees working in remote locations*

The UoC shall ensure that all employees working in remote locations have access to a free, private, real-time communication link to communicate externally.

3.12 Grievance Mechanism



Rationale

Grievance mechanisms may be referred to as dispute, complaint or accountability mechanisms. They offer a system in which parties can effectively address a problem together, provide remediation where needed and serve as an early warning system for human rights issues to inform corrective actions. They also offer the right to external redress. Well-functioning grievance mechanisms are transparent, fair, predictable, accessible to all stakeholder groups and foster trust among participants.[83]

This Criterion focuses on the development of effective grievance mechanisms for employees on ASC-certified farms, and neighbouring communities.

Intent – The aquaculture industry fosters dialogue with employees and communities over dispute, and where needed seeks resolution through robust grievance mechanisms.

Indicators:	
3.12.1	The UoC shall, when concerns arise, engage in dialogue with employees or their representatives, with the intent of avoiding an escalation to a **grievance**. The UoC shall ensure that employees understand how to engage in this dialogue.
3.12.2	The UoC shall have an employee grievance mechanism that is accessible, fair and applicable to all employees.
3.12.3	The UoC shall ensure that all employees are trained on the employee grievance mechanism.
3.12.4	The UoC shall have a community grievance mechanism that is proactively communicated, accessible, fair and applicable to Indigenous and tribal peoples, and local communities.
3.12.5	The UoC shall ensure the grievance mechanisms in Indicators 3.12.2 and 3.12.4 include provisions for non-retaliation.

[83] United Nations. (2011). *Guiding Principles on Business and Human Rights. Implementing the United Nations "Protect, Respect and Remedy" Framework*. Human Rights Office of the High Commissioner.

3.12.6 The UoC shall ensure that:

a. grievances are acknowledged within 10 days from submission; and

b. grievances are resolved within 90 days from submission.

Where resolution is not possible within 90 days, justification and an alternative timeline shall be provided to relevant parties.

3.12.7 The UoC shall maintain written records of all grievances, responses and resolutions.

3.12.8 The UoC shall ensure that employees are engaged in the implementation and maintenance of the grievance mechanism.

3.12.9 The UoC shall ensure that grievance mechanisms are confidential, and information is only shared where necessary to investigate the grievance.

3.13 Community Engagement



Rationale

If conducted irresponsibly, any economic activity can potentially create negative impacts or infringe on the legal and customary rights of neighbouring Indigenous and tribal people, and local communities as established in ILO conventions.[84]

Local communities that depend on fishing or agriculture may face economic challenges or risks to their food security as aquaculture operations may compete with, or deplete, their resources. **Customary rights** of Indigenous and tribal people to use specific lands and waters for cultural or subsistence activities may also be affected. Aquaculture operations may also affect communities in other ways, such as by increasing traffic or causing pollution.

This Criterion focuses on how ASC-certified farms can create positive relationships with the local community. This involves understanding potential adverse impacts, acknowledging legal and customary rights, constructive and continuous engagement, and the involvement of the local community and Indigenous people in business ventures.

Intent – The aquaculture industry supports local development and conducts meaningful community engagement.

Indicators:	
3.13.1	The UoC shall identify any Indigenous and Tribal Peoples and local communities that: a. have legal and/or customary rights in the area of its operations; or b. may be affected by its operations.
3.13.2	*Indicator applicability: Every UoC that has identified its operations may affect Indigenous and Tribal Peoples and local communities* The UoC shall demonstrate it has obtained ownership or usage rights from Indigenous and Tribal Peoples, and local communities, where they hold legal or formally recognised customary rights.

[84] International Labour Organization (ILO). (1989). Indigenous and Tribal Populations, 1989 (No. 169). Geneva, Switzerland: ILO.

3.13.3 *Indicator applicability: Every UoC that has identified its operations may affect Indigenous and Tribal Peoples and local communities*

The UoC shall proactively and continuously engage with Indigenous and Tribal Peoples and local communities, to promote a positive relationship and to support the identification of potential negative impacts.

3.13.4 *Indicator applicability: Every UoC that has identified its operations may affect Indigenous and Tribal Peoples and local communities*

The UoC shall identify, avoid, and mitigate potential negative impacts of its activities on Indigenous and Tribal Peoples and local communities, including:

a. impacts on access to sites of cultural, ecological, economic, religious, or spiritual significance, to which they have legal or customary rights; and

b. environmental and physical impacts; and

c. livelihood impacts; and

d. other cultural and spiritual impacts; and

e. indirect impacts on distant communities.

3.13.5 *Indicator applicability: Every UoC that has identified its operations may affect Indigenous and Tribal Peoples and local communities*

The UoC shall, where possible, source goods, services, and employment from Indigenous and Tribal Peoples and local communities.



Principle 4

The aquaculture industry upholds responsible animal health and welfare practices



Principle 4

The aquaculture industry upholds responsible aquatic animal health and welfare practices

Rationale

Aquatic animal health and welfare are crucial for responsible aquaculture and underpin the ASC vision for the development of the industry. Through this commitment, ASC also addresses a spectrum of global challenges, including food security, ecosystem resilience, global warming and threats to public health. By recognising the connection between these issues, aquatic animal health and welfare in aquaculture emerges as a critical focus, providing a holistic approach to safeguarding people, aquatic animals and the environment.

The ASC Farm Standard adopts a comprehensive framework for aquatic animal health and welfare that encompasses ethical, economic, environmental, and regulatory considerations to mitigate risks, and prevents poor aquatic animal health and welfare outcomes.

ASC embraces a definition of welfare defined by the physical and mental state of an aquatic animal in relation to the conditions in which it lives and its capacity to cope with the environment providing opportunities foraquatic animals to 'thrive' and not simply survive. This perspective is linked to the concept of Positive Animal Welfare (PAW), which can be characterised by four features: positive emotions, positive affective engagement, quality of life and happiness. These features extend the original Five Freedoms[85],[86] to incorporate consideration of quality of life.

The criteria in this principle cover best practices in handling and slaughter, as well as disease prevention and the use of therapeutants, for fish, crustaceans and molluscs. By promoting high standards of aquatic animal health and welfare, ASC not only reinforces its commitment to responsible aquaculture but also addresses consumer concerns, and contributes to the ethical production of sustainable blue foods.

[85] Green, T., & Mellor, D. (2011). Extending ideas about animal welfare assessment to include 'quality of life' and related concepts. New Zealand Veterinary Journal, 59(6), 263–271. https://doi.org/10.1080/00480169.2011.610283
[86] Mellor, D. J. (2016). Updating Animal Welfare Thinking: Moving beyond the "Five Freedoms" towards "A Life Worth Living". Animals, 6(3), 21. https://doi.org/10.3390/ani6030021

4.1 Fish (including Cleaner Fish)



Rationale

Many aquatic animals, including fish, are sentient beings that can feel and experience pain, stress and anxiety. Keeping them in good health and welfare is a responsible practice that support aquatic animals to adapt to their surroundings, boosts productivity, prevents the spread of disease and reduces reliance on chemicals with potentially negative environmental effects. Handling activities and **slaughter** are major factors in the welfare of farmed aquatic animals. If not carried out appropriately, they can lead to stress and overall suffering.[87]

Maintaining good health and welfare in aquaculture production includes consideration of a wide range of practices and conditions. Key aspects include disease detection and response, feeding practices, appropriate handling of aquatic animals and monitoring of water conditions.[87] Best practices in fish slaughter include the implementation of responsible stunning and killing methods to ensure that there is rapid loss of consciousness, which is not regained before killing.[88] An effective management plan and site-specific handling plans can help avoid **mortality events**, demonstrating commitment to responsible aquaculture practices.

This Criterion focuses on farming, handling, and slaughter practices by ASC-certified farms to support good aquatic animal health and welfare, including training, monitoring, veterinarian oversight, and development of a site-specific Health and Welfare Management Plan (HWMP).

Intent – The aquaculture industry ensures good health and welfare, humane handling and slaughter practices of cultured fish.

[87] Ashley, P. J. (2007). Fish welfare: current issues in aquaculture. *Applied Animal Behaviour Science*, *104*(3-4), 199-235.
[88] Lines, J. A., & Spence, J. (2014). Humane harvesting and slaughter of farmed fish. Revue scientifique et technique (International Office of Epizootics), 33(1), 255-264.

4.1.1 – Fish - Health and Welfare

Indicators 4.1.1.1-4.1.1.13:
Scope: all fish species except cleaner fish (see Indicators 4.1.1.14-4.1.1.27)

4.1.1.1 The UoC shall ensure that all relevant employees are trained on general aquatic animal health and welfare awareness, including biosecurity, according to **Appendix 12 (12.2, Table 1)**.

4.1.1.2 The UoC shall ensure that any person involved in aquatic animal husbandry and handling activities is trained on aquatic animal health and welfare, according to **Appendix 12 (12.2, Table 1)**.

4.1.1.3 The UoC shall ensure that the content of the training in Indicators 4.1.1.1 and 4.1.1.2 is updated as necessary, and is approved by a **registered veterinarian** or **aquatic animal health professional**.

4.1.1.4 The UoC shall implement a vaccination plan that:

a. considers the relevant diseases and vaccine availability; and

b. includes justification for vaccine selection; and

c. is approved by a registered veterinarian or aquatic animal health professional.

4.1.1.5 *Indicator applicability: cod and marine salmonids in cages*

The UoC shall only stock a single **cohort** of fish per site.

4.1.1.6 The UoC shall calculate mortality rate and real percentage mortality, according to **Appendix 12 (12.6.1)**, and shall adhere to species-specific mortality limits, according to **Appendix 2 (2.3)**[89].

4.1.1.7 The UoC shall only stock batches of fish that have been **tested** prior to stocking and are free from diseases of regional concern.

4.1.1.8 The UoC shall ensure that a registered veterinarian or aquatic animal health professional periodically visits the site to perform routine checks. Checks shall be carried out at least annually for all fish species and quarterly for salmon, as well as reactively in cases of fish health or welfare concerns.

[89] An exemption applies where there is no species-specific metric listed in Appendix 2.

4.1.1.9 *Indicator applicability: every UoC using feed*

The UoC shall develop and implement a feeding plan that includes at least the following:

a. time and frequency of feeding; and

b. feed rations; and

c. feeding methods; and

d. different environmental conditions; and

e. prevention of the use of feed which has expired, spoiled or shows signs of excessive leakage; and

f. feed types for the nutritional needs and life stages of the species.

An exception applies to (f) when such feeds are not available, in which case the UoC shall use feed suitable for aquatic animals with similar nutritional needs.

4.1.1.10 The UoC shall develop, implement and maintain a site-specific Health and Welfare Management Plan (HWMP), approved by a registered veterinarian, with the intention of preventing disease outbreaks, and ensuring the good health and welfare of farmed fish.

The HWMP shall include all of the following:

a. disease monitoring; and

b. response, including quarantine, treatment, and humane culling; and

c. mechanisms to report to relevant authorities where required; and

d. biosecurity risks; and

e. predation risks.

The HWMP shall be reviewed:

f. at least annually for sites with cycles under one year or using continuous production methods; or

g. after each cycle for sites with longer cycles or all-in-all-out production methods.

Where the review determines that changes are required, the HWMP shall be revised.

4.1.1.10.1 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes a water quality monitoring process according to **Appendix 12 (12.3, Table 2).**

4.1.1.10.2 *Indicator applicability: every UoC using feed*

The UoC shall ensure[90] the HWMP includes a morphological monitoring process for live fish.

Monitoring shall be conducted at least once a month coinciding with any fish handling activity, and shall include at least the following scoring parameters:

a. eye damage
b. operculum damage
c. skin damage
d. fin damage
e. deformities
f. change of colouration
g. emaciation

An exception applies where deviation from monitoring frequency and/or scoring parameters is justified by any of the following reasons:

h. there is no handling of the fish during the month; or
i. fish are undergoing a disease event and/or being treated; or
j. a documented risk assessment is present which demonstrates that the monitoring frequency and/or one or more scoring parameter is not relevant to the species

In which case monitoring shall be conducted using cameras or from the side of the culture unit for as many parameters as possible. The reason for any deviation shall be recorded.

4.1.1.10.3 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes a feeding monitoring process for live fish in accordance with the time and frequency established in the feeding plan (see Indicator 4.1.1.9 a).

4.1.1.10.4 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes a mortality monitoring process which includes at least the following:

a. daily monitoring and recording of mortalities; and
b. removal of mortalities at least every two days; and
c. classification of all recovered mortalities and a post-mortem analysis for each mortality event; and

[90] An exemption applies immediately after smolting and stocking, or under environmental conditions that affect the welfare of the fish or the health and safety of employees. The reason for the exemption shall be recorded.

d. investigation of mortality events which remain unexplained or unattributed to fish health reasons; and

e. daily collection of moribund fish and culling according to Criterion 4.1.3.

Where any of the listed items above are not possible, the UoC shall record the reason.

4.1.1.10.5 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes a system to identify acceptable, warning, and unacceptable levels of health or welfare for:

a. water quality (Indicator 4.1.1.10.1); and

b. morphology (Indicator 4.1.1.10.2); and

c. feeding (Indicator 4.1.1.10.3); and

d. mortality (Indicator 4.1.1.10.4).

Where levels are warning or unacceptable, the UoC shall, where possible, increase monitoring and implement corrective actions to restore levels to acceptable.

4.1.1.10.6 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes trend analysis to determine changes in health and welfare over time. This analysis shall consider drivers of the trends, and shall be based on the data analysed in Indicator 4.1.1.10.5 and feedback from the processing plant where relevant.

4.1.1.10.7 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes a mortality reduction plan which defines annual targets for both total and unexplained mortalities by considering the results of the trend analysis in Indicator 4.1.1.10.6, and shall implement appropriate actions to meet the annual targets.

4.1.1.10.8 The UoC shall report the following to a registered veterinarian or aquatic animal health professional:

a. all mortality events; and

b. fish health and welfare concerns identified during mortality classification.

4.1.1.11 The UoC shall report to the relevant authorities if a WOAH-notifiable disease[91] is confirmed at a site, and shall:

a. apply the measures according to applicable legal requirements; and

b. increase disease-monitoring in other batches of fish; and

c. coordinate oversight by a registered veterinarian or aquatic animal health professional.

4.1.1.11.1 *Indicator applicability: marine salmonids in cages*

The UoC shall immediately notify other sites within the Area-Based Management (ABM) (see Indicator 4.5.1) if a WOAH-notifiable disease is confirmed.

4.1.1.12 The UoC shall calculate stocking densities, following the method outlined in **Appendix 12 (12.6.3)**.

4.1.1.13 The UoC shall report mortality related data in accordance with the ASC Data Submission Procedure.



Indicators 4.1.1.14-4.1.1.27:
Scope: Cleaner fish

4.1.1.14 The UoC shall ensure that all relevant employees are trained on general aquatic animal health and welfare awareness, including biosecurity, according to **Appendix 12 (12.2, Table 1)**.

4.1.1.15 The UoC shall ensure that any person involved in aquatic animal husbandry and handling activities is trained on aquatic animal health and welfare, according to **Appendix 12 (12.2, Table 1)**.

4.1.1.16 The UoC shall ensure that the content of the training in Indicators 4.1.1.14 and 4.1.1.15 is updated as necessary and is approved by a registered veterinarian or aquatic animal health professional.

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[91] An exemption applies where the WOAH-notifiable disease is classified as endemic by the relevant authorities and reporting is not required under applicable legal requirements.

4.1.1.17 The UoC shall only use native **cleaner fish** species.

4.1.1.18 The UoC shall carry out a risk assessment prior to stocking cleaner fish, considering at least the following:

a. the suitability of use of cleaner fish for parasite control (see Indicator 4.5.17); and

b. the disease history of the cleaner fish to avoid cross contamination (*only where using farmed cleaner fish*); and

c. site-specific environmental conditions considering the species-specific needs of cleaner fish; and

d. net mesh size; and

e. salmon size in relation to cleaner fish.

4.1.1.19 The UoC shall only stock batches of cleaner fish that have been tested prior to stocking and are free from diseases of regional concern[92].

4.1.1.20 The UoC shall implement a vaccination plan that:

a. considers the relevant diseases and vaccine availability; and

b. includes justification for vaccine selection; and

c. is approved by a registered veterinarian or aquatic animal health professional.

4.1.1.21 The UoC shall provide hides and refuges for the cleaner fish that are:

a. designed and placed according to the species-specific needs; and

b. sufficient for the number of cleaner fish stocked.

4.1.1.22 The UoC shall only stock cleaner fish:

a. during daylight; and

b. in calm weather; and

c. below the waterline; and

[92] An exemption applies to wild caught species sourced from zones or compartments declared disease free. See COUNCIL DIRECTIVE 2006/88/EC of 24 October 2006 on animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals and European Union Reference Laboratory for Fish Diseases: Cleaner fish in aquaculture: Health management and legislative issues.

d. close to hides and refuges; and

e. after salmon have been fed; and

f. without forcing removal from their transport container.

4.1.1.23 *Indicator applicability: every UoC using feed*

The UoC shall develop and implement a feeding plan that considers at least all of the following:

a. time and frequency of feeding; and

b. feed rations; and

c. feeding methods; and

d. different environmental conditions; and

e. prevention of the use of feed which has expired, spoiled or shows signs of excessive leakage; and

f. feed types for the nutritional needs and life stages of the species.

An exception applies to (f) when such feeds are not available, in which case the UoC shall use feed suitable for aquatic animals with similar nutritional needs.

4.1.1.24 The UoC shall ensure that cleaner fish feed is not withdrawn to enhance sea lice control.

4.1.1.25 The UoC shall ensure that a registered veterinarian or aquatic animal health professional periodically visits the site to perform routine checks. Checks shall be carried out at least annually, as well as reactively in cases of fish health or welfare concerns.

4.1.1.26 The UoC shall develop, implement and maintain a site-specific Health and Welfare Management Plan (HWMP), approved by a registered veterinarian, with the intention of preventing disease outbreaks and ensuring the good health and welfare of cleaner fish.

The HWMP shall include all of the following:

a. disease monitoring; and

b. response, including quarantine, treatment, and humane culling; and

c. mechanisms to report to relevant authorities where required; and

d. biosecurity risks; and

e. predation risks.

The HWMP shall be reviewed:

f. at least annually for sites with cycles under one year or using continuous production methods; or

g. after each cycle for sites with longer cycles or all-in-all-out production methods.

Where the review determines that changes are required, the HWMP shall be revised.

4.1.1.26.1 The UoC shall ensure the HWMP includes a water quality monitoring process according to **Appendix 12 (12.3, Table 2).**

4.1.1.26.2 The UoC shall ensure the HWMP includes a morphological monitoring process for live cleaner fish. Monitoring shall be conducted at least once every three months coinciding with any fish handling activity, and shall include at least the following scoring parameters:

a. eye damage

b. operculum damage

c. skin damage

d. fin damage

e. deformities

f. change of colouration

g. emaciation

An exception applies where deviation from monitoring frequency is justified by any of the following reasons:

h. there is no handling of the cleaner fish during the three-month period; or

i. cleaner fish are undergoing a disease event and/or being treated; or

j. a documented risk assessment is present which demonstrates that one or more scoring parameter is not relevant to the species

In which case monitoring shall be conducted using cameras or from the side of the culture unit for as many parameters as possible. The reason for any deviation shall be recorded.

4.1.1.26.3 The UoC shall ensure the HWMP includes a feeding monitoring process for live cleaner fish. Monitoring shall be conducted weekly.

An exception applies where deviation from weekly monitoring is justified under environmental conditions that affect the welfare of the cleaner fish or the health and safety of employees.

The reason for any deviation shall be recorded.

4.1.1.26.4 The UoC shall ensure the HWMP includes a mortality monitoring process which includes at least the following:

a. daily monitoring and recording of mortalities; and

b. removal of mortalities at least every two days; and,

c. classification of all recovered mortalities and conducting a post-mortem analysis for each mortality event; and

d. investigation of mortality events which remain unexplained or unattributed to fish health reasons; and

e. daily collection of moribund fish and culling according to Criterion 4.1.3.

Where any of the listed items above are not possible, the UoC shall record the reason.

4.1.1.26.5 The UoC shall ensure the HWMP includes a mortality reduction plan which defines annual targets for both total and unexplained mortalities, and shall implement appropriate actions to meet the annual targets.

4.1.1.26.6 The UoC shall report the following to a registered veterinarian or aquatic animal health professional:

a. all mortality events; and

b. cleaner fish health and welfare concerns identified during mortality classification.

4.1.1.27 The UoC shall calculate cleaner fish stocking densities in relation to salmon stocking, following the method outlined in **Appendix 12 (12.6.3)**.

4.1.2 – Fish - Handling

Indicators 4.1.2.1-4.1.2.16:
Scope: all fish species except cleaner fish (see Indicators 4.1.2.17-4.1.2.32)

4.1.2.1 The UoC shall develop, implement and maintain a site-specific Handling Management Plan (HMP), with the intent of ensuring the good health and welfare of farmed fish.

The HMP shall be periodically reviewed and revised as necessary.

4.1.2.2 The UoC shall ensure that the HMP includes all handling activities.

4.1.2.3 The UoC shall ensure that the HMP includes contingency plans for handling activities, including at least the following:

a. immediate response measures in the case of system failure; and

b. humane culling response measures (see Indicator 4.1.3.2); and

c. mass mortality event response measures.

4.1.2.4 The UoC shall ensure that the HMP includes consideration of the environmental conditions associated with handling activities, with the intent of preventing handling under adverse conditions that could affect the health and welfare of the fish.

4.1.2.5 The UoC shall ensure that the HMP, following consultation with a registered veterinarian or aquatic animal health professional, considers the use of anaesthesia during handling activities.

4.1.2.6 The UoC shall ensure that the HMP includes a fitness assessment of the fish prior to handling activities[93], approved by a registered veterinarian or aquatic animal health professional.

For the specific handling activities listed below, the fitness assessment shall be carried out:

a. within a two week period prior to transport or treatment that requires handling of the fish, except when the same type of treatment is repeated, in which case the assessment shall be carried out at least once a month after the initial treatment;

b. within a two-week period prior to net change and passive grading.

[93] An exemption applies to handling activities related to health examinations (e.g. health assessment, parasite counting) and in the case of emergencies (e.g. containment of an escape).

4.1.2.7 The UoC shall ensure that the HMP considers crowding activities with the intention of preventing stress, injury and mortality. Crowding activities shall be carried out:

a. under supervision; and

b. for a maximum of two hours.

An exception applies where a registered veterinarian or aquatic animal health professional demonstrates that exceeding two hours of crowding does not negatively impact aquatic animal welfare, in which case the maximum time period shall be defined by the registered veterinarian or aquatic animal health professional.

4.1.2.8 The UoC shall ensure that the HMP considers biosecurity risks specific to the types of handling activities, and shall include appropriate biosecurity measures to prevent the transfer of disease.

4.1.2.9 The UoC shall ensure that the HMP considers predation risks specific to the types of handling activities, and shall include appropriate predator control measures.

4.1.2.10 The UoC shall ensure that the HMP includes a water quality monitoring process according to **Appendix 12 (12.3, Table 2).**

In the case of live transport[94], monitoring shall be conducted at the point of departure, during transport and on arrival.

4.1.2.11 The UoC shall ensure that the HMP includes a visual inspection process to identify abnormal behaviour in relation to the handling activity, and defines mitigation measures when identified.

4.1.2.12 The UoC shall ensure that the HMP includes a post-handling evaluation process that considers at least the following:

a. abnormal behaviour; and,

b. morphological scores; and,

c. moribund aquatic animals and mortalities.

4.1.2.13 The UoC shall ensure that the HMP includes acclimatisation measures to prevent sudden changes in water conditions affecting the health and welfare status of the fish.

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[94] An exemption applies where live transport after uplift of fish is conducted by a third party outside of the scope of the UoC's certification and the fish are no longer owned by the UoC, or where monitoring during transport negatively affects aquatic animal health and welfare.

4.1.2.14 The UoC shall ensure that the HMP includes consideration of the use of appropriate equipment during handling activities to avoid affecting the health and welfare status of the fish.

4.1.2.15 The UoC shall adhere to a maximum limit of 15 seconds out of water[95].

4.1.2.16 The UoC shall adhere to species-specific limits on maximum fasting duration before any handling[96], according to **Appendix 2 (2.4)[97].**

An exception applies before slaughter where a registered veterinarian or aquatic animal health professional demonstrates that exceeding the maximum fasting duration does not negatively impact fish welfare, in which case the maximum fasting duration shall be defined in the HMP by the registered veterinarian or aquatic animal health professional.

Indicators 4.1.2.17-4.1.2.32:
Scope: Cleaner fish

4.1.2.17 The UoC shall develop, implement and maintain a site-specific Handling Management Plan (HMP), with the intent of ensuring the good health and welfare of cleaner fish.

The HMP shall be periodically reviewed and revised as necessary.

4.1.2.18 The UoC shall ensure that the HMP includes all handling activities.

4.1.2.19 The UoC shall ensure that the HMP includes contingency plans for handling activities, including at least the following:

a. immediate response measures in the case of system failure; and

b. humane culling response measures (see Indicator 4.1.3.9); and

c. mass mortality event response measures.

[95] An exemption applies to anaesthetised fish and pangasius, *Clarius*, *Heterobranchus* and their hybrids (due to their ability to breathe air facultatively).
[96] An exemption applies in exceptional situations of severe weather, adverse environmental conditions (e.g. jellyfish, algal bloom) or during disease events.
[97] An exemption applies where there is no species-specific metric listed in Appendix 2.

4.1.2.20 The UoC shall ensure that the HMP includes consideration of the environmental conditions associated with handling activities, with the intent of preventing handling under adverse conditions that could affect the health and welfare of the cleaner fish.

4.1.2.21 The UoC shall ensure that the HMP, following consultation with a registered veterinarian or aquatic animal health professional, considers the use of anaesthesia during handling activities.

4.1.2.22 The UoC shall ensure that the HMP includes a fitness assessment of the cleaner fish prior to handling activities[98], approved by a registered veterinarian or aquatic animal health professional.

For the specific handling activities listed below, the fitness assessment shall be carried out:

a. within a two-week period prior to transport or treatment that requires handling of the cleaner fish, except when the same type of treatment is repeated, in which case the assessment shall be carried out at least once a month after the initial treatment;

b. within a two-week period prior to net change and passive grading.

4.1.2.23 The UoC shall ensure that the HMP considers crowding activities with the intention of preventing stress, injury and mortality. Crowding activities shall be carried out:

a. under supervision; and

b. for a maximum of two hours.

An exception applies where a registered veterinarian or aquatic animal health professional demonstrates that exceeding two hours of crowding does not negatively impact cleaner fish welfare, in which case the maximum time period shall be defined by the registered veterinarian or aquatic animal health professional.

4.1.2.24 The UoC shall ensure that the HMP includes a water quality monitoring process according to **Appendix 12 (12.3, Table 2).**

In the case of live transport[99], monitoring shall be conducted at the point of departure, during transport and on arrival.

[98] An exemption applies to handling activities related to health examinations (e.g. health assessment, parasite counting) and in the case of emergencies (e.g. containment of an escape).
[99] An exemption applies where live transport after uplift of fish is conducted by a third party outside of the scope of the UoC's certification and the cleaner fish are no longer owned by the UoC, or where monitoring during transport negatively affects aquatic animal health and welfare.

4.1.2.25 The UoC shall ensure that the HMP includes a visual inspection process to identify abnormal behaviour in relation to the handling activity and defines mitigation measures when identified.

4.1.2.26 The UoC shall ensure that the HMP includes a post-handling evaluation process that considers at least the following:

a. abnormal behaviour; and

b. morphological scores; and

c. moribund aquatic animals and mortalities.

4.1.2.27 The UoC shall ensure that the HMP includes acclimatisation measures to prevent sudden changes in water conditions affecting the health and welfare status of the cleaner fish.

4.1.2.28 The UoC shall ensure that the HMP includes consideration of the use of appropriate equipment during handling activities to avoid affecting the health and welfare status of the cleaner fish.

4.1.2.29 *Indicator applicability: cleaner fish from wild caught origin*

The UoC shall demonstrate that the fishing gear used avoids injuries and unnecessary stress, and that it is suitable for the size and species of cleaner fish being captured.

4.1.2.30 The UoC shall adhere to a maximum limit of 15 seconds out of water[100].

4.1.2.31 The UoC shall adhere to species-specific limits on maximum fasting duration before any handling[101], according to **Appendix 2 (2.4)**[102].

An exception applies before slaughter where a registered veterinarian or aquatic animal health professional demonstrates that exceeding the fasting duration does not negatively impact cleaner fish welfare, in which case the maximum fasting duration shall be defined in the HMP by the registered veterinarian or aquatic animal health professional.

4.1.2.32 The UoC shall segregate cleaner fish in advance of any salmonid-specific treatments and ensure they are retained under appropriate conditions.

[100] An exemption applies to anaesthetised fish.
[101] An exemption applies in exceptional situations of severe weather, adverse environmental conditions (e.g. jellyfish, algal bloom) or during disease events.
[102] An exemption applies where there is no species-specific metric listed in Appendix 2.

4.1.3 – Fish – Slaughter and Killing

Indicators 4.1.3.1-4.1.3.8:
Scope: all fish species except cleaner fish (see Indicators 4.1.3.9-4.1.3.18)

4.1.3.1 The UoC shall appoint a staff member responsible for overseeing the implementation of fish health and welfare requirements during **slaughter**.

4.1.3.2 The UoC shall ensure all fish, including fish not destined for human consumption, are stunned prior to killing.

4.1.3.3 The UoC shall define the maximum time between stunning and killing and shall ensure the time is as short as possible so it does not negatively impact fish welfare.

4.1.3.4 The UoC shall ensure all fish, including fish not destined for human consumption, are stunned according to the applicable species-specific methods and usage requirements outlined in **Appendix 12 (12.4, Table 5).**

4.1.3.5 *Indicator applicability: UoCs where the species-specific transition period for permitted stunning methods has ended*

The UoC shall ensure that at least 95% of the fish lose consciousness immediately after stunning (see Indicator 4.1.3.4), and any remaining conscious fish are re-stunned. Unconsciousness shall persist until the fish are killed.

4.1.3.6 *Indicator applicability: UoCs where the species-specific transition period for permitted stunning methods has ended*

The UoC shall ensure that stunning (see Indicator 4.1.3.4) and killing are effective by verifying the absence of all of the following:

a. opercular movements; and

b. eye movements; and

c. body movements (except for involuntary muscular spasms); and

d. reaction to a physical stimulus.

4.1.3.7 *Indicator applicability: UoCs where the species-specific transition period for permitted stunning methods has ended*

The UoC shall have measures in place to immediately respond to ineffective stunning (see Indicator 4.1.3.4) or killing and shall implement appropriate corrective actions to prevent recurrence.

4.1.3.8 The UoC shall maintain records of the activities carried out under Indicators 4.1.3.5 and 4.1.3.6.

Indicators 4.1.3.9-4.1.3.18:
Scope: Cleaner fish

4.1.3.9 The UoC shall appoint a staff member responsible for overseeing the implementation of cleaner fish health and welfare requirements during **slaughter**.

4.1.3.10 The UoC shall ensure all cleaner fish are stunned prior to killing.

4.1.3.11 The UoC shall define the maximum time between stunning and killing and shall ensure the time is as short as possible so it does not negatively impact cleaner fish welfare.

4.1.3.12 The UoC shall ensure all cleaner fish are stunned according to the methods and usage requirements outlined in **Appendix 12 (12.4, Table 5).**

4.1.3.13 The UoC shall ensure that at least 95% of the cleaner fish lose consciousness immediately after stunning, and any remaining conscious fish are re-stunned. Unconsciousness shall persist until the cleaner fish are killed.

4.1.3.14 The UoC shall ensure that stunning and killing are effective by verifying the absence of all of the following:

a. opercular movements; and
b. eye movements; and
c. body movements (except for involuntary muscular spasms); and
d. reaction to a physical stimulus.

4.1.3.15 The UoC shall have measures in place to immediately respond to ineffective stunning or killing, and shall implement appropriate corrective actions to prevent recurrence.

4.1.3.16 The UoC shall maintain records of the activities carried out under Indicators 4.1.3.13 and 4.1.3.14.

4.1.3.17 The UoC shall re-use cleaner fish where possible and under the following conditions:

a. re-use shall only occur once; and

b. re-use shall only occur within the site or the ABM (see Indicator 4.5.1); and

c. re-use shall only occur if the outcome of a health assessment indicates low risk of disease transfer. The health assessment shall:

   i. consider the health status of the salmon and the cleaner fish at the origin and destination sites; and

   ii. be conducted no longer than two weeks before re-use; and

   iii. be approved by a registered veterinarian or an aquatic animal health professional.

d. cleaner fish are segregated from the salmon before transfer to the destination site.

4.1.3.18 The UoC shall ensure that cleaner fish are humanely slaughtered where re-use is not possible. The UoC shall not release cleaner fish into the wild.

4.2 Crustaceans



Rationale

Many aquatic animals are sentient beings that can feel and experience pain, stress and anxiety. While the question of the sentience of crustaceans is still being discussed, keeping them in good health and welfare is a responsible practice that supports them to adapt to their surroundings, boosts productivity, prevents the spread of disease and reduces reliance on chemicals with potentially negative environmental effects. Handling activities and slaughter are major factors in the welfare of farmed aquatic animals. If not carried out appropriately, they can lead to stress and overall suffering.[103]

Maintaining good health and welfare in aquaculture production includes consideration of a wide range of practices and conditions. Key aspects include disease detection and response, feeding practices, appropriate handling of aquatic animals and monitoring of water conditions.[87] Best practices in the slaughter of crustaceans include the implementation of responsible stunning and killing methods to ensure that there is rapid loss of consciousness, which is not regained before killing.[104] An effective management plan and site-specific handling plans can help avoid mortality events, demonstrating commitment to responsible aquaculture practices.

This Criterion focuses on farming, handling, and slaughter practices by ASC-certified farms to support good crustacean health and welfare, including training, monitoring, veterinarian oversight, and development of a site-specific Health and Welfare Management Plan (HWMP).

Intent – The aquaculture industry ensures good health and welfare, humane handling and slaughter practices of cultured crustaceans.

[103] Pedrazzani, A. S., Cozer, N., Quintiliano, M. H., Tavares, C. P. d. S., da Silva, U. d. A. T., & Ostrensky, A. (2023). Non-Invasive Methods for Assessing the Welfare of Farmed White-Leg Shrimp (*Penaeus vannamei*). *Animals, 13*(5), 807. https://doi.org/10.3390/ani13050807
[104] Pedrazzani, A. S., Cozer, N., Quintiliano, M. H., Tavares, C. P. d. S., da Silva, U. d. A. T., & Ostrensky, A. (2023).

4.2.1 – Crustaceans - Health and Welfare

Indicators:	
4.2.1.1	The UoC shall ensure that all relevant employees are trained on general aquatic animal health and welfare awareness, including biosecurity, according to **Appendix 12 (12.2, Table 1)**.
4.2.1.2	The UoC shall ensure that any person involved in aquatic animal husbandry and handling activities is trained on aquatic animal health and welfare, according to **Appendix 12 (12.2, Table 1)**.
4.2.1.3	The UoC shall ensure that the content of the training in Indicators 4.2.1.1 and 4.2.1.2 is updated as necessary and is approved by a registered veterinarian or aquatic animal health professional.
4.2.1.4	The UoC shall calculate survival rate, according to **Appendix 12 (12.6.1)**, and shall adhere to species-specific survival rates, according to **Appendix 2 (2.3)**[105].
4.2.1.5	The UoC shall only stock batches of crustaceans, including nauplii, larvae, post-larvae and broodstock, that have been tested prior to stocking, comply with applicable legal requirements for diseases of regional concern, and meet legal importation requirements where applicable.
4.2.1.6	The UoC shall ensure that a registered veterinarian or aquatic animal health professional periodically visits the site to perform routine checks. Checks shall be carried out at least annually, as well as reactively in cases of crustacean health or welfare concerns.
4.2.1.7	*Indicator applicability: every UoC using feed* The UoC shall develop and implement a feeding plan which includes at least the following: a. time and frequency of feeding; and b. feed rations; and c. feeding methods; and d. different environmental conditions; and

[105] An exemption applies where there is no species-specific metric listed in Appendix 2.

e. prevention of the use of feed which has expired, spoiled or shows signs of excessive leakage; and

f. feed types for the nutritional needs and life stages of the species.

An exception applies to (f) when such feeds are not available, in which case the UoC shall use feed suitable for aquatic animals with similar nutritional needs.

4.2.1.8 The UoC shall develop, implement and maintain a site-specific Health and Welfare Management Plan (HWMP), approved by a registered veterinarian or aquatic animal health professional, with the intention of preventing disease outbreaks and ensuring the good health and welfare of farmed crustaceans.

The HWMP shall include all of the following:

a. disease monitoring; and

b. response, including quarantine, treatment, and humane culling; and

c. mechanisms to report to relevant authorities where required; and

d. biosecurity risks; and

e. predation risks.

The HWMP shall be reviewed:

f. at least annually for sites with cycles under one year or using continuous production methods; or

g. after each cycle for sites with longer cycles or all-in-all-out production methods.

Where the review determines that changes are required, the HWMP shall be revised.

4.2.1.8.1 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes a water quality monitoring process according to **Appendix 12 (12.3, Table 3).**

4.2.1.8.2 *Indicator applicability: every UoC using feed*

The UoC shall ensure[106] the HWMP includes a morphological monitoring process for live crustaceans.

Monitoring shall be conducted at least once a week, coinciding with any crustacean handling activity, and shall include at least the following scoring parameters:

a. exoskeleton damage, including at least eyes, antennas, appendages and rostrum;

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[106] An exemption applies immediately after stocking, or under environmental conditions that affect the welfare of the crustaceans or the health and safety of employees. The reason for the exemption shall be recorded.

b. hepatopancreas colouration and size;

c. gill colouration;

d. size dispersion/variation;

e. shell blisters and necrosis;

f. full/empty digestive tube and colouration;

g. loss of appendages, categorised according to causes. If categorisation is not possible, the UoC shall record the reason.

An exception applies where deviation from monitoring frequency is justified by any of the following reasons:

h. there is no handling of the crustaceans during the week; or

i. crustaceans are undergoing a disease event and/or being treated; or

j. a documented risk assessment is present which demonstrates that the monitoring frequency is not relevant to the species.

In which case monitoring shall be conducted using cameras or from the side of the culture unit for as many parameters as possible. The reason for any deviation shall be recorded.

4.2.1.8.3 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes a feeding monitoring process for live crustaceans in accordance with the time and frequency established in the feeding plan (see Indicator 4.2.1.7 a).

4.2.1.8.4 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes a mortality monitoring process which includes at least the following:

a. monitoring and recording of mortalities when spotted; and

b. removal of mortalities when spotted; and

c. conducting a post-mortem analysis for each mortality event; and

d. investigation of mortality events which remain unexplained or unattributed to crustacean health reasons; and

e. collection of moribund crustaceans when spotted and culling according to Criterion 4.2.3.

Where any of the listed items above are not possible, the UoC shall record the reason.

4.2.1.8.5 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes a system to identify acceptable, warning and unacceptable levels of health or welfare for:

a. water quality (Indicator 4.2.1.8.1); and

b. morphology (Indicator 4.2.1.8.2); and

c. feeding (Indicator 4.2.1.8.3); and

d. mortality (Indicator 4.2.1.8.4).

Where levels are warning or unacceptable, the UoC shall, where possible, increase monitoring and implement corrective actions to restore levels to acceptable.

4.2.1.8.6 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes trend analysis to determine changes in health and welfare over time. This analysis shall consider drivers of the trends, and shall be based on the data analysed in Indicator 4.2.1.8.5 and feedback from the processing plant where relevant.

4.2.1.8.7 *Indicator applicability: every UoC using feed*

The UoC shall ensure the HWMP includes a mortality reduction plan which defines annual targets for both total and unexplained mortalities by considering the results of the trend analysis in Indicator 4.2.1.8.6, and shall implement appropriate actions to meet the annual targets.

4.2.1.9 *Indicator applicability: every UoC using feed*

The UoC shall report the following to a registered veterinarian or aquatic animal health professional:

a. all mortality events; and

b. crustacean health and welfare concerns identified during mortality classification.

4.2.1.10 The UoC shall report to the relevant authorities if a WOAH-notifiable disease[107] is confirmed at a site, and shall:

a. apply the measures according to applicable legal requirements; and

b. increase disease-monitoring in other batches of crustaceans; and

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[107] An exemption applies where the WOAH-notifiable disease is classified as endemic by the relevant authorities and reporting is not required under applicable legal requirements.

c. coordinate oversight by a registered veterinarian or aquatic animal health professional.

4.2.1.11 The UoC shall calculate stocking densities, following the method outlined in **Appendix 12 (12.6.3)**.

4.2.1.12 The UoC shall report survival rate related data in accordance with the ASC Data Submission Procedure.



4.2.1.13 *Indicator applicability: Penaeus vannamei and Penaeus monodon*

The UoC shall demonstrate that received nauplii, larvae or post-larvae (PL) originates from ablation free (AF) female broodstock according to the sourcing requirements outlined in **Appendix 12 (12.4, Table 4).** This includes an agreement with the hatchery that allows ASC or its designated agents to conduct oversight activities to verify the AF sources within the facility.

4.2.2 – Crustaceans - Handling

Indicators:

4.2.2.1 The UoC shall develop, implement and maintain a site-specific Handling Management Plan (HMP), with the intent of ensuring good health and welfare of farmed crustaceans.

The HMP shall be periodically reviewed and revised as necessary.

4.2.2.2 The UoC shall ensure that the HMP includes all handling activities carried out on site.

4.2.2.3 The UoC shall ensure that the HMP includes contingency plans for handling activities, including at least the following:

a. immediate response measures in the case of system failure; and

b. culling response measures (see Indicators 4.2.3.2 and 4.2.3.7); and

c. mass mortality event response measures.

Exception applicability: every UoC using feed

An exception to (b) applies in the extreme circumstances of culling whole ponds for disease control, in which case a solution of chlorine is allowed in a concentration that ensures that death occurs rapidly.

4.2.2.4 The UoC shall ensure that the HMP includes consideration of the environmental conditions associated with handling activities, with the intent of preventing handling under adverse conditions that could affect the health and welfare of the crustaceans.

4.2.2.5 *Indicator applicability: every UoC using feed*

The UoC shall ensure that the HMP includes a pond preparation process including at least the following:

a. drying of the pond. An exception applies where areas cannot be dried, in which case they shall be disinfected; and

b. removal of any dead or live aquatic animals from the pond; and

c. removal of excess organic waste; and

d. adjustment of acidic pH; and

e. preparation of the surface of earthen ponds to facilitate oxygenation and UV exposure.

4.2.2.6 The UoC shall ensure that the HMP includes acclimatisation measures to prevent sudden changes in water conditions affecting the health and welfare status of the crustaceans.

4.2.2.7 *Indicator applicability: every UoC using feed*

The UoC shall ensure that the HMP includes a visual inspection process to identify abnormal behaviour in relation to the handling activity and defines mitigation measures when identified.

4.2.2.8 The UoC shall ensure that the HMP considers biosecurity risks specific to the types of handling activities and shall include appropriate biosecurity measures to prevent the transfer of disease.

4.2.2.9 The UoC shall ensure that the HMP considers predation risks specific to the types of handling activities and shall include appropriate predator control measures.

4.2.2.10 The UoC shall ensure that the HMP includes consideration of the use of appropriate equipment during handling activities to avoid affecting the health and welfare status of the crustaceans.

4.2.3 – Crustaceans – Slaughter and Killing

Indicators:	
4.2.3.1	The UoC shall appoint a staff member responsible for overseeing the implementation of crustacean health and welfare requirements during **slaughter**.
4.2.3.2	The UoC shall ensure that crustaceans are killed: a. On-farm: immediately after uplift from the pond; or b. After live transport: as soon as possible, provided that transport conditions follow the HMP requirements. Killing shall be carried out by: c. by immersion in an ice slurry bath; or d. through an electrical stunning device followed by immersion in an ice slurry bath.
4.2.3.3	The UoC shall ensure crustaceans are killed prior to processing.
4.2.3.4	The UoC shall ensure ice slurry baths are maintained at ≤4°C at all times and crustaceans are immersed for an appropriate amount of time to be killed effectively.
4.2.3.5	The UoC shall ensure that if electrical stunning devices are used for stunning, the manufacturer's instructions are followed.
4.2.3.6	The UoC shall ensure that an overdose of anaesthetic is only used to kill crustaceans not destined for human consumption.
4.2.3.7	The UoC shall ensure that killing has been effective by verifying the absence of coordinated leg and body movements.
4.2.3.8	The UoC shall have measures in place to immediately respond to ineffective stunning or killing, and shall implement appropriate corrective actions to prevent recurrence.
4.2.3.9	The UoC shall maintain records of the activities carried out under Indicators 4.2.3.4 and 4.2.3.7.

4.3 Molluscs



Rationale

Many aquatic animals are sentient beings that can feel and experience pain, stress and anxiety. While the question of the sentience of molluscs is still being discussed, keeping them in good health is a responsible practice that boosts productivity and prevents the spread of disease.

This Criterion focuses on farming practices by ASC-certified farms to support good mollusc health, including training, monitoring and the development of an effective health management plan to demonstrate commitment to responsible aquaculture practices.

Intent - The aquaculture industry ensures good health of cultured molluscs.

4.3.1 - Bivalves

Indicators:

4.3.1.1 *Indicator applicability: every UoC using hatchery raised seed*

The UoC shall only stock batches of bivalves which comply with applicable legal requirements for diseases of regional concern and meet legal importation requirements where applicable.

4.3.1.2 *Indicator applicability: every UoC using wild caught seed*

The UoC shall demonstrate that no known diseases of concern are present in the region where the seed is harvested.

4.3.1.3 The UoC shall develop, implement and maintain a site-specific Bivalve Health Management Plan (BHMP).

The BHMP shall include all of the following:

a. environmental monitoring; and

b. biosecurity measures; and

c. emergency response measures; and

d. mechanisms to report to relevant authorities where required.

The BHMP shall be reviewed:

e. at least annually for sites with cycles under one year or using continuous production methods; or

f. after each cycle for sites with longer cycles or all-in-all-out production methods.

Where the review determines that changes are required, the BHMP shall be revised.

4.3.1.4 The UoC shall ensure that all relevant employees are trained in the BHMP.

4.3.1.5 The UoC shall report to the relevant authorities if a WOAH-notifiable disease[108] is confirmed at a site, and shall:

a) apply the measures according to applicable legal requirements; and

b) increase disease-monitoring in other batches of bivalves; and

c) coordinate oversight by a registered veterinarian or aquatic animal health professional.

4.3.2 - Abalone

Indicators:

4.3.2.1 The UoC shall ensure that all relevant employees are trained on general aquatic animal health and welfare awareness, including biosecurity, according to **Appendix 12 (12.2, Table 1)**.

4.3.2.2 The UoC shall ensure that any person involved in aquatic animal husbandry and handling activities is trained on aquatic animal health and welfare, according to **Appendix 12 (12.2, Table 1)**.

4.3.2.3 The UoC shall ensure that the content of the training in Indicator 4.3.2.1 and 4.3.2.2 is updated as necessary and is approved by a veterinarian, aquatic animal health professional or a member of site management with the necessary competencies, experience and training.

4.3.2.4 *Indicator applicability: every UoC using hatchery raised seed*

The UoC shall:

[108] An exemption applies where the WOAH-notifiable disease is classified as endemic by the relevant authorities and reporting is not required under applicable legal requirements.

a. only stock batches which have been tested prior to stocking, comply with applicable legal requirements for diseases of regional concern, and meet legal importation requirements where applicable; and
b. implement a minimum 8-week isolation period[109] for new stock.

4.3.2.5 *Indicator applicability: every UoC using wild caught seed*

The UoC shall only stock batches that have a quarantine procedure which:

a. requires a minimum length of eight weeks of quarantine; and
b. includes **sentinel** monitoring; and
c. includes mortality event response; and
d. requires a pre-release health assessment.

4.3.2.6 The UoC shall develop and implement a feeding plan.

4.3.2.7 The UoC shall develop, implement and maintain a site-specific Abalone Health Management Plan (AHMP), approved by the veterinarian, aquatic animal health professional, or a member of site management with the necessary competencies, experience and training, with the intention of preventing disease outbreaks and ensuring the good health of farmed aquatic animals.

The AHMP shall include all of the following:

a. behaviour monitoring; and
b. disease and mortality monitoring; and
c. response, including quarantine, treatment, and culling; and
d. mechanisms to report to relevant authorities where required; and
e. biosecurity risks; and
f. predation risks.

The AHMP shall be reviewed:

g. at least annually for sites with cycles under one year or using continuous production methods; or
h. after each cycle for sites with longer cycles or all-in-all-out production methods.

Where the review determines that changes are required, the AHMP shall be revised.

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[109] Isolation means not mixed with other animals on the farm, but can be kept in the same culture system.

4.3.2.8 The UoC shall report to the relevant authorities if a WOAH-notifiable disease[110] is confirmed at a site, and shall:

a. apply the measures according to applicable legal requirements; and

b. increase disease-monitoring in other batches of abalone; and

c. coordinate oversight by a registered veterinarian or aquatic animal health professional.

[110] An exemption applies where the WOAH-notifiable disease is classified as endemic by the relevant authorities and reporting is not required under applicable legal requirements.

4.4 Veterinary therapeutants

Rationale

Veterinary therapeutants are chemicals used to treat or improve health conditions in aquatic animals and include antibiotics, antiparasitics, antifungals, antivirals, hormones, anaesthetics and vaccines.

The use of therapeutants has provided many benefits to the aquaculture industry but has also resulted in their overuse and misuse. This has led to the creation of risks associated with the release of drugs or their metabolites to the environment, the presence of drug residues in final products for human consumption, and the development of antimicrobial resistance.[111]

This Criterion focuses on the correct use of antibiotics and therapeutants on ASC-certified farms, including oversight, monitoring and efforts to reduce usage in line with ASC's support of the World Health Organisation's 'One Health' approach to reduce antibiotic dependency over time.[112]

Intent – The aquaculture industry uses therapeutants responsibly and reduces reliance upon therapeutants over time.

Indicators:

4.4.1 The UoC shall only use therapeutants as prescribed by a registered veterinarian or aquatic animal health professional.

4.4.2 The UoC shall ensure that prescriptions for each application of therapeutants include at least the following:

a. the name, address, telephone number and signature of the registered veterinarian or aquatic animal health professional; and

b. the date of the prescription; and

c. the name and address of the site; and

d. the identification, including the species, of the batches of aquatic animals to be treated; and

e. the name and quantity of the therapeutant prescribed; and

[111] World Organization for Animal Health (OIE). (2024). Aquatic Animal Health Code. Available online at https://www.woah.org/en/what-we-do/standards/codes-and-manuals/aquatic-code-online-access/
[112] World Health Organization (WHO). (2017). WHO guidelines on use of medically important antimicrobials in food-producing animals. Geneva, Switzerland: World Health Organization.

f. the dosage and administration instructions; and

g. the withdrawal period.

The UoC shall maintain records of each therapeutant prescription.

4.4.3 The UoC shall not use hormones or antibiotics to stimulate growth.

4.4.4 The UoC shall only use hormones for the following purposes:

a. sex-reversal; or

b. to induce and coordinate spawning; or

c. to produce single-sex stock.

The UoC shall maintain records of each hormonal treatment.

4.4.5 The UoC shall not use antibiotics **prophylactically**.

4.4.6 The UoC shall only use **non-therapeutants** registered or approved by applicable legal requirements and shall apply them according to the manufacturer's instructions.

4.4.7 The UoC shall monitor all **probiotics** produced in-house for build-up of bacteria antimicrobial resistance.

4.4.8 *Indicator applicability: every UoC using antibiotic treatments*

The UoC shall monitor for antibiotic resistance by carrying out antibiotic sensitivity testing either:

a. before or during each antibiotic treatment; or

b. at a frequency determined through a documented risk assessment.

4.4.9 *Indicator applicability: every UoC using antibiotic treatments*

The UoC shall investigate the root cause when an antibiotic treatment does not produce the expected efficacy and shall implement appropriate corrective actions to improve the efficacy of subsequent treatments.

4.4.10 *Indicator applicability: every UoC using antiparasitic treatments except for marine salmonids in cages treated for sea lice*

The UoC shall monitor for antiparasitic resistance by carrying out bioassays[113] either:

a. before or during each antiparasitic treatment; or

b. at regular intervals.

4.4.11 *Indicator applicability: every UoC using antiparasitic treatments except for marine salmonids in cages treated for sea lice*

The UoC shall investigate the root cause when an antiparasitic treatment does not produce the expected efficacy and shall implement appropriate corrective actions to improve the efficacy of subsequent treatments.

4.4.12 The UoC shall not use any antimicrobials listed as Authorised for use in Humans Only by the World Health Organisation (WHO)[114] at any stage in the lifecycle of the product.

4.4.13 The UoC shall not use[115] antimicrobials listed as Highest Priority Critically Important Antimicrobials (HPCIA) [116] or Critically Important Antimicrobials (CIA) by the World Health Organisation (WHO)[117] at any stage in the lifecycle of the product.

An exception applies where the following can be demonstrated:

a. all other available antimicrobials are not effective, or there is no availability of antimicrobials other than the HPCIA and CIA; and

b. previous monitoring has not determined build-up of antimicrobial resistance.

A registered veterinarian shall provide a written justification for the use of any HPCIA and CIA under the exceptional circumstances listed above.

4.4.14 The UoC shall adhere to species-specific limits on antibiotic[118] treatments, according to **Appendix 2 (2.5)**[119].

4.4.15 The UoC shall adhere to species-specific limits on parasiticide treatments[120], according to **Appendix 2 (2.5)**[121].

[113] An exemption applies where no methods exist to determine resistance using bioassays.
[114] https://www.who.int/publications/i/item/9789241515528
[115] Batches treated with antimicrobials listed as Highest Priority Critically Important Antimicrobials (HPCIA)and Critically Important Antimicrobials (CIA) by the World Health Organisation (WHO) are not eligible for ASC certification.
[116] An exemption applies to the use of oxolinic acid in freshwater salmonid production.
[117] https://www.who.int/publications/i/item/9789241515528
[118] Crustaceans treated with antibiotics are not eligible for ASC certification.
[119] An exemption applies where there is no species-specific metric listed in Appendix 2.
[120] The following substances are exempt from this Indicator: freshwater and hydrogen peroxide (seabass, seabream, meagre, seriola, cobia, flatfish and tropical marine fish); formaldehyde (flatfish, seabass, seabream, meagre, seriola and cobia only).
[121] An exemption applies where there is no species-specific metric listed in Appendix 2.

4.4.16 The UoC shall calculate the antibiotic load, following the method outlined in **Appendix 12 (12.6.2)**.

4.4.17 The UoC shall[122] reduce the antibiotic load over time and shall demonstrate measures being taken to achieve this reduction.

4.4.18 The UoC shall adhere to the withdrawal period defined by the therapeutant manufacturer. An exception applies where a withdrawal period is not defined, in which case the UoC shall adhere to a minimum of 500 degree days.

4.4.19 The UoC shall report antibiotic related data in accordance with the ASC Data Submission Procedure.



[122] An exemption applies to sites which have not used antibiotics.

4.5 Parasite Management (Sea Lice)



Scope – Cage culture marine salmonids

Rationale

Responsible health management is crucial for the wellbeing of cultured aquatic animals, farm viability, and the protection of the surrounding environment and wildlife. Parasites can harm both farmed stock and native species and may spread disease. However, improper use of parasiticides can lead to resistance and contamination. With proper aquatic animal husbandry, monitoring and treatment, these disease risks can be managed.

In areas with multiple farms, collaborative and coordinated management is necessary to reduce disease transfer and prevent resistance to treatments. Sea lice on salmon farms are a particular concern because their proliferation may lead to negative impacts on native salmon or seatrout[123]. Reducing sea lice burden on salmon farms minimises potential impacts on native fish and also benefits the welfare of farmed fish.

This Criterion focuses on ASC-certified farms minimising the risk of transmission to native salmonids by maintaining low sea lice levels on-farm, collaborating on research on native fish stocks, and monitoring and reporting.

Intent – The aquaculture industry actively manages farm sea lice load to reduce risks to native salmonids.

Indicators:

4.5.1 The UoC shall participate in an Area-Based Management (ABM) scheme following the method outlined in **Appendix 13 (13.2)**.

4.5.2 *Indicator applicability: areas with native salmonids*[124]

The UoC shall establish, review annually, and revise where needed, a maximum sea lice load for the entire ABM and for the individual site, following the method outlined in **Appendix 13 (13.2)**.

[123] Costello, M. J. (2009). How sea lice from salmon farms may cause wild salmonid declines in Europe and North America and be a threat to fishes elsewhere. Proceedings of the Royal Society B: Biological Sciences, 276(1672), 3385-3394.
[124] Within 75 kilometres of a wild salmonid migration route or habitat. This definition is expected to encompass all, or nearly all, of salmon-growing areas in the northern hemisphere.

4.5.3 The UoC shall demonstrate commitment to collaborating with NGOs, academics and regulators on areas of mutually agreed research to measure possible impacts of sea lice on native fish species, including native salmonids. The collaboration shall include as a minimum:

a. provisions for sharing site-level data; and

b. granting access to sites; and

c. provision of other non-financial support.

4.5.4 *Indicator applicability: areas with native salmonids*

The UoC shall collect sea lice data on native salmonids, following the method outlined in **Appendix 13 (13.3)**.

4.5.5 *Indicator applicability: areas with native salmonids*

The UoC shall publicly disclose sea lice data on native salmonids within 30 days of finalising the collection of the data.

4.5.6 *Indicator applicability: areas with native salmonids*

The UoC shall conduct on-site sea lice sampling, following the method outlined **Appendix 13 (13.4).**

4.5.7 *Indicator applicability: areas with native salmonids*

The UoC shall publicly disclose on-site sea lice levels per site. The disclosure shall:

a. include data for *L. salmonis* for at least the stages required in **Appendix 13 (13.4)**; and,

b. include data for adult *Caligus spp.* for sites located on the west coast of Canada; and,

c. be made publicly available within seven days after the last day of sampling; and,

d. remain publicly available for the duration that the site is ASC-certified.

4.5.8 *Indicator applicability: areas with native salmonids*

The UoC shall report on-site sea lice level related data in accordance with the ASC Data Submission Procedure.

4.5.9 *Indicator applicability: areas with native salmonids*

The UoC shall, during sensitive periods, maintain on-site sea lice levels below the threshold outlined in **Appendix 13 (13.5)**.

4.5.10 *Indicator applicability: areas with native salmonids*

The UoC shall notify the CAB if sea lice thresholds have been reached or exceeded (see Indicator 4.5.9). The notification shall be made by the next working day following the last day of sampling in accordance with the ASC Data Submission Procedure.



4.5.11 *Indicator applicability: areas with native salmonids*

The UoC shall, if sea lice thresholds have been reached or exceeded (see Indicator 4.5.10) reduce on-site levels below the threshold within 21 days following the last day of sampling.

If the reduction is not achieved within 21 days, the UoC shall:

a. submit a formal request to the CAB for cancellation of the certificate or site under the certificate by the next working day; and

b. not identify, sell or dispatch the fish as ASC-certified[125].

An exception applies where a registered veterinarian or aquatic animal health professional delays fish from being treated, affecting the site's ability to reduce sea lice levels within the required timeframe, in which case the site shall reduce the on-farm sea lice levels below the threshold within 14 days from the first day of treatment. The allowed reasons for delaying fish from being treated are:

- Situations of severe weather.
- Adverse environmental conditions.
- Unforeseen increases in on-site lice levels.
- Logistical considerations.
- Fish are undergoing a disease event and/or being treated.
- The registered veterinarian or aquatic animal health professional determines that treatment at that time would compromise fish health or welfare.

The reason for any delay in treatment shall be recorded.

4.5.12 The UoC shall demonstrate that the Weighted Number of Medicinal Treatments (WNMT) for sea lice is at or below the Entry Level (EL) per site, following the method outlined in **Appendix 13 (13.6)**.

[125] This applies to all fish present at the site at the time the UoC submits the formal notification of cancellation of certification to the CAB.

4.5.13 The UoC shall[126] reduce the WNMT for sea lice by 25% every production cycle until the WNMT is at or below the Global Level (GL) per site, following the method outlined in **Appendix 13 (13.6)**.

4.5.14 The UoC shall, when two consecutive applications of a sea lice treatment per site have not produced the expected efficacy, carry out a bioassay to determine resistance.

4.5.15 The UoC shall, when bioassays determine resistance, apply an alternative sea lice treatment or immediately harvest all fish at the site.

4.5.16 The UoC shall apply **treatment rotation** where more than one effective sea lice treatment is available. Every third treatment shall belong to a different family of drugs.

4.5.17 The UoC shall develop, implement and maintain a site-specific Integrated Parasite Management Plan (IPMP) with the intent of controlling sea lice using multiple prevention and control strategies. The IPMP shall:

a. consider non-therapeutic treatments; and

b. be approved by a registered veterinarian; and

c. be periodically reviewed and revised as necessary.

[126] An exemption applies to farms conforming to the EL requirements of Indicator 4.5.12 and where the EL requirement is at or below the GL requirement, as per **Appendix 13 (13.6)**.

Appendix 1 Abbreviations and Additional Resources

1.1 Abbreviations

Abbreviations	Term
AB	Accreditation Body
ABM	Area-based management
ADCP	Acoustic Doppler Current Profiler
AF	Ablation free
AMA	Area management agreement
AMBI	AZTI's Marine Biotic Index
ASC	Aquaculture Stewardship Council
ASFIS	Aquatic Sciences and Fisheries Information System
ASI	Assurance Services International
ATE	Adverse turnover events
BHQ	Benthic Habitat Quality
BOD	Biological oxygen demand
BQI	Benthic Quality Index
CAB	Conformity Assessment Body
CAR	Certification and Accreditation Requirements
CFA	Continuous flow analysis
Chl-a	Chlorophyll-a concentration
CIA	Critically Important Antimicrobials
CO_2e	Carbon dioxide equivalent
CoC	Chain of Custody
CRM	Certified reference material
CT	Clearance time

DCS	Doppler Current Sensors
DDDO	Daily diurnal dissolved oxygen
DHA	Docosahexaenoic acid
DO	Dissolved oxygen
eFCR	Economic Feed Conversion Ratio
EICAT	Environmental Impact Classification for Alien Taxa
EL	Entry level
EPA	Eicosapentaenoic acid
EQS	Ecological quality status
ERA	Environmental risk assessment
ES	Enrichment Stage
FAO	Food and Agriculture Organization
FFDR	Forage fish dependency ratio
GHG	Greenhouse gas
GL	Global level
GMO	Genetically modified organism
HAB	Harmful algal bloom
HCVA	High conservation value area
HIE	Hydrodynamically isolated embayment
HMP	Handling Management Plan
HRT	Hydraulic retention time
HSRA	Health and safety risk assessment
HWMP	Health and Welfare Management Plan
IAF	International Accreditation Forum
IBE	Institute of Business Ethics
IDH	Sustainable Trade Initiative

ILO	International Labour Organisation
IPMP	Integrated parasite management plan
ISI	Indicator Species Index
ISEAL	International Social and Environmental Accreditation and Labelling Alliance
IUCN	International Union for Conservation of Nature
MLA	Multilateral recognition arrangement
MP	Management plan
MPA	Marine Protected Area
MRL	Maximum residue limits
MSC	Marine Stewardship Council
MSCI	Marine Stewardship Council Licensing Team
NGO	Non-governmental organisation
NQI	Norwegian Quality Index
NSI	Norwegian Sensitivity Index
OHCHR	Office of the UN High Commissioner for Human Rights
ORP	Oxidation reduction potential
PA	Protected area
PAW	Positive Animal Welfare
PIC	The Rotterdam Convention on Prior Informed Consent
PL	Post-larvae
POP	The Stockholm Convention on Persistent Organic Pollutants
PPE	Personal protective equipment
PPP	Phytoplankton primary production
PPT	Primary production time
PRE	Protein Retention Efficiency
RAS	Re-circulating aquaculture system

RT	Retention time
RW	Receiving waterbody
SAOB	Sulfide Anti-Oxidant Buffer
SD	Secchi disk
SDG	Sustainable Development Goal
SDS	Safety data sheet
TAG	Technical Advisory Group
TAN	Total ammonia nitrogen
TC	Total carbon concentration
TN	Total nitrogen concentration
TOR	Terms of Reference
TP	Total phosphorus concentration
TSS	Total suspended solids
UDHR	Universal Declaration of Human Rights
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNGP	UN Guiding Principles On Business and Human Rights
UoC	Unit of Certification
VR	Variance Request
WEMP	Water Efficiency Management Plan
WHO	World Health Organisation
WNMT	Weighted number of medicinal treatments
WOAH	World Organisation for Animal Health
WQAC	Water Quality Advisory Committee
WQMN	Water Quality Monitoring Network
WUM	Waterbody unit of management

1.2 ILO Conventions

Number	Year	Title	ASC Farm Standard Criterion
Eleven Fundamental Instruments relating to ILO Declaration on Fundamental Principles and Rights at Work			
29	1930	Forced Labour Convention	3.2
29	2014	2014 Protocol to Forced Labour Convention	3.2
87	1948	Freedom of Association and Protection of the Right to Organise Convention	3.6
98	1949	Right to Organise and Collective Bargaining Convention	3.6
100	1951	Equal Remuneration Convention	3.4
105	1957	Abolition of Forced Labour Convention	3.2
111	1958	Discrimination (Employment and Occupation) Convention	3.4
138	1973	Minimum Age Convention	3.3
155	1981	Occupational Safety and Health Convention	3.5, 3.10
182	1999	Worst Forms of Child Labour Convention	3.3
187	2006	Promotional Framework for Occupational Safety and Health Convention	3.5
Other Conventions			
95	1949	Protection of Wages Convention	3.2, 3.8
131	1970	Minimum Wage Fixing Convention	3.8
132	1970	Holidays with Pay Convention (Revised)	3.9
135	1971	Workers' Representatives Convention	3.6
155	1981	Occupational Safety and Health Convention	3.5
156	1981	Workers with Family Responsibilities Convention	3.4
161	1985	Occupational Health Services Convention	3.5
169	1989	Indigenous and Tribal Peoples Convention	3.13
170	1990	Chemicals Convention	3.5
171	1990	Night Work Convention	3.9
181	1997	Private Employment Agencies Convention	3.2
183	2000	Maternity Protection Convention	3.8
184	2001	Safety and Health in Agriculture Convention	3.5

190	2019	Violence and Harassment Convention	3.4, 3.10
R115	1961	Workers' Housing Recommendation	3.11
R116	1962	Reduction of Hours of Work Recommendation	3.9
R130	1967	Examination of Grievances Recommendation	3.12
R198	2006	Employment Relationship Recommendation	3.7

1.3 Other conventions and declarations

Universal Declaration of Human Rights
United Nations Guiding Principles on Business and Human Rights
OHCHR Convention on the Rights of the Child
United Nations Declaration on the Rights of Indigenous Peoples
International Covenant on Civil and Political Rights
Declaration on the Protection of All Persons from Being Subjected to Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment

Appendix 2 Species-specific Performance Metrics

This Appendix lists the species-specific performance metrics for all relevant Indicators.

The metrics are set at genus or family level, or at a unique species level. The UoC shall adhere to the metric that is relevant to the cultured species.

The metrics are reviewed and revised according to the ASC Metrics Methodology. ASC relies on data as a backbone for the Programme Development and Revision Procedure, requiring farms to submit data in accordance with the ASC Data Submission Procedure.



Section
2.1 Total Nitrogen (TN) and Total Phosphorous (TP) release (Indicator 2.6.1)
2.2 Feed efficiency (Indicator 2.12.5)
2.3 Mortality limits and Survival Rates (Indicator 4.1.1.6 and 4.2.1.4)
2.4. Maximum fasting duration (Indicator 4.1.2.16 and 4.1.2.31)
2.5 Antibiotic and parasiticide treatments (Indicator 4.4.14 and 4.4.15)

2.1 Total Nitrogen (TN) and Total Phosphorous (TP) release (Indicator 2.6.1)

The formulae for calculating TP and TN are explained in **Appendix 8.2**.

Crustaceans

Penaeus spp.:	TP:	<5.4kg/t
(except *P. vannamei*)	TN	<32.4kg/t
P. vannamei:	TP:	<3.9kg/t
	TN:	<25.2kg/t
Cherax spp. *Procambarus spp.* *Astacus spp.*	TP:	<4.0kg/t
	TN:	<26.1kg/t
Macrobrachium spp:	TP:	<6.1kg/t
	TN:	<39.2kg/t

Pangasius

All systems:	TP:	≤7.2kg/t
	TN:	≤27.5kg/t

Salmonids – freshwater

Land-based systems	TP:	≤4kg/t
Cages	TP:	≤5kg/t

Tilapia

All systems	TP:	≤20kg/t

2.2 Feed efficiency (Indicator 2.12.5)

The formulae for calculating feed efficiency are explained in **Appendix 15**.

Crustaceans

Penaeus spp.: (except *P. vannamei*)	FFDRm:	≤1.8
P. vannamei:	FFDRm:	≤1.3
Cherax spp. *Procambarus spp.* *Astacus spp.*	FFDRm:	≤1.4
Macrobrachium spp:	FFDRm:	≤2.1

Molluscs

Haliotis spp.:	FFDRm:	≤0.8
	FFDRo:	≤0.8

Flatfish

Paralichthys spp. *Pseudopleuronectes spp.*	FFDRm:	≤1.6
	FFDRo:	≤2.0
Hippoglossus spp.	FFDRm:	≤2.0
	FFDRo:	≤3.0
Scophthalmus spp.	FFDRm:	≤2.5
	FFDRo:	≤3.0

Pangasius

Pangasiidae:	FFDRm:	≤0.5
	FFDRo:	≤0.5
	(complete production cycle)	

Pike-perch

Sander lucioperca:	FFDRm:	≤2.3
	FFDRo:	≤2.95

Salmonids – freshwater

Salmo spp. *Oncorhynchus spp.* *Salvelinus spp.* *Thymallus spp.* *Coregonus spp.*	FFDRm: FFDRo: ≤2.95 OR max EPA + DHA content	≤1.5 ≤9%

from marine sources as percentage of fatty acids in the feed

Salmonids – marine

Salmo spp. *Oncorhynchus spp.* *Salvelinus spp.*	FFDRm: FFDRo: OR EPA+DHA:	≤1.2 ≤2.52 <30g/kg feed

Seabass, Seabream, Meagre

Sparus spp. *Dicentrarchus spp.*	FFDRm: FFDRo:	≤1.85 ≤2.9
Pagrus spp.	FFDRm: FFDRo:	≤2.5 ≤2.9
Argyrosomus spp.	FFDRm: FFDRo:	≤2.35 ≤2.9

Seriola and Cobia

Seriola spp. *Rachycentron canadum*	FFDRm: FFDRo:	≤2.9 ≤2.9

Tilapia

Oreochromis spp. *Tilapia spp.* *Coptodon spp.*	FFDRm: FFDRo:	≤0.8 ≤0.8

Tropical Marine Finfish

Epinephelus spp. *Cromileptes spp.* *Plectropomus spp.* *Cephalopholis spp.* *Lutjanus spp.* *Ocyurus spp.*	FFDRm: FFDRo:	≤2.6 ≤2.6
Trachinotus spp.	FFDRm: FFDRo:	≤2.0 ≤2.0
Lates spp.	FFDRm: FFDRo:	≤1.4 ≤2.0
Larimichthys spp.	FFDRm: FFDRo:	≤2.9 ≤3.5

Catfish

Clarius	FFDRm FFDRo	≤1.0 ≤0.5
Heterobranchus	FFDRm FFDRo	≤1.3 ≤1.0
Clarius x Heterobranchus	FFDRm FFDRo	≤1.0 ≤1.3
Ictaluriidae	FFDRm FFDRo	≤0.4 ≤1.0
Silurus	FFDRm FFDRo	≤1.0 ≤0.5

Cod	FFDRm FFDRo	<2.3 then <2.1 from October 2029 <1.0

2.3 Mortality Limits (Indicator 4.1.1.6) and Survival Rates (Indicator 4.2.1.4)

The formulae for calculating mortality limits are explained in **Appendix 12 (12.6.1)**.

Catfish

Based on real percentage mortality	
All systems	≤20%

Cod

Based on observed mortality rate	
Viral disease related mortality	≤10%
Unexplained mortality rate from each of the previous two production cycles, for sites with total mortality >6%	≤40%

Pangasius

Based on real percentage mortality	
All systems	≤20%

Salmonids – marine

Based on observed mortality rate	
Viral disease related mortality	≤10%
Unexplained mortality rate from each of the previous two production cycles, for sites with total mortality >6%	≤40%

Tilapia

Based on real percentage mortality	
All systems after they have attained a size of 100g	≤35%

The formulae for calculating survival rates are explained in **Appendix 12 (12.6.1)**

Crustaceans

Unfed and non-permanently aerated ponds	>25%
Fed but non-permanently aerated ponds	>45%
Fed and permanently aerated ponds	>65%

2.4 Maximum fasting duration (Indicator 4.1.2.16 and 4.1.2.31)

Catfish

Maximum fasting duration	72h

Pangasius

Maximum fasting duration	≤62° days

Salmonids – marine

Maximum fasting duration	≤54° days

Salmonids - freshwater

Maximum fasting duration	≤54° days

Seabass, Seabream, Meagre

Maximum fasting duration	≤ 45° days if water temperature <15°, otherwise 72h

Seriola and Cobia

Maximum fasting duration	
Seriola:	72h
Cobia:	≤ 62° days

Tropical Marine Finfish

Maximum fasting duration	72h

Cleaner Fish

Maximum fasting duration	≤54° days

2.5 Antibiotic and Parasiticide Treatments (Indicators 4.4.14 and 4.4.15)

Catfish

Number of antibiotic treatments	≤3
Number of parasiticide treatments	0

Cod
Gadus Morhua

Number of antibiotic treatments (grow out)	≤3
Number of antibiotic treatments (juvenile)	≤3

Crustaceans

Number of antibiotic treatments[127]	0

Flatfish

Number of antibiotic treatments	≤3
Number of parasiticide treatments	0

Pangasius

Number of antibiotic treatments	≤3

Salmonids – marine

Number of antibiotic treatments (grow out)	≤3
Number of antibiotic treatments (smolt)	≤3

Seabass, Seabream, Meagre

Number of antibiotic treatments	≤3 (incl. hatchery)
Number of parasiticide treatments	1 (incl. hatchery)

Seriola and Cobia

Number of parasiticide treatments	0

Tilapia

Number of antibiotic treatments	≤3

Tropical Marine Finfish

Number of antibiotic treatments	≤3
Number of parasiticide treatments	0

[127] Crustaceans treated with antibiotics are not eligible for ASC certification.

Appendix 3 Method for Risk Management

This Appendix provides the method for risk management and the requirements for conducting an Environmental Risk Assessment (ERA) and a Health and Safety Risk Assessment (HSRA).

Section
3.1 Introduction
3.2 Risk assessment method
3.3 Environmental Risk Assessment (Indicators 2.1.1 and 2.1.2)
3.4 Health and Safety Risk Assessment (Indicator 3.5.1)

3.1 Introduction

A Risk Management Framework is a structured method used to assess and control risks in a systematic and consistent manner. It helps to understand how likely and severe a risk is so that steps can be taken to reduce or prevent it. Conducting risk assessments helps individuals and companies in the aquaculture industry become aware of risks and improve operational processes. The main steps involve identifying risks, assessing the risk level, implementing control measures, monitoring, regularly reviewing and updating the assessment to ensure its effectiveness.

3.2 Risk Assessment Method

Step 1 – Identify the risks

The site shall identify the risk factors (the 'risks' or 'issues') that are relevant to its context. These risk factors are usually related to a wider theme (e.g. environmental risks) and are either generic or specific to the context of the site.

Examples of risk factors are:

- Negative wildlife interaction (environmental).
- Physical harm due to contact with hazardous chemicals (health and safety).

For each risk factor, information regarding the following shall be considered:

a) The evidence used to score the risk level.

b) What or who could be impacted by the risk factor.

c) What are the risk drivers of the risk level (i.e. what drives the risk).

d) Existing control measures.

Step 2 – Assess the risk level

The risk level is determined by scoring the elements of **likelihood** and **severity** of each identified risk.

Once the likelihood and severity of the identified risks has been assessed, each risk factor is scored in a risk matrix. A typical risk matrix consists of three levels (low, medium, high) for each element (see example Table 1).

Table 1. Example of a 3*3 risk matrix.

		Risk Severity		
		Low	Medium	High
Risk Likelihood	Low	Low Risk	Low Risk	Medium Risk
	Medium	Low Risk	Medium Risk	High Risk
	High	Medium Risk	High Risk	High Risk

Likelihood is the estimated probability that a risk will materialise into an incident, impact, injury, illness, damage or other negative outcome, or how probable the event is to occur under given conditions. It answers the question: *"How often could this risk occur?"*.

- **Low likelihood** is where an event could occur, but is unlikely to occur under normal site conditions and existing control measures.
- **Medium likelihood** is where an event could occur occasionally under normal site conditions and existing control measures.
- **High likelihood** is where an event is expected to occur, occurs frequently, or is likely to occur under current site conditions or existing control measures.

Severity is the estimated potential impact or consequence of a risk if it materialises into an incident, impact, injury, illness, damage or other negative outcome. Severity focuses on reasonably foreseeable consequence of the event, regardless of how likely it is to occur. It answers the question: *"How serious would the outcome be if this risk occurs?"*.

- **Low severity** is a minor, localised, short-term or easily corrected consequence.
- **Medium severity** is a moderate consequence requiring corrective action, treatment, notification, or additional monitoring.
- **High severity** is a severe, widespread, long-term, irreversible or legally significant consequence.

Step 3 – Implement control measures

Control measures shall be defined and implemented for all risk factors rated as 'medium' or 'high' to reduce their risk levels over time.

Risk levels shall be reduced using the following control measures:

- Mitigation measures: reducing the risk level when the risk factor cannot be eliminated fully; or
- Remediation measures: reducing the risk level to a point where the risk factor no longer is relevant.

Step 4 – Monitor control measures

The implemented control measures shall be monitored to ensure their effectiveness in reducing the risk level.

Step 5 – Review

Regular review of the control measures and risk levels shall be conducted, and revisions made where necessary, including under at least the following circumstances:

- When related timelines have expired
- When triggered by the monitoring outcome
- When changes occur that influence the relevance of site-specific risk factors.

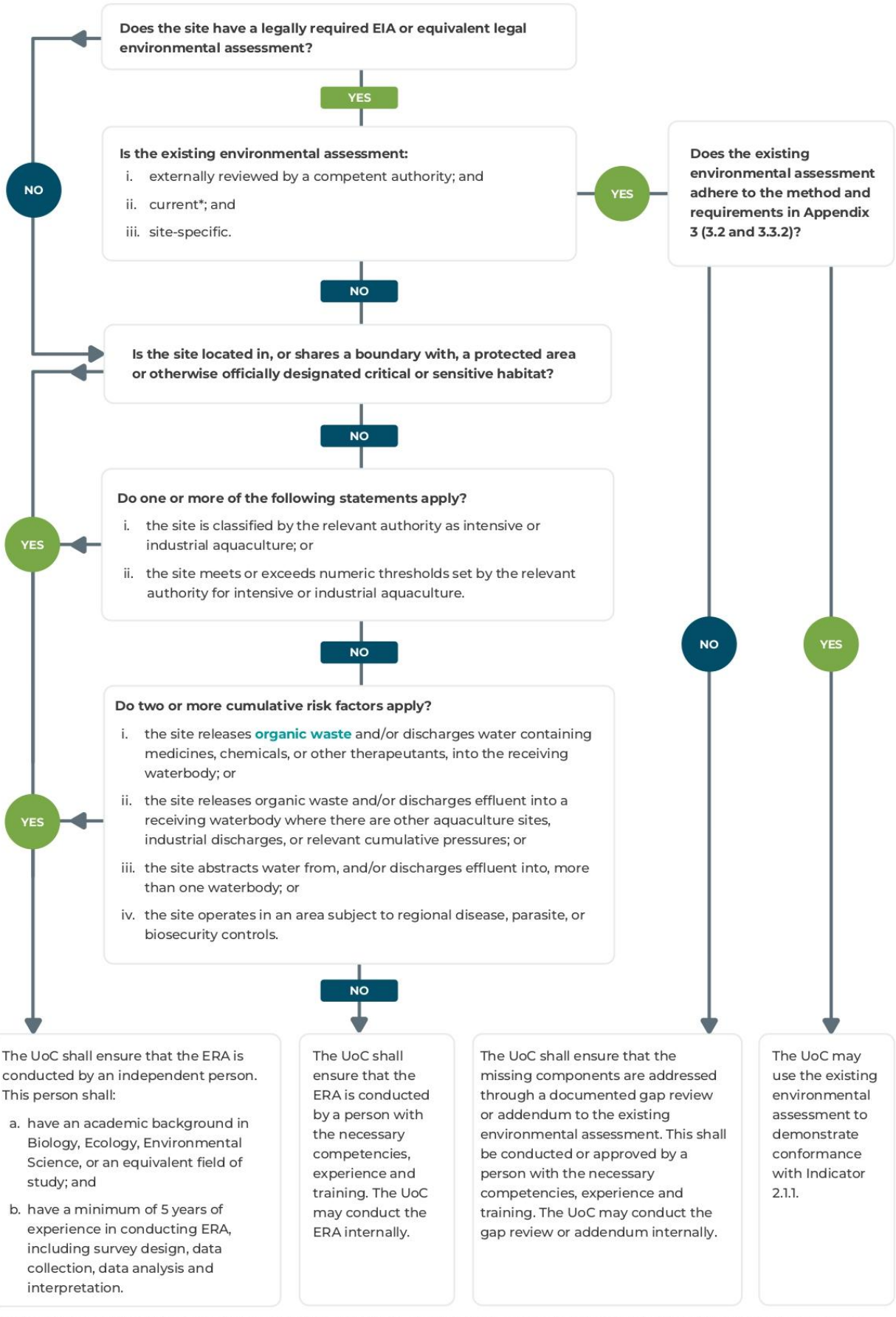
3.3 Environmental Risk Assessment (Indicators 2.1.1 and 2.1.2)

The decision tree in Appendix 3.3.1 identifies the applicable assessment route and the requirements for the person conducting the ERA. Together with the additional ERA requirements in Appendix 3.3.2, the ERA shall be site-specific and shall follow the risk assessment method in Appendix 3.2.

3.3.1 Decision Tree

The following decision tree determines whether:

- an existing legally required Environmental Impact Assessment (EIA), or equivalent legal environmental assessment, can be used to demonstrate conformance with **Indicator 2.1.1**;
- additional components are required to supplement an existing legally required EIA, or equivalent legal environmental assessment, to adhere to the method in **Appendix 3 (3.2** and **3.3.2)**; or
- an independent person shall conduct the ERA, demonstrating conformance with **Indicator 2.1.2.**



*For this purpose, "current" means externally reviewed within the last five (5) years or reviewed/updated following any material change to the UoC, production system, production scale, receiving environment, legal requirements, or permit conditions.

3.3.2 Environmental Risk Assessment

In addition to the Risk Assessment Method outlined in Section 3.2, the site shall adhere to the following requirements for conducting an Environmental Risk Assessment (ERA).

Related to Step 1:

The following risk factors shall be considered as a minimum in conducting an ERA:

Habitat-related:

- Presence of Protected Areas (see Indicator 2.2.1) and risk drivers that increase the likelihood of negative impacts upon these.
- Presence of Critical Habitats (see Indicator 2.2.2) and risk drivers that increase the likelihood of negative impacts upon these.
- Presence of Sensitive Habitats (see Indicator 2.2.4) and risk drivers that increase the likelihood of negative impacts upon these. As a minimum, the following sensitive habitats shall be considered:
    a. Seagrass habitats (see Indicator 2.2.5); and
    b. Areas containing biogenic structures that are not particularly adapted to sedimentation or organic enrichment (e.g. tubeworm mounds, bryozoan mounds, bivalve beds and reefs or sponge gardens that form a structure for other epifauna).
- Presence of Wildlife Corridors (see Indicator 2.2.6) and risk drivers that increase the likelihood of negative impacts upon these.
- The minimum width of the riparian zone between the site and any confined or linear waterbody (see Indicator 2.2.7).
- The minimum width of the coastal barrier between the site and any large or open waterbody (see Indicator 2.2.8).
- The conversion of natural wetland before and after 1999 (see Indicators 2.2.9 and 2.2.10).

Wildlife-related:

- Presence of mammals, elasmobranchs, birds, amphibians or reptiles and farm-related drivers which increase the likelihood of Human-Wildlife Conflict (see Indicator 2.3.1) or other negative impacts upon these (see Indicator 2.3.3).
- Presence of Threatened Species (see Indicator 2.3.2) and risk drivers that increase the likelihood of negative impacts upon these.

Related to Step 2:

See Section 3.3.1 for the competencies of the person conducting the ERA.

Related to Step 3:

In addition to the requirements prescribed in the Risk Assessment Method outlined in Section 3.2, Risk level reduction shall be completed within the following timelines:

- For 'high' risk level - reduce to 'medium' within a short period (for example 6-9 months after detection).
- For 'medium' risk level - reduce to 'low' within a medium period (for example 12-18 months after detection).

Where a 'medium' risk cannot reasonably be reduced to 'low', the UoC shall document the justification, demonstrate that all reasonably practicable control measures have been implemented, and continue to monitor and review of the residual risk.

Related to Step 4:

No additional requirements beyond those prescribed in the Risk Assessment Method outlined in Section 3.2.

Related to Step 5:

No additional requirements beyond those prescribed in the Risk Assessment Method outlined in Section 3.2.

3.4 Health and Safety Risk Assessment (Indicator 3.5.1)

In addition to the Risk Assessment Method outlined in Section 3.2, the site shall adhere to the following requirements for conducting a Health and Safety Risk Assessment (HSRA).

Related to Step 1:

The following risk factors shall be considered as a minimum in conducting an HSRA:

Chemical and biological • Contact with hazardous material and chemicals, including biosolids handling • Food handling • Drinking water **Diving** **Electricity and electrical equipment** **Other equipment** • Compressed air/pressurised equipment • Sharpening tools • Machine guarding • Knives • Display screen equipment	**Mechanical and manual handling** • Cranes • Workplace transport • Conveyors • Operation of lift trucks • Moving heavy objects **Natural/physical disaster/event** • Tsunami • Earthquake • Typhoon • Hurricane • Avalanche • Landslide **Welfare**	**Workplace** • Building and structure safety • Slips, trips and falls • Traffic movements/routes (deliveries etc.) • Falls from a height • Lone working • Confined spaces, including biosolids-holding units • Workstation and seating **Workplace Environment** • Noise • Ventilation • Temperature • Lighting

Fire	• Hygiene/comfort/welfare • Unfamiliarity with the site and/or uncertainty about the job	• Weather conditions, including extreme heat

Related to Step 2:

- Assess the risk level for the occurrence of acute and chronic injury or damage.
- See Indicator 3.5.2 for the competencies of the person conducting the HSRA.

Related to Step 3

Control measures to reduce the risk level should be taken as soon as is possible.

Related to Step 4:

No additional requirements beyond those prescribed in the Risk Assessment Method outlined in Section 3.2.

Related to Step 5:

No additional requirements beyond those prescribed in the Risk Assessment Method outlined in Section 3.2.

Appendix 4 Allowance for siting in Protected Areas

This Appendix details the conditions under which siting in various types of Protected Areas (PAs) are allowed (Indicator 2.2.1).

Section
4.1 Introduction
4.2 Conditional allowances

4.1 Introduction

As part of the development of the ASC Farm Standard, research has been initiated to better understand which types of aquaculture production systems are conditionally allowed in the various types of PAs.

At the time of publication of ASC Farm Standard v1.1, this work is still ongoing and not yet available for implementation.

Therefore, the conditional allowances listed below are taken from the ASC species standards and will be replaced with aligned conditional allowances in a future version of the ASC Farm Standard.

4.2 Conditional allowances (Indicator 2.2.1)

Species group	Conditional allowances
Salmonids – marine *Salmo spp.* *Oncorhynchus spp.* *Salvelinus spp.* **Seabass, Seabream, Meagre** *Dicentrarchus spp.*	Siting in PAs is not allowed. An exception applies if sites are: ○ Located in areas classified by the International Union for the Conservation of Nature (IUCN) as Category V or VI[128]; or ○ Located in High Conservation Value Areas (HCVA), if the site can demonstrate that its environmental impacts are compatible with the conservation objectives of the HCVA designation; or ○ Located in any category of PA if: • The PA was designated after the site was already in operation; and

[128] Dudley, N. (Editor) (2008). Guidelines for Applying Protected Area Management Categories. Gland, Switzerland: IUCN

Species group	Conditional allowances
Sparus spp. *Pagrus spp.* *Argyrosomus spp.* **Flatfish** *Paralichthys spp.* *Pseudopleuronectes spp.* *Hippoglossus spp.* *Scophthalmus spp.* **Tropical Marine Finfish** *Epinephelus spp.* *Cromileptes spp.* *Plectropomus spp.* *Cephalopholis spp.* *Lutjanus spp.* *Ocyurus spp.* *Trachinotus spp.* *Lates spp.* *Larimichthys spp.* **Cod** *Gadus morhua*	• The site can demonstrate that its environmental impacts are compatible with the objectives of the PA designation; and • The site complies with any applicable conditions or regulations placed on the site as a result of the formation/designation of the PA.
Salmonids – freshwater *Salmo spp.* *Oncorhynchus spp.* *Salvelinus spp.* *Thymallus spp.* *Coregonus spp.* **Pike-perch** *Sander lucioperca*	Siting in PAs is not allowed. An exception applies if sites are: o Located in areas classified by International Union for the Conservation of Nature (IUCN) as Category V or VI[128]; or o Located in any Category of PA if: • The PA was designated after the site was already in operation; and • The site can demonstrate that its environmental impacts are compatible with the objectives of the PA designation; and • The site complies with any applicable conditions or regulations placed on the site as a result of the formation/designation of the PA.
Seriola and Cobia	Siting in PAs is not allowed. An exception applies if sites are: o Located in areas classified by International Union for the Conservation of Nature (IUCN) as Category V or VI[128]; or

Species group	Conditional allowances
Seriola spp. *Rachycentron canadum*	○ Located in a designated PA, if the site can demonstrate that its environmental impacts are compatible with the objectives of the PA designation. The site shall demonstrate that it is not negatively impacting the objectives of the PA; or ○ Located in a Marine Protected Area (MPA) and the site pre-dates the designation of the MPA.
Crustaceans *Penaeus spp.* *P. vannamei* *Cherax spp.* *Procambarus spp.* *Astacus spp.* *Macrobrachium spp:*	Siting in PAs is not allowed. An exception applies if sites are: ○ Located in areas classified by International Union for the Conservation of Nature (IUCN) as Category V[128128] if the farming system is regarded as traditional land use; or ○ Located in Category VI if the site was built legally prior to the designation of the PA. For both allowances, the following conditions apply: 1. The site shall conform to the management objectives and plan of the PA; and 2. Crustacean farming is no more than 25% of the total PA.

Appendix 5 Methods for Calculating Phytoplankton Depletion by Bivalve Culture

This Appendix details the method for the calculation of phytoplankton depletion in waterbodies required in Criterion 2.2.

Section
5.1 Introduction
5.2 Estimating the zone of influence
5.3 Primary Production Time (PPT) calculation

5.1 Introduction

As filter-feeders, bivalves depend on the natural abundance of phytoplankton for feeding. In situations where bivalve aquaculture exceeds the ability of the waterbody to provide for sufficient phytoplankton for both natural bivalve populations and cultured populations, the carrying capacity can be exceeded and depletion can occur. Within this Appendix, various calculations are provided to determine if phytoplankton depletion occurs within a waterbody.

If the renewal of water, or Retention Time (RT), is faster than water clearance, or Clearance Time (CT) (CT>RT), it is expected that the carrying capacity of a waterbody will not be exceeded and phytoplankton depletion will not occur as sufficient replenishment is occurring.

To determine phytoplankton depletion, the site is required to estimate its zone of influence. Section 5.2 outlines the method to estimate the zone of influence of the site and determine RT and CT.

If CT<RT, as determined in Section 5.2, cultured bivalves may negatively impact carrying capacity; therefore, an additional method is required to link CT to Primary Production Time (PPT). The method to determine PPT is outlined in Section 5.3.

5.2 Estimating the zone of influence (Indicator 2.2.11)

The UoC shall use one of the following two methods to determine the zone of influence of the site.

Method 1

If the site is in an easily definable waterbody, for example an estuary or bay, and has tidally dominated water exchange, the steps to determine the zone of influence are as follows:

1. Calculate the mean depth at high tide and the surface area of the waterbody.
2. Calculate the volume of the waterbody (Vt) as the depth multiplied by the surface area at high tide.
3. Calculate RT using the following formula:

$$RT\ (days) = -1 \times P \div \ln(\mathrm{VI} \div \mathrm{Vt})$$

Where:

- P is the tidal periodicity, the length of the tidal cycle (days) (e.g. ~0.5 days for semidiurnal tides); and
- ln is the natural logarithm; and
- Vl is the total volume of the waterbody at low tide (litres); and
- Vt is the total volume of the waterbody at high tide (litres).

4. Calculate CT using the following formula:

$$\mathrm{CT\ (days)} = \mathrm{Vt} \div (\mathrm{N} \times \mathrm{C})$$

Where:

- Vt is the total volume of the waterbody at high tide (litres); and
- N is number of bivalves; and
- C is average clearance rate (litres/individual species/day) at harvest size.

Method 2

Where there are no clear boundaries to the waterbody, or if it is located some distance offshore, the steps to determine the zone of influence are as follows:

1. Calculate the 'radius of influence' (RI) as the cumulative current speed over a 24-hour period.
2. Calculate the volume of the waterbody (Vt) by assuming a circular surface area multiplied by the depth ($Vt = (pi \times RI^2) \times depth$). If the area is in deep waters, the depth used shall be that defining the lower limits of phytoplankton growth ('lower growth line').
3. RT = 24 hours.
4. Calculate CT using the following formula:

$$\mathrm{CT\ (days)} = \mathrm{Vt} \div (\mathrm{N} \times \mathrm{C})$$

Where:

- Vt is the total volume of the waterbody at high tide (litres); and
- N is number of bivalves; and
- C is average clearance rate (litres/individual species/day) at harvest size.

5.3 Primary Production Time (PPT) calculation (Indicator 2.2.11)

PPT shall be determined per site, either by calculating its value using the formula outlined below, or from values derived from secondary data.

$$\mathrm{PPT} = \mathrm{B} \div \mathrm{PPP}$$

Where:

- B is the yearly averages of phytoplankton biomass; and,
- PPP is the phytoplankton primary production (PPP) within the system.

Appendix 6 Escapes and native biodiversity

This Appendix details the method to calculate known escapes required by Indicators 2.4.8 and 2.4.10.

Section
6.1 – Introduction
6.2 – Known escapes calculation

6.1 – Introduction

Known escapes are escape incidents where there is clear evidence that animals have escaped from captivity, whether or not the escape itself was directly observed. Evidence may include, for example, damaged or failed containment infrastructure, a sudden unexplained reduction in stock numbers linked to a specific incident, or reports of farmed fish being recovered outside the site. Known escapes can result from causes such as handling errors, containment failure, or other identifiable escape events.

On the contrary, unexplained losses are described as when the cause of loss is unknown. These losses can occur due to counting errors, undetected escapes, unrecovered mortalities or predation and cannibalism.

6.2 – Known escapes calculation (Indicators 2.4.8 and 2.4.10)

Known escapes shall be calculated as follows for all-in-all-out production methods:

$$Known\ escapes\ (\%) = 100 * \frac{Number\ of\ known\ escapes}{Number\ of\ stocked\ animals}$$

For cod and marine salmonid species, known escapes are counted individuals (not percentages).

Appendix 7 Methods for Benthic Monitoring

This Appendix details the methods for benthic monitoring required in Criterion 2.5. It also details the method for determining the distance between the site and seagrass habitats (required in Criterion 2.2), and copper monitoring (required in Criterion 2.11) for sites using copper nets or copper-treated nets.

Section
7.1 Introduction
7.2 Method for cage culture in marine/brackish waters
7.3 Method for cage culture in freshwater lakes/reservoirs
7.4 Method for suspended marine mollusc systems
7.5 Method for freshwater systems discharging into rivers
7.6 Method for determining the distance between the site and seagrass habitats
7.7 Method for cage culture in marine/brackish waters using copper nets or copper-treated nets
7.8 Methods for field analysis of abiotic Indicators

7.1 Introduction

For cage culture and suspended marine mollusc culture systems (Indicators 2.5.1 and 2.5.2), the ASC method for benthic monitoring requires sampling at predefined zones to determine benthic status. The method is based on a three-level approach in which a site conducts increasingly more detailed benthic monitoring if the results of Level 1 or Level 2 monitoring do not demonstrate an 'Acceptable' benthic status. Conversely, a site that demonstrates an 'Acceptable' benthic status in Level 1 or Level 2 does not need to conduct a higher level of monitoring. Sites may decide to start monitoring at any of the three levels. The method uses five benthic Ecological Quality Status (EQS) categories that are numerically defined using a range of abiotic and biotic Indicator thresholds (see Table 1 and Table 2). An EQS Category is assigned to the monitoring results of each sampling zone which determines the benthic status of a site.

In the case of cage culture in marine/brackish waters using copper nets or copper-treated nets (Indicator 2.11.11), the method requires additional benthic monitoring to determine the copper level in sediments.

Sites producing Seabass, seabream and meagre are required to determine the distance to seagrass habitat from the zone 1 boundary (Indicator 2.2.5) outlined in Figure 1.

For freshwater systems discharging into rivers (Indicator 2.5.4), the ASC method for benthic monitoring requires sampling upstream and downstream from the site outflow point to determine the presence, composition, abundance and diversity of invertebrate fauna, and to categorise the benthic status upstream and downstream.

ASC has benchmarked the ASC Farm Standard methods for benthic monitoring against applicable regulatory requirements. Outcomes of the benchmark are available via the ASC Programme Centre.

Table 1. Abiotic Indicator thresholds for the EQS categories used by the methods for cage culture and suspended marine mollusc systems.

Abiotic Indicators	EQS Category Thresholds				
	High	Good	Moderate	Poor	Bad
Total Free Sulphide (S^{2-}_{UV}; µM)	75	250	500	1100	> 1100
Total Free Sulphide (S^{2-}_{ISE}; µM)	750	1500	3000	6000	> 6000
Redox potential (*Eh*)	100	0	-100	-150	<-150
Total Ammonia Nitrogen (TAN; mg/L)	< 1.9 at pH 7, 20°C		1.9 at pH 7, 20°C[129]	>1.9 at pH 7, 20°C	

Table 2. Biotic Indicator thresholds for the EQS categories used by the methods for cage culture and suspended marine mollusc systems.

Biotic Indicators	EQS Category Thresholds				
	High	Good	Moderate	Poor	Bad
Richness (% of max *S*)	>80	50	35	15	<15
Opportunistic Taxa (*GrV*; %)	<20	40	60	80	>80
Polychaete/Amphipod Ratio (*BPOFA*)	<0.031	0.126	0.187	0.237	>0.237
AZTI's Marine Biotic Index (*AMBI*)	<1.2	3.0	3.9	4.8	>4.8

[129] At pH 7 and 20°C. For other pH and/or temperature see applicable thresholds in Section 7.8.5.1.

Biotic Indicators	EQS Category Thresholds				
	High	Good	Moderate	Poor	Bad
Multivariate *AMBI* (*M-AMBI*)	>0.83	0.59	0.47	0.35	<0.35
Benthic Habitat Quality (*BHQ*)	>8	6	4	2	<2
Simplified Richness (S_{50})	>16	11.7	7.5	5.4	<5.4
Benthic Quality Index (*BQI*)	>16.0	12.0	8.0	4.0	<4.0
Benthic Quality Index (*BQI-family*)	>20.8	9.2	5.7	1.9	<1.9
BENTIX	>0.67	0.5	0.42	0.33	<0.33
Norwegian Quality Index (*NQI1*)	>0.86	0.68	0.43	0.20	<0.20
Norwegian Sensitivity Index (NSI_{2012})	> 27.4	23.1	18.8	10.4	< 10.4
Indicator Species Index (ISI_{2012})	>9.6	7.5	6.2	4.5	<4.5
Enrichment Stage (*ES*)	1	2	3 to 4	4 to 5	6 to 7

7.2 Method for Cage Culture in Marine/Brackish Waters (Indicators 2.5.1 and 2.5.2)

7.2.1 Sampling Method

Level 1: This monitoring level provides a rapid assessment of benthic impacts in the direction of greatest risk (i.e. the direction of the predominant current) and employs practical abiotic Indicators.

1. Sediment sampling shall be conducted in duplicate within each of the sampling zones outlined in Figure 1: 0-30, 31-100, 101-150, and at 500 metres from the edge of the cage array, in one transect situated in the direction of the predominant current. The 500-metre sampling location represents the reference zone.
2. The samples shall be analysed immediately on the survey vessel for:

- Total free sulphide (S^{2-}): in triplicate for each sample (six analyses in total for each sampling location), either using the ion-selective electrode method (S^{2-}_{ISE}) or the UV spectrophotometry method (S^{2-}_{UV})[130] outlined in Section 7.8; and
- Redox potential (Eh): single measure for each sample (two analyses in total for each sampling location), using the method outlined in Section 7.8.

3. With the results of the analysis of the samples, the EQS Category shall be calculated to determine the benthic status of each sampling zone following the steps outlined in Section 7.2.2.

If the EQS Category results in:

- An 'Acceptable' benthic status for each sampling zone; no additional sampling is required.
- An 'Unacceptable' benthic status for any sampling zone; either Level 2 or Level 3 monitoring shall be conducted immediately.

Level 2: This monitoring level provides a two-dimensional spatial analysis of benthic conditions using abiotic Indicators.

1. Sediment sampling shall be conducted as for Level 1 but in three additional transect directions according to Figure 1.
2. The samples shall be analysed immediately on the survey vessel for:
   - Total free sulphide (S^{2-}): in triplicate for each sample (6 analyses in total for each sampling location, and 24 analyses in total for each sampling zone), either using the ion selective electrode method (S^{2-}_{ISE}) or the UV spectrophotometry method (S^{2-}_{UV})[130] outlined in Section 7.8; and
   - Redox potential (Eh): single measure for each sample (2 analyses in total for each sampling location and 8 in total for each sampling zone) using the method outlined in Section 7.8.
3. With the results of the analysis of the samples, the EQS Category shall be calculated to determine the benthic status of each sampling zone following the steps outlined in Section 7.2.2.

If the EQS Category results in:

- An 'Acceptable' benthic status for each sampling zone; no additional sampling is required.
- An 'Unacceptable' benthic status for any sampling zone; Level 3 monitoring shall be conducted immediately.

Level 3: This monitoring level provides direct information on the impact of the site on the benthic macrofauna community.

[130] From May 2028, UV spectrophotometry will be the only acceptable method for total free sulphide analysis.

1. Sediment samples shall be collected in duplicate at the sampling locations outlined for Level 2, at a minimum, on the two transects in the direction of the predominant current, according to Figure 1.
2. The samples shall be screened through a 1.0mm mesh, and all organisms shall be preserved for taxonomic analysis.
3. The samples shall be analysed for three biotic Indicators from Table 2.
4. With the results of the analysis of the samples, the EQS Category shall be calculated to determine the benthic status of each sampling zone following the steps outlined in Section 7.2.2.

If the EQS Category results in:

- An 'Acceptable' benthic status for each sampling zone; no additional sampling is required.
- An 'Unacceptable' benthic status for any sampling zones; the site does not conform with Indicator 2.5.2.

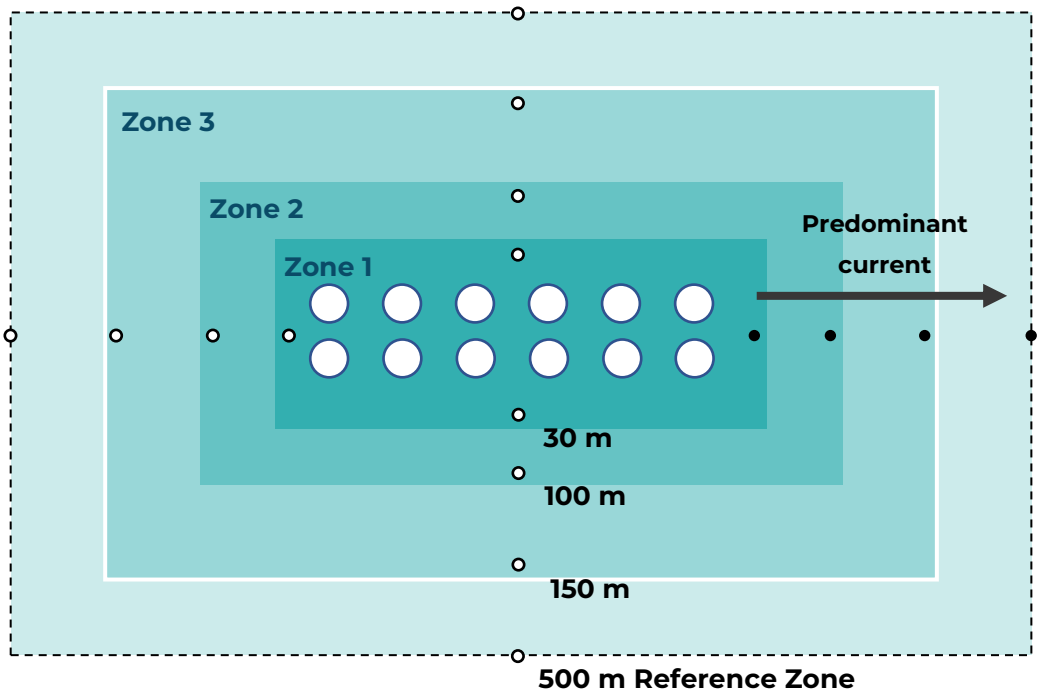


Figure 1. Cage Systems in Marine/Brackish - Sampling zones (shaded areas) and sampling locations (dots) required for Level 1 (●), 2 (● and ○) and 3 (● and ○) monitoring. Sampling locations are established on transects within the boundaries of sampling zones 1, 2 and 3 and at the 500 metres reference zone. Sample stations in zones 1, 2 and 3 can be located at any distance within the zone (from the cage array). For example, the zone 2 sample station can be located anywhere within 30 m and 100 m from the cage array. Figure 1 presents an example of the sampling locations inside the boundaries of zones 1, 2 and 3.

Sampling Timing

Sampling shall be conducted during the period when the benthic impact is expected to be highest. Sites shall provide information on when the maximum impact on the benthos is predicted to occur. Based on this information:

- Sampling shall be conducted during the final year of each production cycle within 30 days:
  - after peak feeding; or,
  - after peak biomass; or
  - after maximum annual bottom water temperature.
- In the case of multiple peaks in feeding/biomass occurring in any year, sampling shall be conducted annually within 30 days after the maximum annual bottom water temperature.

After three years of demonstrating conformance with Indicator 2.5.2, sites with multiple peaks in feeding/biomass occurring in any year may reduce sampling to once per certification cycle (i.e. every three years) as long as there have been no significant changes to farming practices and thus that previously determined benthic status provides a credible proxy for future performance.

7.2.2 Conformance Framework

A numerical scoring method is used to combine all Indicator data collected within each sampling zone, which allows for determining the EQS Category and benthic status of the site as required by Indicator 2.5.2.

The steps to calculate the EQS Category for each sampling zone are as follows:

1. The mean value for each Indicator shall be calculated for each sampling zone and compared with Table 1, in the case of abiotic Indicators, or Table 2, in the case of biotic Indicators, to determine the EQS Category that applies to each Indicator (i.e. 'High', 'Good', 'Moderate', 'Poor' and 'Bad').
2. The determined EQS Category for each Indicator shall be compared with Table 3 to assign an Indicator EQS Score to each sampling zone.

Table 3. Indicator EQS Scores associated with the EQS Categories.

EQS Category	High	Good	Moderate	Poor	Bad
Indicator EQS Score	1	2	3	4	5

3. The overall Zone EQS Score shall then be calculated by combining the Indicator EQS Scores using the following formulas:
   - Level 1 and 2 monitoring:
     - $S^{2-}{}_{UV}$ and Eh Indicators:

$$EQS\ Score_{\ zone} = EQS_{S^{2-}{}_{uv}} \times 0.75 + EQS_{Eh} \times 0.25$$

- $S^{2-}{}_{ISE}$ and Eh Indicators:

$$EQS\ Score_{zone} = \frac{EQS_{S^{2-}{}_{ISE}} + EQS_{Eh}}{2}$$

- Level 3 monitoring:
  - Three biotic Indicators: A, B and C.

$$EQS\ Score_{zone} = \frac{EQS_A + EQS_B + EQS_C}{3}$$

4. The resulting Zone EQS Score determines the EQS Category to be applied to each sampling zone, as shown in Table 4:

Table 4. EQS Categories associated with the Zone EQS Scores

Zone EQS Score	1.0	1.1 to 2.0	2.1 to 3.0	3.1 to 4.0	>4.0
EQS Category	High	Good	Moderate	Poor	Bad

5. The EQS Category obtained from Table 4 shall be compared with Table 5 to determine the benthic status of the sampling zone. The EQS Category of the reference zone determines the EQS Category for 'Acceptable' benthic status for each sampling zone.

Table 5. EQS Categories for 'Acceptable' benthic status.

EQS Category Reference Zone	Sampling Zone	EQS Category for 'Acceptable' Benthic Status
'High' EQS Category	Zone 1	At least 'Moderate' EQS Category shall be achieved by 30m
	Zone 2	At least 'Good' EQS Category shall be achieved by 100m
	Zone 3	'High' EQS Category shall be achieved by 150m
'Good' EQS Category	Zone 1	At least 'Moderate' EQS Category shall be achieved by 30m
	Zones 2 and 3	'Good' EQS Category shall be achieved at 100 and 150m
'Moderate' EQS Category	Zone 1, 2 and 3	At least 'Moderate' EQS Category shall be achieved in all zones
'Poor' or 'Bad' EQS Category		Not an acceptable EQS Category

7.3 Method for Cage Culture in Freshwater Lakes/Reservoirs (Indicators 2.5.1 and 2.5.2)

7.3.1 Sampling Method

Level 1: This monitoring level provides a rapid assessment of benthic impacts in the direction of greatest risk (i.e. the direction of the predominant current) and employs practical abiotic Indicators.

1. Sediment sampling shall be conducted in duplicate within each of the sampling zones outlined in Figure 2: 0-30, 31-100 and at 150 metres from the edge of the cage array, in one transect situated in the direction of the predominant current. The 150-metre sampling location represents the reference zone.
2. The samples shall be analysed immediately on the survey vessel for:
    - Redox potential (*Eh*): single measure for each sample (two analyses in total for each sampling location), using the method outlined in Section 7.8; and
    - Total Ammonia Nitrogen (TAN): single measure for each sample (two analyses in total for each sampling location), using the method outlined in Section 7.8. TAN analysis requires information on the sample temperature and pH. The method to analyse pH is also outlined in Section 7.8.
3. With the results of the analysis of the samples, the EQS Category shall be calculated to determine the benthic status of each sampling zone following the steps outlined in Section 7.3.2.

If the EQS Category results in:

- An 'Acceptable' benthic status for each sampling zone; no additional sampling is required.
- An 'Unacceptable' benthic status for any sampling zone; either Level 2 or Level 3 monitoring shall be conducted immediately.

Level 2: This monitoring level provides a two-dimensional spatial analysis of benthic conditions using abiotic Indicators.

1. Sediment sampling shall be conducted as for Level 1 but in three additional transect directions according to Figure 2.
2. The samples shall be analysed immediately on the survey vessel for:
    - Redox potential (*Eh*): single measure for each sample (two analyses in total for each sampling location), using the method outlined in Section 7.8; and
    - Total Ammonia Nitrogen (TAN): single measure for each sample (two analyses in total for each sampling location), using the method outlined in Section 7.8. TAN analysis requires information on the sample temperature and pH. The method to analyse pH is also outlined in Section 7.8.
3. With the results of the analysis of the samples, the EQS Category shall be calculated to determine the benthic status of each sampling zone following the steps outlined in Section 7.3.2.

If the EQS Category results in:

- An ‘Acceptable’ benthic status for each sampling zone; no additional sampling is required.
- An ‘Unacceptable’ benthic status for any sampling zone; Level 3 monitoring shall be conducted immediately.

Level 3: This monitoring level provides direct information on the impact of the site on the benthic macrofauna community.

1. Sediment samples shall be collected in duplicate at the sampling locations outlined for Level 2, at a minimum, on the two transects in the direction of the predominant current, according to Figure 2.
2. The samples shall be screened through a 1.0mm mesh, and all organisms preserved for taxonomic analysis.
3. The samples shall be analysed for three biotic Indicators from Table 2.
4. With the results of the analysis of the samples, the EQS Category shall be calculated to determine the benthic status of each sampling zone following the steps outlined in Section 7.3.2.

If the EQS Category results in:

- An ‘Acceptable’ benthic status for each sampling zone; no additional sampling is required.
- An ‘Unacceptable’ benthic status for any sampling zones; the site does not conform with Indicator 2.5.2[131].

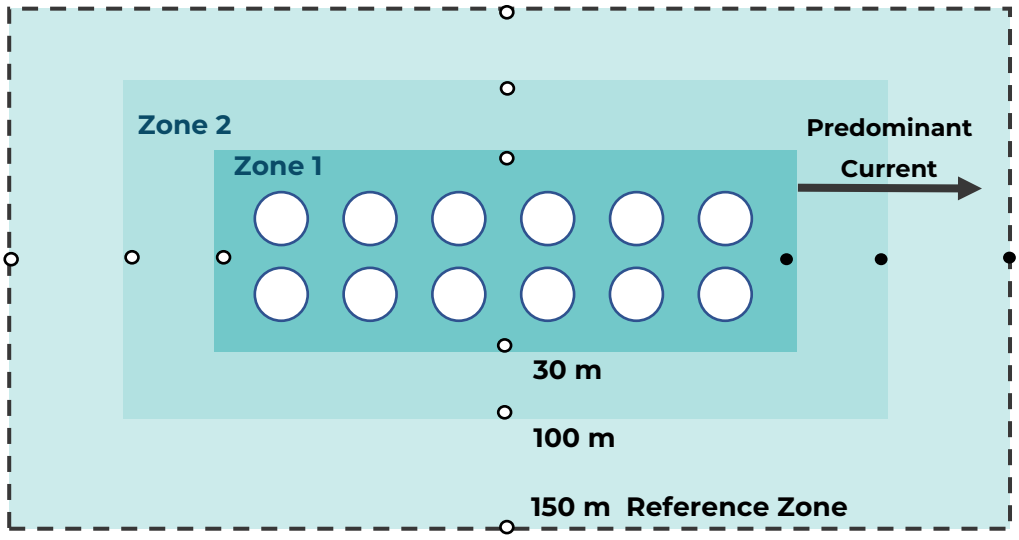


Figure 2. Cage Systems in Freshwater Lakes/Reservoirs - Sampling zones (shaded areas) and sampling locations (dots) required for Level 1 (●), 2 (● and ○) and 3 (● and ○) monitoring. Sampling locations are

[131] Demonstration that the status is 'Acceptable' is not required until the mandatory date of the ASC Farm Standard in May 2028.

established on transects within the boundaries of sampling zones 1 and 2 and at the 150 metre reference zone. Sample stations in zones 1 and 2 can be located at any distance within the zone (from the cage array). The reference station shall be located 150 m from the cage array. For example, the zone 2 sample station can be located anywhere within 30 m and 100 m from the cage array. Figure 2 presents an example of the sampling locations inside the boundaries of zones 1 and 2.

Sampling Timing

Sampling shall be conducted during the period when the benthic impact is expected to be highest. Sites shall provide information on when the maximum impact on the benthos is predicted to occur. Based on this information:

- Sampling shall be conducted during the final year of each production cycle within 30 days:
  - after peak feeding; or,
  - after peak biomass; or
  - after maximum annual bottom water temperature.
- In the case of multiple peaks in feeding/biomass occurring in any year, sampling shall be conducted annually within 30 days after the maximum annual bottom water temperature.

After three years of demonstrating conformance with Indicator 2.5.2, sites with multiple peaks in feeding/biomass occurring in any year may reduce sampling to once per certification cycle (i.e. every three years) as long as there have been no significant changes to farming practices and thus that previously determined benthic status provides a credible proxy for future performance.

7.3.2 Conformance Framework

A numerical scoring method is used to combine all Indicator data collected within each sampling zone, which allows for determining the EQS Category and benthic status of the site as required by Indicator 2.5.2.

The steps to calculate the EQS Category for each sampling zone are as follows:

1. The mean value for each Indicator shall be calculated for each sampling zone and compared with Table 1, in the case of abiotic Indicators, or Table 2, in the case of biotic Indicators, to determine the EQS Category that applies to each Indicator (i.e. 'High', 'Good', 'Moderate', 'Poor' and 'Bad').
2. The determined EQS Category for each Indicator shall be compared with Table 6 to assign an Indicator EQS Score within each sampling zone.

Table 6. Indicator EQS Scores associated with the EQS Categories.

EQS Category	High	Good	Moderate	Poor	Bad
Eh Indicator EQS Score	1	2	3	4	5

EQS Category	High	Good	Moderate	Poor	Bad
TAN Indicator EQS Score	1		3	5	

3. The overall Zone EQS Score shall then be calculated by combining the Indicator EQS Scores using the following equations:
    - Level 1 and 2 monitoring:
        - TAN and *Eh* Indicators:

$$EQS\ Score_{zone} = \frac{EQS_{\mathrm{TAN}} + EQS_{Eh}}{2}$$

    - Level 3 monitoring:
        - Three biotic Indicators: A, B and C.

$$EQS\ Score_{zone} = \frac{EQS_A + EQS_B + EQS_C}{3}$$

4. The resulting Zone EQS Score determines the EQS Category to be applied to each sampling zone, as shown in Table 7:

Table 7. EQS Categories associated with the Zone EQS Scores

Zone EQS Score	1.0	1.1 to 2.0	2.1 to 3.0	3.1 to 4.0	>4.0
EQS Category	High	Good	Moderate	Poor	Bad

5. The EQS Category obtained from Table 7 shall be compared with Table 8 to determine the benthic status of the sampling zone. The EQS Category of the reference zone determines the EQS Category for 'Acceptable' benthic status for each sampling zone.

Table 8 EQS Categories for 'Acceptable' benthic status

EQS Category Reference Zone	Sampling Zone	EQS Category for 'Acceptable' Benthic Status
'High' or 'Good' EQS Category	Zone 1	At least 'Moderate' EQS Category shall be achieved by 30m
'Moderate' EQS Category	Zone 1 and 2	At least 'Moderate' EQS Category shall be achieved in both zones
'Poor'"or 'Bad' EQS Category		Not an acceptable EQS Category

7.4 Method for Suspended Marine Molluscs Systems (Indicators 2.5.1 and 2.5.2)

7.4.1 Sampling Method

Level 1: This monitoring level provides a rapid assessment of benthic impacts in the direction of greatest risk (i.e. the direction of the predominant current) and uses practical abiotic Indicators.

1. Sediment sampling shall be conducted in duplicate in each of the five sampling locations situated 10m apart along one transect located in the direction of the predominant current, with the third sampling location (i.e. the middle of the five locations) being situated inside the edge of the site boundary, as outlined in Figure 3[132].
2. The samples shall be analysed immediately on the survey vessel for:
    - Total free sulphide (S^{2-}): in triplicate for each bottom sample (six analyses in total for each sampling location), either using the ion-selective electrode method (S^{2-}_{ISE}) or the UV spectrophotometry method (S^{2-}_{UV})[133] outlined in Section 7.8; and
    - Redox potential (Eh): single measure at each sampling location (two analyses in total for each sampling location), using the method outlined in Section 7.8.
3. With the results of the analysis of the samples, the EQS Category shall be calculated to determine the benthic status of each sampling zone following the steps outlined in Section 7.4.2.

If the EQS Category results in:

- An 'Acceptable' benthic status for each sampling zone; no additional sampling is required.
- An 'Unacceptable' benthic status for any sampling zone; either Level 2 or Level 3 monitoring shall be conducted immediately.

Level 2: This monitoring level provides a two-dimensional spatial analysis of benthic conditions using abiotic Indicators.

1. Sediment sampling shall be conducted as for Level 1 but in three additional transect directions according to Figure 3.
2. The samples shall be analysed immediately on the survey vessel for:
    - Total free sulphide (S^{2-}): in triplicate for each sample (six analyses at each station and 24 analyses in total for each sampling distance), either using the ion selective electrode method (S^{2-}_{ISE}) or the UV spectrophotometry method (S^{2-}_{UV})[133] outlined in Section 7.8.
    - Redox potential (Eh): single measure for each sediment sample (two analyses at each station and eight in total for each sampling distance) using the method outlined in Section 7.8.
3. With the results of the analysis of the samples, the EQS Category shall be calculated to determine the benthic status of each sampling zone following the steps outlined in Section 7.4.2.

[132] ASC will develop sampling guidance for circumstances in which multiple marine mollusc sites have shared boundaries.
[133] From May 2028, UV spectrophotometry will be the only acceptable method for total free sulphide analysis.

If the EQS Category results in:

- An 'Acceptable' benthic status for each sampling zone; no additional sampling is required.
- An 'Unacceptable' benthic status for any sampling zone; Level 3 monitoring shall be conducted immediately.

Level 3: This monitoring level provides direct information on the impact of the site on the benthic macrofauna community.

1. Sediment samples shall be collected in duplicate at the sampling locations outlined for Level 2, at a minimum, on the two transects in the direction of the predominant current, according to Figure 3.
2. The samples shall be screened through a 1.0mm mesh, and all organisms preserved for taxonomic analysis.
3. The samples shall be analysed for three biotic Indicators from Table 2.
4. With the results of the analysis of the samples, the EQS Category shall be calculated to determine the benthic status of each sampling zone following the steps outlined in Section 7.4.2.

If the EQS Category results in:

- An 'Acceptable' benthic status for each sampling zone; no additional sampling is required.
- An 'Unacceptable' benthic status for any sampling zones; the site does not conform with Indicator 2.5.2.

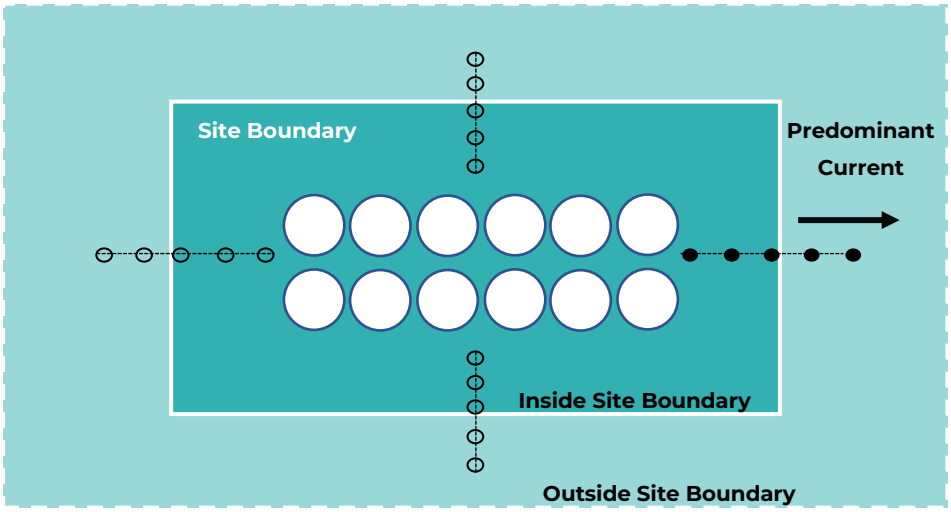


Figure 3. Suspended Marine Molluscs Systems - Sampling locations (dots) per zone (inside and outside site boundary) required for Level 1 (●), 2 (● and ○) and 3 (● and ○). Sampling locations on each transect are 10m apart, with the third sampling location (i.e. the middle of the five locations) being situated inside the edge of the site boundary.

Sampling Timing

- Sampling shall be conducted during the final year of each production cycle within 30 days after peak biomass.

- In the case of multiple peaks in biomass occurring in any year, sampling shall be conducted annually within 30 days after the maximum annual bottom water temperature.

Sites may reduce the sampling frequency to once per certification cycle (i.e. every three years) if the EQS Category for Benthic Status inside the site boundary is 'Good' or High' and the EQS Category for Benthic Status outside the site boundary is at least 'Moderate'.

The reduction in sampling frequency shall be permitted as long as there have been no significant changes to farming practices and therefore the previously determined benthic status provides a credible proxy for future performance.

7.4.2 Conformance Framework

A numerical scoring method is used to combine all Indicator data collected within each sampling zone, which allows for determining the EQS Category and benthic status of the sampling zones surrounding the site as required by Indicator 2.5.2.

The steps to calculate the EQS Category for each sampling zone are as follows:

1. The mean value for each Indicator shall be calculated for each sampling zone and compared with Table 1, in the case of abiotic Indicators, or Table 2, in the case of biotic Indicators, to determine the EQS Category that applies to each Indicator (i.e. 'High', 'Good', 'Moderate', 'Poor' and 'Bad').
2. The determined EQS Category for each Indicator shall be compared with Table 9 to assign an Indicator EQS Score within each sampling zone.

Table 9. Indicator EQS Scores associated with the EQS Categories.

EQS Category	High	Good	Moderate	Poor	Bad
Indicator EQS Score	1	2	3	4	5

3. The overall Zone EQS Score shall then be calculated by combining the Indicator EQS scores using the following equations:
    - Level 1 and 2 monitoring:
        - $S^{2-}{}_{UV}$ and Eh Indicators:

$$EQS\ Score_{\ zone} = EQS_{S^{2-}{}_{uv}} \times 0.75 + EQS_{Eh} \times 0.25$$

        - $S^{2-}{}_{ISE}$ and Eh Indicators:

$$EQS\ Score_{zone} = \frac{EQS_{S^{2-}{}_{ISE}} + EQS_{Eh}}{2}$$

    - Level 3 monitoring:
        - Three biotic Indicators: A, B and C.

$$EQS\ Score_{zone} = \frac{EQS_A + EQS_B + EQS_C}{3}$$

4. The resulting Zone EQS Score determines the EQS Category to be applied to each sampling zone, as shown in Table 10:

Table 10. EQS Categories associated with the Zone EQS Scores.

Zone EQS Score	1.0	1.1 to 2.0	2.1 to 3.0	3.1 to 4.0	>4.0
EQS Category	High	Good	Moderate	Poor	Bad

5. The EQS Category obtained from Table 10 shall be compared with Table 11 to determine the benthic status of the sampling zone.

Table 11. EQS Categories for "Acceptable' benthic status.

Sampling Location Zones	EQS Category for 'Acceptable' Benthic Status
Inside Site Boundary	At least 'Moderate' EQS Category shall be achieved
Outside Site Boundary	'Poor' or "Bad" EQS Category are not acceptable categories

7.5 Method for Freshwater Systems Discharging into Rivers (Indicator 2.5.4)

7.5.1 Sampling Method

1. Sediment sampling for macrofauna taxonomic analysis shall be conducted yearly in the receiving river in at least three transects 10 metres apart, upstream and downstream from the site outflow point. Each transect shall contain at least four sampling locations for a minimum of 24 samples.
    - The sampling shall focus on key sensitive Indicator species for the region.
    - The transects shall be located to include sampling locations midstream, near the bank and in areas with slower water flow.
    - The sampling locations shall include areas with similar conditions, such as bottom type, water flow and/or substrate types, along the bank in the upstream and downstream sampling locations.
    - The position of the sampling locations downstream shall reflect a scientific assessment of the most likely area of potential impact from the site, considering the mixing of water and the minimum and maximum distance from the site outflow point.
2. The samples shall be analysed to determine the presence, composition, abundance and diversity of invertebrate benthic fauna.
3. With the results of the analysis of the samples, the benthic status for the upstream and downstream sampling locations shall be determined using a categorisation system that includes at least five categories of benthic status.

4. The determined category downstream shall be compared with the category upstream to demonstrate that the benthic status of the river does not deteriorate downstream from the site's outflow point.

In case the downstream sampling locations drop in benthic status category, two sediment sampling for macrofauna taxonomic analysis shall be conducted during the next 12-month period following the method outlined in this section and using the previously used categorisation system.

After three years of demonstrating conformance with Indicator 2.5.4, sites may reduce sampling to once per certification cycle (i.e. every three years) as long as there have been no significant changes to farming practices and thus that previously determined benthic status provides a credible proxy for future performance.

7.6 Method for determining the distance between the site and seagrass habitats (Indicator 2.2.5)

1. The zone 1 boundary of the site shall be identified, in accordance with Figure 1 outlined in Section 7.2.1.
2. The nearest edge of seagrass habitat from the boundary of the site shall be determined by the Environmental Risk Assessment (**Appendix 3 (3.3)**).
3. The distance to the nearest edge of seagrass habitat shall be then be identified from the zone 1 boundary.

7.7 Method for Cage Culture in Marine/Brackish Waters Using Copper Nets or Copper-Treated Nets (Indicator 2.11.11)

7.7.1 Sampling Method

1. Sediment sampling shall be conducted in duplicate in three of the transects required by the Level 2 monitoring sampling method for Cages in Marine/Brackish Waters outlined in Section 7.2.1.
    - Of the three transects, one should be upstream and one downstream with respect to the direction of the predominant current.
2. In each transect, samples shall be collected in Zone 2 and at the reference site outlined in Figure 1.
3. The samples shall be analysed for copper levels expressed in mg Cu/kg dry sediment weight, and the result compared with the metric required by Indicator 2.11.11.
4. Sampling shall be conducted at the same time as per the timing required by the benthic sampling method for cages in marine/brackish waters outlined in Section 7.2.1.

7.8 Methods for Field Analysis of Abiotic Indicators (Indicator 2.5.1)

7.8.1 Total Free Sulphide - UV Spectrophotometry (S^{-2}_{UV})

The method is described and assessed in Cranford (2024)[134] and is listed as a recognised, validated method in the US National Environmental Methods Index (listed as "A simple and rapid method for measuring total free sulfides in marine sediments[135]"). This field method includes the extraction and analysis of porewater in surficial sediments collected by core or grab samplers.

Standard Operating Procedure

1. Drain water in the sediment sampler to the sediment surface.
2. Three Rhizon tubes are inserted into the sediment between the undisturbed surface and 2cm depth. Note that a 5cm long Rhizon is inserted at an angle to sample within the 0–2 cm depth range.
3. Flush each tube by withdrawing 0.5–1.0mL of porewater into each syringe. Discard the flushing water inside the syringe.
4. A 100-µL sample of porewater is immediately removed from inside each Rhizon tube by inserting the needle attached to a 100-µL gas-tight syringe. An extension tube or adapter may be necessary between the Rhizon and syringe to hold sufficient sample volume.
5. The 100-µL sample is immediately added to a 1.4mL capacity semi-micro quartz cuvette (1cm pathlength) along with 1mL of deionised water having a pH of approximately 8. The pH of this alkaline dilution water is previously adjusted with ammonium hydroxide and confirmed with pH-Indicator strips.
6. Immediately place the cuvette into a mobile UV spectrophotometer and measure light absorption at 230, 240 and 250nm wavelengths. The instrument is to be frequently blanked with a cuvette containing the alkaline dilution water.
7. Calculate the total free sulfide concentration using the absorbance values and the regression equations determined by the calibration procedure below. Although absorption data are collected for three wavelengths, S^{2-} is only calculated using the lowest wavelength that provides absorbance readings below 2. If the absorbance reading at 230nm is >2, then use the 240nm absorbance, etc.

UV Spectrophotometer Calibration

The calibration of the UV spectrophotometer is highly stable and only needs to be conducted once a month to ensure the instrument has not been damaged. Calibration of UV spectrophotometers ensures accurate and reliable measurements and involves assessments of wavelengths and absorbance accuracy and linearity. The following equations shall be used to calibrate total free sulphide (S^{2-}) concentrations from absorbance data collected at the three wavelengths:

- $S^{2-}(\mu M) = \text{absorbance}_{230\,nm} \times 1580$

[134] Cranford, P. J. (2024). A simple and rapid method for measuring total free sulfides in marine sediments. Limnology and Oceanography: Methods. https://doi.org/10.1002/lom3.10619
[135] National Environmental Methods Index

- S^{2-} (µM) = absorbance$_{240\ nm}$ x 2388
- S^{2-} (µM) = absorbance$_{250\ nm}$ x 6788

One of the following four methods shall be used to calibrate the UV Spectrophotometer:

Certified Reference Material (CRM)

A CRM or Reference Standard is used as the stock solution for preparing five working standards of known sulfide concentration between 0 and 15,000µM.

1. Dilute the stock CRM solution to prepare five known concentrations using pipettors and the alkaline deionised water.
2. Blank (zero) the instrument and then add 100µL of the working standard to the cuvette along with 1mL of alkaline water. Record the light absorbance of each working standard at 230, 240 and 250nm wavelengths.
3. Calculate the calibration equations for each of the three wavelengths using regression analysis (x= absorbance at selected wavelength and y= working standard concentration in µM units) while excluding any absorbance readings above 2.

Sulphide Standard Method 4500-S2-A

1. Prepare the standards from sodium sulphide nonahydrate ($Na_2S \cdot 9H_2O$) crystals.
2. Verify concentration of stock solution using the iodometric method (4500-S2-F).

Note that the standards are technically difficult to accurately prepare and are not certified. However, they can serve to assess wavelength accuracy (peak S^{2-} absorbance at 230 nm) and measurement linearity.

Nicotinic acid reference for wavelength absorbance and linearity assessment

1. Accurately weigh approximately 100 mg of nicotinic acid standard and dissolve it in 100 mL of 0.1 M hydrochloric acid to prepare a stock solution of 1 mg/mL. Dilute the stock solution with 0.1 M hydrochloric acid to prepare a series of working standards with concentrations in the desired linear range (e.g., 5-25 µg/mL).
    a. Sealed certified reference sets are commercially available.
2. Use 0.1 M hydrochloric acid as the blank to zero the instrument when using in-house prepared standards.
    a. Nicotinic acid should give a spectral scan containing characteristic peaks at 213 nm and 261 nm.
3. To evaluate linearity, plot a graph of concentration against absorbance for each of the two wavelengths. If using a commercial reference set, the absorbance scale is verified by assuring that the absorbance readings on your instrument are within the readings on the certificate supplied with the reference set.

Commercial accredited sources: Starna Cells, Sigma-Aldrich, Carl Roth, US Pharmacopeia

Holmium oxide reference for wavelength assessment

1. Dissolve 4 % weight per volume high purity holmium oxide in 100 mL of 1.4 M perchloric acid filled into a stoppered 10 mm quartz cuvette.
2. Note the four characteristic absorption peaks at 241.13, 249.79, 278.10, 287.18 nm.
    a. Acceptable wavelength accuracy tolerance is ±1 nm at each wavelength or certified spectrum by the manufacturer.

Commercial accredited sources: NIST-traceable reference materials from Starna Cells (UK), Hellma Analytics (Germany), Reagecon (Ireland), Camspec (UK), Thermo Scientific, Holmium glass solid reference.

Materials List

- UV Spectrophotometer that accepts a 10 mm cuvette and includes the 230 to 250 nm wavelength range. If used on small boats, the instrument should be compact and have no moving parts. The instrument can be powered by internal batteries (for example, IMPLEN C40 mobile nanophotometer) or an external source such as a small power station.
    - Additional examples of suitable instruments include the DeNovix DS-C or DS-7, SpectraMax QuickDrop and Cole-Parmer SP-500-UV.
- Semi-micro quartz cuvette, 200-2500 nm spectral range, 10 mm pathlength, 1.4 ml capacity. Helma Analytics cuvettes available from Sigma-Aldrich (Part No. Z600237 or Z600288)
- 5cm MacroRhizon porewater samplers. Part No. 19.21.32 from Rhizosphere (https://www.rhizosphere.com/rhizons/macrorhizons/).
- 10cc Luer Lock syringes for porewater extraction. Automatic extraction (applies constant vacuum) can be performed with a locking syringe (e.g. VacLok®. www.qosina.com) or by inserting a stainless-steel compression spring inside a plastic or glass BD™ syringe (for example, Qosina No. C3307).
- 100µL gas-tight syringes (for example, Hamilton 1700 series gastight syringe Part No. 81085 or 81065 available from Sigma-Aldrich). It is recommended to rinse the syringe with fresh water at the end of each day to prevent the needle clogging with salt.
- 1mL pipettor or bottle-top dispenser for rinsing cuvette for adding the alkaline water to the cuvette and for preparing standards.
- Ammonia hydroxide, 0.44M or similar concentration.
- pH Indicator papers for adjusting the dilution water to ~8 (For example, Whatman Indicator papers; 4.5 – 10.0 range – No. WHA2614991 from Sigma-Aldrich)
- Lint-free optical wipes (e.g. Kimwipes) for cleaning cuvette surfaces.
- Concentrated Sulfide ISO Certified Reference Material or Reference Standard. An example of a tested and calibrated material is Absolute Standards, Inc. Sulfide (S): No. ABS54139 from Chromatographic Specialties Inc.

7.8.2 Total Free Sulphide - Ion Selective Electrode (S^{-2}_{ISE})

The following procedure is based on Standard Method 4500-S^{2-}-F (APHA 2017) for water samples and the Canadian Aquaculture Activities Regulations Guidance Document (www.dfo-mpo.gc.ca) for sediment samples.

Standard Operating Procedure

1. Prior to field measurements, prepare the Sulfide Anti-Oxidant Buffer (SAOB). Dissolve 20.0g NaOH (sodium hydroxide) crystals in 250ml of de-aerated deionised water (use a volumetric type flask). Add 17.9g EDTA (ethylene diamine tetra acetic acid disodium salt dehydrate) to NaOH solution and swirl until dissolved. Place solution in plastic screw top jar. Larger volumes can be prepared as necessary provided ratio of reagents is maintained. Add L-ascorbic acid just prior to analysis of samples. Store in the dark at 4°C. De-aerated deionised water must be at a similar temperature as that of the sediment to be sampled. The SAOB expiration period is 3 hours.
2. The Ag+/S= combination electrode must be recalibrated a minimum of once every 3 hours and each time sampling is initiated at a new site.
3. The tip of the electrode should be gently cleaned using an abrasive strip or detergent solution before each calibration. If difficulty is experienced in obtaining the expected slope for the relationship between mV potential and log sulfide concentrations cleaning may be necessary to remove coatings formed on the electrode tip.
4. The level of the electrode filling solution should be checked and either topped up or replaced with fresh electrolyte (if the latter option is chosen, wait at least 30 minutes for electrode to stabilise prior to using it).
5. In order to measure $S^{2-}{}_{ISE}$ a 1:1 volume ratio of SAOB to sediment is required. Place 10 mL of SAOB in a small plastic or glass graduated container and then add surface sediment (0 – 2cm depth) until the meniscus is at the 20mL gradation (always add SAOB first).
6. Briefly stir the mixture and then insert the Ag+/S= electrode into the sample. Ensure the tip of the electrode is fully covered by the SAOB/sediment slurry. Gently move the electrode in the slurry until the electrode stabilises. Depending on the electrode, a 'Ready' message appears on the meter screen and/or a beep is heard (typically requiring 1 – 4 minutes to stabilise).
7. Gently wipe the electrode and remove all sediment prior to insertion into the next sample.
8. Any oily residue on the electrode must be removed prior to further use.
9. If potentials recorded with the Ag+/S= electrode in a sediment sample do not stabilise in 1 – 2 minutes, performance can be assessed by determining the $S^{2-}{}_{ISE}$ concentration in one of the working standards that has been stored in a dark cooled container with a minimum head space. Do not attempt to correct the data for drift if deviations are less than 10 – 20% of expected standard values. If measured values have a greater deviation than the expected value a full recalibration should be performed following the calibration protocols.
10. Upon completion of sediment measurements rinse the electrode and drain filling solution (unless electrode will be used within week).

Sulfide (Ag+/S=) Electrode Calibration

Ag+/S= electrodes shall be calibrated before the start of each sampling event and recalibrated a minimum of every 3 hours during an analytical session.

The following protocols are generic to the Ag+/S= electrode. Specific models may have slightly different specific requirements and the operator must be familiar with the model prior to calibrating the electrode. If routinely used, Ag+/S= combination electrodes should be replaced every couple of years as they tend to become less accurate due to wear and tear.

S^{2-} Calibration Solutions:

***Stock Standard*:**

Working in a fume-hood or well-ventilated area, add 0.2402g $Na_2S{\cdot}9H_2O$ to a volumetric flask containing 100 mL of de-aerated deionised water. Swirl until dissolved. Store this 10,000µM stock standard in a refrigerated in dark, air-tight bottle with minimum head space. The stock solution expiration period is two days. Stock standards should be prepared strictly according to Standard Method 4500-S^{2-} (APHA 2017), which provides information on the safe handling and storage of the stock crystals, and the verification of the prepared stock concentration using titration methods (e.g. Iodometric Standard Method 4500-S^{2-}-F).

***Working Standards*:**

Prepare a serial dilution (10,000 μ M, 1,000 μ M, 100 μ M and 10 μ M (if required) of S^{2-} standards immediately before calibrating the Ag+/S= combination electrode by transferring 10mL of the 10,000 μ M Na_2S stock solution into a volumetric flask and diluting with 90mL of de-aerated, deionised water. This procedure is repeated sequentially using 10mL of each successive standard and diluting with 90mL of de-aerated, deionised water. The de-aerated, deionised water must be at a similar temperature as that of the sediment to be sampled. The working standard expiration period is 3 hours.

10,000 μ M, 1,000 μ M, 100 μ M three working standards are recommended for the 3-point calibration. If samples are expected or found to have 'S' concentrations below 100 μ M then a 10 μ M standard should be prepared to create a 3-point calibration series consisting of 10 μ M, 100 μ M and 1,000 μ M. 'S' solutions below 100 μ M are unstable and these values are also at the minimum sensitivity of most commercially available Ag+/S= combination electrodes.

Calibration Procedure:

1. Calibration of the Ag+/S= combination electrode is to be carried out by working from the lowest to highest concentration in a standard 3-point series. A fixed volume of a standard is diluted with an equal volume of SAOB (1:1 by volume) immediately before each potential is measured.
2. The range of standards used for the 3-point calibration should bracket the range of sulfide concentration expected in the sediment samples.
3. mV potentials are stored by the multimeter after they become stable (usually between 1 – 3 minutes depending on the make of the meter).
4. Upon completing the measurement of the third standard instruct the meter to calculate the slope of the concentrations. The theoretical slope is -28mV for each 10-fold increase in the 'S' concentration but because of temperature sensitivities and differences in electrodes the

accepted range of values for the slope is between -27 to -33. If the slope is outside this range, repeat the calibration using fresh standards (also check the cleanliness of the probe, filling solution level, battery function, etc. prior to recalibrating).

5. Following calibration, rinse the electrode with deionised water and blot dry before measuring the first sample.

Materials List

- Ag+/S= combination electrode and appropriate filling solution.
- Multimeter.
- NaOH (sodium hydroxide) crystals.
- EDTA (ethylene diamine tetra acetic acid disodium salt dehydrate).
- L-ascorbic acid.
- De-aerated, de-ionised water
- $Na_2S{\cdot}9H_2O$ crystals.
- Assorted glasswear and pipettors.

7.8.3 Redox Potential (*Eh*)

Eh can be measured directly in the grab/core using an Oxidation Reduction Potential (ORP) probe that uses a silver/silver chloride or platinum reference electrode. The ORP probe must be calibrated, operated and maintained according to strict manufacturer specifications. ORP measurements (referred to as ORP, $E_{Ag/AgCl}$ or E_{Pt}), are by themselves ambiguous and it is only through specifying the reference scale that the data be interpreted. ORP measurements converted to a hydrogen scale are reported as '*Eh*' and some publications designate the same measurements as Eh_{NHE}. ORP data (mV) obtained in the field with Ag/AgCl or Pt electrodes are converted to the hydrogen scale as follows:

$$Eh = \text{ORP (mV)} + \text{half-cell potential of reference electrode,}$$

Where the half-cell potential of the Ag/AgCl or Pt reference electrode is related to the molarity of the probe filling solution and measurement temperature (see Table 12).

Table 12 Half-cell potential of Ag/AgCl reference electrode.

T (°C)	Molarity of KCl (Potassium chloride) filling solution				
	1.5M	3M	3.3M	3.5M	4M
5	254	224	220	219	219
10	251	220	217	215	214
15	249	216	214	212	209

T (°C)	Molarity of KCl (Potassium chloride) filling solution				
	1.5M	3M	3.3M	3.5M	4M
20	244	213	210	208	204
25	241	209	207	205	199
30	238	205	203	201	194

Standard Operating Procedure

1. ORP readings are conducted at the same time as porewater is being extracted for S^{2-}_{UV} analysis.
2. The ORP probe is inserted directly into the sediment surface inside the core/grab. Gently mix the surface sediment (0 and 2cm depth) around the probe location with the probe and leave the probe in the mixed sediment area. Ensure full contact between the ORP electrode tip and wet sediment.
3. The ORP mV reading should stabilise within 1–2 minutes. If redox conditions are not controlled by single oxidation-reduction reactions, as in oxic sediments, there is often a slow, continuous drift of electrode potentials. An arbitrary time (3–4 minutes) can be chosen to record mV readings if they do not stabilise sooner. Potentials in reduced sediments usually stabilise more rapidly.
4. Record the sediment sample temperature.
5. Correct the ORP potential (mV) relative to the normal hydrogen electrode as described above using manufacturer information on the electrode filling solution and the recorded sediment temperature.

Materials List

- A rugged Oxidation Reduction Potential probe (e.g. Hamilton Polyplast ORP BNC).
- A compatible waterproof portable mV meter with temperature probe (e.g. Hanna HI9126).
- ORP electrode storage solution.
- ORP buffer solutions with known mV readings for instrument testing.

7.8.4 pH

As with the *Eh* measurements, pH is to be measured directly in the grab/core with an electrode. The pH can be measured either with an ordinary glass electrode or with an Ion Specific Field Effect Transistor (ISFET) based device. The ISFET sensors are very robust in comparison with glass electrodes and are available with a conic tip that can be inserted into the sediment. The pH electrode potentials are temperature dependent, so the pH meter must be equipped with temperature compensation.

1. The pH electrode is set up and calibrated according to the manufacturer instructions. A two-step calibration of the electrode is carried out on the site before measurements begin using two buffers with a pH of 7.0 and 4.0.
2. The electrode is ready for use when it gives stable readings when placed in a container with freshwater or a buffer. Stir occasionally.
3. The pH electrode is inserted to a depth of 1cm into the sediment and kept as stable as possible. The pH value is read and recorded when the value is stable.
4. Between samples, the electrode is rinsed and kept in a buffer with the same temperature as the samples.
5. Regular checking of the pH of the buffer allows the electrode accuracy to be monitored. Discrepancies larger than 0.2 pH units from the first measured value require recalibrating the electrode.

Materials List

- Field pH meter.
- pH electrode (glass combination electrode set or ISFET electrode).
- Buffers with pH 4.0 and pH 7.0 and distilled water.

7.8.5 Total Ammonia Nitrogen (TAN)

Hach® Company gained USEPA Equivalence on a simple salicylate method for use in wastewater based on the TNTplus™ Ammonia Nitrogen platform. This is a simple, cost-effective, 15-minute test, requiring no calibration and 0.5mL of porewater.

Standard Operating Procedure

1. Extract porewater directly inside the grab sample as described in Section 7.8.1 for Total Free Sulphide - UV Spectrophotometry (S^{-2}_{UV}).
2. Analyse the sample as soon as possible. During TAN analysis, the pH of the porewater sample must be between 4 and 8, and the temperature of the sample and reagents must be between 20–23°C.
3. Pipette 0.5mL of sample into the TNT 831 DosiCap vial and, with the cap on, shake vigorously. Warm the sample in a water bath if necessary.
4. After 15 minutes, clean the outside of the vial and insert it into the reader. Select the TNT 831 method for the spectrophotometer and press 'READ'.
5. The test procedure is to be evaluated monthly using a 10mg/L NH_3-N Wastewater Effluent Ammonia Nitrogen Standard Solution.

Materials List

- Hach DR1900 portable spectrophotometer.
- Hach TNTplus 831 Low Range (1-12 mg/L NH3-N) reagent kits, which each contain 25 test vials.

- Hach 10 mg/L NH_3-N Wastewater Effluent Ammonia Nitrogen Standard Solution.
- Pipette and tips.

7.8.5.1 TAN - Determination of the Moderate EQS Category Threshold

TAN consists of ammonium ion (NH_4^+) and un-ionised ammonia (NH_3). NH_3 makes up a higher proportion of TAN at higher pH and is typically associated with most of its toxic effects. Given the effects of temperature and pH on the speciation and toxicity of TAN, the Moderate EQS threshold from Table 1 (1.9 mg/L) only applies to sediment sample conditions of pH 7 and 20°C. The following formula shall be used to determine the Moderate EQS threshold to be applied to other pH and temperature sediment sample conditions:

$$\text{TAN Moderate EQS threshold } \left(\frac{\text{mg}}{\text{L}}\right) = 0.8876 \times \left(\frac{0.0278}{1+10^{7.688-pH}} + \frac{1.1994}{1+10^{pH-7.688}}\right) \times (2.126 \times 10^{0.028\times(20-T)})$$

Where the TAN Moderate EQS threshold is calculated for each sampling zone using the average temperature (T, in °C) and pH measurements of the sampling zone.

Appendix 8 Methods for measuring water quality

This Appendix details the methods for all water quality measurements and calculations as required in Criterion 2.6. Some calculations are only required for certain waterbody types as classified in Indicator 2.6.4, while others are applicable across all waterbodies.

Section	Waterbody Type Applicability
8.1 Introduction	
8.2 Total Nitrogen (TN) and Total Phosphorous (TP) load	A, B and C
8.3 Percentage of fines in feed	A, B and C
8.4 Receiving waterbody classification	A, B and C
8.5 Waterbody Unit of Management	A
8.6 Components of a Water Quality Monitoring Network	A
8.7 Site level monitoring and baseline characterisation	A
8.8 Point source effluent measurement	B
8.9 Effluent flow contribution	B
8.10 Dissolved oxygen measurement	A, B and C
8.11 Water quality analytical methods	A, B and C

8.1 Introduction

The water quality monitoring methods are based on the type of waterbody in which a site is situated and the type of effluent discharge from the culture system.

The first sections of the Appendix, sections 8.2 to 8.4, apply to all waterbody types and culture systems. They include methods to calculate nutrient releases, fines in feed and how to classify the type of receiving waterbody.

The methods in sections 8.5 to 8.7 outline the steps to determine the Waterbody Unit of Management, form a collaborative network with other aquaculture sites, how to conduct a 24-month water quality monitoring survey and characterise the baseline of the waterbody. These sections apply to sites located in waterbodies that are the most sensitive to nutrient loading, based on the classification outlined in section 8.4.

Calculations can be made using the ASC Water Quality Calculator provided by ASC.

For culture systems with point source discharges, methods outlined in sections 8.8 to 8.10 determine the steps to measure nutrients in effluent waters, calculate the effluent flow contribution to the receiving waterbody and monitor dissolved oxygen.

ASC has benchmarked the ASC Farm Standard methods for water quality against applicable regulatory requirements. Outcomes of the benchmark are available via the ASC Programme Centre.

8.2 Total Nitrogen and Total Phosphorous load (Indicators 2.6.1 and 2.6.2)

To calculate Total Nitrogen (TN) and Total Phosphorous (TP) load per tonne of production, one of the four following formulas shall be used per site:

- **Formula 1:** shall apply to sites in Type A, B and C waterbodies releasing diffuse source effluents.
- **Formula 2:** shall apply to pond-based sites with point-source effluents discharging directly (i.e. without treatment) to Type A or B waterbodies. This formula requires knowledge of the effluent volume.
- **Formula 3:** shall apply to pond-based sites that have some form of effluent treatment. Sites shall control and measure nutrient levels and volumes of effluents entering Type A or B waterbodies. This formula requires estimation of daily water exchange to determine the effluent volume and is most suitable for earthen pond-sites with < 10% daily water exchange.
- **Formula 4:** shall apply to some land-based sites discharging to Type B or C waterbodies that do not need to record effluent water quality.

Unless otherwise stated, all values shall apply over the previous 12-month period. Net production volume shall be calculated using the following formula:

$$\begin{aligned} &Net\ production\ volume\ (tonnes) \\ &\quad = (harvested\ volume\ (tonnes) + other\ removed\ volume\ (tonnes)) \\ &\quad - stocked\ volume\ (tonnes)) \end{aligned}$$

Formula 1:

TN load shall be calculated using the following formula:

$$TN\ load\ (kg\ tonne^{-1}) = \frac{TN\ release\ (kg)}{net\ production\ volume\ (tonnes)}$$

- TN release (kg) shall be the difference between the TN added to the system in feed (TN feed (kg)) and the TN in animals. It is calculated as follows:

$$TN\ release\ (kg) = TN\ in\ feed\ (kg) - TN\ in\ animals\ (kg)$$

- TN in feed shall be equal to the mass of feed used (tonnes, dry weight) multiplied by the feed TN content:

$$TN\ in\ feed\ (kg) = Feed\ use\ (tonnes/year) \times TN\ content\ feed\ (\%)\ \times 10$$

- The mass of TN in animals shall be calculated as follows:

$$TN\ \ in\ animals\ (kg) = net\ production\ volume\ (tonnes/year) \times TN\ in\ animals\ (\%) \times 10$$

- TP load shall be calculated using the following formula:

$$TP\ load\ (kg\ tonne^{-1}) = \frac{TP\ release\ (kg)}{net\ production\ volume\ (tonnes)}$$

- TP release (kg) shall be the difference between the TP added to the system in feed (TP feed (kg)) and the TP in animals. It shall be calculated as follows:

$$TP\ release\ (kg) = TP\ in\ feed\ (kg) - TP\ in\ animals\ (kg)$$

TP in feed shall be equal to the mass of feed used (tonnes, dry weight) multiplied by the feed TP content:

$$TP\ in\ feed\ (kg) = Feed\ use\ (tonnes/year) \times TP\ content\ feed\ (\%) \times 10$$

- The mass of TP in animals shall be calculated as follows:

$$TP\ in\ animals\ (kg) = net\ production\ volume\ (tonnes/year) \times TP\ in\ animals\ \ (\%) \times 10$$

Formula 2:

TN load shall be calculated using the following formula:

$$TN\ load\ (kg\ tonne^{-1}) = \frac{TN_{out}\ (kg) - TN_{in}\ (kg)}{net\ production\ volume\ (tonnes)}$$

- Where TN out (kg) and TN in (kg) shall be the mass of TN in effluent and influent water respectively.
- TN out shall be calculated from the mean TN concentration in effluent, [TN] effluent (mg/L, which is equal to g/m^3), effluent volume (m^3), and a scaling factor of 0.001:

$$TN_{out}\ (kg) = [TN]_{effluent}\left(\frac{mg}{L}\right) \times 0.001\ \times volume_{effluent}\ (m^3)$$

- TN in shall be calculated from mean TN concentration in influent, [TN] influent (mg/L, which is equal to g/m^3), influent volume (m^3), and a scaling factor of 0.001:

$$TN_{in}\ (kg) = [TN]_{influent}\left(\frac{mg}{L}\right) \times 0.001\ \times volume_{influent}\ (m^3)$$

- TP load shall be calculated as follows:

$$TP\ load\ (kg\ tonne^{-1}) = \frac{TP_{out}\ (kg) - TP_{in}\ (kg)}{net\ production\ volume\ (tonnes)}$$

- Where TP out (kg) and TP in (kg) shall be the mass of TP in effluent and influent water respectively.

- TP out shall be calculated from mean TP concentration in effluent, [TP] effluent (µg/L, which is equal to mg/m³), effluent volume (m³), and a scaling factor of 0.000001:

$$TP_{out}\ (kg) = [TP]_{effluent}\left(\frac{\mu g}{L}\right) \times 0.000001\ \times volume_{effluent}\ (m^3)$$

  - TP in shall be calculated from mean TP concentration in influent, [TP] influent (µg/L, which is equal to mg/m³), influent volume (m³), and a scaling factor of 0.000001:

$$TP_{in}\ (kg) = [TP]_{influent}\left(\frac{\mu g}{L}\right) \times 0.000001\ \times volume_{influent}\ (m^3)$$

Formula 3:

The average daily water exchange rate (%/day x 0.01), multiplied by the total pond volume, multiplied by the numbers of days in a year shall give a proxy for the daily effluent volume and influent volume respectively. This formula assumes the influent volume equals the effluent volume.

Annual TN load shall be calculated using the following formula:

$$TN\ load\ (kg\ tonne^{-1}) = \frac{([TN]_{effluent}\ (mg/L) - [TN]_{influent}\left(\frac{mg}{L}\right)) \times volume_{pond}\ (m^3)) \times daily\ water\ exchange\ (\%/day\ \times 0.01) \times days\ (n)}{net\ production\ volume\ (tonnes)} \times 0.001$$

  - Days (n) shall be the number of days during the previous 12 months in which ponds were operational. If the ponds were in continuous operation, the daily value (above) shall be multiplied by 365 to obtain the TN load over a 12-month period.
  - $[TN]_{effluent}$ and $[TN]_{influent}$ shall be the mean TN concentrations in effluent and influent respectively.
  - $Volume_{pond}$ shall be the average water volume of all ponds at the site over the 12-month period on days in which ponds were operational.
  - Daily water exchange shall be the percentage of the total pond volume of all ponds in production at the site that is renewed each day divided by 100. For example, if daily 10% of the total pond volume at the site is renewed, then the daily water exchange is 10/100 = 0.1

Daily Total P load shall be calculated using the following formula:

$$TP\ load\ (kg\ tonne^{-1}) = \frac{([TP]_{effluent}\ (\mu g/L) - [TP]_{influent}\left(\mu\frac{g}{L}\right)) \times volume_{pond}\ (m^3)) \times daily\ water\ exchange\ (\%/day\ \times 0.01) \times days\ (n)}{net\ production\ volume\ (tonnes)} \times 0.000001$$

  - Days (n) shall be the number of days during the previous 12 months in which ponds were operational.
    - If the ponds were in continuous operation, the daily value (above) shall be multiplied by 365 to obtain the TP load over a 12-month period.

- $[TP]_{effluent}$ and $[TP]_{influent}$ shall be the mean of the TP concentrations in effluent and influent respectively.
    - $Volume_{pond}$ shall be the average water volume of all ponds at the site over the 12-month period on days in which ponds were operational.
    - Daily water exchange shall be the percentage of the total pond volume of all ponds in production at the site that is renewed each day divided by 100. For example, if daily 10% of the total pond volume at the site is renewed, then the daily water exchange is 10/100 = 0.1

Formula 4:

Nutrient loads shall be calculated using the following formula:

$$TN\ load\ (kg\ tonne^{-1}) = \frac{TN\ input\ (kg) \times 0.3}{net\ production\ volume\ (tonnes)}$$

$$TP\ load\ (kg\ tonne^{-1}) = \frac{TP\ input\ (kg) \times 0.2}{net\ production\ volume\ (tonnes)}$$

- TN input (kg) shall be the TN input from feed and fertiliser combined over the preceding 12 months. e.g. if a feed contains 5% TN and 100kg is used, then the TN input is 5kg.
- TP input (kg) shall be the TP input from feed and fertiliser combined over the preceding 12 months.

8.3 Percentage of fines in feed (Indicator 2.6.3)

The site shall determine the percentage of fines in feed using one of the two methods outlined below. Testing shall take place either on-site (**Appendix 8 (8.3.1)**) after feed has been delivered to the site, or by the feed manufacturer prior to the feed arriving on-site (**Appendix 8 (8.3.2)**).

8.3.1 On-site testing

This method shall be used when the percentage of fines is determined on-site. The method encompasses the sampling and testing of feed and the calculation of fines. The determination of fines shall be conducted when the feed is delivered to site.

Feed sampling

The steps to conduct the sampling of feed **lots** per site are as follows:

1. A minimum of six samples shall be taken from the lot, evenly distributed throughout the lot.
2. Each sample shall have a mass of 500g.
3. A pooled sample shall be created from the six individual samples (i.e. total of 3kg based on six samples of 500g).
4. The pooled sample shall be reduced to one sample for testing of 500g.

Feed testing

Feed testing can be conducted by either a manual test or by using a sifting machine. The sample of fines shall be sieved with a sieve of a maximum sieve opening of:

- 1mm when the feed diameter is ≤5mm; or
- 2.36mm when the feed diameter is >5mm.

Manual feed testing

The steps to conduct the testing are as follows:

- The sieve shall be placed on top of the fines accumulation box. The type of sieve (based on the maximum sieve opening) shall be determined based on the feed diameter.
- The sieve shall be placed on the balance and tared.
- The sample shall be weighed on the sieve, note the weight (m0).
- The feed shall be sieved smoothly and carefully for about 30 seconds.
- The lid shall be removed and the fines remaining in the accumulation box shall be weighed.
- A brush shall be used to remove all the feed particles from the sieves.
- The feed particles that have passed through the sieve are called fines (md).
- If the feed is fatty, or if the fines that have passed through the sieve are unevenly distributed, the test shall be replicated.

Sifting machine feed testing

The steps to conduct testing with a sifting machine are as follows:

1. The sieve shall be placed on top of the fines accumulation box. The type of sieve (based on the maximum sieve opening) shall be determined based on the feed diameter.
2. The sieve shall be placed on the balance and tared.
3. The analysis sample shall be weighed on the sieve, note the weight (m0).
4. The sieve shall be placed on the sifting machine and then the cover shall be closed properly.
5. The sifting machine shall run 2 x 1 minute.
6. The lid shall be removed and the fines remaining in the accumulation box shall be weighed.
7. The feed particles that have passed through the sieve are called fines (md).
8. If the feed is fatty, or if the fines that have passed through the sieve are unevenly distributed, the test shall be replicated.

Calculations - both methods:

The following equation shall be used to calculate the percentage of fines in the feed sampled: fines percentage (%) = (md/m0) x 100.

1. m0 = weight of feed before sieving.
2. md = weight of fines that has passed through all sieves.

8.3.2 Feed manufacturer testing

If fines testing is conducted by the feed manufacturer, results shall demonstrate a <0.25% difference between manufacturer-tested fines content and on-site tested fines content. Either the manual feed testing or sifting machine feed testing method shall be used to determine on-site fines content.

The requirements for feed manufacturer testing are as follows:

- One full year of quarterly on-site tests shall be collected, with resulting values <1% fines and a difference between manufacturer and on-site testing <0.25% fines content.
- If this is achieved, on-site sampling shall be conducted at least once per year to validate the quarterly test results received by the manufacturer.
- On-site sampling shall revert to every quarter for another year (12 months) if at least one of the following applies:
  - On-site sampling results show a >0.25% difference in fines compared to the results from the manufacturer; or
  - There is a change in feed supplier; or
  - There is a substantial change to transport, handling or storage of feed.

8.4 Receiving Waterbody classification (Indicator 2.6.4)

The site shall classify the Receiving Waterbody (RW) according to Table 1 based on:

- The default waterbody type, or
- The result of the Hydraulic Retention Time (HRT), flow rate and Total Suspended Solids (TSS) calculations (**Appendix 8 (8.4.1)**). These classification parameters determine the sensitivity of a waterbody to nutrient loading.

Table 1. Overview of the Receiving Waterbody types and thresholds for the classification parameters.

Receiving Waterbody Type	Default Waterbody Type	Hydraulic retention time (HRT) and flow rate/total suspended solids (TSS) thresholds
Type A	Default for enclosed freshwater and semi-enclosed marine/brackish waterbodies unless Type C requirements are met	HRT ≥5 days
Type B	Default for confined or linear waterbodies not classified as Type A and unless Type C requirements are met	HRT <5 days
Type C	Default for channelised waterbodies, exposed near-shore and offshore marine/brackish waterbodies Flow rate and TSS are used to distinguish between Types B and C freshwater and brackish systems only	HRT <5 days Flow rate is >1000m^3/s, or TSS is >20mg/L at low flow

8.4.1 Hydraulic Retention Time (HRT)

HRT shall be calculated using the following formula, where HRT is used to classify the RW (according to **Table 1**):

$$\text{Mean Hydraulic Retention Time (days)} = \left(\frac{1{,}000{,}000 * \text{A} * \bar{\text{z}}}{(86{,}400 * \text{Q})}\right)$$

- Q (m^3/s) = the steady state (long-term) average flow rate through the waterbody outflow.
- A (km^2) = the surface area of the waterbody.
- $\bar{z}$ (m) = the mean depth of the waterbody.

8.4.1.1 Flow rate calculation

Flow rate data is required to calculate the HRT of the RW. The method to calculate flow rate is based on the characteristics of the waterbody:

Marine waterbodies:

a. Flow rate shall be calculated as the mean current speed (flow velocity (m/s)) through the waterbody outflow, multiplied by the cross-sectional area (m^2) of the waterbody outflow.

Freshwater and brackish waterbodies:

b. Four (quarterly) measurements shall be taken upstream from the outflow point in a calendar year.

c. Measurements shall be taken during periods of medium and low tidal flow.

d. Low flow shall be determined as the lowest of the four flow measurements taken in a calendar year.

e. Flow rate (Q) (m^3/s) shall be calculated as the mean current speed (flow velocity (m/s)) multiplied by the cross-sectional area (m^2) at a location immediately upstream from the outflow point.

8.4.1.2 Determination of total suspended solids (TSS) at low flow

Flow rate and TSS calculations are used to distinguish between Type B and C freshwater and brackish waterbodies only (TSS is >20mg/L at low flow, according to **Table 1**). The following method shall be used to determine TSS:

- Samples shall be collected during periods of medium and low flow (and can be the same time as flow rate data is collected).
- Samples shall be collected at approximately 0.5m from the surface.
- Samples shall be analysed according to the analytical methods in **Appendix 8 (8.11)**.

8.5 Waterbody Unit of Management (WUM) (Indicator 2.6.5)

A Waterbody Unit of Management (WUM) is the geographic or spatial scope of the waterbody. The WUM shall be defined per site and include information on aquaculture sites discharging effluents in the waterbody.

Using one of the following methods, the site shall demonstrate that a WUM has been created per site:

- Where a WUM has not been defined, the site shall define a new WUM[136]; or,
- Evidence of an existing defined WUM shall be presented; or,
- Evidence that a WUM has been defined by a national or regional regulatory body for the jurisdiction in which a site is located shall be presented.

A map shall be created or presented for the WUM which indicates the following characteristics:

[136] The site can submit information to the ASC Water Quality Advisory Committee (WQAC) to resolve issues with defining the spatial scope of the WUM. More information on the process can be found here.

- The spatial boundaries of the WUM. Semi-enclosed waterbodies (for example a bay) within a larger waterbody shall equate to the WUM by default.
- The distribution of all operational aquaculture sites releasing effluents into the WUM, including cages and any land-based sites, further differentiating ASC-certified sites, non-certified sites belonging to ASC Certificate Holders, ASC applicants and non-certified sites.
- Any sites discharging effluents to a river or channel flowing into a Type A waterbody located <1km upstream of the river/channel mouth.
- Any zones identified for future aquaculture farming expansion.
- The location of the sampling sites for the members of the Water Quality Monitoring Network, according to the method outlined in **Appendix 8 (8.7)**.
- The map shall be accompanied by a written rationale explaining the basis for the boundary setting. The map shall be revised on an annual basis (if required) to reflect any changes in these characteristics.

8.6 Components of a Water Quality Monitoring Network (Indicator 2.6.7)

The intent of the Water Quality Monitoring Network (WQMN) is to establish a mechanism for collaboration and the sharing of information between aquaculture sites in Type A waterbodies. This will provide the foundation for an Area Management Agreement (AMA) in a future version of the ASC Farm Standard.

Based on the WUM characterised according to the method outlined in **Appendix 8 (8.5)**, the site shall establish, join a WQMN or present evidence of an area-based approach to manage water quality at a national level.

The steps to establish a WQMN per site are as follows:

1. Outreach shall be conducted to ASC-certified sites and non-certified sites belonging to ASC Certificate Holders within the defined WUM. This will determine the members of the WQMN.
2. A Terms of Reference (ToR) document shall be developed, outlining how the members will meet the objectives of the WQMN regarding the sharing of water quality data.
3. A focal point shall be appointed to coordinate data sharing and collective agreement of the ToR of the WQMN.
4. Where a WQMN has been established in the WUM, the site shall join the WQMN and agree to the ToR and meet the objectives of the WQMN.

If water quality is managed using an area-based approach by the national or regional regulatory body in which a site is located, the site shall present evidence demonstrating that the area-based approach meets the requirements of the WQMN, as outlined in **Appendix 8 (8.6.1)**.

8.6.1 WQMN Requirements

The requirements of the WQMN are as follows:

- Members shall agree upon, and define the boundaries of, the WUM.

- Data sharing shall take place between members. This shall include:
  - The locations of the water quality monitoring site locations for the site level monitoring survey, according to the method outlined in **Appendix 8 (8.7)**; and
  - The results of the monitoring surveys and baseline characterisations to determine the baseline for the waterbody, according to the method outlined in **Appendix 8 (8.7)**; and
  - Results of the BOD calculations per site, according to the method outlined in **Appendix 8 (8.7.3)**; and
  - Information relating to scenarios indicating excessive nutrient loading, as outlined in Indicator 2.6.12, if one of these scenarios has been determined.

8.7 Site level monitoring survey and baseline characterisation(Indicators 2.6.8 to 2.6.12)

The site level monitoring survey outlines a method to collect data to establish the trophic status and baseline characterisation of Type A waterbodies.

8.7.1 Site level monitoring survey

The steps to conduct the monitoring survey per site are as follows:

1. At the initial audit, 24 months of baseline data shall be presented if available.
   a. Where 24 months of baseline data is not available, 12 months of baseline shall be presented.
   b. If no baseline data is available, a sampling plan shall be presented which outlines the method to initially collect 12 months, and subsequently, 24 months of baseline data.
2. The following parameters shall be monitored: dissolved oxygen (DO) concentration and percent saturation, Secchi disk (SD) depth, Chlorophyll-a (Chl-a), Total Nitrogen (TN) and Total Phosphorus (TP) nutrient concentrations.
3. Sampling shall be conducted at two locations as follows:
   a. **A 'downstream, near-field' impacted location:** immediately downstream of the site. This shall be the same location for each sampling event.
   b. **An 'upstream, far-field' non-impacted reference location:** at a minimum 500m upstream from the site. This shall be the same location for each sampling event.
   c. The sampling locations shall be identified with GPS coordinates on the map of the WUM.
4. Sampling shall be repeated quarterly over a 12-month period to capture seasonal variations.
5. Water quality samples shall be collected at each sample location at 0.5-1.0m depth below the water surface.
6. Samples of TN concentration, TP concentration, TSS (where applicable) and Chl-a shall be collected and analysed, according to the methods outlined in **Appendix 8 (8.11)**.

7. SD depth and the depth of thresholds at which DO=4mg/L ('zone of oxygen depletion') and DO=2mg/L ('zone of anoxia') shall be measured.
8. DO measurements shall take place with a calibrated temperature compensated probe with suitably extended cable length.
    a. If a DO threshold is not reached at either 50m depth or 1m off the bottom, this shall be recorded as the depth of DO depletion.

8.7.2 Trophic status

The steps to determine trophic status are as follows:

1. The results of the 24-month site level monitoring survey shall be submitted per site to ASC, in accordance with the ASC Data Submission Procedure.
2. The ASC Water Quality Calculator will use the submitted data to determine the baseline trophic status at the two sampling locations (see **Appendix 8 (8.7.1)**) and for each of the four classification parameters[137] (see Table 2).
3. After the initial baseline trophic status has been determined, quarterly monitoring data shall be submitted to MyASC, in accordance with the ASC Data Submission Procedure.
4. The ASC Water Quality Calculator will determine whether there has been a change in trophic status compared to the baseline trophic status of the RW (at either of the two sampling locations in **Appendix 8 (8.7.1)**).

Table 2. The Trophic Status Index (TSI) for four classification parameters: Secchi depth (SD), total phosphorous (TP) concentration, total nitrogen (TN) concentration and Chlorophyll-a (Chl-a).

TSI	Status	SD (m)	[TP] (µg/L)	[TN] (mg/L)	[Chl] (µg/L)
<30	Ultra-oligotrophic	≥8	<6	<0.18	<0.9
≥30-<40	Oligotrophic	≥4 - <8	≥6 - <12	≥0.18 - <0.37	≥0.9 - <2.6
≥40-<50	Mesotrophic	≥2 - <4	≥12 - <24	≥0.37 - <0.73	≥2.6 - <7.3
≥50-<60	Eutrophic	≥1 - <2	≥24 - <48	≥0.73 - <1.46	≥7.3 - <20

[137] SD should only be used where the TSI is <40, indicative of oligotrophic conditions, as it becomes progressively less reliable as a trophic status indicator above this level.

TSI	Status	SD (m)	[TP] (µg/L)	[TN] (mg/L)	[Chl] (µg/L)
≥60	Hyper-eutrophic	<1	≥48	≥1.46	≥20

8.7.3 Biological oxygen demand (BOD) calculation

BOD shall be calculated per site per closed calendar year, based on:

- Feed properties: (Total Nitrogen (TN) and Total Carbon (TC) content); and,
- Feed use; and,
- Fertiliser properties (TN and TC content) (where applicable);
- Fertiliser use (where applicable);
- Production volume; and,
- Animal properties (Nitrogen (N) and Carbon (C) content).

BOD shall be calculated according to the following formula:

$$BOD\ (kg\ O2) = \Big(\big((TN\ in\ feed\ (kg) + TN\ in\ fertiliser\ (kg)) - TN\ in\ animals\ (kg)\big) \times 4.57\Big) + \Big(\big((TC\ in\ feed\ (kg) + TC\ in\ fertiliser\ (kg)) - TC\ in\ animals\ (kg)\big) \times 2.67\Big)$$

- TN in feed (kg) = Feed use (tonnes/year) x TN content feed (%) x 10
  - Where TN content feed (%) shall be the TN in the feed (value between 0-100)
- TC in feed (kg) = Feed use (tonnes/year) x TC content feed (%) x 10
  - Where Total Carbon (TC) content feed (%) shall be the TC in the feed (value between 0-100)
- TN in fertiliser (kg) = Fertiliser use (tonnes/year) x TN content fertiliser (%) x 10
  - Where TN content fertiliser (%) shall be the TN in the fertiliser (value between 0-100)
- TC in fertiliser (kg) = fertiliser use (tonnes/year) x TC content fertiliser (%) x 10
  - Where Total Carbon (TC) content fertiliser (%) shall be the TC in the fertiliser (value between 0-100)
- TN in animals (kg) = (Net production volume (tonnes/year) x TN content animals (%) x 10
  - Where TN content animals (%) shall be the crude TN content at harvest of the whole animal (not only edible part) as a percentage of the wet weight (value between 0-100)
- TC in animals (kg) = Net production volume (tonnes/year) x TC content animals (%) x 10
  - Where TC content animals (%) shall be the crude, TC content at harvest of the whole animal (not only edible part) as a percentage of the wet weight (value between 0-100).

- Net production volume (tonnes/year) = the increase in biomass in the indicated calendar year at the site, including known removed volume (e.g. mortalities).
- Feed use (tonnes/year) = the feed used at the site in the indicated calendar year.
- Fertiliser use (tonnes/year) = the fertiliser used at the site in the indicated calendar year.

8.7.4 Baseline characterisation

The results of the site level monitoring survey shall be used to characterise the baseline of the RW per site. The steps to characterise the baseline are as follows:

1. The ASC Water Quality Calculator data submission shall be completed in MyASC per site with the following information, in accordance with the ASC Data Submission Procedure:
    - The results of the site level monitoring survey; and,
    - The results of measurements used to calculate the HRT for the RW (**Appendix 8 (8.4)**):
        - Flow rate (Q; m^3/s); and,
        - Surface area of the RW (A; km^2); and,
        - Mean depth ($\bar{z}$; m).
    - Nutrient settling velocity (m/yr). A value of 8.91m/yr[138] shall be reported if the site has not determined settling velocity; and,
    - The number of (i) adverse turnover events and (ii) harmful algal blooms recorded over the last 10 years; and,
    - Data to calculate BOD, according to the method outlined in **Appendix 8 (8.7.3)**.
    - The submitted data will be used by the ASC Water Quality Calculator to characterise the baseline of the RW.
2. The site shall obtain the baseline of the RW based on the results from the ASC Water Quality Calculator. The baseline will determine:
    - The limiting nutrient(s): N-, P- or co-limited, of the RW; and,
    - The TSI, according to Table 2 in **Appendix 8 (8.7.2)**; and,
    - The result of the BOD calculation.
3. Ongoing quarterly monitoring data shall be submitted to ASC in MyASC, in accordance with the ASC Data Submission Procedure.

[138] Harrison, J.A., Maranger, R.J., Alexander, R.B. *et al.* The regional and global significance of nitrogen removal in lakes and reservoirs. *Biogeochemistry* **93**, 143–157 (2009). https://doi.org/10.1007/s10533-008-9272-x

4. The ASC Water Quality Calculator will determine whether there has been a change in the status of the limiting nutrients, TSI and/or BOD compared to the baseline characterisation.

8.8 Point source effluent measurement (Indicators 2.6.15 to 2.6.17)

The steps to conduct sampling of point source effluents are as follows:

1. Quarterly samples of TN, TP and TSS concentrations shall be taken per site upstream from the inflow point or at the inflow point, and in any effluent water from the outflow point.
2. Samples shall be taken per site at 0.5-1.0m depth below the water surface.
3. Samples of TN, TP and TSS shall be collected and analysed according to the methods outlined in **Appendix 8 (8.11)**.

8.9 Effluent flow contribution (Indicator 2.6.16)

The steps to determine the effluent flow contribution to the RW for sites discharging point-source effluents are as follows:

- Quarterly measurements of flow rate shall be taken at the inflow point and/or upstream from the inflow point and in the effluent water at the outflow point. This will determine the contribution of the effluent water to the natural flow of the waterbody.
- Measurements shall be taken during periods of medium and low flow, with measurements taken at low flow used to determine the flow contribution.
- Low flow shall be determined as the lowest of the quarterly flow measurements taken in a calendar year.

Alternative methods to determine flow rate shall be permitted if data is available from the point-source discharge or culture treatment system.

8.10 Dissolved oxygen measurement (Indicators 2.6.18 to 2.6.21)

Measurements of DO are used to determine whether limits on DO concentration (mg/L) and percent saturation (%) are met.

8.10.1 Diffuse-source effluent release measurements

One of the following methods shall be used to conduct sampling of DO at 5m depth per site:

Method 1

1. DO, temperature and salinity (where relevant) shall be measured twice daily.
2. GPS coordinates and the altitude of the sampling location shall be recorded.
3. Weekly DO concentrations shall be calculated based on the mean of all measurements made during the week.

Method 2

DO shall be measured by conducting continuous monitoring using an electronic probe and recorder, with a 15-minute sampling frequency for at least one week.

Method 3

DO shall be measured at a 'downstream, near-field' impacted location immediately downstream of the site, and at an 'upstream, far-field' non-impacted reference location at a minimum 500m upstream from the site.

8.10.2 Point-source effluent release DO measurements

One of the following methods shall be used to conduct sampling of DO at 0.5m depth per site:

Method 1

DO concentration (mg/L) shall be recorded at sampling locations immediately downstream from the outflow point where mixing is complete. The steps to conduct sampling of DO per site are as follows:

1. DO, temperature and salinity (where relevant) shall be measured twice daily.
2. In tidal systems, measurements shall be conducted at times which correspond with high and low tides.

Method 2

DO shall be measured by conducting continuous monitoring using an electronic probe and recorder, with a 15-minute sampling frequency for at least one week.

Method 3

DO shall be measured at a 'downstream, near-field' impacted location: immediately downstream of the site, and at an 'upstream, far-field' non-impacted reference location at a minimum 500m upstream from the site.

8.10.3 Daily diurnal dissolved oxygen fluctuation

Daily diurnal dissolved oxygen (DDDO) fluctuation shall be calculated according to the following formula:

$$DDDO = \left[\frac{\text{maximum dissolved oxygen (mg/L)}}{\text{tabulated dissolved oxygen at saturation}_{max}\ \text{(mg/L)}} \times 100\right] - \left[\frac{\text{minimum dissolved oxygen (mg/L)}}{\text{tabulated dissolved oxygen at saturation}_{min}\ \text{(mg/L)}} \times 100\right]$$

8.11 Water quality analytical methods (Indicators 2.6.8 to 2.6.11, 2.6.16 and 2.6.18)

Total Phosphorus (TP):

TP shall be measured in unfiltered 500ml samples collected in clear plastic bottles. These shall be placed on ice in a cooler and analysed within 48 hours.

A VanDorn, Kemmerer or Ruttner type sampler shall be used to collect water for field or laboratory analysis. Samples of TP shall be collected using one of the following methods:

- ISO 6878:2004 Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method.
- ISO 15681-2:2018 Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 2: Method by continuous flow analysis (CFA).
- 4500-P PHOSPHORUS: Standard Methods for the Examination of Water and Wastewater. Standard Methods Committee of the American Public Health Association, American Water Works Association, and Water Environment Federation. Accessed November 22, 2023: https://www.standardmethods.org/doi/10.2105/SMWW.2882.093
- United States Environmental Protection Agency: Method 365.3: Phosphorous, All Forms (Colorimetric, Ascorbic Acid, Two Reagent). Accessed June 12, 2026: https://www.epa.gov/sites/default/files/2015-08/documents/method_365-3_1978.pdf

Total Nitrogen (TN):

TN shall be measured in unfiltered 500ml samples collected in clear plastic bottles. These shall be placed on ice in a cooler and analysed within 48 hours.

A VanDorn, Kemmerer or Ruttner type sampler shall be used to collect water for field or laboratory analysis. Samples of TN shall be collected using one of the following methods:

- ISO 11905-1:1997. Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate.
- ISO 29441:2010. Water quality - Determination of total nitrogen after UV digestion - Method using flow analysis (CFA and FIA) and spectrometric detection.
- 4500-N NITROGEN. Standard Methods for the Examination of Water and Wastewater. Standard Methods Committee of the American Public Health Association, American Water Works Association, and Water Environment Federation. Accessed November 22, 2023: https://www.standardmethods.org/doi/10.2105/SMWW.2882.086

Total Suspended Solids (TSS):

TSS shall be measured in unfiltered 500ml samples collected in clear plastic bottles. These shall be placed on ice in a cooler and analysed within 48 hours.

A VanDorn, Kemmerer or Ruttner type sampler shall be used to collect water for field or laboratory analysis. Samples of TSS shall be analysed using one of the following methods:

- ISO 11923:1997. Water quality - Determination of suspended solids by filtration through glass-fibre filters.
- United States Environmental Protection Agency: Method 160.2. Accessed June 12, 2026: https://www.uvm.edu/bwrl/lab_docs/protocols/106.2_TSS_by_gravimetry_(EPA_1971).pdf
- 2540 SOLIDS. Standard Methods Committee of the American Public Health Association, American Water Works Association, and Water Environment Federation. Accessed November 22, 2023: https://www.standardmethods.org/doi/abs/10.2105/SMWW.2882.030?role=tab
- A method equivalent to 2540 SOLIDS.

Chlorophyll-a (chl-a) sensor:

Chl-a shall be measured in-situ using an electronic sensor and calibrated to manufacturer's instructions according to the following method:

- Chl-a shall be measured using ethanol extraction followed by spectrophotometric measurement at wavelengths 665 and 750nm (using accredited methods), or measured in-situ using a field spectrofluorometer. The spectrofluorometer shall be calibrated according to the following method:
  - Measurement range: 0 - 199µg/L chlorophyll-a.
  - Resolution: 0.1µg/L chlorophyll-a.
  - Accuracy: +/- 2% of reading.

Dissolved Oxygen (DO) sensor:

DO shall be measured in-situ using an electronic sensor and calibrated to manufacturer's instructions. The sensor shall record both percentage saturation and temperature corrected/compensated concentrations. The sensor shall be calibrated according to the following method:

- DO[139] readings shall be corrected for altitude and salinity where sites are located above sea level and/or discharge to brackish receiving waters.
- Range (Polarographic DO): 0.00 to 20.00mg/L
- % Saturation Range (Polarographic DO): 0.0 to 200.0% saturation
- Resolution (Polarographic DO): 0.01, 0.1mg/L

[139] Correction factors are available here: 'Dissolved oxygen solubility tables, accessed November 22, 2023: https://water.usgs.gov/water-resources/software/DOTABLES/

Appendix 9 Methods for Calculating Energy Use and Greenhouse Gas Emissions

This Appendix details the methods for calculating energy use and greenhouse gas (GHG) emissions as required by Criterion 2.10. It also provides GHG targets to guide development of GHG management plans.

Section
9.1 Introduction
9.2 Scope and timeframe for calculating energy use and GHG emissions
9.3 On-site energy use (Indicator 2.10.1)
9.4 GHG emissions (Indicator 2.10.2)
9.5 Target-setting for GHG management plans (Indicator 2.10.3)

9.1 Introduction

Measurement, reporting, and management of on-site energy use and GHG emissions are data and calculation-intensive processes. ASC strongly recommends the use of the ASC Greenhouse Gas Calculator (https://ghg.asc-aqua.org) to assist in undertaking calculations; it ensures correct methods and provides results consistent with the required reporting format. Other tools or frameworks may be used if it can be demonstrated that they follow the methodological requirements outlined in this Appendix.

9.2 Scope and timeframe for calculating energy use and GHG emissions

Both energy use and GHG emissions are calculated relative to a quantity of production. This requires that production data and input data (feeds, energy inputs, etc.) relate to a consistent timeframe. Given the differences between production cycles of different culture systems and species, two timeframe options may be used for calculations:

Option A. Calculate values for the most recently completed production cycle.

Option B. Calculate values for the three most recent consecutive years of production.

If insufficient data are available for initial audits, the UoC shall demonstrate how they will collect and calculate values once production data are available (after first production cycle if using Option A or, on an interim basis, after one year of continuous production if using Option B).

All energy use and GHG data calculations may be undertaken at a site-specific or multi-site scale. If calculating values for multiple sites together, all sites included shall farm the same species, use the same production method, and be located in the same country.

9.3 On-site energy use (Indicator 2.10.1)

Energy use of production is calculated as megajoules of energy per tonne of net live weight production (MJ/t). The required scope of activities and inputs to include in energy use calculations is provided in Table 1.

Table 1 Energy inputs required in energy consumption calculations for Indicator 2.10.1.

Included	Excluded
Fuels used for heating, generators, equipment	Employees vehicles and travel
On-grid electricity used for production	Energy use by employees housing, offices and other non-production facilities
District heating and cooling used for production	Energy inputs to processing or other downstream (post-production) activities
Fuel inputs to vessels, owned or contracted, including barges, well boats and vessels servicing sites	Energy inputs to feed mills, hatcheries and other upstream (pre-production) activities
Fuel and electricity used during fallow period preceding production	

On-site energy use shall be calculated using the following formula:

$$E = \frac{\sum(Q_i \times D_i)}{P}$$

Where:

- ***E*** is the energy use in MJ/t.
- $\boldsymbol{Q_i}$ is the quantity of energy input ***i***
- $\boldsymbol{D_i}$ is the energy density of input ***i*** as listed in Table 2.
- ***P*** is the net live weight production in tonnes.

To facilitate calculations, energy densities are automatically calculated when submitting energy use data to ASC.

Table 2 Energy density values for calculation of energy consumption.

Energy input	Units	Energy density (MJ per unit)
Electricity	kWh	3.6
Diesel	L	38.2
Petrol/gasoline	L	34.4
Fuel oil	L	42.6
Natural gas (gaseous)	m^3	39.8
Liquid natural gas	L	22.6
Liquid petroleum gas	L	26.1
Biomass	kg	15.2
Biodiesel	L	30.2
Biogas	kg	19.9

Source: DESNZ (2022)[140]

9.4 GHG emissions (Indicator 2.10.2)

GHG emissions are calculated following an attributional life cycle assessment approach (Figure 1). Emissions are calculated and reported in units of kg carbon dioxide-equivalent (CO_2e) per tonne of live weight production and then converted to kg CO_2e per kg of edible product to inform target-setting and tracking the GHG Management Plan.

[140] DESNZ (2022). Greenhouse gas reporting: Conversion factors 2022. United Kingdom Department for Energy Security and Net Zero. Available at https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022

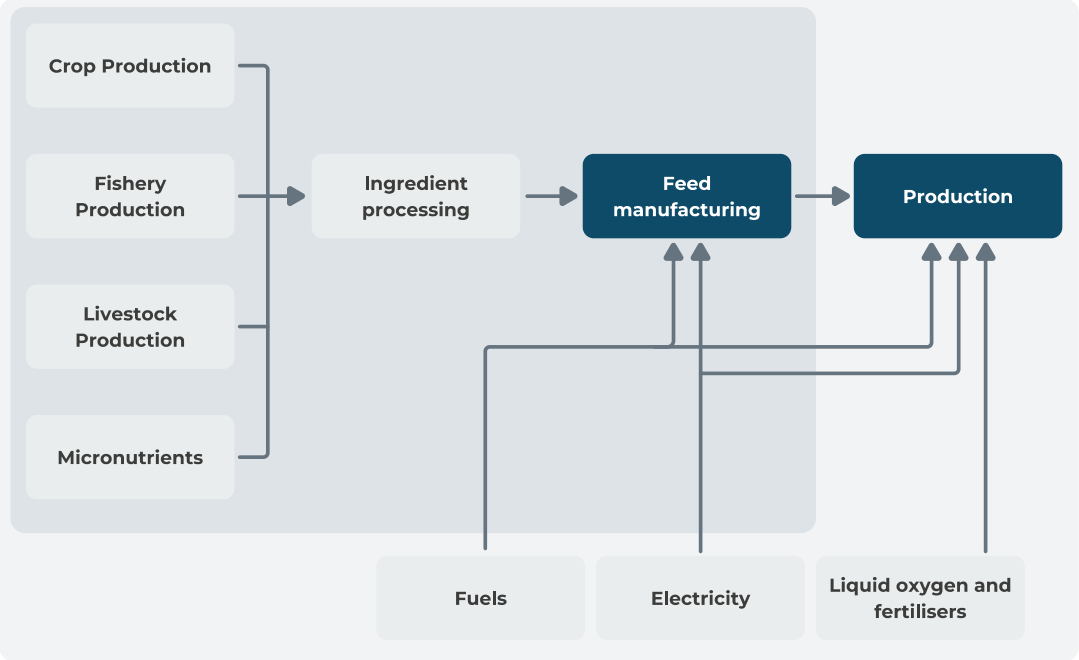


Figure 1 System boundaries for calculating GHG emissions of aquaculture products, showing included processes for feed (shaded) and farm stages.

Calculation of GHG emissions for ASC is categorised following the emission scopes defined by the Greenhouse Gas Protocol (WRI, 2004[141]). To ensure comparability of GHG data between ASC-certified sites, a consistent application of these scopes is used, including activities and inputs listed for each in Table 3.

[141] World Resources Institute (WRI). (2004). The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard. Washington, D. C.: World Resources Institute.

Table 3 Included inputs and activities for GHG emissions calculations according to Greenhouse Gas Protocol scope.

Scope 1
Fuels used for heating, generators, equipment, vessels (including owned or contracted, well boats, etc.)
Fuels used during fallow periods

Scope 2
Electricity and district heating/cooling used for production
Electricity and district heating and cooling used during fallow periods

Scope 3
Production of juveniles if transferred from another grow out facility (salmon only)
Production and processing of feeds and transport of feeds to site
Production and processing of fuels
Production of liquid oxygen (RAS systems only) and fertilisers (pond systems only)

ASC accepts two methods of handling co-product allocation in GHG accounting: mass allocation and economic allocation. This methodological choice affects GHG emission factors for feed ingredients as well as processing of fish products, if applicable. Farms may follow one or both allocation methods. Feed mills are required to provide farms GHG data specific to the allocation method requested. If farms are using the ASC GHG Calculator or another tool that supports both methods, and have data from their feed suppliers reflecting both methods, they shall subsequently report GHG values following both methods.

UoCs are highly encouraged to use the ASC GHG Calculator or another tool to support GHG calculations. If undertaking calculations manually, the following equations shall be used to calculate Scope 1 (**Appendix 9 (9.4.1)**), Scope 2 (**Appendix 9 (9.4.2)**) and Scope 3 (**Appendix 9 (9.4.3)**) emissions. Each calculation requires a combination of input quantities and their corresponding emission factors, which must be documented alongside calculations.

9.4.1 Scope 1 GHG Emissions

Scope 1 GHG emissions shall be calculated using the following formula:

$$S_1 = \frac{\sum(Q_i \times G_i)}{P}$$

Where:

- Q_i is the quantity of fuel input ***i***.

- G_i is the Scope 1 emission factor of input ***i*** as listed in Table 4.
- ***P*** is the net live weight of production in tonnes.

Table 4 Greenhouse gas intensity (kg CO_2e/unit), according to Greenhouse Gas Protocol scope, for calculation of Scope 1 and Scope 3 emissions from on-site energy use.

Energy input	Units	Scope 1	Scope 3
Diesel	L	2.71	0.63
Petrol/gasoline	L	2.34	0.60
Fuel oil	L	3.18	0.70
Natural gas (gaseous)	m^3	2.02	0.35
Liquid natural gas	L	1.16	0.40
Liquid petroleum gas	L	1.56	0.18
Biomass	kg	0.06	0.08
Biodiesel	L	0.17	0.39
Biogas	kg	0.01	0.13

Source: DESNZ (2022)[140]

9.4.2 Scope 2 GHG Emissions

Scope 2 GHG emissions shall be calculated using the following formula:

$$S_2 = \frac{\sum(Q_i \times G_i)}{P}$$

Where:

- Q_i is the quantity of electricity or district heating used.
- G_i is the country-specific emission factor of electricity or district heating.
- ***P*** is the net live weight of production in tonnes.

9.4.3 Scope 3 GHG Emissions

Scope 3 emissions associated with feed ingredients and milling shall be calculated using the following formula:

$$S_{3(Feed)} = \frac{\sum(Q_f \times G_{f,a})}{P}$$

Where:

- Q_f is the total quantity of feed ***f*** used.

- $G_{f,a}$ is the emissions, per tonne of feed ***f***, for each ingredient group ***a*** (and milling) as provided by the feed supplier.
- ***P*** is the net live weight of production in tonnes.

Scope 3 emissions from feed transportation to sites shall be calculated using the following formula:

$$S_{3(Feed\ transport)} = \frac{\sum(Q_f \times T_{f,m} \times G_m)}{P}$$

Where:

- Q_f is the quantity of feed ***f*** used.
- $T_{f,m}$ is the transportation distance in kilometres (km) by transport mode ***m*** (e.g., truck, sea).
- G_m is the emission factor per tonne-km of transport by mode ***m***.
- ***P*** is the net live weight production in tonnes.

Scope 3 emissions associated with (production of) fuels and other inputs (e.g., liquid oxygen) shall be calculated using the following formula:

$$S_{3(Other)} = \frac{\sum(Q_i \times G_i)}{P}$$

Where:

- Q_i is the quantity of fuel or other input.
- G_i is the scope 3 emission factor (Table 4 for fuels) for input ***i***.
- ***P*** is the net live weight production in tonnes.

9.5 Target-setting for GHG management plans (Indicator 2.10.3)

Species-specific targets serve as a basis for understanding the relative emissions of aquaculture production and guiding reduction efforts in GHG management plans (Table 5). These are based on average species-specific estimates of GHG intensity from Gephart et al. (2021)[142]. They will be regularly updated based on data submitted to ASC to support target-setting and tracking relevant to different species and production systems. Farms are not required to meet these targets but they serve as guidance to inform reduction efforts in the GHG management plans.

[142] Gephart, J. A., Henriksson, P. J., Parker, R. W., Shepon, A., Gorospe, K. D., Bergman, K., ... & Troell, M. (2021). Environmental performance of blue foods. *Nature, 597*(7876), 360-365.

Table 5 Species-specific GHG targets to incorporate into GHG management plans.

	kg CO_2e / kg edible		kg CO_2e / tonne live	
Species group	**Mass**	**Economic**	**Mass**	**Economic**
Abalone	3.2	3.2	650	650
Bivalves	3.2	3.2	650	650
Catfish	10.0	6.5	5,000	3,200
Cod	10.0	6.5	5,000	3,200
Crustaceans	9.5	7.8	5,400	4,400
Flatfish	10.0	6.5	5,000	3,200
Salmonids - freshwater	5.4	3.7	3,200	2,100
Pangasius	7.8	6.1	4,200	3,200
Pike-perch	10.0	6.5	5,000	3,200
Salmonids - marine	5.1	3.0	3,000	1,700
Seabass, seabream, meagre	10.0	6.5	5,000	3,200
Seriola and cobia	10.0	6.5	5,000	3,200
Tilapia	10.8	8.8	4,000	3,300
Tropical marine finfish	10.0	6.5	5,000	3,200

Appendix 10 Forced and Child Labour Remediation Process

This Appendix details the process, timeline, and implementation of remediation actions and plans in response to instances of forced labour as required in Criterion 3.2 (Indicator 3.2.2) and child labour as required in Criterion 3.3 (Indicator 3.3.2).

Section
10.1 Introduction
10.2 Immediate response and safeguarding
10.3 Remediation plan development
10.4 Implementation and monitoring of remediation plan
10.5 Corrective action plan to prevent reoccurrence

10.1 Introduction

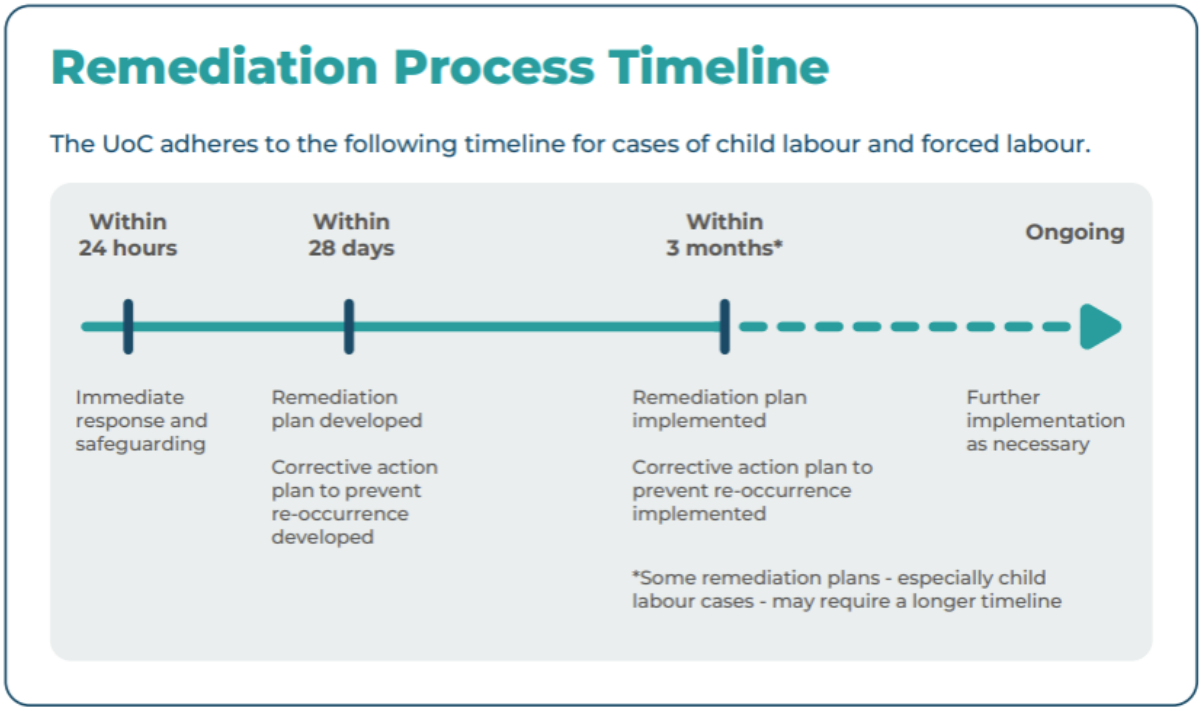
Remediation is the process of restoring an individual after a human rights violation has been discovered, reported and verified. The issue can be discovered in several ways, including through the grievance process, internally at a site or during a third-party audit. The United Nations Guiding Principles for Business and Human Rights (UNGPs)[143] require that both states and businesses take steps to ensure that when there are human rights violations, employees have access to effective remedy.

The UoC can work in partnership with employee representation and external partners but is always responsible for ensuring that the remediation process is carried out and that it prioritises the best interest of the person. The remediation process includes the following steps, which are outlined in this document and shown in Figure 1:

1. Immediate response and safeguarding.
2. Remediation plan development.
3. Implementation and monitoring of remediation plan.
4. Corrective action plan to prevent recurrence.

[143] https://www.business-humanrights.org/en/big-issues/governing-business-human-rights/un-guiding-principles/

Figure 1 Remediation process timeline



10.2 Step 1: Immediate response and safeguarding (within 24 hours of detection)

Once a case has been detected, the first step in remediation is for the site to ensure the person's safety, and make sure that the person does not feel threatened. Not all situations require immediate safeguarding. However, child labour and forced labour often require immediate actions to protect the person and remove them from an unsafe situation until the remediation plan is developed and enacted.

When a person working in forced labour is found to be working on a site:

- Remove the person from the forced labour situation if they are in danger; and
- Provide them with a safe place to stay if necessary; and
- Provide for necessary health checks and medical treatment; and
- When the person is removed from unsafe employment, support the person with an interim stipend until their remediation plan is agreed upon, at least equal to whichever of the following is higher:
  - the salary they had received; or
  - the local minimum wage.

When a child below the allowed working age is found to be working on a site:

- Remove the child from the work situation; and
- Provide for necessary health checks and medical treatment; and
- Make sure that the child is moved to a safe place away from work, and that their basic needs are met; and

- Locate the parent or guardian if the child is not living with them; and
- Contact local child protection authorities, community liaisons/leaders on child labour and/or child labour related NGOs if needed; and
- Support the child with an interim stipend until their remediation plan is agreed upon, at least equal to whichever of the following is higher:
  - the salary they had received; or
  - the local minimum wage.

When a child of legal working age is found to be working in a hazardous situation:

- Remove the child from the dangerous work situation; and
- Provide for necessary health checks and medical treatment; and
- Support the child with an interim stipend until their remediation plan is agreed upon, at least equal to whichever of the following is higher:
  - the salary they had received; or
  - the local minimum wage.

10.3 Step 2: Remediation plan development

The next step is to develop and agree upon a remediation plan for the person, seeking input from the affected person, as well as external experts when appropriate. When it is a case of child labour, the child's family or guardian shall also be involved in the process. When the family is not available, local child protection authorities shall be engaged.

Remediation will take different forms depending on the situation and the needs of the person in question but always considers the best interest of the person. The development and implementation of most plans shall involve working with an NGO or other partner organisation and/or government agencies who are experts in the issue. The criminal justice system is contacted when criminal actions have occurred. How quickly the plan is finalised is dependent on the complexity of actions that need to occur and the urgency of the case, but in any case, within 28 calendar days of an abuse finding.

Elements to consider in the development of a remediation plan for child labour:

Where a child of legal working age is found working in a hazardous situation, the goal is to ensure the child's health and safety and preserve their income with safe work. Remediation actions may include the following:

- Medical treatment, including long-term rehabilitation and recovery support when necessary.
- Transfer to safe work at least at the same level of pay.
- Other compensation.

When a child below the allowed working age is found to be working, the goal is to protect the child and assure access to adequate resources and long-term support for the child and their education. Remediation actions may include the following:

- Clarification of the true age and identity of the child.
- Facilitation of access to schooling.
- Assistance with education-related costs including tuition and transportation fees, costs of uniforms or books or other related costs.
- Financial support to the family to compensate for the loss of the child's income.
- Employment offers for older, eligible members of the family.
- Repatriation when a child wishes to be reunited with family overseas.
- Medical costs.
- Ensuring school attendance.

Elements to consider in the development of a remediation plan for forced labour:

For forced and bonded labour, the goal is usually to provide safe and fairly compensated work where possible, and return any trafficked persons employed against their will to their home when they wish. Remediation actions may include the following:

- Providing medical treatment.
- Debt forgiveness to eliminate debt bondage situations.
- Revising and improving employee working conditions and payment.
- Financial compensation for wage theft or other damages.
- Returning personal/legal documents and property to ensure their freedom of movement.
- Repatriation to their home country.

Whether the issue is discovered through a third-party audit, self-detected by the UoC, or reported through the grievance mechanism, employee representation is involved in the

development of any remediation plan. They are made aware of external resources available for remediation and the development of any remediation plan. This supports mutual learning and accountability.

10.4 Step 3: Implementation and monitoring of remediation plan

Once the plan has been agreed on by all parties, it is implemented and monitored. Major remediation actions shall be completed within three months of finding the abuse. However, in some cases of child labour, implementation of the child's remediation plan can take up to several years until a child has finished schooling and is eligible for legal employment. In this case, the plan shall be underway (e.g. the child is enrolled in school and the family is supported) at the end of the 90 days, with a clear plan of continued action.

Regular monitoring of the plan is important to confirm that the plan is implemented, that the implementation is effective, and that necessary adjustments are made when circumstances change – for example when a child needs to change school enrolment due to a move.

10.5 Step 4: Corrective action plan to prevent reoccurrence

An effective remediation process includes the development of a corrective action plan to ensure that root causes are understood, and to prevent the abuse from happening again to someone else. To develop this, the UoC shall perform a root cause analysis of what went wrong in their system and shall implement and monitor appropriate corrective actions to prevent recurrence.

Appendix 11 Method for Calculating a Living Wage Gap

This Appendix details the methods for calculating comparable employee remuneration and assessing it against the Living Wage estimate to determine a living wage gap, as required in Criterion 3.8 (Indicator 3.8.2).

Section
11.1 Step 1: Select the living wage estimate
11.2 Step 2: Identify employees to include in the calculation
11.3 Step 3: Choose the calculation tool
11.4 Step 4: Calculate allowable wages and bonuses
11.5 Step 5: Calculate in-kind benefits
11.6 Step 6: Calculate total comparable remuneration
11.7 Step 7: Calculate the living wage gap

11.1 Step 1: Select the living wage estimate

Select the relevant living wage estimate for the UoC's location and reference year. The UoC shall use an ASC-approved living wage estimate, following the 'Living Wage Benchmarks' guidance document available via the ASC Programme Centre.

Simplified assessment where a living wage estimate is not available

Where a living wage estimate is not available for the UoC's location because the estimate provider has determined that the statutory minimum wage exceeds the living wage, the UoC can conclude that the living wage gap is 0%. Based on this, the UoC conforms with Indicator 3.8.2 and shall report a living wage gap of 0% under Indicator 3.8.3.

Checklist before moving to Step 2

- ✓ Selected the appropriate living wage estimate for the UoC's location and reference year.

11.2 Step 2: Identify employees to include in the calculation

The employees included in the living wage gap calculation shall be determined using the ASC definition of '**employee**'.

The UoC shall include data on employee remuneration following one of two options:

- **Option A**: Anonymised data from all employees.
- **Option B**: Anonymised data from the majority of employees (>50%), ensuring that at least the following categories are included:
    - The four largest job categories (the occupations or job grades with the highest number of employees); and
    - Lowest-paid employees; and
    - Temporary employees.

For UoCs under multi-site or group certification, employees from all sites may be combined into a single living wage gap calculation. In such cases, the UoC shall ensure that the data collected is representative of all sites included in the certification scope.

Simplified assessment where guaranteed base wage exceeds the living wage estimate

Where the guaranteed base wage of an employee category meets or exceeds the relevant living wage estimate, a full living wage gap calculation is not required. Instead, the UoC can apply a simplified assessment to confirm the living wage gap is 0% by following the steps below:

1. Identify the guaranteed base wage:
   Identify the guaranteed gross monthly base wage (excluding any bonuses, overtime pay, allowances, or other extras) for each employee category. It is recommended to start with the employees with the lowest wage.
2. Compare with the living wage estimate:
   Compare the guaranteed base wage to the applicable living wage estimate using a like-for-like comparison (gross monthly remuneration, based on standard working time, same reference year).
    a. If the guaranteed base wage meets or exceeds the living wage estimate:
        i. Living wage gap = 0%
        ii. No further remuneration calculation is required for those employees.
    b. If the guaranteed base wage is below the living wage estimate:
        i. Complete the full living wage gap calculation for those employees.

If the guaranteed base wage exceeds the living wage estimate for all employees, the UoC can conclude that the living wage gap is 0%. Based on this, the UoC conforms with Indicator 3.8.2 and shall report a living wage gap of 0% under Indicator 3.8.3.

Grouping employees into categories

Grouping employees into categories can make the calculation process easier, particularly for UoCs with many employees. Employees can be grouped into a category where:

- They have the same gender; and
- They perform the same or substantially similar tasks; and

- Their working hours and remuneration components (wages, bonuses, in-kind benefits) do not deviate by more than 10%.

Where these conditions are not met, employees shall be assessed separately.

Checklist before moving to Step 3

- ✓ List of employees to include in the calculation
- ✓ Employees grouped into categories (optional)

11.3 Step 3: Choose the calculation tool

The UoC can calculate a living wage gap using several different tools. All calculations shall follow the approach described below, which is based on the Anker Research Institute's methodology[144]. The key difference between the options is how the calculation is performed. The following options may be used:

1. The IDH Salary Matrix[145]; or
2. Manual calculation; or
3. Other measurement tools aligned with the Anker methodology.

ASC strongly recommends the use of the IDH Salary Matrix. The IDH Salary Matrix automates key steps in the calculation including the capping of in-kind benefits, conversion of remuneration to full-time equivalent (FTE) values, and comparison against the living wage estimate. The tool automatically generates a report for verification and data needed for reporting (See Indicator 3.8.3). This saves time, prevents calculation errors, and ensures accurate results.

Manual calculation requires the same steps to be performed explicitly, including the proration of remuneration to FTE values and comparison with the living wage estimate. The tool is easy to use, available in multiple languages, and guidance is embedded. Further training on living wage concepts and the IDH Salary Matrix is available via the ASC Programme Centre.

Checklist before moving to Step 4

- ✓ Selected a tool for the calculation
- ✓ Accessed ASC training resources on living wage

11.4 Step 4: Calculate allowable wages and bonuses

Table 1 below lists the annual wages and bonuses that are allowed to be included in the calculation. All payroll information must be gross figures (no tax deducted) taken from the previous calendar year.

[144] https://www.ankerresearchinstitute.org/anker-methodology
[145] https://www.salarymatrix.idhtrade.org/

To ensure accuracy, four conditions shall be met for a payment to be counted towards the employee remuneration calculation[146]:

- **Guaranteed to receive**: Employees shall be able to rely on receiving the wage, bonus or benefit for ongoing expenses.
- **Received within one year**: Employees shall receive the payment within a year.
- **Earned during standard working hours**: The wage shall be earned within standard working hours, not including overtime or excessive work.
- **Received in legal tender**: Payment shall be in cash or by bank transfer (excluding in-kind benefits and medical insurance).

Table 1. Description of the Wages and Bonuses included in the living wage gap calculation

Wage/Bonus	Always include	Do not include	Rarely include	Rationale/Notes/Examples
Basic wage and any cost-of-living adjustment	✔			
Overtime pay and pay supplements for holidays, weekends, and night work		✘		
Cash allowances and bonuses	✔			This shall include as a minimum: o 13th month's bonus. National holiday cash bonuses. Birthday cash bonus. o Transportation cash allowance. Housing cash allowance. Health insurance cash allowance.
Production incentive bonuses			✔	Production bonuses should only be included when received by the majority of employees and not associated with an especially fast work pace or overtime.

[146] From Living Wages Around the World by Martha and Richard Anker, *Chapter 15 Measuring Prevailing Wages to Compare to a Living Wage*, page 271.

Time off for holidays, annual leave, and sick leave		✗		Does not add to disposable income of employees. However, if employees with short term contracts are paid an extra daily rate for holidays/vacation, this amount may be included when it increases take-home pay.
Maternity and paternity leave		✗		Does not add to disposable income of employees.
Pension, provident fund, and severance payment		✗		Not received within one year.
Employer contributions required by applicable law, such as for social security programs, unemployment insurance, and employees' compensation/ injury insurance		✗		Does not add to disposable income of employees.

Checklist before moving to Step 5

✓ Assessed payroll data on working hours, wages, and bonuses for each employee category

11.5 Step 5: Calculate in-kind benefits

In-kind benefits are considered in the living wage gap calculation, as they reduce the amount of cash wage that employees require to cover living expenses. The UoC shall calculate allowable in-kind benefits according to the following three-part process[147]:

Part A: Identify allowable in-kind benefits

In-kind benefits marked with a check in Table 2 below can be included in the living wage gap calculation.

[147] From Living Wages Around the World by Martha and Richard Anker, Chapter 15 Measuring Prevailing Wages to Compare to a Living Wage, page 299.

Part B: Value the in-kind benefits

To value in-kind benefits, the UoC shall calculate the total cost to the employer and divide this by the number of employees receiving the benefit. The value of each in-kind benefit shall not exceed any of the following:

- Its cost to the employer; or
- Its replacement cost if purchased by the employee; or
- The cost of an equivalent home-prepared meal in cases of provided food; or
- The amount allocated for the item in the Living Wage estimate.

If an in-kind benefit requires that the employee share some of the cost, the employee's cost should be subtracted from the total value.

Part C: Ensure in-kind benefits fall within the maximum limits

To ensure that employees have a sufficient income they can spend as they choose, and in line with applicable legal requirements in many countries, the percentage of total income that is provided to employees in-kind is limited. Employees shall not receive more than:

- 30% of total wage for all in-kind benefits combined.
- 15% of total wage for housing.
- 10% of total wage for other in-kind benefits like food and transport.

If valuation of in-kind benefits exceeds any of the above percentages, the amount included in the calculation shall be reduced to comply with limits. The IDH Salary Matrix tool automatically limits in-kind benefits.

Table 2. In-Kind Benefits

In-Kind Benefits	Shall include	Do not include	Rationale/Notes/ Examples
Meals at work	✓		Reduces food expense.
Food rations or food commodities given for free or sold at concession rates	✓		Reduces food expense.
Family housing (including electricity, water, and fuel)	✓		Reduces housing expense.
Transport to and from work (and to town on weekends from agricultural estates)	✓		Reduces transport expense.
Childcare	✓		Reduces childcare expense.
School for children of employees	✓		Reduces education expense.
Medical clinic and medical care not required by applicable law and not for work-related matters	✓		Reduces medical expense.
Medical insurance not required by applicable law	✓		Reduces insurance expense.
Employer payment of private medical insurance	✓		Reduces insurance expense.
Visas or work permits for migrant employees.		✗	Employer obligation.
Clothing, equipment, and supplies for work		✗	Employer obligation.
Dormitories or shared housing		✗	Does not reduce family housing cost.
Drinking water provided to employees at work		✗	Employer obligation.
Land for kitchen garden		✗	Does not reduce employees' expenses.
Charitable contributions to the community that do not go exclusively to employees		✗	Does not reduce employees' expenses.

Employers' contributions to Social Security or National Health Service required by applicable law		✗	Employer obligation.
Time off work for vacation, sick leave, maternity leave, or public holiday		✗	Employer obligation.
Any other benefit that does not reduce the cash income necessary for employees to meet their needs		✗	Does not reduce employees' expenses.

Checklist before moving to Step 6

- ✓ Determined monetary values corresponding to the in-kind benefits received by each employee category

11.6 Step 6: Calculate total comparable remuneration

To enable comparison with the living wage estimate and determine the gap, the UoC shall calculate total comparable remuneration for each employee category. All remuneration components (wages, bonuses, and in-kind benefits) identified in Steps 4 and 5 shall be converted into full-time equivalent (FTE) values for comparison with the living wage estimate, which is based on FTE.

Using the IDH Salary Matrix:

When using the IDH Salary Matrix, total comparable remuneration is calculated automatically. The tool:

- Converts all remuneration components to FTE values based on actual working hours; and
- Aggregates all components into total comparable remuneration for each employee category, separated by gender.

Manual calculation:

When calculating manually, the UoC shall:

- Convert all remuneration components to yearly FTE values; and
- Sum all components to determine total comparable remuneration for each employee category; and
- Divide yearly comparable remuneration by 12 to determine monthly comparable remuneration.

The UoC shall maintain records of all calculations to enable effective verification.

Example - Manual calculation of total comparable remuneration

This example is based on a standard working week of 48 hours.

To calculate comparable remuneration for an employee category, gather information on the actual number of hours worked and the wages, bonuses and in-kind benefits received. Then, complete the following calculations:

- Determine the FTE rate by dividing standard working hours by actual working hours.
  48 standard working hours ÷ 36 actual working hours = 1.33 FTE conversion rate.
- Then, multiply the remuneration components by the FTE rate to determine yearly comparable remuneration.
  (9,000 wages + 300 bonuses + 300 in-kind benefits) x 1.33 = 12,768 yearly comparable remuneration
- Finally, divide the yearly figure by 12 to arrive at monthly comparable remuneration.
  12,768 ÷ 12 months = 1,067 monthly comparable remuneration

Category	#	Hours	Wage	Bonus	In-kind benefits	FTE conversion	Monthly comparable remuneration
Pond workers	8	36 hours / week	9,000 / year	300 / year	300 / year	48 ÷ 36 = 1.33	(9,000+300+300 x 1.33) ÷ 12 = 1,067
Feed technicians	6	48 hours / week	15,000 / year	600 / year	600 / year	48 ÷ 48 = 1	(15,000+600+600 x 1) ÷ 12 = 1,350
Harvest workers	5	24 hours / week	6,000 / year	200 / year	100 / year	48 ÷ 24 = 2	(6,000+200+100 x 2) ÷ 12 = 1,050

Checklist before moving to Step 7

✓ Determined monthly comparable remuneration for each employee category*

**For manual calculation only. Steps 6 and 7 are automated in the IDH Salary Matrix.*

11.7 Step 7: Calculate the living wage gap

Monthly comparable remuneration for each employee category shall be compared to the applicable living wage estimate for the same reference year. For example, for an audit taking place in 2026, employee remuneration data from January-December 2025 shall be compared against the 2025 living wage estimate.

Using the IDH Salary Matrix:

The IDH Salary Matrix will automatically calculate living wage gaps for each employee category, the employees below living wage (as % of workforce), and an average living wage gap.

Manual calculation:

For manual calculation, the following calculations need to be performed:

1. Living wage gap for each employee category

$$\text{Employee category living wage gap (\%)} = \frac{Living\ wage\ estimate - Comparable\ remuneration}{Living\ wage\ estimate} \text{X } 100$$

Where comparable remuneration equals or exceeds the living wage estimate, the living wage gap shall be 0% for that employee category.

2. Employees below living wage (% of workforce)

The percentage of employees below living wage shall be calculated as the proportion of employees with a living wage gap.

$$\text{Employees below living wage (\%)} = \frac{Number\ of\ employees\ in\ categories\ with\ a\ living\ wage\ gap}{Total\ number\ of\ employees} \text{X } 100$$

3. Average living wage gap

The average living wage gap shall be calculated for all employees with a living wage gap. This shall be calculated as the sum of each employee category's living wage gap multiplied by the number of employees in that category, divided by the total number of employees with a living wage gap.

$$\text{Average living wage gap (\%)} = \frac{SUM\ (Category\ living\ wage\ gap\ \text{x}\ Number\ of\ employees\ in\ category)}{Total\ number\ of\ employees\ with\ living\ wage\ gap} \text{X}\ 100$$

Example - Manual calculation of the living wage gap

In this example, the monthly living wage estimate is 1,200.

1. Living wage gap for each employee category

Category	#	Monthly comparable remuneration	Living wage estimate	Living wage gap (%)
Pond workers	8	1,067	1,200	(1,200 - 1,067) ÷ 1,200 x 100 = 11.1%
Feed technicians	6	1,350	1,200	(1,200 - 1,350) ÷ 1,200 x 100 = -12,5 → 0%
Harvest workers	5	1,050	1,200	(1,200 - 1,050) ÷ 1,200 x 100 = 12,5%

2. Employees below living wage (% of workforce)

Pond workers (8) and harvest workers (5) have a living wage gap. Together, they make up 68% of the workforce.

$$68\% = \frac{8 + 5}{19} \text{X}\ 100$$

3. Average living wage gap

The average living wage gap across all employees with a living wage gap is 12.1%.

$$12.1\% = \frac{(11.1\ \text{x}\ 8) + (12.5\ \text{x}\ 5)}{(8 + 5)} \text{X}\ 100$$

$$12.1\% = \frac{(Pond\ LW\ gap\ \text{x employees}) + (Harvest\ LW\ gap\ \text{x}\ employees)}{Pond\ employees + Harvest\ employees} \text{X}\ 100$$

Results

- ✓ Completed living wage gap calculation
- ✓ Determined datapoints for reporting under indicator 3.8.3

Appendix 12 Aquatic Animal Health and Welfare

This Appendix details the requirements for Health and Welfare training, monitoring, ablation-free sourcing and permitted stunning method usage, and methodologies to calculate the metrics on mortalities, antibiotic load and stocking density under Principle 4.

Section
12.1 Introduction
12.2 Training requirements
12.3 Water quality monitoring requirements
12.4 Ablation-free requirements
12.5 Permitted stunning methods
12.6 Methodologies

12.1 Introduction

Aquatic animal health and welfare is highly context-specific, given the diversity of species and culture systems. This variability highlights the importance of adjusted approaches within the ASC Farm Standard, as maintaining health and welfare is key to ensuring sustainable and ethical aquaculture practices. To address this complexity, the tables below and methodologies outline requirements that must be implemented according to the specific scenarios and needs of different species and systems.

12.2 Training requirements

Table 1 below outlines the requirements for basic and advanced aquatic animal health and welfare training.

Table 1. Aquatic animal Health and Welfare Training Requirements

Indicator reference	Audience	Training level	Training format	Training frequency	Content outline
4.1.1.1 **4.1.1.14** **4.2.1.1**	All relevant employees	Basic	Theory	During the onboarding period at the start of employment	General aquatic animal health and welfare awareness training to inform about the importance of aquatic animal health and welfare, including biosecurity
4.1.1.2 **4.1.1.15** **4.2.1.2**	Any person involved in: Aquatic animal husbandry; or Aquatic animal handling, including slaughter and processing	Advanced	Theory and Practice	Annual (refresher-courses shall incorporate advances/developments in the training subject matter)	Basic anatomy and physiology of the species being farmed
					Advanced aquatic animal health and welfare assessment - this shall include all welfare Indicators in the ASC Farm Standard (morphological, behavioural, water quality, feeding, stocking density, disease recognition, mortality classification and necropsy forms)
					Handling
					Slaughter (harvesting)
					Biosecurity
					Data collection, logging and reporting systems
					Assessment of stunning and killing effectiveness
					Data collection, logging and reporting systems
4.3.2.1 4.3.2.2	All relevant employees	Advanced	Theory and Practice	During the onboarding period at the start	Biosecurity Disease recognition Handling

				of employment and then annually (refresher-courses shall incorporate advances/developments in the training subject matter)	Behaviour Feeding

12.3 Water Quality Monitoring Requirements

Table 2 below outlines the water quality monitoring requirements for fish culture (including cleaner fish) in the various culture systems, water types and during live transport. Table 3 below outlines the water quality monitoring requirements for crustacean culture in the various culture systems and water types.

Table 2. Water quality monitoring requirements for fish culture and live transport (including cleaner fish) as required by Indicators 4.1.1.10.1, 4.1.1.26.1, 4.1.2.10, 4.1.2.24.

PARAMETERS	TYPE OF CULTURE SYSTEM								TRANSPORT
	Freshwater				Brackish and Marine Water				Live transport
	Ponds	RAS	Cages	Flow-through	Ponds	RAS	Cages	Flow-through	
Temperature	Daily	Daily	Daily	Daily	Daily	Daily	Daily	Daily	At the point of departure, during transport and on arrival
Dissolved oxygen	Daily	Daily	Daily	Daily	Daily	Daily	Daily	Daily	At the point of departure, during transport and on arrival
Turbidity	Daily (for intensive systems) Risk assessed (for semi-intensive and extensive systems)	Daily	Daily	Daily	Daily (for intensive systems) Risk assessed (for semi-intensive and extensive systems)	Daily	Risk assessed	Daily	Risk assessed
Carbon dioxide	Biweekly (for intensive systems) Risk assessed (for semi-intensive and extensive systems)	Daily		Biweekly	Biweekly (for intensive systems) Risk assessed (for semi-intensive and extensive systems)	Daily		Biweekly	Risk assessed
pH	Daily	Daily	Daily	Daily	Biweekly (for intensive systems) Risk assessed (for extensive systems)	Daily	Risk assessed	Biweekly	Risk assessed
Salinity		Daily			Risk assessed	Daily	Risk assessed	Risk assessed	

Ammonia/nitrite/nitrate	Biweekly	Daily		Biweekly	Biweekly	Daily		Biweekly	Risk assessed
Metals	Risk assessed	Risk assessed		Risk assessed	Risk assessed	Risk assessed		Risk assessed	
Water flow/velocity			Risk assessed				Risk assessed		
Hydrogen sulphide	Risk assessed	Risk assessed			Risk assessed	Risk assessed			Risk assessed

Table 3. Water quality monitoring requirements for crustacean culture as required by Indicator 4.2.1.8.1

PARAMETERS	TYPE OF CULTURE SYSTEM					
	Freshwater			Brackish and Marine Water		
	Ponds	RAS	Flow-through	Ponds	RAS	Flow-through
Temperature	Twice a day[148]	Twice a day	Twice a day	Twice a day	Twice a day	Twice a day
Dissolved oxygen	Twice a day	Twice a day	Twice a day	Twice a day	Twice a day	Twice a day
Transparency	Risk assessed	Risk assessed	Risk assessed	Risk assessed	Risk assessed	Risk assessed
Turbidity	Risk assessed	Risk assessed	Risk assessed	Risk assessed	Risk assessed	Risk assessed
Carbon dioxide	Risk assessed	Risk assessed	Fortnight	Risk assessed	Risk assessed	Fortnight
pH	Daily	Daily	Daily	Daily	Daily	Daily
Salinity	Risk assessed	Risk assessed	Risk assessed	Weekly/Daily[149]	Daily	Weekly/Daily[149]
Alkalinity and hardness	Weekly	Weekly	Weekly	Risk assessed	Weekly	Risk assessed
Ammonia	Risk assessed	Daily	Fortnight	Risk assessed	Daily	Fortnight
Nitrite	Risk assessed	Daily	Weekly	Risk assessed	Daily	Weekly
Nitrate	Risk assessed	Daily	Fortnight	Risk assessed	Daily	Fortnight
Metals	Risk assessed	Risk assessed	Risk assessed	Risk assessed	Risk assessed	Risk assessed
Minerals *(Ca2+, K+, Mg2+)*	Weekly	Weekly	Weekly	Risk assessed	Risk assessed	Risk assessed
Hydrogen sulphide	Risk assessed	Risk assessed	Risk assessed	Risk assessed	Risk assessed	Risk assessed

[148]Measured at dawn and dusk.
[149] Daily monitoring during the rainy season.

12.4 Ablation-free requirements

Table 4 below outlines the requirements for UoCs culturing *Penaeus vannamei* and *Penaeus monodon* to progress towards sourcing entirely from ablation-free female broodstock.

Table 4. Sourcing requirements for UoCs culturing *Penaeus vannamei* and *Penaeus monodon*, as required by Indicator 4.2.1.13.

Percentage of the production sourced from AF female broodstock			
Sourcing requirements for UoCs[150]	*Penaeus vannamei*	**Sourcing requirements for UoCs**[150]	*Penaeus monodon*
Current sourcing requirement	**25%**	Sourcing requirement from May 2028	**25%**
Sourcing requirement from May 2027	**50%**	Sourcing requirement from May 2030	**50%**
Sourcing requirement from May 2029	**100%**	Sourcing requirement from May 2032	**75%**
		Sourcing requirement from May 2034	**100%**

[150] These requirements are based on the original issue date of the ASC Farm Standard V1.0 in May 2025.

12.5 Permitted stunning methods

Table 5 below outlines the permitted stunning methods and usage requirements for UoCs for the various fish species.

Table 5. Species-specific permitted stunning methods and usage requirements for UoCs, as required by Indicators 4.1.3.4 and 4.1.3.12

	Species										
Permitted stunning methods[151]	Salmonids	Wrasse	Lumpfish	Cod	Seabass, Seabream, Meagre	Pangasius	Catfish	Tilapia	Seriola, Cobia	Flatfish	Tropical Marine Finfish
Percussion (Automatic)	✓	✓		✓			✓		✓	Turbot only	✓
Percussion (Manual[152])	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Electrical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Anaesthetic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Usage requirements for UoCs[153]	UoCs currently required to use permitted stunning methods			UoCs required to use permitted stunning methods from May 2028							

[151] ASC will review available stunning methods on a yearly basis, to make sure that any new developments that are considered suitable are incorporated into this list.
[152] Techniques such as 'spiking', or 'ikejime', or destruction of the medulla oblongata are acceptable.
[153] These requirements are based on the original issue date of the ASC Farm Standard V1.0 in May 2025.

12.6 Methodologies

The methodologies below outline the formulae to calculate the metrics on mortalities, survival rates, antibiotic load and stocking density under Principle 4.

12.6.1

The **mortality rate and real percentage mortality** is calculated for each species in production at each site, as required by Indicator 4.1.1.6.

The **mortality rate** is calculated as the observed mortality count as a percentage of the stocking count:

$$Mortality\ rate\ (\%) = \frac{observed\ mortality\ count\ (\#\ animals)}{stocking\ count\ (\#animals)} * 100$$

The **real percentage mortality** is calculated as the difference between stocked and harvested animals divided by the stocked animals:

$$Real\ percentage\ mortality\ (\%) = \frac{\left(stocking\ count\ (\#\ animals) - \ harvest\ count\ (\#\ animals)\right)}{stocking\ count\ (\#\ animals)} * 100$$

The **survival rate** for crustaceans is calculated for each species in production at each site, as required by Indicator 4.2.1.4.

The survival rate is calculated as the harvest count as a percentage of the stocking count:

$$Survival\ rate\ (\%) = \frac{harvest\ count\ (\#\ animals)}{stocking\ count\ (\#animals)} * 100$$

12.6.2 The formula below outlines the methodology for antibiotic load calculation, as required by Indicator 4.4.16.

The antibiotic load is calculated for each species in production at each site and is the total amount of active component used from all applied antibiotics used divided by the net production volume.

$$Antibiotic\ load\ (kg\ tonne^{-1}) = \frac{total\ mass\ of\ active\ component\ (kg)}{net\ production\ (tonnes)}$$

12.6.3 The formulae below outline the methodologies for stocking density calculation, as required by Indicators 4.1.1.12, 4.1.1.27, and 4.2.1.11.

The UoC shall calculate stocking densities at the **highest stocked volume** or **highest stocking count**.

Depending on the species in production, the stocking density is reported as biomass per surface area (kg/m^2), biomass per water volume (kg/m^3) or number of aquatic animals per surface area (# aquatic animals/m^2):

$$stocking\ density\ \left(\frac{kg}{m^2}\right) = \frac{stocked\ production\ (kg)}{water\ surface\ area\ (m^2)}$$

$$stocking\ density\ \left(\frac{kg}{m^3}\right) = \frac{stocked\ production\ (kg)}{water\ volume\ (m^3)}$$

$$stocking\ density\ \left(\frac{\#\ animals}{m^2}\right) = \frac{stocking\ count\ (\#\ animals)}{water\ surface\ area\ (m^2)}$$

The water surface area of circular production units can be calculated as follows:

$$surface\ area\ (m^2) = \pi \times \text{radius}^2\ (\text{m}) \times \#\ \text{production units}$$

Where radius is calculated as:

$$radius\ (m) = \frac{diameter(m)}{2}$$

The water surface area for rectangular production units can be calculated as follows:

$$surface\ area\ (m^2) = \ length\ (m) \times \ \text{width (m)} \times \ \#\ \text{production units}$$

The water volume can be calculated by multiplying the surface area with the height of the production units for circular and rectangular production units, respectively:

$$water\ volume\ (m^3) = \ \pi \ \times \ \text{radius}^{\,2}\ \text{(m)} \times \text{height (m)} \times \#\ \text{production units}$$

$$water\ volume\ (m^3) = \ length\ (m) \times \ \text{width (m)} \times \text{height(m)} \times \#\ \text{production units}$$

Appendix 13 Parasite Management (Sea Lice)

This Appendix details:

- The Area-Based Management (ABM) scheme (Indicators 4.5.1 and 4.5.2)
- Methods for:
  - the collection of sea lice data on native salmonids (Indicator 4.5.4)
  - on-site sea lice sampling (Indicator 4.5.6)
  - calculating the Weighted Number of Medicinal Treatments (WNMT) (Indicator 4.5.12)
- On-site sea lice thresholds for sensitive periods (Indicator 4.5.9)

Section
13.1 Introduction
13.2 Area-Based Management (ABM) scheme (Indicators 4.5.1 and 4.5.2)
13.3 Method for the collection of sea lice data on native salmonids (Indicator 4.5.4)
13.4 Method for on-site sea lice sampling (Indicator 4.5.6)
13.5 On-site sea lice thresholds for sensitive periods (Indicator 4.5.9)
13.6 Method for calculating the Weighted Number of Medicinal Treatments (WNMT) (Indicator 4.5.12)

13.1 Introduction

Effective sea lice management is essential to protect the health of both farmed and native salmonid populations. An element of management includes setting limits to the number of on-site sea lice to ensure the health and welfare of farmed fish and minimise the risk of sea lice from farmed fish origin affecting native populations, especially during sensitive periods such as the out-migration.

Effective management also includes the cooperation of multiple sites within a specific area to manage sea lice collectively. This Area-Based Management approach helps reduce the overall sea lice burden and mitigate the risk of infestation spreading between sites. Key elements of this cooperation include the coordination of activities, such as stocking, treatment and fallowing, and information sharing.

Parasiticide treatments are used to reduce the number of sea lice on farmed fish. However, relying heavily on these chemical treatments is not a sustainable long-term solution, as they pose challenges related to environmental impact, the development of resistance, and the health and welfare of the farmed fish. Addressing these challenges requires alternatives to chemical parasiticide treatments aiming to reduce their use and ultimately eliminate reliance on them.

13.2 Area-Based Management - ABM (Indicators 4.1.1.11.1, 4.5.1 and 4.5.2)

13.2.1 Attributes of the ABM (Indicator 4.1.1.11.1 and 4.5.1)

The purpose of the ABM scheme is to improve health and biosecurity management at the site, ultimately aiming to reduce potential negative impacts on native fish populations.

A. Definition of the 'area'

The area covered by the ABM shall reflect a logical geographic scope, such as a fjord or a group of ecologically-connected fjords.

The boundaries of the area shall be defined considering:

a. The zone where significant cumulative impacts on native fish may occur; and

b. Hydrodynamic characteristics of the waterbody; and

c. Other relevant aspects of ecosystem structure and function.

If an ABM is a regulatory requirement and its definition of 'area' aligns with these considerations, sites may use that definition for the requirements in Criterion 4.5.

B. Participation in the ABM

At least 80% of farmed salmonid production in the area, by weight, shall participate in the ABM.

Participation shall include all sites owned by ASC Certificate Holders, including those that are not ASC-certified, and ASC applicants.

C. Documentation

The ABM shall document the following:

- The name of the companies and sites participating in the ABM; and
- The name and contact details of the responsible person for each site participating in the ABM; and
- The shared ABM objectives for disease management, related to understanding and minimising the risk of on-site disease transfer to native fish species.

The objectives shall be reviewed and revised as necessary based on new information, including substantiated concerns raised by communities or local native fish interest groups as part of engagement with stakeholders required by Indicator 3.13.4.

D. Information and Data Sharing

The ABM shall ensure the sharing of information and data amongst sites to facilitate effective coordination, including at least the following:

- Plans for stocking and fallowing; and
- Disease and parasite monitoring results, including sea lice levels (see Indicators 4.1.1.10, 4.5.4 and 4.5.6); and
- Therapeutic treatments; and

- Resistance monitoring results, including information on treatments that do not produce the expected efficacy (see Indicators 4.4.8, 4.4.9 and 4.5.14); and
- Suspected presence of an unidentifiable transmissible pathogenic agent; and
- Confirmed presence of a WOAH-notifiable disease (see Indicator 4.1.1.11.1).

E. Coordination

The ABM shall include coordination amongst sites regarding:

- Stocking: It shall be demonstrated that:
  - all stocked fish in the ABM are of the same year; and
  - stocking is coordinated.
- Treatments: It shall be demonstrated that a coordinated treatment plan is implemented within the ABM. The plan shall consider the following:
  - rotation of treatments; and
  - monitoring cumulative use of antimicrobials, including antiparasitics, within the ABM, by chemical, annually, and by production cycle; and
  - assessing the potential risks to human health from the development of resistance by the cumulative use of antimicrobials listed as Highest Priority Critically Important Antimicrobials (HPCIA) or Critically Important Antimicrobials (CIA), or Highly Important Antimicrobials (HIA) by the World Health Organisation (WHO)[154]. The use of antimicrobials listed as Highly Important for Human Medicine shall be considered a last resort.
- Fallowing: It shall be demonstrated that fallowing between each production cycle is coordinated so there is a period when there are no farmed fish in the ABM.

13.2.2 Establishment, review and revision of ABM sea lice load and on-site sea lice levels (Indicator 4.5.2)

In areas with native salmonids, Indicator 4.5.2 requires the ABM to establish, review and potentially revise the maximum sea lice load. The purpose is to assess the potential cumulative infection pressure from on-site sea lice, expressed as the number of sea lice on all sites in the ABM. This maximum sea lice load provides accurate information on the potential risks to native salmonid populations.

- The ABM shall initially establish the maximum total load based on the regulatory requirements applicable to the region or jurisdiction (i.e. the maximum on-site lice levels set by regulators during the sensitive period, multiplied by the number of farmed salmonids in the ABM).hOver time, the ABM shall demonstrate how the collected sea lice data on native salmonids required by Indicator 4.5.4 is used to review and potentially revise the maximum sea lice load for the

[154] https://www.who.int/publications/i/item/9789241515528

ABM each year and/or production cycle. hrevisions to the ABM maximum sea lice load shall lead to corresponding limits on sea lice levels at individual sites during sensitive periods

- if collected sea lice data on native salmonids demonstrates that the on-site sea lice thresholds for sensitive periods outlined in Table 1 are not protective of native salmonids, the sites shall establish a lower threshold in subsequent sensitive periods
- conversely, data consistently demonstrating healthy native salmonid populations allows for a level higher than the established threshold. In this case, a Variance Request (VR)[155] shall be submitted to ASC to revise the threshold for the entire ABM.

- the revision shall document how the ABM is being protective of native salmonids through the interpretation of sea lice data. Specifically, the review shall:
  - include a final recommendation and justification for maintaining or revising maximum sea lice loads in the ABM and the on-site sea lice thresholds; and
  - be documented and made available to the Conformity Assessment Body (CAB). Documentation shall include, as a minimum, the following:
    - the names of participating sites/companies, including responsible persons for each site; and
    - meeting minutes that include recommendations, justifications and actions.

13.3 Method for collecting sea lice data on native salmonids (Indicator 4.5.4)

The purpose is to clarify the correlation between sea lice occurrence in native and farmed salmonids through objective data. The collected data provides meaningful information for the ABM review of the maximum sea lice load (see Indicator 4.5.2 and Section 13.2.2).

Data collection shall conform with the following:

- The monitoring, data collection and analysis of results demonstrate scientific rigour in the sampling size, location, species sampled, which shall be chosen based on relevance to the area (e.g. out-migrating salmon juveniles, coastal sea trout and Arctic char) and method; and
- Monitoring is conducted yearly and is geographically relevant to the area where the site/ABM is located; and
- Metrics include numbers of sea lice per fish, abundance and prevalence; and
- The monitoring involves the participation of third parties, such as independent scientists.

An exception applies where:

[155] Variance Request (VR) Procedure

- Data is collected by regulators and made publicly available, in which case sites shall demonstrate the use of this data to revise the maximum sea lice load required by Indicator 4.5.2; or
- Applicable legal requirements prohibit the handling of native salmonids, in which case sites shall provide evidence that populations are being monitored, though direct involvement in the monitoring is not required.

13.4 Method for on-site sea lice sampling (Indicator 4.5.6)

The on-site sea lice sampling shall conform with the following:

- Frequency: weekly sampling during the sensitive period. Monthly sampling during the rest of the year.

  An exception applies where deviation from the sampling frequency during the sensitive period is justified by a registered veterinarian or aquatic animal health professional for any of the following reasons:

  - immediately after smolting and stocking; or
  - environmental conditions that affect the welfare of the fish; or
  - fish undergoing a disease event and/or being treated, in which case the maximum deviation shall be two weeks; or
  - adherence to anaesthetic withdrawal periods associated with planned harvests.

  The reason for any deviation shall be recorded.
- Number of cages: at least 50% of cages sampled over a 2-week period, with the entire site sampled over at least a 6-week period.
- Number of fish per cage: a minimum of 10 fish samples per cage.
- Sea lice stage: at a minimum, provide data on mobiles (i.e. pre-adult and adult sea lice males) and adult female sea lice.
- Sites shall ensure that sea lice detached from the fish while sampling are included in the final sampling count.
- Sites shall conduct on-site sea lice sampling during the month prior to the sensitive period for the purpose of achieving sea lice levels below the thresholds for sensitive periods outlined in Section 13.5 at the time of the first sampling event within the sensitive period.

13.5 On-site sea lice thresholds for sensitive periods (Indicator 4.5.9)

Indicator 4.5.9 requires that on-site sea lice levels remain below the thresholds outlined in Table 1 during sensitive periods.

Table 1 Sea lice thresholds and sensitive period per region

Region	Sea Lice Thresholds (*L. salmonis*)*	Sensitive Period**
Canada (West Coast)	3 motile***	1st March to 30th June
Faroe Islands	0.5 adult female	1st May to 31st July
Iceland	0.5 mature female	Not established
Ireland	0.3 ovigerous female	1st March to 31st May
Norway	0.2 adult female	○ Nord-Trøndelag and southwards: weeks 16 to 21 ○ Nordland, Troms and Finnmark: week 21 to 26
Scotland	0.5 adult female	1st February to 30th June

* In regions where a threshold is not established, 0.2 adult females apply.

**In regions where a sensitive period is not established, the length and timing should be specified according to a defined criterion (e.g. when juveniles are in proximity to cages) and using the latest knowledge.

***Motile includes adult *L. salmonis* females (with or without egg strings) and other motile *L. salmonis* (including adult males and preadults). Mobile is considered a synonym of motile.

13.6 Method for calculating the Weighted Number of Medicinal Treatments (WNMT) (Indicator 4.5.12)

The Weighted Number of Medicinal Treatments (WNMT) is the total number of medicinal parasiticide treatments applied on a site over the production cycle[156]. Indicator 4.5.12 requires sites to meet an Entry Level (EL) that expresses an initial WNMT to conform with, after which a 25% reduction needs to be achieved until the WNMT meets a defined Global Level (GL) (see Indicator 4.5.13). Table 2 shows the EL and GL per region.

Table 2 Entry Level and Global Level per region

Region*	Entry Level (EL)**	Global Level (GL)**
Canada (West Coast)	1	3***
Canada (East Coast)	9	
Chile	9	
Faroe Islands	6	
Iceland	6	
Ireland	3	
Norway	5	
Scotland	9	

*In regions not listed, an EL of 6 and GL of 3 shall apply.

**Partial treatments (i.e. treatments applied to some cages from the total number of cages in use) should be counted as a proportion of the cages treated.

*** An exception applies where two times a 'coupled treatment[157]' is given (counted as 2+2 = 4 WNMT), in which case a GL of 4 applies. Additional treatments applied will result in an exceedance of GL=4.

[156] Hydrogen peroxide (H_2O_2) is considered a medicinal parasiticide treatment.
[157] A "coupled treatment" is defined as a bath treatment applied in two treatment events (i.e., one treatment at t1 and a follow-up treatment at t2). Each treatment (t1 and t2) shall be included in the calculation of the WNMT.

Appendix 14 Upstream Supply Chain Requirements

Introduction

The impacts of aquaculture extend beyond the UoC, as many species rely on upstream supply chain stages (such as hatchery and nursery production) occurring across different sites. This Appendix sets out the requirements for fish supplier sites in the UoC's upstream supply chain, in accordance with the species defined in the scope of Indicator 1.5.2. These requirements are based on the Principles of the ASC Farm Standard and focus on the impacts most relevant to these sites.

The UoC shall maintain documentation from the supplier sites within the upstream supply chain as evidence that these sites conform with the requirements of this Appendix.

Indicators:	
14.1	The UoC shall demonstrate that supplier sites hold all applicable legal licences and permits.
14.2	The UoC shall demonstrate that supplier sites are not located in Protected Areas (PA). An exception applies where conditional siting is allowed according to **Appendix 4**.
14.3	*Indicator applicability: land-based systems* The UoC shall demonstrate that supplier sites do not convert natural wetland after May 1999. An exception applies where conversion is needed for establishing and maintaining pumping stations, water pipes or canals, in which case the sites shall successfully restore 100% of the converted area.
14.4	The UoC shall demonstrate that supplier sites have a Human-Wildlife Interaction Plan, which includes at least the following: a. identification of Threatened Species present in the region; and b. mitigation measures to avoid injuries or cause mortalities of any Threatened Species.
14.5	The UoC shall demonstrate that supplier sites have an Escape Prevention Plan, which includes at least the following:

a. consideration of the installation, inspection and maintenance of containment structures appropriate for the species, size, life stages and the conditions in which the site operates; and

b. procedures for the handling of fish; and

c. procedures in case of severe weather events; and

d. escape response procedures.

14.6 The UoC shall demonstrate that supplier sites have a procedure for the responsible disposal of waste, which includes at least the following types of waste:

a. organic waste, including mortalities and human waste

b. biosolids

c. chemicals

d. therapeutants

14.7 The UoC shall demonstrate that supplier sites using hormones have a procedure to hold water containing hormones for at least 48 hours or as per product specifications, whichever is greater, prior to discharge.

14.8 The UoC shall demonstrate that supplier sites have a site-specific Health and Welfare Plan (HWP), approved by a registered veterinarian, with the intention of preventing disease outbreaks, and ensuring the good health and welfare of farmed fish.

a. The HWMP shall include at least the following:

   i. disease monitoring; and

   ii. response, including quarantine, treatment, and humane culling; and

   iii. reporting mechanisms, including reporting WOAH-notifiable disease to authorities; and

   iv. biosecurity risks; and

   v. predation risks.

b. The HWP shall be reviewed and revised as necessary:

   i. at least annually for sites with cycles under one year or using continuous production methods; or

   ii. after each cycle for sites with longer cycles or all-in-all-out production methods.

14.9 The UoC shall demonstrate that supplier sites only use therapeutants as prescribed by a registered veterinarian or aquatic animal health professional.

14.10 The UoC shall demonstrate that supplier sites disclose the antibiotic treatments on fish supplied to the UoC, including the number of treatments, the reason for their use and the quantity used.

14.11 The UoC shall demonstrate that supplier sites do not use antimicrobials listed as Authorised for use in Humans Only, Highest Priority Critically Important Antimicrobials (HPCIA) or Critically Important Antimicrobials (CIA) by the World Health Organisation (WHO).

14.12 The UoC shall demonstrate that supplier sites have policies for at least the following:

a. not engaging in or supporting forced labour; and

b. not engaging in child labour; and

c. not engaging in or tolerating any form of discrimination; and

d. allowing all employees to join or form a trade union or worker organisation. An exception applies where this is restricted by law, in which case an alternative lawful mechanism for employee engagement is allowed; and

e. allowing all employees to engage in collective bargaining. An exception applies where this is restricted by law, in which case an alternative lawful mechanism for employee engagement is allowed.

14.13 The UoC shall demonstrate that supplier sites:

a. carry out a site-specific health and safety risk assessment; and

b. provide health and safety training for any person working on the site as required to carry out their job.

14.14 The UoC shall demonstrate that supplier sites have a community grievance mechanism that is proactively communicated, accessible, fair and applicable to Indigenous and tribal peoples, and local communities.

Appendix 15 Methods for Calculating Feed Efficiency

This Appendix details the methods to calculate the metrics on feed efficiency required by Indicator 2.12.5: economic Feed Conversion Ratio (eFCR), Forage Fish Dependency Ratio (FFDR), and EPA and DHA content in feed and as percentage of fish oil in feed.

Section
15.1 - economic Feed Conversion Ratio (eFCR)
15.2 - Forage Fish Dependency Ratio (FFDR)
15.3 - EPA and DHA content in feed
15.4 - EPA and DHA content as percentage of fish oil in feed

Calculations can be made using the calculation templates provided by ASC.

15.1 - economic Feed Conversion Ratio (eFCR)

The economic Feed Conversion Ratio (eFCR) is the ratio between the amount of feed used and the weight of animals produced, taking into account uneaten feed and loss of animals during production, such as mortality or escapes. The eFCR is calculated according to Aas et al. (2019)[158] as follows:

$$eFCR = \frac{total\ feed\ use\ (tonnes)}{net\ production\ \ (tonnes)}$$

- *Total feed use* is the total amount of all feed types in metric tonnes used during production.
- *Net production* for **all-in-all-out** production is calculated as:

$$net\ production\ \ (tonnes) = harvested\ \ production\ (tonnes) - stocked\ \ production\ (tonnes)$$

- *Harvested production* is the wet weight of the harvested animals in metric tonnes.
- *Stocked production* is the wet weight of stocked animals in metric tonnes.

15.2 - Forage Fish Dependency Ratio (FFDR)

The Forage Fish Dependency Ratio (FFDR) measures the amount of forage fish in fishmeal (FFDRm) and fish oil (FFDRo) used to produce one kg of farmed animal.

[158] Aas, T.S., Ytrestøl, T. & Åsgård, T. (2019). Utilization of feed resources in the production of Atlantic salmon (Salmo salar) in Norway: An update for 2016. *Aquaculture Reports 15*. https://doi.org/10.1016/j.aqrep.2019.100216

The ratio considers the differences in content and yield between the feed types used. FFDRm and FFDRo are calculated according to Aas et al. (2019)[158]:

$$FFDR_m = \frac{\left(\frac{fm\ content_{type\ 1}\ (\%)}{fm\ yield_{type\ 1}\ (\%)} * feed\ use_{type\ 1}(tonnes)\right) + \left(\frac{fm\ content_{type\ 2}\ (\%)}{fm\ yield_{type\ 2}\ (\%)} * feed\ use_{type\ 2}(tonnes)\right) + etc}{total\ feed\ use\ (tonnes)} * eFCR$$

$$FFDR_o = \frac{\left(\frac{fo\ content_{type\ 1}\ (\%)}{fo\ yield_{type\ 1}\ (\%)} * feed\ use_{type\ 1}(tonnes)\right) + \left(\frac{fo\ content_{type\ 2}\ (\%)}{fo\ yield_{type\ 2}\ (\%)} * feed\ use_{type\ 2}(tonnes)\right) + etc}{total\ feed\ use\ (tonnes)} * eFCR$$

fm content (%) and *fo content (%)* are the fishmeal or fish oil content of each feed type respectively*fo yield (%)* and *fm yield (%)* are the efficiencies at which fish oil or meal are derived for each feed type a (note that yield is equal to fishmeal production (tonnes)/fish landings (tonnes) * 100). ASC-certified farms receive this information from the ASC-certified feed mill.

Only fishmeal and fish oil derived directly from forage fisheries (e.g. anchoveta) is to be included in the calculation of FFDR.

Fishmeal and fish oil derived from fisheries' by-products, such as trimmings and offal, shall not be included in the calculation of FFDR. Trimmings are defined as by-products when fish are processed for human consumption or if whole fish is rejected for use in human consumption.

15.3 – EPA and DHA content in feed (marine salmonids)

The EPA and DHA content in feed is calculated per site as follows:

$$EPA\ and\ DHA\ in\ feed\ (g/kg\ ) = \frac{fo\ content\ (\%) * EPA\ and\ DHA\ content\ (\%)}{10}$$

- If the fish oil content (*fo content (%)*) varies in different feeds used during production, a weighted average is calculated as follows:

$$weighted\ EPA\ and\ DHA\ in\ feed\ (g/kg\ ) = \frac{total\ EPA\ and\ DHA\ in\ feed\ (g)}{total\ feed\ use\ (tonnes) * 1000}$$

Total EPA and DHA in feed are calculated as follows:

$$\begin{aligned} total\ EPA\ and\ DHA\ in\ feed\ (g) \\ &= \left(EPA\ and\ DHA\ content_{type\ 1}(\%) * fo\ content_{type\ 1}(\%) * feed\ use_{type\ 1}(tonnes) * 100\right) \\ &+ \left(EPA\ and\ DHA\ content_{type\ 2}(\%) * fo\ content_{type\ 2}(\%) * feed\ use_{type\ 2}(tonnes) * 100\right) + etc. \end{aligned}$$

Only fish oil derived directly from a forage fishery (e.g. anchoveta) is to be included in the calculation of EPA and DHA.

Fish oil derived from fisheries' by-products, such as trimmings and offal, shall not be included in the calculation of EPA and DHA. Trimmings are defined as by-products when fish are processed for human consumption or if whole fish is rejected for use in human consumption.

15.4 – EPA and DHA Content as percentage of fish oil in feed (freshwater salmonids)

The EPA and DHA content as percentage of fish oil in feed is calculated per site as follows:

$$weighted\ EPA\ and\ DHA\ in\ fish\ oil\ (\%) = \frac{\left(EPA\ and\ DHA\ content_{type\ 1}(\%) * feed\ use_{type\ 1}(tonnes)\right) + \left(EPA\ and\ DHA\ content_{type\ 2}(\%) * feed\ use_{type\ 2}(tonnes)\right) + etc.}{total\ feed\ use\ (tonnes)}$$

Where EPA and DHA content (%) is the feed-specific percentage of EPA and DHA content of the fish oil.

Only fish oil derived directly from a forage fishery (e.g. anchoveta) is to be included in the calculation of EPA and DHA.

Fish oil derived from fisheries' by-products, such as trimmings and offal, shall not be included in the calculation of EPA and DHA. Trimmings are defined as by-products when fish are processed for human consumption or if whole fish is rejected for use in human consumption.