SALMON AQUACULTURE DIALOGUE

Final standards for responsible salmon aquaculture

June 2012

These standards are released by the Steering Committee of the Salmon Aquaculture Dialogue. The Steering Committee is composed of a representative from each of the following organizations:

Coastal Alliance for Aquaculture Reform
Canadian Aquaculture Industry Alliance
Marine Harvest Group
Norwegian Seafood Federation (FHL)
Pew Environment Group
SalmonChile
Skretting
Fundación Terram
World Wildlife Fund

These standards have been significantly revised over the course of two public comment periods, based on public feedback and the deliberations of the Salmon Aquaculture Dialogue Steering Committee. On any given standard, individual Steering Committee members have a range of views, and sometimes disagree strongly. As a package, the Steering Committee believes the standards represent an important step forward in defining environmentally and socially responsible production of farmed salmon. These standards are intended to be implemented as a package to reduce key impacts from the status quo while also being economically viable and within the range of achievability for the industry.

Collectively, the standards seek to minimize or eliminate the key negative environmental and social impacts of salmon farming, while permitting the industry to remain economically viable. In order to improve the industry's overall performance, the standards focus on today's best performers and are intended to be at a level where enough producers strive to achieve them, bringing about actual change on the ground.

The standards are intended to be a starting point for continuous improvement and to be periodically updated to reflect the best available scientific knowledge, management practices and technologies, and the data collected during the certification of farms to the standards. The standards call for a high level of transparency around farm-level data and monitoring to assist in these future revisions.

The standards are intended to be one tool to improve the sustainability of the industry. The Steering Committee recognizes that farm-level standards must be complemented by effective governmental regulations and coastal zone planning. Governments play a particularly important role in managing potential cumulative impacts from multiple farms. These standards seek to harness the power of the marketplace to promote meaningful, positive change in the way salmon is farmed.

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INTRODUCTION

Seafood is one of the most popular sources of protein worldwide. By volume, approximately half of the seafood we eat is wild caught. But the other half is from aquaculture, the fastest-growing food production system in the world.

As with many rapidly growing industries, the growth in aquaculture production has raised concerns about negative social and environmental impacts related to farming, such as water pollution, the spread of diseases and unfair labor practices at farms. Although there are some businesses addressing these issues well, others are not doing so at all or are doing so poorly.

One tool to help encourage more responsible aquaculture is global standards—performance levels that must be reached to help minimize or eliminate a set of key impacts. Standards can serve as the basis for a certification program. They also can be used to benchmark other standards, be incorporated into existing certification programs, be adopted for government programs and be the foundation for buyer and investment screens. Through the Salmon Aquaculture Dialogue (SAD) roundtable, global, farm-level performance-based standards are being created for salmon farming.

PURPOSE AND SCOPE OF THE SALMON AQUACULTURE DIALOGUE STANDARDS

The SAD is a science-based forum initiated by World Wildlife Fund (WWF) in 2004. The goal of the Dialogue is to credibly develop measurable, performance-based standards that minimize or eliminate the key negative environmental and social impacts of salmon farming, while permitting the industry to remain economically viable.

More than 500 stakeholders, including producers, environmental and social non-governmental organizations (NGOs), seafood buyers, scientists and government representatives have participated in the Dialogue. A nine-person Steering Committee (SC) is responsible for managing the SAD process and making all final decisions related to the salmon standards document. This group of volunteers includes representatives from salmon producer associations and companies, feed manufacturers, and environmental and social NGOs. More information on the Dialogue, including meeting summaries and reports on key issues that were commissioned by the Dialogue, is available at http://www.worldwildlife.org/salmondialogue.

Definition of Standards

The Dialogue is an iterative, participatory process that began with identifying the key negative environmental and social impacts of salmon production. Using a step-wise process, the Dialogue is building agreement on principles, criteria, indicators and standards that address the impacts. These terms are defined in the table below.

	Definition	*Non-aquaculture example*	*Aquaculture example*
Impact	The problem we want to minimize	Overweight	Water pollution
Principle	The guiding principle for addressing the impact	Maintain a healthy weight	Conserve and protect water resources
Criteria	The area to focus on to	Food consumption*	Effluents*

	address the impact		
Indicator	What to measure in order to determine the extent of the impact	Calories	Nitrogen concentration in the effluent
Standard	The number and/or performance level that must be reached to determine if the impact is being minimized**	< 10 calories/pound of body weight/day	4 mg/L total nitrogen in effluent

**For this example, only one criterion is listed even though there often are several criteria for each principle and several indicators for each criterion.*

***A number is not necessary when an indicator cannot be measured (e.g., the indicator for the principle "obey the law," which might be "documentation of compliance with national and local regulations").*

Issue Areas of Salmon Aquaculture to Which the Standards Apply

The SAD establishes principles, criteria, indicators and measurable performance levels for responsible salmon aquaculture with regard to social and environmental issues. The seven areas of key potential negative impact that were identified within the Dialogue are: feed, escapes, nutrient loading and carrying capacity, benthic impacts and siting, disease and parasite transfer, chemical inputs and social impacts (i.e., labor and community impacts). It is recognized that there is overlap within the impact areas and the principles. The full suite of standards is intended to address the suite of potential negative impacts, focusing on key potential impacts of smolt and grow-out stages of production.

Range of Activities within Aquaculture to Which the Standards Apply

Aquaculture is the production of aquatic organisms. It involves the planning, development and operation of facilities, which in turn affect the inputs, production, processing and chain-of-custody components.

The SAD standards apply to the planning, development and operation of salmon aquaculture production systems. The focus of the standards is on production and the immediate inputs to production.

Biological and Geographic Scope to Which the Standards Apply

The salmon standards are applicable to species belonging to the genus *Salmo* and *Oncorhynchus*, and can be applied to all locations and scales of salmon aquaculture production systems.

Unit of Certification to Which the Standards Apply

The unit of certification is a farming site, which in practice means a cluster of cages located together in an operational unit. In undergoing assessment for certification, a company that owns multiple grow-out sites will be subject to compliance only at the particular site(s) for which they choose to undergo certification. A farm must comply with all the standards in this document to be certified, including providing required documentation from their feed and smolt suppliers.

Implementation of the Standards

When finalized, the SAD standards will be handed off to a new organization, the Aquaculture Stewardship Council (ASC), which will be responsible for working with independent, accredited, third-party entities to certify farms that are in compliance with the standards. Farms will be certified on a production cycle basis, though some data will be submitted on an annual basis. The ASC will also offer a Chain of Custody (CoC) assurance that tracks fish from a certified farm to the consumer. More information on the ASC and their certification and accreditation processes is available on their website, www.ascworldwide.org.

In addition to their use by the ASC, the standards could potentially be incorporated into existing certification programs, government regulations, and buyer and investment screens.

PROCESS FOR CREATING THE STANDARDS

General Considerations

The process of setting standards is critical, as it significantly affects the credibility, viability, practicality and acceptance of the standards. The process of creating the SAD standards has been multi-stakeholder, open to anybody to participate and transparent. This is in line with the International Social and Environmental Accreditation and Labeling (ISEAL) Alliance's "Code of Good Practice for Setting Social and Environmental Standards." A goal of the SAD is to follow the ISEAL code.

Standards Setting Process

- In February 2004, under the leadership of WWF, the inaugural meeting of the SAD was held in Washington, DC. The primary goal of the meeting was to begin identifying which impacts to address through the standards. Several additional meetings were held in 2004 and 2005 to finalize the list of impacts.
- The process and format for the SAD was discussed at the June 2004 SAD meeting and formalized in a process document that was finalized in July 2008 (available at http://www.worldwildlife.org/what/globalmarkets/aquaculture/WWFBinaryitem9675.pdf).
- The scope and purpose of the Dialogue was discussed and finalized at the October 2004 SAD meeting. Roles, structure and governance were refined and then finalized at the November 2005 meeting.
- Technical Working Groups (TWGs) were created, starting in 2005, to help research issues related to salmon aquaculture. Members of the Dialogue were actively involved in choosing experts and developing a scope of work for the TWGs. Each of the seven TWGs was tasked with producing a "State of Information Report" that reviews the status of existing research related to the impact, identifies gaps or areas of disagreement in the research and suggests a process for addressing the gaps. The reports were presented at SAD meetings, beginning in December 2007.
- The SAD SC was created over the course of 2004 and 2005. The SC now includes the following people:

Name	Organization	Sector	Country
Petter Arnesen	Marine Harvest	Producer	Norway
Hernan Frigolett	Fundacion Terram	NGO	Chile
Rachel Hopkins	Pew Environment Group	NGO	United States
Javier Ovalle	SalmonChile	Producer association	Chile
Trygve Berg Lea	Skretting	Feed manufacturer	Norway
Kjell Maroni	Norwegian Seafood Federation	Producer association	Norway
Jay Ritchlin	Coastal Alliance for	NGO	Canada

	Aquaculture Reform		
Jose Villalon	World Wildlife Fund	NGO	United States
Mary Ellen Walling	Canadian Aquaculture Industry Alliance	Producer association	Canada

- The SAD has been coordinated and facilitated by Katherine Bostick of WWF-US and David Plumb from the Consensus Building Institute.
- Draft principles were presented and discussed at the January 2008 SAD meeting, then edited based on feedback from that meeting and further SC discussion. The draft principles were posted on the SAD website for public comment for a 60-day period which ended October 15, 2008, then discussed at the November 2008 Dialogue meeting. Principles were revised a second time based on feedback from the comment period and November meeting.
- Draft criteria were presented and discussed at the November 2008 SAD meeting, then edited based on feedback from that meeting and further SC discussion. Revised draft criteria were open for public comment via the website for a 30-day comment period that ended March 6, 2009. They were presented and discussed at the March 2009 SAD meeting. Feedback from the meeting and the public comment period were used by the SC to develop final draft criteria.
- From December 2009 to July 2010, the SC met regularly via phone and several times in person, and consulted with various experts from the TWGs in order to develop draft indicators and standards.
- Draft principles, criteria, indicators and standards were posted for a 60-day public comment period on August 3, 2010. A revised draft was posted for a second, 30-day comment period in May 2011. Feedback received during both comment periods was used by the SC to revise and finalize the standards document. All comments received, as well as the SC's overarching responses to the feedback, have been posted on the SAD website. Comments and responses were sorted according to key issues, themes and frequency.
- The final draft standards, for which the audit manual was drafted, were posted in February 2012.
- In June 2012, final standards and a draft audit manual were e given to a new entity, the Aquaculture Stewardship Council (ASC), which will be responsible for working with independent, third-party entities to certify farms that are in compliance with the standards being created by participants of the Aquaculture Dialogues. The ASC became operational in 2011.
- Throughout the process, WWF has, on behalf of the SC, written and disseminated press releases, and developed and updated the SAD website, to keep people informed of upcoming meetings and progress within the SAD.
- Throughout the process, the SC and SAD coordinator also have held outreach meetings (in person, or via phone or e-mail) with stakeholder groups identified in the outreach strategy.

Continuous Improvement of the Salmon Aquaculture Dialogue Standards

As stated in the ISEAL "Code of Good Practices for Setting Social and Environmental Standards," "... standards shall be reviewed on a periodic basis for continued relevance and effectiveness in meeting their stated objectives and, if necessary, revised in a timely manner." It is implicit in the development of the SAD standards that the numerical values, or performance levels, will be raised or lowered over time to reflect new data, improved practices and new technology.

Throughout the standards development process, the SAD SC has become aware of a number of areas where there is ongoing scientific research, promising technologies under development, or production practices being tested that will likely lead to an increased understanding about impacts and risks from salmon farming and ways

to further reduce those impacts. Those areas include, but are by no means limited to, the certification of responsible small pelagic fisheries, disease interactions between farms and wild populations, and the risks of smolt production in open systems. The SC expects that new scientific literature, along with new technologies and production methods, will assist in making wise revisions to the standards in a few years. The SC encourages additional research around the key areas of environmental and social concern identified in these standards.

INFORMATION FOR THE READER

In the following pages, tables with indicators and their corresponding standards are included. Within each criterion, standards tables are followed by a rationale section that provides a brief overview of why the issues are important and how the proposed standards address them.

Definitions are provided in footnotes.

The documentation that a farm must provide around its smolt supplier(s) is outlined in a separate section of the document.

PREAMBLE

The principles serve as a platform to minimize or eliminate the social and environmental impacts of salmon aquaculture while permitting the salmon farming industry to remain economically viable. These principles—along with the corresponding criteria, indicators and standards—are applicable at the farm level.

Farms must meet 100 percent of the standards in this document to achieve certification. Meeting the full suite of standards will require farms to have a high level of transparency and regular monitoring of a number of key indicators. The standards require the farm to make some performance data publicly available and other performance data available to the Aquaculture Stewardship Council (ASC). See Appendix VI for details on required data transparency, which includes approximately 50 specific reporting requirements.

Although the SAD is creating farm-level standards, they are intended to help protect and maintain ecosystem function and ecosystem services in salmon-producing areas, with the recognition that aquaculture operations are not solely responsible for total ecosystem health. The standards are intended to be revisited and updated periodically (e.g., every three to five years) to ensure that the standards are based on the best available scientific knowledge and management practices and to encourage continuous improvement.

PRINCIPLES, CRITERIA, INDICATORS AND STANDARDS FOR GROW-OUT

This section of the document contains the full suite of principles, criteria, indicators and standards for responsible salmon farming at saltwater grow-out sites.

PRINCIPLE 1: COMPLY WITH ALL APPLICABLE NATIONAL LAWS AND LOCAL REGULATIONS

Principle 1 is intended to ensure that all farms aiming to be certified against the SAD standards meet their legal obligations as a baseline requirement. Adhering to the law will ensure that producers meet the basic environmental and social requirements and the minimal structures, such as legitimate land tenure rights, on which the effectiveness of the standards will stand.

Criterion 1.1 Compliance with all applicable local and national legal requirements and regulations

INDICATOR	STANDARD
1.1.1 Presence of documents demonstrating compliance with local and national regulations and requirements on land and water use	Yes
1.1.2 Presence of documents demonstrating compliance with all tax laws	Yes
1.1.3 Presence of documents demonstrating compliance with all relevant national and local labor laws and regulations	Yes
1.1.4 Presence of documents demonstrating compliance with regulations and permits concerning water quality impacts	Yes

Rationale

Salmon aquaculture operations must, as a baseline, adhere to the national and local laws of the regions where production is taking place. Farm operations that, intentionally or unintentionally, break the law violate a fundamental benchmark of performance for certified farms. It is important that aquaculture operations demonstrate a pattern of legal and responsible behavior, including the implementation of corrective actions for any legal violations.

PRINCIPLE 2: CONSERVE NATURAL HABITAT, LOCAL BIODIVERSITY AND ECOSYSTEM FUNCTION

Principle 2 is intended to address potential impacts from salmon farms on natural habitat, local biodiversity and ecosystem function. Specifically, the key impact areas of benthic impacts, siting, effects of chemical inputs and effects of nutrient loading are addressed within this principle.

Criterion 2.1 Benthic biodiversity and benthic effects[1]

INDICATOR		STANDARD
2.1.1	Redox potential or[2] sulphide levels in sediment outside of the Allowable Zone of Effect (AZE),[3] following the sampling methodology outlined in Appendix I-1	Redox potential > 0 millivolts (mV) or Sulphide ≤ 1,500 microMoles / l
2.1.2	Faunal index score indicating good[4] to high ecological quality in sediment outside the AZE, following the sampling methodology outlined in Appendix I-1	AZTI Marine Biotic Index (AMBI[5]) score ≤ 3.3, or Shannon-Wiener Index score > 3, or Benthic Quality Index (BQI) score ≥ 15, or Infaunal Trophic Index (ITI) score ≥ 25
2.1.3	Number of macrofaunal taxa in the sediment within the AZE, following the sampling methodology outlined in Appendix I-1	≥ 2 highly abundant[6] taxa that are not pollution indicator species
2.1.4	Definition of a site-specific AZE based on a robust and credible[7] modeling system	Yes, within three years of the publication[8] of the SAD standard

[1] Closed production systems that can demonstrate that they collect and responsibly dispose of > 75% of solid nutrients from the production system are exempt from standards under Criterion 2.1. See Appendix VI for requirements on transparency for 2.1.1, 2.1.2 and 2.1.3.

[2] Farm sites can choose whether to use redox or sulphide. Farms do not have to demonstrate that they meet both.

[3] Allowable Zone of Effect (AZE) is defined under this standard as 30 meters. For farm sites where a site-specific AZE has been defined using a robust and credible modeling system such as the SEPA AUTODEPOMOD and verified through monitoring, the site-specific AZE shall be used.

[4] "Good" Ecological Quality Classification: The level of diversity and abundance of invertebrate taxa is slightly outside the range associated with the type-specific conditions. Most of the sensitive taxa of the type-specific communities are present.

[5] http://www.azti.es/en/ambi-azti-marine-biotic-index.html.

[6] Highly abundant: Greater than 100 organisms per square meter (or equally high to reference site(s) if natural abundance is lower than this level).

[7] Robust and credible: The SEPA AUTODEPOMOD modeling system is considered to be an example of a credible and robust system. The model must include a multi-parameter approach. Monitoring must be used to ground-truth the AZE proposed through the model.

[8] Publication: Refers to the date when the final standards and accompanying guidelines are completed and made publicly available. This definition of publication applies throughout this document.

Rationale

This suite of indicators provides multiple layers of security related to benthic impacts, using a chemical proxy for health combined with biodiversity measurements both below and a distance from the cages. Technical experts suggest the chemical proxy of redox potential and sulphide levels, which are good chemical indicators for benthic health. Given that both methods are valid, audited farms can choose their preference for one or the other. Standards have been set for both. Through the consultation of technical experts and review of Hargrave et al.[9] (2008), a level of 1,500 mM sulphide levels and equivalent redox potential of > 0 mV was set to ensure acceptable and transitory benthic conditions. As a precautionary approach, these standards are applicable regardless of the depth of the site.

When considering benthic effects, experts recommended measuring effects below the cages and away from the cages, within and outside the AZE. Though an AZE is difficult to identify as a constant, experts discuss this in terms of 25 meters to 125 meters depending on a range of factors, including currents. In an effort to take a precautionary approach to permissible zone of benthic impact, the SAD standards define the AZE as a distance of 30 meters from cages. For sites where a site-specific AZE has been determined using a valid modeling and video surveillance system, farms will use the site-specific AZE and sampling stations based on actual depositional patterns. Within three years of the publication of the SAD standards, all certified farms must have undertaken the appropriate analysis to determine the site-specific AZE and depositional patterns. This will help ensure that sampling is taking place in areas most appropriate to protect benthic health around farms.

Potential negative impacts on benthic biodiversity are addressed in the standard through the incorporation of an analysis using a benthic faunal index and minimum score at multiple monitoring stations outside the AZE, including a reference site (see Appendix I-1). Farms can use their choice of these four faunal indices to further establish the environmental quality of the soft-bottom benthos. The indices are calculated using the same dataset. Equivalencies for these indices were set using Hargraves et al. (2008) and Zettler et al. (2007)[10] and through consultation with experts. The scores were set to relate to an environmental quality status of good or better according to the definitions of the EU Water Framework Directive.[11] Within the AZE, a demonstration that two or more benthic macrofaunal species, such as sessile macrophytes and worms, are present in high abundance is required to ensure that impacts fall within an acceptable level.

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[9] Hargrave, B.T., Holmer, M. and Newcombe, C.P. 2008. Towards a classification of organic enrichment in marine sediments based on biogeochemical indicators. Marine Pollution Bulletin 56, 810–824.

[10] Zettler, M.L., Schiedek, D. and Bobertz, B. 2007. Benthic biodiversity indices versus salinity gradient in the southern Baltic Sea. Marine Pollution Bulletin 55, 258–270.

[11] Additional references for index equivalencies:

- Borja, A., Franco, J. and Perez, V. 2000. A marine biotic index to establish the ecological quality of soft-bottom benthos within European estuarine and coastal environments. Mar. Poll. Bull. 40, 1100–1114.
- Muxika, I., Borja, A. and Bonne, W. 2005. The suitability of the marine biotic index (AMBI) to new impact sources along European coasts. Ecological Indicators 5, 19–31.
- Muniz, P. et al. 2005. Testing the applicability of a Marine Biotic Index (AMBI) to assessing the ecological quality of soft-bottom benthic communities in the South America Atlantic region. Marine Pollution Bulletin 50, 624–637.

Criterion 2.2 Water quality in and near the site of operation[12]

INDICATOR	STANDARD
2.2.1 Weekly average percent saturation[13] of dissolved oxygen (DO)[14] on farm, calculated following methodology in Appendix I-4	≥ 70%[15]
2.2.2 Maximum percentage of weekly samples from 2.2.1 that fall under 2 mg/liter DO	5%
2.2.3 For jurisdictions that have national or regional coastal water quality targets[16], demonstration through third-party analysis that the farm is in an area recently[17] classified as having "good" or "very good" water quality[18]	Yes[19]
2.2.4 For jurisdictions without national or regional coastal water quality targets, evidence of weekly monitoring of nitrogen and phosphorous[20] levels on farm and at a reference site, following methodology in Appendix I-5	Yes

[12] See Appendix VI for transparency requirements for 2.2.1, 2.2.2, 2.2.3 and 2.2.5.

[13] Percent saturation: Percent saturation is the amount of oxygen dissolved in the water sample compared to the maximum amount that could be present at the same temperature and salinity.

[14] Averaged weekly from two daily measurements (proposed at 6 am and 3 pm).

[15] An exception to this standard shall be made for farms that can demonstrate consistency with a reference site in the same water body.

[16] Related to nutrients (e.g., N, P, chlorophyll A).

[17] Within the two years prior to the audit.

[18] Classifications of "good" and "very good" are used in the EU Water Framework Directive. Equivalent classification from other water quality monitoring systems in other jurisdictions are acceptable.

[19] Closed production systems that can demonstrate the collection and responsible disposal of > 75% of solid nutrients as well as > 50% of dissolved nutrients (through biofiltration, settling and/or other technologies) are exempt from standards 2.2.3 and 2.2.4.

[20] Farms shall monitor total N, NH4, NO3, total P and Ortho-P in the water column. Results shall be submitted to the ASC database. Methods such as a Hach kit are acceptable.

2.2.5 Demonstration of calculation of biochemical oxygen demand (BOD[21]) of the farm on a production cycle basis	Yes

Rationale

Water quality is essential for the health of farmed salmon and wild species surrounding a farm. One component of water quality, dissolved oxygen (DO), is particularly critical for the survival and good performance of farmed salmon. As a result, most farms regularly measure DO. DO levels (in mg/l) naturally fluctuate in the environment. This is due to a range of factors, including temperature, time of day and upwelling of oxygen-poor waters from deep in the ocean. Low DO levels can also be a sign of excessive nutrient loading. DO provides a useful overall proxy for a water body's ability to support healthy biodiversity and supplements the benthic indicators that will also pick up excessive nutrient loading.

Salmon ideally need a level of dissolved oxygen over 5 mg/l to avoid any possible stress, although they are able to live under lower oxygen concentrations, particularly if only for short periods. Under routine production, the average minimum percent saturation of DO in the water column should be above 70 percent. Measuring DO as a percent saturation takes into account salinity and temperature at the farm site. Additionally, compliance with the SAD standards will limit the number of low DO readings in the water column below 2 mg/lt to less than 5 percent incidence rate, which will allow for periodic physical phenomena, such as upwelling. The standard also addresses natural fluctuations in DO levels and percent saturation through allowing comparison to a reference site as a means to meet standard 2.2.1. This will ensure that if the percent saturation is lower than ideal, it is the result of natural conditions in the water body and not due to nutrient release from the salmon farm.

The standards also incorporate a requirement that farms demonstrate they are located in areas of "good" or "very good" water quality, in jurisdictions such as the European Union that have coastal targets. Not all salmon-producing regions have such targets, however. In these situations, farms must collect data on nutrient levels near the farm and at a reference site and make that data available under Appendix VI. No threshold is placed on this standard.

Lastly, the standards incorporate a requirement for farms to calculate the BOD associated with their production cycle in order to better understand the input of nutrients from the farm to the water body. There is no performance threshold associated with this standard, and the data from this standard will provide data to better understand nutrient loads, ranges of performance, the degree to which different systems reduce BOD, and the relationship between calculated BOD and the other water quality indicators in the SAD standard.

The SAD technical working group on nutrient loading identified the potential link between nutrients around salmon farms and harmful algal blooms as one that had yet to be established but around which there remained

[21] BOD calculated as: ((total N in feed – total N in fish)*4.57) + ((total C in feed – total C in fish)*2.67). A farm may deduct N or C that is captured, filtered or absorbed through approaches such as IMTA or through direct collection of nutrient wasted. In this equation, "fish" refers to harvested fish. Reference for calculation methodology: Boyd C. 2009. Estimating mechanical aeration requirement in shrimp ponds from the oxygen demand of feed. In: Proceedings of the World Aquaculture Society Meeting; Sept 25-29, 2009; VeraCruz, Mexico. And: Global Aquaculture Performance Index BOD calculation methodology available at http://web.uvic.ca/~gapi/explore-gapi/bod.html.

some uncertainty and for which there was an intuitive concern around the effect of the cumulative anthropogenic nutrient load into coastal waters. The group noted a shortage of field studies to validate hypotheses from lab-based work. The data collected under this criterion can be used to help better understand potential linkages around salmon farming, ambient nutrient levels and environmental phenomena such as harmful algal blooms. Farm operators may also find this data useful in management decisions, and it can be useful in ensuring that nutrient inputs from salmon farms and other sources fall within the carrying capacity of the water body. Data collected with regard to BOD and nutrient levels shall be reviewed, and the setting of a threshold related to nutrient loads should be seriously considered when the standards are updated.

Criterion 2.3 Nutrient release from production

INDICATOR	STANDARD
2.3.1 Percentage of fines[22] in the feed at point of entry to the farm[23] (calculated following methodology in Appendix I-2)	< 1% by weight of the feed

Rationale

The release of nutrients into the environment from salmon farms was identified by SAD participants as a key impact of production. The impact is addressed throughout the standards with a range of water quality and benthic performance metrics. Standard 2.3.1 complements these other standards by addressing the direct release of uneaten feed in the form of fines into the environment. By setting a maximum percentage of fines in the feed, it addresses the efficient and proper transport, storage and physical delivery of feed pellets to the farm site. Poor performance in any of the above phases of feed handling will result in a higher percentage of fines (fine particles of feed) and potentially increased environmental impacts, due to an increase in suspended organic particles and nutrients released into the environment.

Criterion 2.4 Interaction with critical or sensitive habitats and species

INDICATOR	STANDARD

[22] Fines: Dust and fragments in the feed. Particles that separate from feed with a diameter of 5 mm or less when sieved through a 1 mm sieve, or particles that separate from feed with a diameter greater than 5 mm when sieved through a 2.36 mm sieve. To be measured at farm gate (e.g., from feed bags after they are delivered to farm).

[23] To be measured every quarter or every three months. Samples that are measured shall be chosen randomly. Feed may be sampled immediately prior to delivery to farm for sites with no feed storage where it is not possible to sample on farm. Closed production systems that can demonstrate the collection and responsible disposal of > 75% of solid nutrients and > 50% of dissolved nutrients (through biofiltration, settling and/or other technologies) are exempt.

2.4.1	Evidence of an assessment of the farm's potential impacts on biodiversity and nearby ecosystems that contains at a minimum the components outlined in Appendix I-3	Yes
2.4.2	Allowance for the farm to be sited in a protected area[24] or High Conservation Value Areas[25] (HCVAs)	None[26]

Rationale

The intent of the standards under criterion 2.4 is to minimize the effects of a salmon farm on critical or sensitive habitats and species. The habitats and species to consider include marine-protected areas or national parks, established migratory routes for marine mammals, threatened or endangered species, the habitat needed for endangered and threatened species to recover, eelgrass beds and HCVAs, where these have been defined. These standards are consistent with the Global Reporting Index indicators EN12, EN14 and EN15, which relate to the identification and description of significant impacts of activities on biodiversity, protected habitats and threatened species, and the communication of strategies to manage these impacts.

The standards under Criteria 2.4 ensure that a farm is aware of any nearby critical, sensitive or protected areas, understands the impacts it might have on those areas, and has a functioning plan in place to address those potential impacts. They also ensure that extra care is taken in areas that are recognized for ecological importance either through designation as a protected area or through designation as being an area of high conservation value, by not allowing production in these areas to be eligible for certification, with some exceptions made if extra conditions are met to ensure that the farms are compatible with the conservation goals of the areas.

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[24] Protected area: "A clearly defined geographical space, recognized, dedicated and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values." Source: Dudley, N. (Editor) (2008), Guidelines for Applying Protected Area Management Categories, Gland, Switzerland: IUCN. x + 86pp.

[25] High Conservation Value Areas (HCVA): Natural habitats where conservation values are considered to be of outstanding significance or critical importance. HCVA are designated through a multi-stakeholder approach that provides a systematic basis for identifying critical conservation values—both social and environmental—and for planning ecosystem management in order to ensure that these high conservation values are maintained or enhanced (http://www.hcvnetwork.org/).

[26] The following exceptions shall be made for Standard 2.4.2:

- For protected areas classified by the International Union for the Conservation of Nature (IUCN) as Category V or VI (these are areas preserved primarily for their landscapes or for sustainable resource management).
- For HCVAs if the farm can demonstrate that its environmental impacts are compatible with the conservation objectives of the HCVA designation. The burden of proof would be placed on the farm to demonstrate that it is not negatively impacting the core reason an area has been identified as a HCVA.
- For farms located in a protected area if it was designated as such after the farm was already in operation and provided the farm can demonstrate that its environmental impacts are compatible with the conservation objectives of the protected area and it is in compliance with any relevant conditions or regulations placed on the farm as a result of the formation/designation of the protected area. The burden of proof would be placed on the farm to demonstrate that it is not negatively impacting the core reason an area has been protected.

Criterion 2.5 Interaction with wildlife, including predators[27]

INDICATOR		STANDARD
2.5.1	Number of days in the production cycle when acoustic deterrent devices (ADDs) or acoustic harassment devices (AHDs) were used	0, within three years of the date of publication[28] of the SAD standard
2.5.2	Prior to the achievement of 2.5.1, if ADDs or AHDs are used, maximum percentage of days[29] in the production cycle that the devices are operational	≤ 40%
2.5.3	Number of mortalities[30] of endangered or red-listed[31] marine mammals or birds on the farm	0
2.5.4	Evidence that the following steps were taken prior to lethal action[32] against a predator: 1. All other avenues were pursued prior to using lethal action 2. Approval was given from a senior manager above the farm manager 3. Explicit permission was granted to take lethal action against the specific animal from the relevant regulatory authority	Yes[33]
2.5.5	Evidence that information about any lethal incidents on the farm has been made easily publicly available[34]	Yes
2.5.6	Maximum number of lethal incidents[35] on the farm over the prior two years	< 9 lethal incidents,[36] with no more than two of the incidents being marine

[27] See Appendix VI for transparency requirements for 2.5.2, 2.5.5 and 2.5.6.

[28] Publication: Refers to the date when the final standards and accompanying guidelines are completed and made publicly available. This definition of publication applies throughout this document.

[29] Day: 24-hour cycle.

[30] Mortalities: Includes animals intentionally killed through lethal action as well as accidental deaths through entanglement or other means.

[31] Species listed as endangered or critically endangered by the IUCN or on a national endangered species list.

[32] Lethal action: Action taken to deliberately kill an animal, including marine mammals and birds.

[33] Exception to these conditions may be made for a rare situation where human safety is endangered. Should this be required, post-incident approval from a senior manager should be made and relevant authorities must be informed.

[34] Posting results on a public website is an example of "easily publicly available." Shall be made available within 30 days of the incident and see Appendix VI for transparency requirements.

[35] Lethal incident: Includes all lethal actions as well as entanglements or other accidental mortalities of non-salmonids.

		mammals
2.5.7	In the event of a lethal incident, evidence that an assessment of the risk of lethal incident(s) has been undertaken and demonstration of concrete steps taken by the farm to reduce the risk of future incidences	Yes

Rationale

The suite of standards related to mortalities and lethal incidents of predators or other wildlife is intended to ensure that certified farms have minimal impact on populations of wildlife, placing limits on both accidental and intentional mortalities of these species. The standards ensure that endangered species have not died as a result of interaction with the farm and require transparency of farms on any lethal incidents and wildlife mortalities for non-threatened species. Good management practices with regards to when to take action and how to reduce risk of future incidents are also required.

A large variety of acoustic deterrent (and harassment) devices is used in salmon aquaculture. Based on available research,[37] it appears that the effectiveness of these devices in reducing farmed salmon predation by marine mammals can vary widely including by location, marine mammal species, period of use, etc. Available research suggests that noise and high-pitched sounds resulting from currently available acoustic devices can cause pain to dolphins, porpoises and whales. As intended, acoustic devices can cause marine mammals including seals, porpoises and whales to avoid areas that may be important for feeding, breeding and travel/migration. While the devices may be initially effective in deterring marine mammals in certain scenarios, research studies suggest that they lose their effectiveness over several years. Additionally, evidence suggests that alternative measures such as promptly removing dead fish, reducing stocking densities, net tensioning and use of seal blinds are important in reducing depredation on salmon farms.

Given the impacts associated with ADDs/AHDs and the availability of other, potentially less impactful and more effective deterrence practices, the standards encourage farms not to use ADDs/AHDs, requires that they not be used on a continuous basis and that they are actively used less than 40 percent of the days in the production cycle. The standard additionally requires that their use be phased out on certified farms within three years of the publication of the SAD standard. Starting three years from the date of publication, no farm meeting the

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[36] Standard 2.5.6 applicable to incidents related to non-endangered and non-red-listed species. This standard complements, and does not contradict, 2.5.3.

[37] References for the section of the rationale related to ADDs/AHDs:

- Northridge, S.P., Gordon, J.G., Booth, C., Calderan, S., Cargill, A., Coram, A., Gillespie, D., Lonergan, M. and Webb, A. 2010. Assessment of the impacts and utility of acoustic deterrent devices. Final Report to the Scottish Aquaculture Research Forum, Project Code SARF044. 34pp.
- Morton, A. B., and Symonds, H. K. 2002. Displacement of *Orcinus orca* (L.) by high amplitude sound in British Columbia, Canada. ICES Journal of Marine Science, 59: 71–80.
- Scottish Association for Marine Science and Napier University (SAMS)2002. Review and synthesis of the environmental impacts of aquaculture. Scottish Executive Research Unit. www.scotland.gov.uk/cru/kd01/green/reia-00.asp.
- Milewski, I. 2001. Impacts of salmon aquaculture on the coastal environment: a review.
- Young, S. 2001. Potential adverse effects of aquaculture on marine mammals: in Tlusty, M.F., Bengston, D.A., Halvorson, H.O., Oktay, S.D., Pearce, J.B., Rheault, Jr., R.B. (eds.). Marine Aquaculture and the Environment: A Meeting for Stakeholders in the Northeast. Cape Cod Press, Falmouth, Massachusetts.

standard shall use ADDs/AHDs. An exception to this standard for new technologies may be granted by the Technical Advisory Group of the ASC if there is clear scientific evidence that future ADD/AHD technology presents significantly reduced risk to marine mammals and cetaceans.

PRINCIPLE 3: PROTECT THE HEALTH AND GENETIC INTEGRITY OF WILD POPULATIONS

The primary aim of Principle 3, in combination with Principle 5, is to ensure that salmon farms do not harm the health of wild fish populations. This principle addresses impacts associated with disease and parasites, escapes and siting.

Criterion 3.1 Introduced or amplified parasites and pathogens[38, 39]

INDICATOR	STANDARD
3.1.1 Participation in an Area-Based Management (ABM) scheme for managing disease and resistance to treatments that includes coordination of stocking, fallowing, therapeutic treatments and information-sharing. Detailed requirements are in Appendix II-1.	Yes
3.1.2 A demonstrated commitment[40] to collaborate with NGOs, academics and governments on areas of mutually agreed research to measure possible impacts on wild stocks	Yes
3.1.3 Establishment and annual review of a maximum sea lice load for the entire ABM and for the individual farm as outlined in Appendix II-2	Yes
3.1.4 Frequent[41] on-farm testing for sea lice, with test results made easily publicly available[42] within seven days of testing	Yes

[38] Farm sites for which there is no release of water that may contain pathogens into the natural (freshwater or marine) environment are exempt from the standards under Criterion 3.1.

[39] See Appendix VI for transparency requirements for 3.1.1, 3.1.3, 3.1.4, 3.1.6 and 3.1.7.

[40] Commitment: At a minimum, a farm and/or its operating company must demonstrate this commitment through providing farm-level data to researchers, granting researchers access to sites, or other similar non-financial support for research activities.

[41] Testing must be weekly during and immediately prior to sensitive periods for wild salmonids, such as outmigration of wild juvenile salmon. Testing must be at least monthly during the rest of the year, unless water temperature is so cold that it would jeopardize farmed fish health to test for lice (below 4 degrees C). Within closed production systems, alternative methods for monitoring sea lice, such as video monitoring, may be used.

[42] Posting results on a public website is an example of "easily publicly available."

3.1.5	In areas with wild salmonids,[43] evidence of data[44] and the farm's understanding of that data, around salmonid migration routes, migration timing and stock productivity in major waterways within 50 kilometers of the farm	Yes
3.1.6	In areas of wild salmonids, monitoring of sea lice levels on wild out-migrating salmon juveniles or on coastal sea trout or Artic char, with results made publicly available. See requirements in Appendix III-1.	Yes
3.1.7	In areas of wild salmonids, maximum on-farm lice levels during sensitive periods for wild fish.[45] See detailed requirements in Appendix II, subsection 2.	0.1 mature female lice per farmed fish

Rationale

Salmon farms interact with wild fish populations that live or migrate near the open net pens. A particular concern is the interaction with wild salmon and sea trout with regard to pathogens and parasites. There is significant debate in the scientific literature about the extent of the interaction and impact. The Disease Report[46] commissioned by the SAD concluded that there is "shared benefit to farm productivity and to minimizing impacts on wild fish by continually seeking to reduce disease on salmon farms."

Sea lice have emerged as a pressing challenge for the salmon industry and its potential impacts on wild populations. The SAD's Sea Lice Technical Report concluded that the "weight of evidence is that sea lice of farm origin can present, in some locations and for some host species populations, a significant threat." The report called for a "concerted precautionary approach" in managing the issue.

Standards under Criterion 3.1, in combination with standards under Criterion 5.4, seek to address these concerns by establishing best practice in managing potential disease and parasite risks to wild populations. The standards recognize that the cumulative impacts from a group of farms in an area can become harmful even when an individual farm is operating its own production in a responsible way. Farms located in areas of wild salmonids, defined as farms situated within 75 km of a migration route or sea trout habitat, have additional requirements under this standard because of the transmission of disease between farms and wild salmonids.

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[43] For purposes of these standards, "areas with wild salmonids" are defined as areas within 75 kilometers 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.

[44] Farms do not need to conduct research on migration routes, timing and the health of wild stocks under this standard if general information is already available. Farms must demonstrate an understanding of this information at the general level for salmonid populations in their region, as such information is needed to make management decisions related to minimizing potential impact on those stocks.

[45] Sensitive periods for migrating salmonids is during juvenile outmigration and approximately one month before.

[46] This report and other reports on State of Information of key impacts commissioned by the Salmon Aquaculture Dialogue are available at www.worldwildlife.org/salmondialogue.

Area-based management (ABM) is a requirement under this standard. Some salmon-growing jurisdictions have begun to require ABM or are considering it because neighboring farms can achieve significantly improved results when coordinating management of diseases and biosecurity measures. Conversely, a lack of coordination can lead to negative outcomes, such as resistance to treatments. Farms that don't have ABM schemes already established in their jurisdiction will need to show leadership in working with neighboring farms to establish such a scheme, even if the regulatory structure doesn't require it.

The commitment to research required under 3.1.2 intends to ensure that farms are working with researchers and regulators to address the many gaps in understanding around a farm's interaction with wild populations. A demonstrated commitment means that the farm is participating in joint research efforts. Although funding of research is encouraged, transparency around site-level data and/or access to sites is seen as an extremely valuable contribution to scientific research and is, therefore, the requirement under this standard.

The standards address the challenge of sea lice in several ways. First, farms seeking certification must be able to demonstrate that the ABM scheme has set a maximum lice load for the entire area that reflects regulatory requirements. In areas of wild salmonids, the ABM must also show how this maximum load reflects the results of monitoring of wild populations (more below on monitoring).

The standards also call for an enhanced level of transparency around sea lice monitoring data. Second, farms must conduct frequent testing of on-farm lice levels, and make those results publicly available. This transparency reflects the goal of building credibility among the interested public around the actual experience of sea lice levels on the farm and in the wild.

Farms located in areas of wild salmonids must participate in monitoring of lice levels on wild out-migrating juvenile salmon or other important salmonids in the area, such as coastal sea trout or arctic char. The standards assume this monitoring will be conducted in collaboration with researchers and/or regulatory bodies. Area-based management schemes must demonstrate how the scheme has incorporated the results of wild monitoring into maximum lice loads permitted across the area. These standards require farms to show leadership in managing the interaction with wild populations. This leadership will mean that some farms seeking certification will need to take on roles and responsibilities that they previously didn't view to be inside the scope of responsibility for an individual farm. Enhanced leadership is an essential part of showing best practice in this high-priority issue of farm interaction with wild populations.

Under 3.1.7, the standards also require farms located in areas of wild salmonids to demonstrate precautionary low lice levels near zero during sensitive periods for wild fish, such as during juvenile out-migration and immediately prior.

The monitoring and disease management presuppose that farmers are aware of salmon migration routes, the timing of out migration and basic information around stock status. This information, along with sea lice monitoring results, should be compiled by ASC in an effort to consolidate data and promote future research.

Criterion 3.2 Introduction of non-native species

INDICATOR	STANDARD

3.2.1	If a non-native species is being produced, demonstration that the species was widely commercially produced in the area by the date of publication of the SAD standard	Yes[47]
3.2.2	If a non-native species is being produced, evidence of scientific research[48] completed within the past five years that investigates the risk of establishment of the species within the farm's jurisdiction and these results submitted to ASC for review[49]	Yes, within five years of publication of the SAD standard[50,51]
3.2.3	Use of non-native species for sea lice control or on-farm management purposes	None

Rationale

Accidental or intentional introductions of non-native species are significant global environmental problems.[52] Aquaculture is considered one of the major pathways for introducing non-native aquatic plants and animals that may become harmful invasive species. The SAD believes these standards are in line with FAO guidelines that permit the culture of non-native species only when they pose an acceptable level of risk to biodiversity. This standard does not permit introductions of non-native salmonids, unless farming of the species already occurs in the area, or a completely closed production system is used, or all cultured fish are sterile.

Research to date, reviewed by the SAD Technical Working Group on Escapes, has not shown that the production of farmed salmon has led to the establishment of viable populations in the wild of non-native species. Given this research and existing analyses of the risks associated with the farming of salmonids as either a native or non-

[47] Exceptions shall be made for production systems that use 100 percent sterile fish or systems that demonstrate separation from the wild by effective physical barriers that are in place and well-maintained to ensure no escapes of reared specimens or biological material that might survive and subsequently reproduce.

[48] The research must at a minimum include multi-year monitoring for non-native farmed species, use credible methodologies and analysis, and undergo peer review.

[49] If the review demonstrates there is increased risk, the ASC will consider prohibiting the certification of farming of non-native salmon in that jurisdiction under this standard. In the event that the risk tools demonstrate "high" risks, the SAD expects that the ASC will prohibit the certification of farming of non-native salmon in that jurisdiction.

[50] Farms have five years to demonstrate compliance with this standard from the time of publication of the final SAD standards and accompanying auditing guidelines.

[51] Farms are exempt from this standard if they are in a jurisdiction where the non-native species became established prior to farming activities in the area and the following three conditions are met: eradication would be impossible or have detrimental environmental effects; the introduction took place prior to 1993 (when the Convention on Biological Diversity (CBD) was ratified); the species is fully self-sustaining.

[52] Leung, K.M.Y. and Dudgeon, D. 2008. Ecological risk assessment and management of exotic organisms associated with aquaculture activities. In M.G. Bondad-Reantaso, J.R. Arthur and R.P. Subasinghe (eds.) Understanding and applying risk analysis in aquaculture. FAO Fisheries and Aquaculture Technical Paper. No. 519. Rome, FAO. pp. 67–100.

native species, this standard permits the certification of farming of non-native species in locations where production already exists.

Nonetheless, the standard also requires that farms producing non-native salmon demonstrate new research every five years that investigates the risks of establishment in that jurisdiction. The standard is intended to create an incentive for continuing research. The SAD is asking ASC to review the results of this research, and use a tool such as the Marine Fish Invasiveness Score (MFISK) to gauge changes in risk. In the event of increased risks, the SAD expects that the ASC will promptly consider prohibiting the certification of farming of non-native salmon in that area under this standard. In the event that the risk tools demonstrate "high" risks, the SAD expects that the ASC will prohibit the certification of farming of non-native salmon in that area. The SAD expects that these standards will be audited on a regional or ABM level, meaning that all farms in a given area will be viewed the same under these standards.

The use of alternatives to chemical treatments for farm management, such as the use of cleaner fish for sea lice control, is permitted and encouraged under the SAD standards. However, any wrasse, cleaner fish or other species used for management during production must be native species in order to prevent introduction of new species to an area.

Criterion 3.3 Introduction of transgenic species

INDICATOR	STANDARD
3.3 Use of transgenic[53] salmon by the farm	None

Rationale
Transgenic fish are not permitted under this standard because of concerns about their unknown impact on wild populations. The culture of genetically enhanced[54] salmon is acceptable under the SAD. This allows for further progress in feed conversion, which should increase the efficient use of local resources. Also allowed under the SAD standard is the cultivation of triploid or all female fish, as long as those fish are not transgenic.

Criterion 3.4 Escapes[55]

INDICATOR	STANDARD

[53] Transgenic: Containing genes altered by insertion of DNA from an unrelated organism. Taking genes from one species and inserting them into another species to get that trait expressed in the offspring (http://www.csrees.usda.gov/nea/biotech/res/biotechnology_res_glossary.html).

[54] Genetic enhancement**:** The process of genetic improvement via selective breeding that can result in better growth performance and domestication but does not involve the insertion of any foreign genes into the genome of the animal.

[55] See Appendix VI for transparency requirements for 3.4.1, 3.4.2 and 3.4.3.

3.4.1 Maximum number of escapees[56] in the most recent production cycle	300[57]
3.4.2 Accuracy[58] of the counting technology or counting method used for calculating stocking and harvest numbers	≥ 98%
3.4.3 Estimated unexplained loss[59] of farmed salmon is made publicly available	Yes
3.4.4 Evidence of escape prevention planning and related employee training, including: net strength testing; appropriate net mesh size; net traceability; system robustness; predator management; record keeping and reporting of risk events (e.g., holes, infrastructure issues, handling errors, reporting and follow up of escape events); and worker training on escape prevention and counting technologies	Yes

Rationale

Escaped farmed salmon have the potential to disrupt ecosystems and alter the overall pool of genetic diversity through competition with wild fish and interbreeding with local wild stocks of the same population. It has been shown that interbreeding of farmed with wild salmon of the same species can result in reduced lifetime success, lowered individual fitness and decreases in production over at least two generations.[60] The most effective way to address these risks is to reduce the number of escapes of farmed salmon to zero or near zero.

Escapes can occur in large events that are immediately noticeable at a farm, smaller events that are still noticeable, and through slower, lower levels of losses of fish that might go unnoticed. These standards place a

[56] Farms shall report all escapes; the total aggregate number of escapees per production cycle must be less than 300 fish. Data on date of escape episode(s), number of fish escaped and cause of escape episode shall be reported as outlined in Appendix VI.

[57] A rare exception to this standard may be made for an escape event that is clearly documented as being outside the farm's control. Only one such exceptional episode is allowed in a 10-year period for the purposes of this standard. The 10-year period starts at the beginning of the production cycle for which the farm is applying for certification. The farmer must demonstrate that there was no reasonable way to predict the events that caused the episode. See auditing guidance for additional details.

[58] Accuracy shall be determined by the spec sheet for counting machines and through common estimates of error for any hand-counts.

[59] Calculated at the end of the production cycle as: Unexplained loss = Stocking count – harvest count – mortalities – other known escapes. Where possible, use of the pre-smolt vaccination count as the stocking count is preferred.

[60] Thorstad, E.B., Fleming, I.A., McGinnity, P., Soto, D., Wennevik, V. and Whoriskey, F. 2008. Incidence and impacts of escaped farmed Atlantic salmon *Salmo salar* in nature. NINA Special Report 36. 110 pp.

cap on the total amount of escapees. The cap effectively prevents a farm that has had a significant escape event from being certified, except under extremely unusual circumstances in which the farm can demonstrate there was no reasonable way to predict the cause.

The standards require transparency about unexplained loss of salmon to help the farm and the public understand trends related to the cumulative numbers of losses of fish that go unnoticed during production. The accuracy of these numbers is limited by the margin of error of fish counting machines and other counting techniques. The standards seek to encourage farmers to use counting devices that are as accurate as possible, requiring a minimum 98 percent accuracy of the counting method.

A number of other standards throughout the document complement the standards on escapes from grow-out sites in terms of minimizing impact on wild salmon populations. The SAD includes standards related to escapes from smolt production facilities, and a move away from production of smolts in open systems to closed and semi-closed systems with lower risk of escapees. Standards related to escapees from smolt systems are particularly important in minimizing the potential for interbreeding, as some studies show comparatively high reproductive success rates in escaped precocious male parr.[61] The SAD also includes standards related to siting in protected or high conservation value areas, including areas that are designated as such in order to protect threatened wild salmonid populations.

[61] Garant, D., Fleming I.A., Einum, S. and Bernatchez, L. Alternate male life-history tactics as potential vehicles for speeding introgression of farm salmon traits into wild populations. Ecology Letters 2003;6: 541-549.

PRINCIPLE 4: USE RESOURCES IN AN ENVIRONMENTALLY EFFICIENT AND RESPONSIBLE MANNER

Principle 4 is intended to address negative impacts that stem from resource use, including feed and non-therapeutic chemical inputs.

Criterion 4.1 Traceability of raw materials in feed

INDICATOR		STANDARD
4.1.1	Evidence of traceability, demonstrated by the feed producer, of feed ingredients that make up more than 1% of the feed.[62]	Yes

Rationale

Raw material traceability is fundamental to many of the SAD standards and, therefore, is required under this standard. This standard will make raw material sourcing more transparent. It must be demonstrated at the feed manufacturer or feed producer level. For some feed ingredients, this will be evidence of traceability with regard to country of origin, while for other feed ingredients that relate specifically to other SAD standards, this may be a finer level of detail, such as traceability back to the fishery as outlined in the following criteria 4.2 and 4.3.

Criterion 4.2 Use of wild fish for feed[63]

INDICATOR		STANDARD
4.2.1	Fishmeal Forage Fish Dependency Ratio (FFDRm) for grow-out (calculated using formulas in Appendix IV- 1)	< 1.35
4.2.2	Fish Oil Forage Fish Dependency Ratio (FFDRo) for grow-out (calculated using formulas in Appendix IV- 1), OR Maximum amount of EPA and DHA from direct marine sources[64] (calculated according to Appendix IV-2)	FFDRo < 2.95 or (EPA + DHA) < 30 g/kg feed

[62] Traceability shall be at a level of detail that permits the feed producer to demonstrate compliance with the standards in this document (i.e., marine raw ingredients must be traced back to the fishery, soy to the region grown, etc.). Feed manufacturers will need to supply the farm with third-party documentation of the ingredients covered under this standard.

[63] See Appendix VI for transparency requirements for 4.2.1 and 4.2.2.

[64] Calculation excludes DHA and EPA derived from fisheries by-products and trimmings. Trimmings are defined as by-products when fish are processed for human consumption or if whole fish is rejected for use of human consumption because the quality at the time of landing does not meet official regulations with regard to fish suitable for human consumption.

Rationale

The salmon aquaculture industry has significantly reduced the inclusion rates of fishmeal and fish oil from forage fish in salmon feeds during the past two decades. The Forage Fish Dependency Ratios (FFDR) contained in these standards aim to support the trend toward lower inclusion rates and increasingly efficient use of marine resources, which are expected to continue. Fishmeal and fish oil are both finite resources that are shared across a range of users with increasing demands, from direct human consumption to aquaculture to pig and poultry production. The SAD intends to promote the efficient use of these resources, producing increasing amounts of farmed salmon from a given input of fishmeal and oil.

The ratios, one for fishmeal and another for fish oil, calculate the dependency on forage fisheries through an assessment of the quantity of live fish from small pelagic fisheries required to produce the amount of fishmeal or fish oil needed to produce a unit of farmed salmon. The SAD offers the calculation of levels of EPA and DHA from wild fish in feeds as an alternate method of measuring dependency on forage fisheries. The standard encourages producers who want to produce salmon with high levels of omega-3 fatty acids to do so by sourcing the EPA and DHA from sources other than fish oil derived from direct industrial fisheries. The ratios complement the standards described in criterion 4.3, which will move farms toward using feed with marine ingredients from fisheries certified as responsibly managed. Producers will be able to improve their FFDR by using a greater percentage of fishmeal and fish oil from trimmings and offal, using other sources of meal and oil (e.g., vegetables) and improving their feeding efficiency. The standard was set at a level that is achievable by better performers today according to available nutritional knowledge, scientific results and data on the range of performance on this indicator today. The threshold for the standard for EPA and DHA was set to be equivalent to the FFDR for oil of 2.95, meaning that the effect of meeting either is equivalent. This alternative was suggested as a way that may be easier for some feed manufacturers to calculate based on their current systems and calculations.

Criterion 4.3 Source of marine raw materials

INDICATOR		STANDARD
4.3.1	Timeframe for all fishmeal and fish oil used in feed to come from fisheries[65] certified under a scheme that is an ISEAL member[66] and has guidelines that specifically promote responsible environmental management of small pelagic fisheries	< 5 years after the date of publication[67] of the SAD standards

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Fishmeal and fish oil that are produced from trimmings can be excluded from the calculation as long as the origin of the trimmings is not any species that are classified as critically endangered, endangered or vulnerable in the IUCN Red List of Threatened Species (http://www.iucnredlist.org).

[65] This standard and standard 4.3.2 apply to fishmeal and oil from forage fisheries, pelagic fisheries, or fisheries where the catch is directly reduced (including krill) and not to by-products or trimmings used in feed.

[66] Meets ISEAL guidelines as demonstrated through full membership in the ISEAL Alliance, or equivalent as determined by the Technical Advisory Group of the ASC.

[67] Publication: Refers to the date when the final standards and accompanying guidelines are completed and made publicly available. This definition of publication applies throughout this document.

4.3.2	Prior to achieving 4.3.1, the FishSource score[65, 68] for the fishery(ies) from which all marine raw material in feed is derived	All individual scores ≥ 6, and biomass score ≥ 8
4.3.3	Prior to achieving 4.3.1, demonstration of third-party verified chain of custody and traceability for the batches of fishmeal and fish oil which are in compliance with 4.3.2.	Yes
4.3.4	Feed containing fishmeal and/or fish oil originating from by-products[69] or trimmings from IUU[70] catch or from fish species that are categorized as vulnerable, endangered or critically endangered, according to the IUCN Red List of Threatened Species[71]	None[72]

Rationale

Wild fish harvested from the ocean and reduced into fishmeal and fish oil are an important component of salmon feeds. Many wild small pelagic fish resources are fished at capacity or overfished.[73] Demand for these resources is increasing as the aquaculture industry expands and as forage fish are increasingly consumed by humans or by other industries including other animal production. There is concern that higher demand could lead to the overfishing—and collapse—of small forage fish stocks. Wild small pelagic fish play a critical role in the ecosystem and the marine food chain. Some conservation groups and scientists are concerned that even fisheries that are not classified as overfished from a population perspective are, or could be, overfished from an ecological perspective.

These indicators strive to ensure that marine-based feed ingredients come from sustainable sources in the short- and long-term. The standards aim to align industry incentives to support processes that will lead to

[68] Or equivalent score using the same methodology. See Appendix IV-3 for explanation of FishSource scoring.

[69] Trimmings are defined as by-products when fish are processed for human consumption or if whole fish is rejected for use of human consumption because the quality at the time of landing does not meet official regulations with regard to fish suitable for human consumption.

[70] IUU: Illegal, Unregulated and Unreported.

[71] The International Union for the Conservation of Nature reference can be found at http://www.iucnredlist.org/static/introduction.

[72] For species listed as "vulnerable" by IUCN, an exception is made if a regional population of the species has been assessed to be *not* vulnerable in a National Red List process that is managed explicitly in the same science-based way as IUCN. In cases where a National Red List doesn't exist or isn't managed in accordance with IUCN guidelines, an exception is allowed when an assessment is conducted using IUCN's methodology and demonstrates that the population is not vulnerable.

[73] FAO, The State of World Fisheries and Aquaculture (SOFIA), 2010.

improved fisheries management and ultimately the certification of forage fisheries as an independent measure of the ecological health of those fisheries.

In the medium term, the standards will require marine ingredients in feed to be certified by a widely recognized authority. This recognized authority must be a member of the ISEAL Alliance, which promotes transparent, multi-stakeholder processes. The authority must also have a methodology that specifically addresses the ecological role of low trophic-level species. As of the date of publication of these final draft standards, the Marine Stewardship Council (MSC) is the only fishery scheme that is a full member of ISEAL, and MSC is in the process of developing specific standards for small pelagic fisheries. Additional schemes may emerge in the future that meet these requirements. This standard begins to be applicable five years after the publication of the SAD standards because there is a current lack of such certified sources of fishmeal and fish oil and the transformation of the industry will take some time. The SAD encourages fisheries to begin immediately to make any needed management changes or regulatory reforms needed to achieve certification.

In the short term, the standards restrict fisheries currently known to have the poorest status from being used for fishmeal and fish oil and places traceability requirements on the fishmeal and fish oil used in the feed. Standard 4.3.2 requires the fishmeal and fish oil from forage fisheries to originate from fisheries meeting a minimum score using the FishSource scoring methodology, which is outlined in Appendix IV-3.

Rigorous traceability requirements are built into standard 4.3.3. The traceability scheme must also incorporate baseline measures related to sustainability that serve as an additional measure to ensure that fish from unsustainable fisheries are not used in feed. The International Fishmeal and Fish Oil Organization's Global Standard for Responsible Supply[74] or a future equivalent that might emerge can be used to meet this standard.

Last, standard 4.3.4 prevents the use of by-products and trimmings that come from species categorized as vulnerable or worse on the IUCN Red List of Threatened Species. Using by-products from fisheries for human consumption in salmon feeds is a valuable use of products that may otherwise be wasted. However, a minimum level of sustainability of these fisheries is still required under the SAD standards. For species classified globally as vulnerable by IUCN, the standard offers the opportunity for feed suppliers to demonstrate through a scientific process that a regional population of a species is not actually vulnerable.

Criterion 4.4 Source of non-marine raw materials in feed

INDICATOR		STANDARD
4.4.1	Presence and evidence of a responsible sourcing policy for the feed manufacturer for feed ingredients that comply with recognized crop moratoriums[75] and local laws[76]	Yes

[74] http://www.iffo.net/default.asp?contentID=636.

[75] Moratorium: A period of time in which there is a suspension of a specific activity until future events warrant a removal of the suspension or issues regarding the activity have been resolved. In this context, moratoriums may refer to suspension of the growth of defined agricultural crops in defined geographical regions.

4.4.2	Percentage of soya or soya-derived ingredients in the feed that are certified by the Roundtable for Responsible Soy (RTRS) or equivalent[77]	100%, within five years of the publication[78] of the SAD standards
4.4.3	Evidence of disclosure to the buyer[79] of the salmon of inclusion of transgenic[80] plant raw material, or raw materials derived from transgenic plants, in the feed	Yes, for each individual raw material containing > 1% transgenic content[81]

Rationale

The SAD standards aim to promote responsible sourcing of all feed ingredients. Thus, the SAD requires producers to provide evidence that they are sourcing feed products from feed manufacturers that have a sustainable sourcing policy for feed ingredients.

Feed ingredients sourced from areas where significant ecological damage has occurred was of concern to the SAD. Therefore, the standard requires producers to source feed from feed producers who comply with any relevant, recognized crop moratoriums that, at the time of the writing of these standards, includes only the Brazilian Soy Moratorium,[82] as far as the SAD understands. Such moratoriums are temporary measures intended to protect defined geographic regions. Looking to the future, the SAD incorporates a requirement for feed manufacturers to use soy certified by the RTRS, which the SAD recognizes as the most environmentally meaningful soy certification process today. Because the scheme is recently starting up, the standards build in a five-year window for this requirement.

Transgenic plants are commonly used in aquaculture and animal feeds throughout the world. Some consumers and retailers want to be able to identify food products, including farmed salmon, that are genetically modified or that have been fed genetically modified ingredients. The SAD standards ensure transparency (above one percent) around any transgenic material used in the feed in order to support informed choices by retailers and consumers. The SAD standards require that the producer disclose to the first-order buyer of their salmon the use of any genetically modified ingredients in feed, and publicly disclose whether transgenic ingredients are used under Appendix VI.

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[76] Specifically, the policy shall include that vegetable ingredients, or products derived from vegetable ingredients, must not come from areas of the Amazon Biome that were deforested after July 24, 2006, as geographically defined by the Brazilian Soy Moratorium. Should the Brazilian Soy Moratorium be lifted, this specific requirement shall be reconsidered.

[77] Any alternate certification scheme would have to be approved as equivalent by the Technical Advisory Group of the ASC.

[78] Publication: Refers to the date when the final standards and accompanying guidelines are completed and made publicly available. This definition of publication applies throughout this document.

[79] The company or entity to which the farm or the producing company is directly selling its product. This standard requires disclosure by the feed company to the farm and by the farm to the buyer of their salmon.

[80] Transgenic: Containing genes altered by insertion of DNA from an unrelated organism. Taking genes from one species and inserting them into another species to get that trait expressed in the offspring.

[81] See Appendix VI for transparency requirement for 4.4.3.

[82] See http://www.abiove.com.br/english/ss_moratoria_us.html for additional information on the soy moratorium.

Criterion 4.5 Non-biological waste from production

INDICATOR		STANDARD
4.5.1	Presence and evidence of a functioning policy for proper and responsible[83] treatment of non-biological waste from production (e.g., disposal and recycling)	Yes
4.5.2	Evidence that non-biological waste (including net pens) from grow-out site is either disposed of properly or recycled	Yes

Rationale

The purpose of these indicators is to ensure that all non-biological waste produced by a farm is recycled, reused or disposed of properly and does not affect neighboring communities. Proper handling and treatment of wastes may vary across farms depending on the remoteness of the farm site and the disposal and recycling options available in the region.

Initial Auditing Guidance

The SAD recognizes that some farms are located in extremely remote locations with no viable recycling systems nearby and where waste disposal presents challenges. Auditing guidelines will need to clarify what "proper" disposal means and be flexible enough to recognize that what is "proper" on one site is different from what is "proper" on another site. Regardless of the remoteness of a farm, these standards would, for example, prohibit the dumping of non-biological waste (e.g., feedbags or nets) into the ocean.

Criterion 4.6 Energy consumption and greenhouse gas emissions on farms[84]

INDICATOR		STANDARD
4.6.1	Presence of an energy use assessment verifying the energy consumption on the farm and representing the whole life cycle at sea, as outlined in Appendix V- 1	Yes, measured in kilojoule/mt fish/production cycle
4.6.2	Records of greenhouse gas (GHG[85]) emissions[86] on farm and evidence of an annual GHG assessment, as outlined in Appendix V-1	Yes

[83] Proper and responsible disposal will vary based on facilities available in the region and remoteness of farm sites. Disposal of non-biological waste shall be done in a manner consistent with best practice in the area. Dumping of non-biological waste into the ocean does not represent "proper and responsible" disposal.

[84] See Appendix VI for transparency requirements for 4.6.1, 4.6.2 and 4.6.3.

[85] For the purposes of this standard, GHGs are defined as the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF_6).

[86] GHG emissions must be recorded using recognized methods, standards and records as outlined in Appendix V.

4.6.3	Documentation of GHG emissions of the feed[87] used during the previous production cycle, as outlined in Appendix V, subsection 2	Yes, within three years of the publication[88] of the SAD standards

Rationale

Climate change represents perhaps the biggest environmental challenge facing current and future generations. Because of this, energy consumption used in food production has become a source of major public concern. The SAD recognizes the importance of efficient and sustainable energy use. Therefore, these indicators will require that energy consumption in the production of fish should be monitored on a continual basis and that growers should develop means to improve efficiency and reduce consumption of energy sources, particularly those that are limited or carbon-based. The data collected in this process will help the SAD set a meaningful numerical standard for energy use in the future. Energy assessments are a new area for producers. Requiring that farms do these assessments will likely raise awareness of the issues related to energy and build support for adding a standard in the future related to the maximum energy of GHG emissions allowed.

Criterion 4.7 Non-therapeutic chemical inputs[89,90]

INDICATOR		STANDARD
4.7.1	For farms that use copper-treated nets[91], evidence that nets are not cleaned[92] or treated in situ in the marine environment	Yes
4.7.2	For any farm that cleans nets at on-land sites, evidence that net-cleaning sites have effluent treatment[93]	Yes

[87] GHG emissions from feed can be given based on the average raw material composition used to produce the salmon (by weight) and not as documentation linked to each single product used during the production cycle. Feed manufacturer is responsible for calculating GHG emissions per unit feed. Farm site then shall use that information to calculate GHG emissions for the volume of feed they used in the prior production cycle.

[88] Publication: Refers to the date when the final standards and accompanying guidelines are completed and made publicly available. This definition of publication applies throughout this document.

[89] Closed production systems that do not use nets and do not use antifoulants shall be considered exempt from standards under Criterion 4.7.

[90] See Appendix VI for transparency requirements for 4.7.1, 4.7.3 and 4.7.4.

[91] Under the SAD, "copper-treated net" is defined as a net that has been treated with any copper-containing substance (such as a copper-based antifoulant) during the previous 18 months, or has not undergone thorough cleaning at a land-based facility since the last treatment. Farms that use nets that have, at some point prior in their lifespan, been treated with copper may still consider nets as untreated so long as sufficient time and cleaning has elapsed as in this definition. This will allow farms to move away from use of copper without immediately having to purchase all new nets.

[92] Light cleaning of nets is allowed. Intent of the standard is that, for example, the high-pressure underwater washers could not be used on copper treated nets under this standard because of the risk of copper flaking off during this type of heavy or more thorough cleaning.

[93] Treatment must have appropriate technologies in place to capture copper if the farm uses copper-treated nets.

4.7.3	For farms that use copper nets or copper-treated nets, evidence of testing for copper level in the sediment outside of the AZE, following methodology in Appendix I-1	Yes
4.7.4	Evidence that copper levels[94] are < 34 mg Cu/kg dry sediment weight OR in instances where the Cu in the sediment exceeds 34 mg Cu/kg dry sediment weight, demonstration that the Cu concentration falls within the range of background concentrations as measured at three reference sites in the water body	Yes
4.7.5	Evidence that the type of biocides used in net antifouling are approved according to legislation in the European Union, or the United States, or Australia	Yes

Rationale

Copper (Cu) is an abundant trace element found in a variety of rocks and minerals. It is an essential micronutrient and is also necessary for a wide range of metabolic processes in animals and plants. At elevated levels, however, Cu becomes toxic. Collectively, the set of standards related to copper encourage any sites that can do so to not use copper. Simultaneously, they recognize that in some situations phasing out copper usage may not yet be possible if, for example, alternate antifoulants or cleaning methods don't leave nets at a given site clean enough for the use of wrasse to manage sea lice to be feasible. In situations where copper is used, the standards ensure precautionary healthy levels of copper in the benthos.

In order to minimize release of Cu from salmon farms into the environment, the standard includes better management practices of not cleaning copper treated nets in the aquatic environment and requires that land-based cleaning facilities have the appropriate effluent treatment.

Additionally, a maximum level of Cu concentration in the sediment outside of the AZE is built into the standard to ensure that any benthic effect that may occur from the use of copper on the net pens is minimal. The variability in environmental factors makes it very difficult to identify a generic threshold of copper in the environment that can be used to define the environmental risk. However, experts suggest that the threshold of 34mg/kg sediment adequately protects the benthos. The level of 34 mg is also consistent with the level at which Scottish regulation requires some action to ensure benthic health, and with levels recognized by other jurisdictions as the level at which there may be possible environmental effect. Under the SAD standard, if Cu levels in the sediment just outside the AZE are higher than the threshold, as may be the case in areas with naturally high levels of Cu, the farm must demonstrate that the level just outside of the AZE is consistent with reference sites and the background levels in the area.

The SAD is aware that other biocides are commercially applied to netting material. It is difficult to address all biocides used or to be used in the future. To address the high variability of biocides used, the SAD elected to

[94] According to testing required under 4.7.3. The standards related to testing of copper are only applicable to farms that use copper-based nets or copper-treated nets.

limit use to those chemicals approved for legal use by the European Union, the United States or Australia. The SAD encourages the development and review of alternative antifoulants that are protective of the marine environment. The European Union, the United States and Australia were selected as a representation of jurisdictions that were viewed to be undertaking rigorous analyses of biocides.

PRINCIPLE 5: MANAGE DISEASE AND PARASITES IN AN ENVIRONMENTALLY RESPONSIBLE MANNER

Principle 5 aims to address negative impacts of salmon farming associated with disease, parasites and therapeutic chemical inputs. The SAD recognizes the role of proper fish handling and minimized levels of fish stress as an important element in good husbandry and in reducing levels of disease on farms, mortalities and therapeutic treatments. In addition to addressing environmental risks, compliance with standards under Principle 5 helps ensure farmed fish health and welfare.

Criterion 5.1 Survival and health of farmed fish[95]

5.1.1. Evidence of a fish health management plan for the identification and monitoring of fish diseases and parasites	Yes
5.1.2 Site visits by a designated veterinarian[96] at least four times a year, and by a fish health manager[97] at least once a month	Yes
5.1.3 Percentage of dead fish removed and disposed of in a responsible manner	100%[98]
5.1.4 Percentage of mortalities that are recorded, classified and receive a post-mortem analysis	100%[99]
5.1.5 Maximum viral disease-related mortality[100] on farm during the most recent production cycle	≤ 10%
5.1.6 Maximum unexplained mortality rate from each of the previous two production cycles, for farms with total	≤ 40% of total mortalities

[95] See Appendix VI for transparency requirements for 5.1.4, 5.1.5 and 5.1.6.

[96] A designated veterinarian is the professional responsible for health management on the farm who has the legal authority to diagnose disease and prescribe medication. In some countries such as Norway, a fish health biologist or other professional has equivalent professional qualifications and is equivalent to a veterinarian for purposes of these standards. This definition applies to all references to a veterinarian throughout the standards document.

[97] A fish health manager is someone with professional expertise in managing fish health, who may work for a farming company or for a veterinarian, but who does not necessarily have the authority to prescribe medicine.

[98] The SAD recognizes that not all mortality events will result in dead fish present for collection and removal. However, such situations are considered the exception rather than the norm.

[99] If on-site diagnosis is inconclusive, this standard requires off-site laboratory diagnosis. A qualified professional must conduct all diagnosis. One hundred percent of mortality events shall receive a post-mortem analysis, not necessarily every fish. A statistically relevant number of fish from the mortality event shall be analyzed.

[100] Viral disease-related mortality count shall include unspecified and unexplained mortality as it could be related to viral disease.

	mortality > 6%	
5.1.7	A farm-specific mortalities reduction program that includes defined annual targets for reductions in mortalities and reductions in unexplained mortalities	Yes

Rationale

Farmed salmon are susceptible to numerous diseases that have the potential to be amplified and transferred, thereby posing a risk to the health of fish and other marine organisms in adjacent ecosystems. One of the best ways to mitigate the risk of disease transfer to wild stocks is to reduce or eliminate the disease from happening initially.

These standards seek to ensure proactive health management on the farm through a detailed health management plan and frequent visits by the designated veterinarian and other fish health professionals. The standards under Criterion 5.1 are complemented by requirements related to the health of smolts, as outlined under Section 8 of this document. Requirements related to smolt seek to ensure that farmed salmon have all relevant vaccinations and enter the water as healthy as possible.

Healthy farms also must keep detailed records of all mortalities and cause of death. The post-mortem analysis required in this standard is essential to provide an early warning against emerging diseases. Repeated high mortality rates, or a high rate of unexplained mortalities, may indicate poor management or poor siting. The mortality standards in 5.1.5 and 5.1.6 are not intended as a goal, but rather a minimum required. The standard focuses on mortalities from viral disease and unknown causes, as those categories were highlighted by experts as presenting a greater potential risk to wild fish populations and neighboring farms. The standard requires that mortalities from viral disease be kept at or below 10 percent. Only farms with mortality rates greater than six percent per production cycle must also then meet the standard related to percentage of unexplained mortalities. The farm must be able to demonstrate that it is working seriously to reduce its mortalities, including tracking diseases and carrying out a farm-specific plan to reduce diseases and mortalities. The information collected on mortalities will be useful for future revisions of the standards.

Criterion 5.2 Therapeutic treatments[101]

INDICATOR		STANDARD
5.2.1	On-farm documentation that includes, at a minimum, detailed information on all chemicals[102] and therapeutants used during the most recent production cycle, the amounts used (including grams per ton of fish produced), the dates used, which group of fish were treated and against which diseases, proof of proper dosing, and all disease and pathogens detected on the site	Yes

[101] See Appendix VI for transparency requirements for 5.2.1, 5.2.5, 5.2.6 and 5.2.10.

[102] Chemicals used for the treatment of fish.

5.2.2 Allowance for use of therapeutic treatments that include antibiotics or chemicals that are banned[103] in any of the primary salmon producing or importing countries[104]	None
5.2.3 Percentage of medication events that are prescribed by a veterinarian	100%
5.2.4 Compliance with all withholding periods after treatments	Yes
5.2.5 Maximum farm level cumulative parasiticide treatment index (PTI) score as calculated according to the formula in Appendix VII	PTI score ≤ 13
5.2.6 For farms with a cumulative PTI ≥ 6 in the most recent production cycle, demonstration that parasiticide load[105] is at least 15% less that of the average of the two previous production cycles	Yes, within five years of the publication of the SAD standard
5.2.7 Allowance for prophylactic use of antimicrobial treatments[106]	None
5.2.8 Allowance for use of antibiotics listed as critically important for human medicine by the World Health Organization (WHO[107])	None[108]
5.2.9 Number of treatments[109] of antibiotics over the most recent production cycle	≤ 3
5.2.10 If more than one antibiotic treatment is used in the most	Yes,[111] within five years of the publication

[103] "Banned" means proactively prohibited by a government entity because of concerns around the substance. A substance banned in any of the primary salmon-producing or importing countries, as defined here, cannot be used in any salmon farm certified under the SAD, regardless of country of production or destination of the product. The SAD recommends that ASC maintain a list of a banned therapeutants.

[104] For purposes of this standard, those countries are Norway, the UK, Canada, Chile, the United States, Japan and France.

[105] Parasiticide load = Sum (kg of fish treated x PTI). Reduction in load required regardless of whether production increases on the site. Farms that consolidate production across multiple sites within an ABM can calculate reduction based on the combined parasiticide load of the consolidated sites.

[106] The designated veterinarian must certify that a pathogen or disease is present before prescribing medication.

[107] The third edition of the WHO list of critically and highly important antimicrobials was released in 2009 and is available at: http://www.who.int/foodborne_disease/resistance/CIA_3.pdf.

[108] If the antibiotic treatment is applied to only a portion of the pens on a farm site, fish from pens that did not receive treatment are still eligible for certification.

[109] A treatment is a single course medication given to address a specific disease issue and that may last a number of days.

	recent production cycle, demonstration that the antibiotic load[110] is at least 15% less that of the average of the two previous production cycles	of the SAD standard
5.2.11	Presence of documents demonstrating that the farm has provided buyers[112] of its salmon a list of all therapeutants used in production	Yes

Rationale

When disease outbreaks occur on salmon farms, farmers often opt to treat using chemical therapeutants as a means of protecting on-farm fish and the health of wild populations near the farm. With any chemical introduction into a wild environment, there is a need to ensure that non-target organisms are not being negatively impacted by the use of that chemical. Accurate and detailed documentation of all treatments is the first step to ensure proper dosing and safe use of therapeutants. The data collected from this standard will also help the SAD set more measurable standards in the future.

To minimize the risk of treatments posing a risk to the environment, farms shall not use treatments that have been banned by any of the regulatory bodies in the world's largest salmon-producing or importing countries. The chemical must have been proactively prohibited or banned, versus being not approved. Part of a farm's responsibility to operate within the law involves taking appropriate measures to ensure that its product complies with import laws of the countries where the salmon is eventually sold. Standard 5.2.11 above ensures that buyers and importers have the information they need to verify that the product complies with import regulations.

Prophylactic use of antimicrobial treatments, and treatments that aren't prescribed by a licensed professional, are unacceptable under the standard because they open the door to overuse and abuse of therapeutants.

Stakeholders within the SAD share a common interest and common goal of reducing the use of parasiticides and reducing the risk of needed chemical treatments to the environment. The ultimate goal would be that farms could meet the SAD standards without using therapeutants or without the risk of those therapeutants negatively impacting the environment. Simultaneously, the SAD is focused on protecting wild stocks of salmonids and thus sets low thresholds (standard 3.1.7) for allowable lice on farmed fish in areas with wild salmonids. Taking into account current technology and knowledge, and balancing between the objectives of minimizing impact on wild stocks and at the same time addressing threats to the environment related to unrestricted use of therapeutants, the SC is allowing restricted use of parasiticides to treat sea lice under the standard.

The purpose of the PTI in standard 5.2.5 is to place a cap on the number of treatments of parasiticides, while taking into account differences in risk associated with each treatment option (the parasiticide), the treatment method and treatment timing (both in term of repeated use of a single parasiticide during a given period of time

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[111] Reduction in load required, regardless of whether production increases on the site. Farms that consolidate production across multiple sites within an ABM can calculate reduction based on the combined antibiotic load of the consolidated sites.

[110] Antibiotic load = the sum of the total amount of active ingredient of antibiotics used (kg).

[112] Buyer: The company or entity to which the farm or the producing company is directly selling its product.

and the time or year with regard to risk to wild species). In essence, it addresses the frequency of use of the therapeutant on certified farms and key risk factors related to its use. The PTI does not directly address the issue of total amount of parasiticide used in an area because it does not factor in the size of the farm or the amount of fish being treated, and it does not address use on neighboring farms that are not certified.

Since environmental risk from parasiticides is closely linked to total release of active therapeutant into the environment, the SAD requires that, within five years of the publication of the standard, farms with a cumulative PTI greater than six demonstrate a reduction over time of the parasiticide load from treatments on the farm. Parasiticide load is calculated by multiplying the PTI scores for each parasiticide treatment by the weight of the fish treated. This standard is consistent with industry efforts to reduce both frequency and amount of parasiticide used, as well as with initiatives to develop treatment methods that do not release active parasiticides into the environment. To encourage thinking about cumulative use across a broader area, tracking of total use of parasiticides is required under the ABM.

With regards to the use of antibiotics, there is a global effort led by the WHO to ensure that antibiotics important for human medicine are used in a way that doesn't jeopardize their effectiveness in treating human diseases. These standards seek to be in line with that effort. The standards set a cap on a maximum allowable number of treatments of antibiotics on certified farms that is intended to set a reasonable limit on what may be needed on a well-managed farm and excludes any farms that fail to follow industry guidelines for prudent use of antibiotics. Through 5.2.10, the SAD standards address environmental risk from cumulative load of antibiotics entering the environment from certified farms. The standard requires a reduction, within five years, of the actual load of antibiotics released from farms that use more than one treatment of antibiotics. This is in line with industry goals to reduce total antibiotic use and with trends in industry to use precise pen-by-pen treatments when appropriate.

Additionally, the Salmon Dialogue's technical working group on chemical inputs recommended that antibiotics important for human health only be used with extreme reluctance. These standards are also intended to further raise awareness within the aquatic veterinary community on the use of medically important antimicrobial drugs in food-animal production, and the public health risks associated with antibiotic resistance. This issue is addressed in standard 5.2.8 and through a coordination requirement within the ABM related to the use of antibiotics classified by the WHO as "highly important" for human health.

Criterion 5.3 Resistance of parasites, viruses and bacteria to medicinal treatments

INDICATOR	STANDARD
5.3.1 Bio-assay analysis to determine resistance when two applications of a treatment have not produced the expected effect	Yes
5.3.2 When bio-assay tests determine resistance is forming, use of an alternative, permitted treatment, or an immediate harvest of all fish on the site	Yes

Rationale

One of the more serious risks of overusing chemical therapeutants is the development of resistance, which lowers the overall effectiveness. In some salmon-growing regions, resistance to emamectin benzoate has become a growing problem, increasing the challenge for salmon farmers to control sea lice on farmed and wild fish.

Efforts to prevent and monitor resistance are done most effectively through an area-based approach. Timely, accurate sea lice counts on the farm can detect when sea lice treatment is no longer effective. Bioassays are important to confirm if resistance is developing. If a farm doesn't have alternative treatments that are authorized in its jurisdiction and under this standard, immediate harvest of the fish is necessary to halt the outbreak and prevent further development of resistance.

Criterion 5.4 Biosecurity management[113]

INDICATOR	STANDARD
5.4.1 Evidence that all salmon on the site are a single-year class[114]	100%[115]
5.4.2 Evidence that if the farm suspects an unidentifiable transmissible agent, or if the farm experiences unexplained increased mortality,[116] the farm has: 1. Reported the issue to the ABM and to the appropriate regulatory authority 2. Increased monitoring and surveillance[117] on the farm and within the ABM 3. Promptly[118] made findings publicly available	Yes

[113] See Appendix VI for transparency requirements for 5.4.2 and 5.4.4.

[114] Gaps of up to six months between inputs of smolts derived from the same stripping are acceptable as long as there remains a period of time when the site is fully fallow after harvest.

[115] Exception is allowed for: 1) farm sites that have closed, contained production units where there is complete separation of water between units and no sharing of filtration systems or other systems that could spread disease, or, 2) farm sites that have ≥95% water recirculation, a pre-entry disease screening protocol, dedicated quarantine capability and biosecurity measures for waste to ensure there is no discharge of live biological material to the natural environment (e.g. UV or other effective treatment of effluent) .

[116] Increased mortality: A statistically significant increase over background rate on a monthly basis.

[117] Primary aim of monitoring and surveillance is to investigate whether a new or adapted disease is present in the area.

[118] Within one month.

5.4.3 Evidence of compliance[119] with the OIE *Aquatic Animal Health Code*[120]	Yes
5.4.4 If an OIE-notifiable disease[121] is confirmed on the farm, evidence that: 1. the farm has, at a minimum, immediately culled the pen(s) in which the disease was detected 2. the farm immediately notified the other farms in the ABM[122] 3. the farm and the ABM enhanced monitoring and conducted rigorous testing for the disease 4. the farm promptly[123] made findings publicly available	Yes

Rationale

Biosecurity measures reduce the risk of disease transmission to the wild and between farms. These standards aim to ensure that farms don't harm the health of wild populations by amplifying or spreading disease. It is recognized that disease flow is bidirectional between farmed and wild fish, and these standards aim to minimize effect of disease transmission and retransmission. The SAD recognizes that broad-level response to disease, in particular aggressive response to OIE-notifiable disease, must be led by regulators in the jurisdiction. This is important both because of legal implications of actions and because a mandatory response required by government has greatest potential to be effective.

[119] Compliance is defined as farm practices consistent with the intentions of the Code, to be further outlined in auditing guidance. For purposes of this standard, this includes an aggressive response to detection of an exotic OIE-notifiable disease on the farm, which includes depopulating the infected site and implementation of quarantine zones in accordance with guidelines from OIE for the specific pathogen. Quarantine zones will likely incorporate mandatory depopulation of sites close to the infected site and affect some, though not necessarily all, of the ABM. Exotic signifies not previously found in the area or had been fully eradicated (area declared free of the pathogen).

[120] OIE 2011. Aquatic Animal Health Code. http://www.oie.int/index.php?id=171.

[121] At the time of publication of the final draft standards, OIE-notifiable diseases relevant to salmon aquaculture were: Epizootic haematopoietic necrosis, Infectious haematopoietic necrosis (IHN), Infectious salmon anemia (ISA), Viral hemorrhagic septicemia (VHS) and Gyrodactylosis (Gyrodactylus salaris).

[122] This is in addition to any notifications to regulatory bodies required under law and the OIE Aquatic Animal Health Code.

[123] Within one month.

PRINCIPLE 6: DEVELOP AND OPERATE FARMS IN A SOCIALLY RESPONSIBLE MANNER

Principle 6 aims to address potential negative social impacts related to farm development and operation, including labor concerns.

Criterion 6.1 Freedom of association and collective bargaining[124]

INDICATOR	STANDARD
6.1.1 Evidence that workers have access to trade unions (if they exist) and union representative(s) chosen by themselves without managerial interference	Yes
6.1.2 Evidence that workers are free to form organizations, including unions, to advocate for and protect their rights	Yes
6.1.3 Evidence that workers are free and able to bargain collectively for their rights	Yes

Rationale

Having the freedom to associate and bargain collectively is a critical right of workers because it enables them to engage in collective bargaining over issues such as wages and other working conditions. Freedom of Association and the effective recognition of the right to collective bargaining is one of the core principles of the International Labor Organization's (ILO) "Declaration on Fundamental Principles and Rights at Work." The declaration was adopted in 1998 by the 86th International Labor Conference and has since been ratified by the overwhelming majority of ILO's 183 member nation-states.

Criterion 6.2 Child labor

INDICATOR	STANDARD
6.2.1 Number of incidences of child[125] labor[126]	None

[124] Bargain collectively: A voluntary negotiation between employers and organizations of workers in order to establish the terms and conditions of employment by means of collective (written) agreements.

[125] Child: Any person under 15 years of age. A higher age would apply if the minimum age law of an area stipulates a higher age for work or mandatory schooling. Minimum age may be 14 if the country allows it under the developing country exceptions in ILO convention 138.

[126] Child Labor: Any work by a child younger than the age specified in the definition of a child.

6.2.2	Percentage of young workers[127] that are protected[128]	100%

Rationale

The effective abolition of child labor is one of the core principles of the ILO "Declaration on Fundamental Principles and Rights at Work." Adherence to the child labor codes and definitions included in this section indicates compliance with what the ILO and international conventions generally recognize as the key areas for the protection of child and young workers. Children are particularly vulnerable to economic exploitation, due to their inherent age-related limitations in physical development, knowledge and experience. Children and youth need adequate time for education, development and play. Therefore, they should not have to work or be exposed to working hours and conditions that are hazardous[129,130] to their physical or mental well-being. To this end, the standards related to what constitutes child labor will protect the interests of children and young workers at salmon farms certified to these standards.

Criterion 6.3 Forced, bonded or compulsory labor

INDICATOR		STANDARD
6.3.1	Number of incidences of forced,[131] bonded[132] or compulsory labor	None

Rationale

Forced labor—such as slavery, debt bondage and human trafficking—is a serious concern in many industries and regions of the world. The elimination of all forms of forced or compulsory labor is one of the core principles of the ILO "Declaration on Fundamental Principles and Rights at Work." Ensuring that contracts are clearly articulated and understood by workers is critical to determining that labor is not forced. The inability of a worker to freely leave the workplace and/or an employer withholding original identity documents of workers are indicators that employment may not be at-will. Adherence to these policies shall indicate that an aquaculture operation is not using forced, bonded or compulsory labor forces.

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[127] Young Worker: Any worker between the age of a child, as defined above, and under the age of 18.

[128] Protected: Workers between 15 and 18 years of age will not be exposed to hazardous health and safety conditions; working hours shall not interfere with their education and the combined daily transportation time and school time, and work time shall not exceed 10 hours.

[129] Hazard: The inherent potential to cause injury or damage to a person's health (e.g., unequipped to handle heavy machinery safely, and unprotected exposure to harmful chemicals).

[130] Hazardous work: Work that, by its nature or the circumstances in which it is carried out, is likely to harm the health, safety or morals of workers (e.g., heavy lifting disproportionate to a person's body size, operating heavy machinery, exposure to toxic chemicals).

[131] Forced (Compulsory) labor: All work or service that is extracted from any person under the menace of any penalty for which a person has not offered himself/herself voluntarily or for which such work or service is demanded as a repayment of debt. "Penalty" can imply monetary sanctions, physical punishment, or the loss of rights and privileges or restriction of movement (e.g., withholding of identity documents).

[132] Bonded labor: When a person is forced by the employer or creditor to work to repay a financial debt to the crediting agency.

Criterion 6.4 Discrimination[133]

INDICATOR		STANDARD
6.4.1	Evidence of comprehensive[134] and proactive anti-discrimination policies, procedures and practices	Yes
6.4.2	Number of incidences of discrimination	None

Rationale

The elimination of discrimination in respect of employment and occupation is one of the core principles of the ILO "Declaration on Fundamental Principles and Rights at Work." Unequal treatment of workers based on certain characteristics (such as sex or race), is a violation of a workers' human rights. Additionally, widespread discrimination in the working environment can negatively affect overall poverty and economic development rates. Discrimination occurs in many work environments and takes many forms. A common form is discrimination against women workers.

In order to ensure that discrimination does not occur at salmon farms certified to this standard, employers must demonstrate their commitment to equality with an official anti-discrimination policy, a policy of equal pay for equal work, and clearly outlined procedures to raise, file and respond to a discrimination complaint in an effective manner. Evidence, including worker testimony, of adherence to these policies and procedures will indicate minimization of discrimination. "Positive" discrimination (i.e., special treatment to protect the rights and health of particular groups of workers, or to provide opportunities for groups which have historically been disadvantaged) is allowed, and often required by laws related to such issues as maternity and affirmative action.

Criterion 6.5 Work environment health and safety

INDICATOR		STANDARD
6.5.1	Percentage of workers trained in health and safety practices, procedures[135] and policies on a yearly basis	100%
6.5.2	Evidence that workers use Personal Protective Equipment (PPE) effectively	Yes

[133] Discrimination: Any distinction, exclusion or preference that has the effect of nullifying or impairing equality of opportunity or treatment. Not every distinction, exclusion or preference constitutes discrimination. For instance, a merit- or performance-based pay increase or bonus is not by itself discriminatory. Positive discrimination in favor of people from certain underrepresented groups may be legal in some countries.

[134] Employers shall have written anti-discrimination policies stating that the company does not engage in or support discrimination in hiring, remuneration, access to training, promotion, termination or retirement based on race, caste, national origin, religion, disability, gender, sexual orientation, union membership, political affiliation, age or any other condition that may give rise to discrimination.

[135] Health and safety training shall include emergency response procedures and practices.

6.5.3 Presence of a health and safety risk assessment and evidence of preventive actions taken	Yes
6.5.4 Evidence that all health- and safety-related accidents and violations are recorded and corrective actions are taken when necessary	Yes
6.5.5 Evidence of employer responsibility and/or proof of insurance (accident or injury) for 100% of worker costs in a job-related accident or injury when not covered under national law	Yes
6.5.6 Evidence that all diving operations are conducted by divers who are certified	Yes

Rationale

A safe and healthy working environment is essential for protecting workers from harm. It is critical for a responsible aquaculture operation to minimize these risks. One of the key risks to workers is hazards resulting from accidents and injuries. Consistent, effective and regular worker training in health and safety practices is an important preventative measure. When an accident, injury or violation occurs, the company must record it and take corrective action to identify the root causes of the incident, remediate, and take steps to prevent future occurrences of similar incidents. This addresses violations and the long-term health and safety risks. Finally, while many national laws require that employers assume responsibility for job-related accidents and injuries, not all countries require this and not all workers (in some cases migrant and other workers) will be covered under such laws. When not covered under national law, employers must prove they are insured to cover 100 percent of worker costs when a job-related accident or injury occurs.

Criterion 6.6 Wages

INDICATOR	STANDARD
6.6.1 The percentage of workers whose basic wage[136] (before overtime and bonuses) is below the minimum wage[137]	0 (None)
6.6.2 Evidence that the employer is working toward the payment of basic needs wage[138]	Yes

[136] Basic wage: The wages paid for a standard working week (no more than 48 hours).

[137] If there is no legal minimum wage in a country, basic wages must meet the industry-standard minimum wage.

[138] Basic needs wage: A wage that covers the basic needs of an individual or family, including housing, food and transport. This concept differs from a minimum wage, which is set by law and may or may not cover the basic needs of workers.

6.6.3 Evidence of transparency in wage-setting and rendering[139]	Yes

Rationale
Wages and the process for setting wages are important components of the ILO core principles. For this reason, it is important to highlight under these standards the importance of workers' basic wages meeting the legal minimum wage and being rendered to workers in a convenient manner. Unfortunately, minimum wage in many countries does not always cover the basic needs of workers. Unfairly and insufficiently compensated workers can be subject to a life of sustained poverty. Therefore, it is important for socially responsible employers to pay or be working toward paying a basic needs wage. The calculation of a basic needs wage can be complex, and it is important for employers to consult with workers, their representatives and other credible sources when assessing what a basic needs wage would be.

Certified salmon farms shall also demonstrate their commitment to fair and equitable wages by having and sharing a clear and transparent mechanism for wage-setting and a labor conflict resolution policy[140] that tracks wage-related complaints and responses. Having these policies outlined in a clear and transparent manner will empower the workers to negotiate effectively for fair and equitable wages that shall, at a minimum, satisfy basic needs.

Criterion 6.7 Contracts (labor) including subcontracting

INDICATOR	STANDARD
6.7.1 Percentage of workers who have contracts[141]	100%
6.7.2 Evidence of a policy to ensure social compliance of its suppliers and contractors	Yes

Rationale
Fair contracting is important to ensure transparency between the employer and employee and fairness in the employment relation. Short-term and temporary contracts are acceptable but cannot be used to avoid paying benefits or to deny other rights. The company shall also have policies and mechanisms to ensure that workers contracted from other companies for specific services (e.g., divers, cleaning or maintenance) and the companies providing them with primary inputs or supplies have socially responsible practices and policies.

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[139] Payments shall be rendered to workers in a convenient manner.

[140] See Criterion 6.8.

[141] Labor-only contracting relationships or false apprenticeship schemes are not acceptable. This includes revolving/consecutive labor contracts to deny benefit accrual or equitable remuneration. False Apprenticeship Scheme: The practice of hiring workers under apprenticeship terms without stipulating terms of the apprenticeship or wages under contract. It is a "false" apprenticeship if its purpose is to underpay people, avoid legal obligations or employ underage workers. Labor-only contracting arrangement: The practice of hiring workers without establishing a formal employment relationship for the purpose of avoiding payment of regular wages or the provision of legally required benefits, such as health and safety protections.

Criterion 6.8 Conflict resolution

INDICATOR	STANDARD
6.8.1 Evidence of worker access to effective, fair and confidential grievance procedures	Yes
6.8.2 Percentage of grievances handled that are addressed[142] within a 90-day timeframe	100%

Rationale

Companies must have a clear labor conflict resolution policy in place for the presentation, treatment and resolution of worker grievances in a confidential manner. Workers shall be familiar with the policy and its effective use. Such a policy is necessary to track conflicts and complaints raised, and responses to conflicts and complaints.

Criterion 6.9 Disciplinary practices

INDICATOR	STANDARD
6.9.1 Incidences of excessive or abusive disciplinary actions	None
6.9.2 Evidence of a functioning disciplinary action policy whose aim is to improve the worker[143]	Yes

Rationale

The rationale for discipline in the workplace is to correct improper actions and maintain effective levels of worker conduct and performance. However, abusive disciplinary actions can violate workers' human rights. The focus of disciplinary practices shall always be on the improvement of the worker. Fines or basic wage deductions shall not be acceptable as methods for disciplining workforce. A certified salmon farm shall never employ threatening, humiliating or punishing disciplinary practices that negatively impact a worker's physical and mental[144] health or dignity.

[142] Addressed: Acknowledged and received, moving through the company's process for grievances, corrective action taken when necessary.

[143] If disciplinary action is required, progressive verbal and written warnings shall be engaged. The aim shall always be to improve the worker; dismissal shall be the last resort. Policies for bonuses, incentives, access to training and promotions are clearly stated and understood, and not used arbitrarily. Fines or basic wage deductions shall not be acceptable disciplinary practices.

[144] Mental Abuse: Characterized by the intentional use of power, including verbal abuse, isolation, sexual or racial harassment, intimidation or threat of physical force.

Criterion 6.10 Working hours and overtime

INDICATOR	STANDARD
6.10.1 Incidences, violations or abuse of working hours[145] and overtime laws	None
6.10.2 Overtime is limited, voluntary,[146] paid at a premium rate and restricted to exceptional circumstances	Yes

Rationale

Abuse of overtime working hours is a widespread issue in many industries and regions. Workers subject to extensive overtime can suffer consequences in their work-life balance and are subject to higher fatigue-related accident rates. In accordance with better practices, workers in certified salmon farms are permitted to work—within defined guidelines—beyond normal work week hours but must be compensated at premium rates.[147] Requirements for time off, working hours and compensation rates as described should reduce the impacts of overtime.

Criterion 6.11 Education and training

INDICATOR	STANDARD
6.11.1 Evidence that the company encourages and sometimes supports education initiatives for all workers (e.g., courses, certificates and degrees)	Yes

Rationale

Education and training can be beneficial to companies and enable workers to improve their incomes. Such human capital development should be encouraged where it is in the interest of the company. Incentives, such as subsidies for tuition or textbooks and time off prior to exams, should be offered. The offer of training may be contingent on workers committing to stay with the company for a pre-arranged time. This should be made clear to participants before they start the training.

Criterion 6.12 Corporate policies for social responsibility

INDICATOR	STANDARD

[145] In cases where local legislation on working hours and overtime exceed internationally accepted recommendations (48 regular hours, 12 hours overtime), the international standards will apply.

[146] Compulsory overtime is permitted if previously agreed to under a collective bargaining agreement.

[147] Premium rate: A rate of pay higher than the regular work week rate. Must comply with national laws/regulations and/or industry standards.

6.12.1 Demonstration of company-level[148] policies in line with the standards under 6.1 to 6.11 above	Yes

Rationale

Companies must be able to demonstrate that not only are the specific farm sites applying for certification able to meet this robust set of social and labor standards, but that they also have company-wide policies related to these key issue areas that are in line with the Salmon Dialogue standards. Such policies must relate to all of the company's salmon operations in the region, whether they be smolt production facilities, grow-out facilities or processing plants.

[148] Applies to the headquarters of the company in a region or country where the site applying for certification is located. The policy shall relate to all of the company's operations in the region or country, including grow-out, smolt production and processing facilities.

PRINCIPLE 7: BE A GOOD NEIGHBOR AND CONSCIENTIOUS CITIZEN

Principle 7 aims to address any broader off-site potential social impacts associated with salmon production, including interactions with local communities.

Criterion 7.1 Community engagement

INDICATOR		STANDARD
7.1.1	Evidence of regular and meaningful[149] consultation and engagement with community representatives and organizations	Yes
7.1.2	Presence and evidence of an effective[150] policy and mechanism for the presentation, treatment and resolution of complaints by community stakeholders and organizations	Yes
7.1.3	Evidence that the farm has posted visible notice[151] at the farm during times of therapeutic treatments and has, as part of consultation with communities under 7.1.1, communicated about potential health risks from treatments	Yes

Rationale

A salmon farm must respond to human concerns that arise in communities located near the farm and to concerns related to the farm's overall operations. In particular, appropriate consultation must be undertaken within local communities so that risks, impacts and potential conflicts are properly identified, avoided, minimized and/or mitigated through open and transparent negotiations. Communities shall have the opportunity to be part of the assessment process (e.g., by including them in the discussion of any social investments and contributions by companies to neighboring communities).

Channels of communication with community stakeholders are important. Regular consultation with community representatives and a transparent procedure for handling complaints are key components of this communication. Negative impacts may not always be avoidable. However, the process for addressing them must be open, fair and transparent and demonstrate due diligence. A company shall share with neighboring communities information about any potential human health risks that may be associated with the use of therapeutic treatments and communicate about typical treatment patterns. They shall also post notices around the farm during times of treatment.

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[149] Regular and meaningful: Meetings shall be held at least bi-annually with elected representatives of affected communities. The agenda for the meetings should in part be set by the community representatives. Participatory Social Impact Assessment methods may be one option to consider here.

[150] Effective: In order to demonstrate that the mechanism is effective, evidence of resolutions of complaints can be given.

[151] Signage shall be visible to mariners and, for example, to fishermen passing by the farm.

Criterion 7.2 Respect for indigenous and aboriginal cultures and traditional territories

INDICATOR	STANDARD
7.2.1 Evidence that indigenous groups were consulted as required by relevant local and/or national laws and regulations	Yes
7.2.2 Evidence that the farm has undertaken proactive consultation with indigenous communities	Yes[152]
7.2.3 Evidence of a protocol agreement, or an active process[153] to establish a protocol agreement, with indigenous communities	Yes

Rationale

Interactions with and evidence of due diligence to prevent and mitigate negative impacts on communities is important globally, and takes on an additional dimension in regions where indigenous or aboriginal people or traditional territories are involved. In some jurisdictions, aboriginal groups have legal rights related to their territories. These shall be respected, as in Principle 1. It is also expected that operations seeking to meet the SAD standards have directly consulted with bodies functioning as territorial governments and have come to agreement with indigenous governments, or are working towards an agreement, for farms that are operating in indigenous territories. The standards are designed to be consistent with the United Nations Declaration on the Rights of Indigenous Peoples.

Criterion 7.3 Access to resources

INDICATOR	STANDARD
7.3.1 Changes undertaken restricting access to vital community resources[154] without community approval	None
7.3.2 Evidence of assessments of company's impact on access to resources	Yes

[152] All standards related to indigenous rights only apply where relevant, based on proximity of indigenous territories.

[153] To demonstrate an active process, a farm must show ongoing efforts to communicate with indigenous communities, an understanding of key community concerns and responsiveness to key community concerns through adaptive farm management and other actions.

[154] Vital community resources can include freshwater, land or other natural resources that communities rely on for their livelihood. If a farm site were to block, for example, a community's sole access point to a needed freshwater resource, this would be unacceptable under the Dialogue standard.

Rationale

Companies should make a maximum effort to not affect the surrounding community's access to vital resources as a result of its presence and activities. Some change in access is expected. What is to be prevented is an unacceptable degree of change.

INDICATORS AND STANDARDS FOR SMOLT PRODUCTION

This section of the document contains the full suite of principles, criteria, indicators and standards for responsible salmon farming at freshwater smolt sites.

SECTION 8: STANDARDS FOR SUPPLIERS OF SMOLT

A farm seeking certification must have documentation from all of its smolt suppliers to demonstrate compliance with the following standards.[155] The requirements are, in general, a subset of the standards in Principles 1 through 7, focusing on the impacts that are most relevant for smolt facilities. In addition, specific standards are applied to open systems (net pens), and to closed and semi-closed systems (recirculation and flow-through).

Standards related to Principle 1

INDICATOR	STANDARD
8.1 Compliance with local and national regulations on water use and discharge, specifically providing permits related to water quality	Yes
8.2 Compliance with labor laws and regulations	Yes

Rationale
Please see the relevant Rationale in Principle 1. The standards do not require the smolt producer to provide confidential business documents such as tax documentation.

Standards related to Principle 2

INDICATOR	STANDARD
8.3 Evidence of an assessment of the farm's potential impacts on biodiversity and nearby ecosystems that contains the same components as the assessment for grow-out facilities under 2.4.1	Yes

[155] The SAD SC proposes this approach to addressing environmental and social performance during the smolt phase of production. In the medium term, the SC anticipates a system to audit smolt production facilities on site. In the meantime, farms will need to work with their smolt suppliers to generate the necessary documentation to demonstrate compliance with the standards. The documentation will be reviewed as part of the audit at the grow-out facility.

8.4 Maximum total amount of phosphorus released into the environment per metric ton (mt) of fish produced over a 12-month period (see Appendix VIII-1)	5 kg/mt of fish produced over a 12-month period; within three years of publication of the SAD standards, 4 kg/mt of fish produced over a 12-month period

Rationale
Please see the relevant Rationale in Principle 2. See also the relevant Rationale related to Additional Requirements for both open net-pen smolt production and closed and semi-closed smolt production.

Standards related to Principle 3

INDICATOR	STANDARD
8.5 If a non-native species is being produced, the species shall have been widely commercially produced in the area prior to the publication[156] of the SAD standards	Yes[157]
8.6 Maximum number of escapees[158] in the most recent production cycle	300[159] fish
8.7 Accuracy[160] of the counting technology or counting method used for calculating the number of fish	≥98%

Rationale
Please see the relevant Rationale in Principle 3.

[156] Publication: Refers to the date when the final standards and accompanying guidelines are completed and made publicly available. This definition of publication applies throughout this document.

[157] Exceptions shall be made for production systems that use 100 percent sterile fish or systems that demonstrate separation from the wild by effective physical barriers that are in place and well-maintained to ensure no escapes of reared specimens or biological material that might survive and subsequently reproduce.

[158] Farms shall report all escapes; the total aggregated number of escapees per production cycle must be less than 300 fish.

[159] A rare exception to this standard may be made for an escape event that is clearly documented as being outside of the farm's control. Only one such exceptional episode is allowed in a 10-year period for the purposes of this standard. The 10-year period starts at the beginning of the production cycle for which the farm is applying for certification. The farmer must demonstrate that there was no reasonable way to predict the events that caused the episode. Extreme weather (e.g., 100-year storms) or accidents caused by farms located near high-traffic waterways are not intended to be covered under this exception.

[160] Accuracy shall be determined by the spec sheet for counting machines and through common estimates of error for any hand counts.

Standards related to Principle 4

INDICATOR	STANDARD
8.8 Evidence of a functioning policy for proper and responsible treatment of non-biological waste from production (e.g., disposal and recycling)	Yes
8.9 Presence of an energy-use assessment verifying the energy consumption at the smolt production facility (see Appendix V subsection 1 for guidance and required components of the records and assessment)	Yes, measured in kilojoule/mt fish/production cycle
8.10 Records of greenhouse gas (GHG[161]) emissions[162] at the smolt production facility and evidence of an annual GHG assessment (See Appendix V, subsection 1)	Yes

Rationale
Please see the relevant Rationale in Principle 4.

Standards related to Principle 5

INDICATOR	STANDARD
8.11 Evidence of a fish health management plan, approved by the designated veterinarian, for the identification and monitoring of fish diseases and parasites	Yes
8.12 Percentage of fish that are vaccinated for selected diseases that are known to present a significant risk in the region and for which an effective vaccine exists[163]	100%

[161] For the purposes of this standard, GHGs are defined as the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF_6).

[162] GHG emissions must be recorded using recognized methods, standards and records as outlined in Appendix V.

[163] The farm's designated veterinarian is responsible for undertaking and providing written documentation of the analysis of the diseases that pose a risk in the region and the vaccines that are effective. The veterinarian shall determine which vaccinations to use and demonstrate to the auditor that this decision is consistent with the analysis.

8.13	Percentage of smolt groups[164] tested for select diseases of regional concern prior to entering the grow-out phase on farm	100%
8.14	Detailed information, provided by the designated veterinarian, of all chemicals and therapeutants used during the smolt production cycle, the amounts used (including grams per ton of fish produced), the dates used, which group of fish were treated and against which diseases, proof of proper dosing and all disease and pathogens detected on the site	Yes
8.15	Allowance for use of therapeutic treatments that include antibiotics or chemicals that are banned[165] in any of the primary salmon producing or importing countries[166]	None
8.16	Number of treatments of antibiotics over the most recent production cycle	≤ 3
8.17	Allowance for use of antibiotics listed as critically important for human medicine by the WHO[167]	None[168]

[164] A smolt group is any population that shares disease risk, including environment, husbandry and host factors that might contribute to sharing disease agents for each group. Only diseases that are proven, or suspected, as occurring in seawater (and for which seawater fish-to-fish transmission is a concern) but originating in freshwater should be on the list of diseases tested. The designated veterinarian to the smolt farm is required to evaluate, based on scientific criteria and publicly available information, which diseases should be tested for. This analysis shall include an evaluation of whether clinical disease or a pathogen carrier state in fresh water is deemed to have a negative impact on the grow-out phase, thereby disqualifying a smolt group from being transferred. A written analysis must be available to the certifier on demand.

[165] "Banned" means proactively prohibited by a government entity because of concerns around the substance.

[166] For purposes of this standard, those countries are Norway, the UK, Canada, Chile, the United States, Japan and France.

[167] The 3rd edition of the WHO list of critically and highly important antimicrobials was released in 2009 and is available at: http://www.who.int/foodborne_disease/resistance/CIA_3.pdf.

[168] If the antibiotic treatment is applied to only a portion of the pens on a farm site, fish from pens that did not receive treatment are still eligible for certification.

8.18 Evidence of compliance[169] with the OIE *Aquatic Animal Health Code*[170]	Yes

Rationale
Please see the relevant Rationale in Principle 5.

Standards related to Principle 6

INDICATOR	STANDARD
8.19 Evidence of company-level policies and procedures in line with the labor standards under 6.1 to 6.11	Yes

Rationale
Please see the relevant Rationale in Principle 6.

Standards related to Principle 7

INDICATOR	STANDARD
8.20 Evidence of regular consultation and engagement with community representatives and organizations	Yes
8.21 Evidence of a policy for the presentation, treatment and resolution of complaints by community stakeholders and organizations	Yes
8.22 Where relevant, evidence that indigenous groups were consulted as required by relevant local and/or national laws and regulations	Yes
8.23 Where relevant, evidence that the farm has undertaken proactive consultation with indigenous communities	Yes

[169] Compliance is defined as farm practices consistent with the intentions of the Code, to be further outlined in auditing guidance. For purposes of this standard, this includes an aggressive response to detection of an exotic OIE-notifiable disease on the farm, which includes depopulating the infected site and implementation of quarantine zones in accordance with guidelines from OIE for the specific pathogen. Exotic signifies not previously found in the area or had been fully eradicated (area declared free of the pathogen).

[170] OIE 2011. Aquatic Animal Health Code. http://www.oie.int/index.php?id=171.

Rationale
Please see the relevant Rationale in Principle 7.

ADDITIONAL REQUIREMENTS FOR OPEN (NET-PEN) PRODUCTION OF SMOLT
IN ADDITION TO THE REQUIREMENTS ABOVE, IF THE SMOLT IS PRODUCED IN AN OPEN SYSTEM, EVIDENCE SHALL BE PROVIDED THAT THE FOLLOWING ARE MET:

INDICATOR	STANDARD
8.24 Allowance for producing or holding smolt in net pens in water bodies with native salmonids	None
8.25 Allowance for producing or holding smolt in net pens in any water body	Permitted only for five years from publication of the SAD standards
8.26 Evidence that carrying capacity (assimilative capacity) of the freshwater body has been established by a reliable entity[171] within the past five years,[172] and total biomass in the water body is within the limits established by that study (see Appendix VIII-5 for minimum requirements)	Yes
8.27 Maximum baseline total phosphorus concentration of the water body (see Appendix VIII-6)	≤ 20 μg/l [173]
8.28 Minimum percent oxygen saturation of water 50 centimeters above bottom sediment (at all oxygen monitoring locations described in Appendix VIII-6)	≥ 50%
8.29 Trophic status classification of water body remains unchanged from baseline (see Appendix VIII-7)	Yes
8.30 Maximum allowed increase in total phosphorus concentration in lake from baseline (see Appendix VIII-7)	25%

[171] E.g., Government body or academic institution.

[172] If the study is older than two years, and there has been a significant increase in nutrient input to the water body since the completion of the study, a more recent assessment is required.

[173] This concentration is equivalent to the upper limit of the Mesotrophic Trophic Status classification as described in Appendix VIII-7.

8.31	Allowance for use of aeration systems or other technological means to increase oxygen levels in the water body	None

Rationale

Globally, the majority of salmon smolt are produced in closed (e.g., recirculating) or semi-closed (e.g., flow-through) systems and there is a trend towards moving out of open smolt production systems for both environmental and economic reasons. Simultaneously, significant concerns have been raised about the effects of smolt production in open systems (i.e., net pens and cages).

Impacts of concern include the effect of escapees on wild fish populations, nutrient loading, disease transmission, and antibiotics and chemicals entering the freshwater environment. The vast majority of salmon smolt production takes places in closed or semi-closed systems where these impacts can be significantly reduced in a way that is not possible in fully open systems, such as net pens.

The introduction and amplification of parasites and pathogens, and the potential genetic effects of escapees, have been raised as particularly concerning in areas where native salmonids exist. For this reason, the SAD standards allow only closed or semi-closed smolt systems to be certified in areas of wild salmonids.

Additionally, due to the broader range of impacts associated with open net pen smolt production in all regions, and the particular ecological importance of freshwater lakes in Chile[174] (which is the largest salmon producer in the non-native range), the SAD standards require a phase out of all net pen smolt production under the standard within five years. Many smolt in Chile are already currently being produced in recirculating or semi-closed systems and this trend is expected to increase. Through these standards, the SAD encourages the continuous movement globally towards producing smolt in closed systems.

During the five years following publication of the SAD standards, open net pen smolt producers must demonstrate that a rigorous carry capacity study has been conducted of the fresh water body in which their pens are located. The total biomass of aquaculture production in that water body must be within the limit established by the study.

On the lake bottom, decreases in oxygen levels are an indication of the degradation of organic wastes from the cages. DO levels measured 50 centimeters from the bottom sediments provide a signal of the build-up of organic matter and the risks of oxygen deficiency in the lake bottom.

Water quality in a lake can be assessed in many ways. These standards focus on phosphorus as a reference for water quality. The SAD recognizes that other indicators, such as nitrogen and biological indicators, are important as well. Phosphorus provided the most practical global proxy for these standards, despite the challenges of its likely fluctuations during the year.

The standards require that a smolt farm monitor total phosphorus concentrations to gauge potential changes in water quality over time. Potential increases in concentrations may or may not be the result of farming activities. Regardless of the cause, if total phosphorus concentrations rise to the point that the lake's trophic status

[174] Various sources as summarized in: León-Muñoz, Jorge; Tecklin, David; Farías, Aldo and Díaz, Susan. 2007. Salmon Farming in the Lakes of Southern Chile - Valdivian Ecoregion. History, tendencies and environmental impacts. Valdivia, Chile: WWF. Full report at:http://assets.panda.org/downloads/informe_salmones_lagos_sur_de_chile_restriccion.pdf.

changes, or if they rise more than 25 percent from a baseline, smolt produced in that lake would no longer be eligible for use in certified grow-out sites under the standard. Scientists have argued that increases in concentration greater than 25 percent would cause stresses that would likely result in changes in ecosystem structure and function.[175]

Under standard 8.4, all smolt producers must also meet phosphorous discharge standards, calculated as total phosphorus per metric ton of production.

ADDITIONAL REQUIREMENTS FOR SEMI-CLOSED AND CLOSED PRODUCTION OF SMOLTS

ADDITIONALLY, IF THE SMOLT IS PRODUCED IN A CLOSED OR SEMI-CLOSED SYSTEM (FLOW THROUGH OR RECIRCULATION) THAT DISCHARGES INTO FRESHWATER, EVIDENCE SHALL BE PROVIDED THAT THE FOLLOWING ARE MET:[176]

INDICATOR	STANDARD
8.32 Water quality monitoring matrix completed and submitted to ASC (see Appendix VIII-2)	Yes[177]
8.33 Minimum oxygen saturation in the outflow (methodology in Appendix VIII-2)	60%[178,179]
8.34 Macro-invertebrate surveys downstream from the farm's effluent discharge demonstrate benthic health that is similar or better than surveys upstream from the discharge (methodology in Appendix VIII-3)	Yes
8.35 Evidence of implementation of biosolids (sludge) Best Management Practices (BMPs) (Appendix VIII-4)	Yes

Rationale

Effluent from semi-closed and closed smolt facilities can have an environmental effect on rivers, streams and other bodies of water that receive the discharge. Phosphorus is the key limiting nutrient in most temperate and cool freshwater systems. It is a stable nutrient in that it does not volatilize like nitrogen compounds. It is also

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[175] Moss, Johnes & Phillips (1995), Cambridge University Press.

[176] Production systems that don't discharge into fresh water are exempt from these standards.

[177] See Appendix VI for transparency requirements for 8.32.

[178] A single oxygen reading below 60 percent would require daily continuous monitoring with an electronic probe and recorder for at least a week demonstrating a minimum 60 percent saturation at all times.

[179] See Appendix VI for transparency requirements for 8.33.

added to feeds in proportions that can allow estimations of other waste constituents (organic matter and nitrogen). Thus, phosphorus is an ideal variable to set load limits for freshwater aquaculture.

The SAD developed the phosphorus load standard (8.4) based on a unit of production, making it an indicator of how well a farm is minimizing nutrient discharges per ton of fish produced. From an environmental standpoint, farms should aim for as low an annual load of phosphorus per ton of fish as possible. Farms can lower their phosphorus load on the environment by using a better feeding strategy (ratio and feed distribution), improving feed conversion efficiency through the improvement of the environmental conditions in the farm, utilizing feed that is more digestible and has lower phosphorus content, and by employing cleaning technologies such as settling ponds and filters. Smolt production facilities are encouraged to develop methodologies to reduce their phosphorus burdens over time, while ensuring farmed fish are getting the appropriate nutrients to protect the health of the smolt.

In an attempt to limit the oxygen burden on natural water bodies from the release of nutrients, these standards include a minimum saturation level of dissolved oxygen at discharge.

Benthic biodiversity is often a measure of aquatic ecosystem health. These standards use faunal surveys as a reference for a farm's actual impact on the environment. By comparing surveys downstream and upstream from the farm's effluent discharge, the standard aims to isolate the impact of the production facility, and ensure that no significant impact is occurring.

Biosolids are a mixture of organic waste and sediment produced or accumulated through the farming activity. Biosolids discharged into natural water bodies are of concern because solids can restrict light penetration in water bodies, accumulate downstream, cover plants and habitat, and cause general shallowing of water bodies. Additionally, the organic component of biosolids will exert an oxygen demand as the organic matter decays. The simplest and best way to minimize these impacts is to remove sediments from the water column and allow organic matter to decay prior to discharge. Functionally, this infers the use of settling basins or ponds to let solids settle out of the water column, and for bacterial decomposition and oxygen depletion to occur at the same time prior to disposal of biosolids. To provide assurance of appropriate disposal of biosolids, these standards include a small number of BMPs.

These standards do not require a specific effluent monitoring regime beyond the dissolved oxygen standard and benthic analyses. However, the standards do require farms to submit to the ASC the results of the effluent monitoring they conduct as part of their regulatory requirements. In particular, the standard requires data on any sampling of phosphorus, nitrogen, total suspended solids (TSS) and biological oxygen demand (BOD). This data will help to distinguish the performance of farms certified by this standard over time, and assist in revisions to the standard.

Appendix I: Methodologies Related to Principle 2 and Benthic Testing

Subsections

1. Sampling methodology for calculation of faunal index, macrofaunal taxa, sulphide and redox, and copper
2. Calculation methodology for the percent fines in feed
3. Biodiversity-focused impact assessment
4. Methodology for sampling dissolved oxygen
5. Methodology for sampling nitrogen and phosphorous

Appendix I-1. Sampling methodology for calculation of faunal index, macrofaunal taxa, sulphide and redox, and copper

Grab sampling for the faunal index, macrofaunal taxa measurements, and sulphide and redox should be conducted at nine stations in duplicate during peak cage biomass for the production cycle.

1. Two stations should be from the cage edge, one at each end of the long axis of the farm
2. Three should be from within the Allowable Zone of Effect (AZE), 25 meters from the edge of the array of cages at slack tide measured with a marked line and recorded using GPS. Of these three, one should be upstream and one downstream with respect to the direction of the residual current, and the other should be to one side of the farm in a direction orthogonal to the residual current
3. Three should be 25 meters outside the AZE, or 55 meters from the edge of the array of cages measured with a marked line and recorded using GPS. Of these, one should be upstream and one downstream with respect to the direction of the residual current, and the other should be to one side of the farm in a direction orthogonal to the residual current
4. One from a reference site 500-1000 meters from the farm (edge of the array of cages), in similar water depth and substratum type (where this exists), and recorded using GPS
5. For farm sites using a site-specific AZE, sampling locations shall be determined based on that AZE, at distances consistent from the boundary of the AZE as for other farms (e.g., five meters inside of AZE and 25 meters outside of the AZE, recorded using GPS, and in multiple directions as determined appropriate through the modeling

For farms using copper-based nets or copper-treated nets, copper sampling shall be conducted at the same locations outside the AZE as the other benthic sampling, at three stations outside the AZE, in duplicate. The reference site used shall also be the same, and two additional reference sites are needed. Timing shall also be the same, sampling at peak cage biomass during the production cycle.

Appendix I-2. Calculation methodology for the percent fines in feed

Introduction

This method determines the fines (dust and small fragments) in finished product of fish feed which has a diameter of 3 mm or more.

The amount of dust and fragments shall be determined when the feed is delivered to the farming site.[180]

Procedure
The test can be performed either by use of a sieving machine or by a manual test.
The sample of feed shall be put through a sieve with a maximum sieve opening of:

1. 1 mm when the particle diameter is equal to 5 mm or less
2. 2.36 mm when the particle diameter is more than 5 mm

Manual test

1. Put the accumulation box and the sieves on top of each other, with the accumulation box on the lowest part, then the smallest sieve and the biggest on top
2. Place the sieves on the balance and tare it
3. Weigh at least 300 g of the feed on the upper sieve, note the weight (m0)
4. Put on the lid
5. Sieve the feed smoothly and carefully for about 30 seconds
6. Remove the lid and weigh what is left in the accumulation box
7. Use a brush to remove all the particles from the sieves
8. The feed particles that have passed through all sieves are called dust (md)
9. If the feed is fatty, or if dust is unevenly distributed, two replicates must be taken

Sifting machine

1. Put the accumulation box and the sieves on top of each other, with the accumulation box at the bottom and the biggest sieve on top
2. Place the sieves on the balance and tare it
3. Weigh at least 300 g of feed on the upper sieve, note the weight (m0)
4. Place the sieves on the sifting machine and then close the cover properly
5. Press the "START" button by holding it for 2-3 seconds, and then run the machine twice (2 x 1 min)
6. Remove the sieves and weigh what is left in the accumulation box
7. The feed particles that have passed through all sieves are called dust (md)

Calculations

1. Weight of feed before sieving = **m0**
2. Weight of feed that has passed through all sieves = **md**

Dust % = (md / m0) x 100

Feed Sampling Protocol
Sampling of feed lots—delivered as material in bulk, big bags or small bags—shall, at a minimum, be sampled as follows:

1. Cut a minimum of six increment samples from the lot, evenly distributed throughout the lot
2. Each increment sample should have a mass of approximately 500 grams
3. Make a pooled sample from all the increment samples and be sure to use all sampled material (i.e., around 6 kg)
4. Reduce the pooled sample to one analysis sample (for testing), each of approximately 500 grams

[180] Feed can be sampled prior to delivery to farm site for sites where there is no feed storage.

Appendix I-3. Biodiversity-focused impact assessment

Standard 2.4.1 requires the farm to demonstrate that a biodiversity-focused environmental impact assessment has been undertaken for the farm.

The assessment shall include habitats and species that could reasonably be impacted by the farm. For example, coldwater corals near the farm could be impacted by nutrients, or whale populations in the region could be impacted by acoustic deterrent devices.

The assessment shall incorporate:

1. Identification of proximity to critical, sensitive or protected habitats and species:
    a. This includes key wild species within the marine environment around the farm
    b. Particular attention to be paid to species listed on International Union for the Conservation of Nature (IUCN) or national threatened/endangered lists and on any areas that have been identified as HCVAs, areas important for conservation/biodiversity or the equivalent
    c. Sensitive species may include non-threatened species of high economic value in the area that may be affected by the salmon farm (e.g., lobsters)
2. Identification and description of the potential impacts the farm might have on biodiversity, with a focus on those habitats or species
3. Description of strategies and current and future program(s) underway on the farm to eliminate or minimize any identified impacts the farm may have, and for the monitoring of outcomes of said programs and strategies

Appendix I-4. Methodology for sampling dissolved oxygen

Standards 2.2.1 and 2.2.2 require the sampling of dissolved oxygen on the farm site and the calculation of the percent saturation for those samples.

- DO, salinity and temperature shall be measured twice daily (proposed at 6 am and 3 pm, but with recognition that this will vary depending on region and operational practices). Percent saturation shall be calculated for each sample from the data and a weekly average percent saturation shall result.
    - A minimal amount of missed samples due to extreme weather conditions will be considered acceptable.
    - Sampling once daily shall also be considered acceptable, though not preferred.
- DO shall be measured at a depth of five meters at a location where the conditions of the water will be similar to those the fish experience. For example, measurements can be taken at the edge of the net-pen array, in the downstream direction of the current, or off a feed shed or housing structure on the site. Measurements shall be taken at the same location, recorded with GPS, at the same time to allow for comparison between days.
- Weekly averages shall be calculated and remain at or above 70 percent saturation.
- Should a farm not meet the minimum 70 percent weekly average saturation requirement, the farm must demonstrate the consistency of percent saturation with a reference site. The reference site shall be at least 500 meters from the edge of the net pen array, in a location that is understood to follow similar patterns in upwelling to the farm site and is not influenced by nutrient inputs from anthropogenic causes including aquaculture, agricultural runoff or nutrient releases from coastal communities.

Appendix I-5. Methodology for sampling nitrogen and phosphorous

Under standard 2.2.4, some farms are required to monitor nitrogen and phosphorous levels on the farm and at reference sites. Farms shall monitor total N, NH4, NO3, total P and Ortho-P in the water column. Monitoring of nitrogen and phosphorous shall follow the following methodology or an equivalent:

- The N and P (dissolved) sampling shall be conducted at a depth equivalent to mid-cage depth within and near the center of the net pen array, at the same depth (5 meters) from the outside edge of the net pen array along the predominant current direction, at the same depth (50 meters) from the outside edge of the net pen array along the predominant current direction and at a similar depth at a nearby reference site shown to be beyond the influence of the farm (minimum separation distance of 500 meters from the net pen array).
- Samples should be taken using a VanDorn or Kemmerer type water sampler. 500 ml samples should be placed in clear plastic bottles, placed on ice and in a cooler, and analyzed within 48 hours. Ideally, analyses shall be done by a private (third-party) laboratory following standard methods. However, Hach field kits can be used. Clear and detailed records or the sampling frequency and analytical results must be kept. For best practice, the samples from Hach kits should be sent periodically (e.g., once a quarter and at minimum once a year) to an independent laboratory for analysis to ensure consistency of results and ensure/establish quality control.

Appendix II: Area-Based Management (ABM) Scheme

Subsections
1. Attributes and Required Components of the ABM
2. Setting and Revising ABM Lice Loads and On-farm Lice Levels

Appendix II-1. Attributes and required components of the ABM

Participation in an area-based scheme[181] for managing disease and parasites and resistance to treatments is required under the SAD standards. This appendix outlines the main components of the area-based management scheme that the SAD standards require under Criteria 3.1 and 5.4.

The purpose of the area-based management scheme is to improve health and biosecurity management on the farm, with the ultimate goal of minimizing potential negative impacts on wild populations.

II-1. A Definition of "area"

If area-based management is already a regulatory requirement of the farm's jurisdiction, then farms will use this definition of "area" for the purposes of these standards. In jurisdictions where ABM is not a regulatory requirement, the area covered under the ABM must reflect a logical geographic scope such as a fjord or a collection of fjords that are ecologically connected. The boundaries of an area should be defined, taking into account the zone in which key cumulative impacts on wild populations may occur, water movement and other relevant aspects of ecosystem structure and function.

II-1.B Requirements related to participation in the scheme

Within the defined area, at least 80 percent of farmed production (by weight) must participate in the area-based management scheme, even if not all farms are seeking certification under this standard. Without the vast majority of farms participation, the scheme will likely be ineffective. All farms owned by the company applying for certification in the area must participate in the ABM, though not all must be applying for certification.

II-1.C ABM components and guidance

In order to be considered as applicable under the SAD standard, the ABM scheme used by a farm must ensure that there is:

1. Clear documentation of the farms/companies included in the ABM, contact people (including contact information) and mechanisms for communication
2. Development and documentation of shared disease management goals and objectives for the ABM. Goals shall include components related to understanding and minimizing risk of on-farm disease to wild fish. Objectives shall be updated regularly based on new information, including concerns raised to the farms in the ABM from communities and wild fish interests are part of company engagement with stakeholders as outlined under 7.1.1.
3. Information and data-sharing among farms of any data needed to ensure coordination, including plans for stocking and fallowing; on-farm disease and parasite monitoring results including sea lice numbers; suspicion of an unidentifiable transmissible agent, information on therapeutic treatments; and data on

[181] For more information on the principles of place-based or area-based management, see Young et al., 2007. Solving the Crisis in Ocean Governance: Place-Based Management of Marine Ecosystems. Environment: Volume 49, Number 4, pages 20–32.

resistance including information related to treatments not being as effective as expected.

The ABM scheme must include coordination among farms as relates to:

1. Application and rotation of treatments:
    a. Farmers must be able to demonstrate a coordinated treatment plan and evidence that the schedule and rotation of treatments are being implemented.
    b. Consideration of the cumulative use, and potential risks[182] of this use, of antibiotics classified as "highly important" by the WHO[183] is a required component of coordination and information-sharing about treatments.
    c. Where applicable, treatments and/or strategic harvesting of salmon is coordinated prior to outmigration of wild salmonids to ensure minimal on-farm lice levels at this sensitive time period for those species (as has been determined under 3.1.5).
    d. Tracking of cumulative use of parasiticides (by chemical, annually and by production cycle) within the ABM.
2. Stocking: Records must demonstrate that all stocked fish within the ABM are of the same year class and that stocking dates were coordinated with other farms.
3. Fallowing: Coordination of fallowing between each production cycle to help break disease cycles, with a clear period of time when there are no farmed salmon in the area in the water.
4. Monitoring schemes:
    a. On-farm disease and pathogen monitoring and information sharing among farms
    b. On-farm resistance monitoring and information sharing among farms
    c. For farms located in areas where there are wild salmonids, monitoring of wild salmonid populations that is relevant for the area must occur as specified under 3.1.6, either under the auspices of the ABM or under some other auspices
5. Setting and revising a maximum ABM lice load:
    a. The entire ABM scheme will set a maximum lice load, expressed as total mature female lice on all farms in the area. In areas of wild salmonids, the ABM scheme must demonstrate how the scheme incorporates the results of wild monitoring into revisions of this total lice load over time (see Section 2 below for additional details on this feedback loop)

Appendix II-2. Setting and revising ABM lice loads and on-farm lice levels

Standard 3.1.3 requires that the ABM scheme set a maximum lice load. A core purpose of this requirement is to be able to see the potential cumulative infection pressure from on-farm lice, expressed as the number of mature female lice on all farms in the scheme. This "total load" figure is a better reflection of the potential risks to wild populations than on-farm lice levels, measured as lice per farmed fish.

An ABM scheme shall initially set this total load figure based on the regulatory obligations of the jurisdiction in which it operates and the results of any wild monitoring done to date. In practice, this would mean that farms in most ABM schemes would take the on-farm lice levels they are required to achieve by regulators, and

[182] Assessment of risk shall take into account the cumulative use of these antibiotics from salmon production within the area in order to assess the potential risk to human health from the development of resistance in the environment. Prescribing antibiotics highly important for human health shall be considered as a last resort.

[183] The third edition of the WHO list of critically and highly important antimicrobials was released in 2009 and is available at: http://www.who.int/foodborne_disease/resistance/CIA_3.pdf.

multiply them times the number of farmed fish in the area. This would be a starting place.

For farms located in areas of wild salmonids, the ABM scheme shall demonstrate how the scheme is using the results of wild monitoring to review and potentially revise the maximum lice load for the area each year and/or production cycle. Adjustments to the area's lice load would lead to corresponding limits on lice levels on individual farms. This feedback loop must be transparent and document how the ABM scheme is being protective of wild fish through the interpretation of wild monitoring data. Given the time lag in collecting and analyzing data from wild monitoring, it is expected that the ABM scheme will look at data from previous periods, particularly sensitive periods such as outmigration of wild salmon juveniles.

Standard 3.1.7 requires farms seeking certification to maintain on-farm lice levels at 0.1 mature female lice (leps) during and immediately prior to sensitive periods, particularly outmigration of wild juvenile salmon. The results of wild monitoring must inform this level over time, with a similar type of feedback loop as described for the ABM total lice level. If wild monitoring reveals that 0.1 mature female lice are not being protective of wild populations, the farm must set a lower level in subsequent sensitive periods. Conversely, data from wild monitoring that consistently demonstrates healthy wild populations would allow a farm to make the case for a level higher than 0.1. This case would need to be made for the ABM as a whole to the Technical Advisory Group of the ASC.

Appendix III: Methodologies and Thresholds Related to Monitoring Wild Salmonids

Appendix III-1. Methodologies for monitoring wild salmonids

The SAD standards require all farms located in areas of wild salmonids to participate in monitoring of sea lice on wild salmonids. The purpose of this monitoring is to assist in clarifying the link between the health of wild and farmed fish through objective information. These standards do not demand a specific methodology for this monitoring. Nonetheless, the monitoring must comply with the following requirements:

- The methodology, the results and the analysis are made publicly available and demonstrate scientific rigor in the sampling size, location and method.
- Monitoring must be geographically relevant to the area where the farm/ABM is located, so it provides meaningful information for ABM management practices.
- The process must involve third parties beyond the farm, such as independent scientists. Government programs, in which the company may be contributing little or nothing are acceptable, given the program is geographically relevant.
- Numbers of lice per wild fish, and prevalence of lice are both meaningful metrics that could be considered in the research.
- Species should be chosen based on importance to area (i.e., sea trout vs. salmon vs. arctic char).

Appendix IV: Feed Resource Calculations and Methodologies

Subsections

1. Forage Fish Dependency Ratio calculation
2. Calculation of EPA and DHA in feed
3. Explanation of FishSource scoring

Appendix IV-1. Forage Fish Dependency Ratio calculation

Feed Fish Dependency Ratio (FFDR) is the quantity of wild fish used per quantity of cultured fish produced. This measure can be calculated based on fishmeal (FM) and/or fish oil (FO). In the case of salmon currently, in most cases the FFDR for fish oil will be higher than that for fishmeal. The dependency on wild forage fish resources shall be calculated for both FM and FO using the formulas noted below. This formula calculates the dependency of a single site on wild forage fish resources, independent of any other farm.

$$FFDR_m = \frac{(\%\ fishmeal\ in\ feed\ from\ forage\ fisheries) \times (eFCR)}{24}$$

$$FFDR_o = \frac{(\%\ Fish\ oil\ in\ feed\ from\ forage\ fisheries) \times (eFCR)}{5.0\ or\ 7.0,\ depending\ on\ source\ of\ fish}$$

Where:

1. Economic Feed Conversion Ratio (eFCR) is the quantity of feed used to produce the quantity of fish harvested.

$$eFCR = \frac{Feed, kg\ or\ mt}{Net\ aquacultural\ production, kg\ or\ mt\ (wet\ weight)}$$

i.

2. The percentage of fishmeal and fish oil excludes fishmeal and fish oil derived from fisheries' by-products.[184] Only fishmeal and fish oil that is derived directly from a pelagic fishery (e.g., anchoveta) or fisheries where the catch is directly reduced (such as krill or blue whiting) is to be included in the calculation of FFDR. Fishmeal and fish oil derived from fisheries' by-products (e.g., trimmings and offal) should not be included because the FFDR is intended to be a calculation of direct dependency on wild fisheries.
3. The amount of fishmeal in the diet is calculated back to live fish weight by using a yield of 24%.[185] This is an assumed average yield.

[184] Trimmings are defined as by-products when fish are processed for human consumption or if whole fish is rejected for use of human consumption because the quality at the time of landing do not meet official regulations with regard to fish suitable for human consumption. Restrictions on what trimmings are allowed for use under the standard are under 4.3.4.

[185] Reference for FM and FO yields: Péron, G., et al. 2010. Where do fishmeal and fish oil products come from? An analysis of the conversion ratios in the global fishmeal industry. Marine Policy, doi:10.1016/j.marpol.2010.01.027.

4. The amount of fish oil in the diet is calculated back to live fish weight by using an average yield in accordance with this procedure:
    a. Group a - Fish oil originating from Peru and Chile and Gulf of Mexico, five percent yield of fish oil
    b. Group b - Fish oil originating from the North Atlantic (Denmark, Norway, Iceland and the UK) seven percent yield of fish oil
    c. If fish oil is used from other areas than mentioned above, they should be classified as belonging to group a if documentation shows a yield less than six percent, and into group b if documentation shows a yield more than six percent
5. FFDR is calculated for the grow-out period in the sea as long as the smolt phase does not go past 200 grams per smolt. If the smolt phase goes past 200g then FFDR is calculated based on all feed used from 200 grams and onwards. If needed, the grow-out site shall collect this data from the smolt supplier.

Appendix IV-2. Calculation of EPA and DHA in feed

In order to demonstrate compliance with the standard related to the maximum amount EPA and DHA from direct forage fisheries in the feed, the calculations shall be done according to the following formula:

$$\text{Grams of EPA and DHA in feed} = \frac{((\text{grams of fish oil per kg feed}) \times (\%\text{ of EPA and DHA in fish oil}))}{100}$$

Where:

1. If the fish oil content varies in different feeds used during the production cycle, a weighted average can be used. The grams of fish oil relate to fish oil originating from forage fisheries for industrial purposes.
2. The content of EPA and DHA of the fish oil shall be calculated using the average figures
    a. group a - Fish oil originating from Peru and Chile and Gulf of Mexico, 30 percent EPA and DHA in fish oil
    b. group b - Fish oil originating from the North Atlantic (Denmark, Norway, Iceland and UK) 20 percent EPA and DHA in fish oil
    c. If fish oil is used from other areas than mentioned above, they should be classified as belonging to group a if analyses of EPA and DHA is above 25 percent, and into group b if analyses of EPA and DHA is below 25 percent

Analyses of EPA and DHA are the percentage of fatty acids in the oil that are EPA and DHA. In the calculation above, we make the simplification that 100 percent of the oil consists of fatty acids. EPA and DHA originating from fish oil originating from by-products and trimmings are not included in the calculation above. The feed producer can justify and demonstrate the amount of fish oil coming from trimmings and by-products by using a percentage of fish oil originating from trimmings based on information from purchases in an annual year, either using information related to the current year when the feed is produced or the previous year.

Appendix IV-3. Explanation of FishSource scoring

FishSource scores provide a rough guide to how a fishery stacks up against existing definitions and measures of sustainability. The FishSource scores currently only cover five criteria of sustainability, whereas a full assessment—such as that by the Marine Stewardship Council (MSC)—will typically cover more than 60. As such, the FishSource scores are not a firm guide to how a fishery will perform overall. Nonetheless, the FishSource scores do capture the main outcome-based measures of sustainability.

FishSource scores are based on common measures of sustainability, as used by the International Council for the Exploration of the Seas, the National Marine Fisheries Service and the MSC, among others (e.g., current fishing mortality relative to the fishing mortality target reference point, or current adult fish biomass relative to its maximum sustainable yield (B_{msy})).

Components of the FishSource score

Issue	Measure	Underlying Ratio
Is the management strategy precautionary?	Determine whether harvest rates are reduced at low stock levels	$F_{advised}/F_{target\ reference\ point}$ or $F_{actual}/F_{target\ reference\ point}$
Do managers follow scientific advice?	Determine whether the catch limits set by managers are in line with the advice in the stock assessment	Set TAC / Advised TAC
Do fishers comply?	Determine whether the actual catches are in line with the catch limits set by managers	Actual Catch / Set TAC
Is the fish stock healthy?	Determine if current biomass is at long-term target levels	SSB/B_{40} (or equivalent)
Will the fish stock be healthy in future?	Determine if current fishing mortality is at the long-term target level	$F/F_{target\ reference\ point}$

If existing measures of sustainability consider a fishery to be relatively well-managed, then it will typically score eight or more out of 10 on FishSource. If the fishery is judged to be doing okay, but requires improvement, then it will typically score between six and eight on FishSource. A fishery falling short of minimum requirements of existing measures of sustainability is scored six or below, with the score declining as the condition of the fishery deteriorates.

The key relation between the MSC scoring system and FishSource scores is “80 <-> 8”. For example, a FishSource score of eight or above would mean an unconditioned passing for that particular aspect on the MSC system. Sustainable Fisheries Partnership devised scores in a way that, departing from eight, a score of six relates to a score of 60, and below six, an MSC “below 60”, “no-pass” condition. Please note, however, that the MSC criteria have been interpreted through time with a substantial degree of variability among fisheries.

More information on FishSource is available at www.fishsource.org, and an overview of the FishSource indices is available at http://www.fishsource.org/indices_overview.pdf.

About scoring and availability of product meeting a minimum score

A typical full assessment of a fishery through the MSC will include significantly more areas/criteria assessed than through FishSource, typically including more than 60 sustainability criteria. A fishery is deemed sustainable by the MSC if it scores 60 or more in every performance indicator, and an average of 80 or more at the principle level. The MSC requires certified fisheries to take corrective actions to improve any areas of the fishery that scored between 60 and 80, with the intention of achieving a score of 80 or above in every area of the fishery.

As of May 2011, FishSource released updated information on the ratings of the 25 principal forage fisheries around the Atlantic and South America in their “Reduction Fisheries League Table 2011.” Ten of the 25 fisheries met a minimum FishSource score of six in all categories with a minimum score of eight in the biomass category.

These ten fisheries had a total combined 2009 catch of 9157 thousand mt, accounting for just over 66 percent of the total catch of those 25 forage fisheries.

The ratings of fisheries under the FishSource methodology will change over time based on the performance of those fisheries. Farms undergoing certification and feed companies should be attuned to updates of the "Reduction Fisheries League Table" and use the latest version publicly available. Auditing guidelines will be developed around the timing of purchasing of fishmeal and fish oil and the updates of the ratings to ensure reasonable interpretation of the standard and timing of shifts in purchasing if a fishery's performance declines to a point where it fails to meet the minimum score needed under the standard.

Appendix V: Energy Records and Assessment

Subsections

1. Energy use assessment and greenhouse gas (GHG) accounting for farms
2. GHG accounting for feed

Appendix V-1. Energy use assessment and GHG accounting for farms

The SAD SC encourages companies to integrate energy use assessments and GHG accounting into their policies and procedures across the board in the company. However, this standard only requires that operational energy use and GHG assessments have been done for the farm sites that are applying for certification.

Assessments shall follow either the GHG Protocol Corporate Standard or ISO 14064-1 (references below). These are the commonly accepted international standards, and they are largely consistent with one another. Both are also high level enough not to be prescriptive and they allow companies some flexibility in determining the best approach for calculating emissions for their operations.

If a company wants to go beyond the requirement of the SAD standard and conduct this assessment for their entire company, then the full protocols are applicable. If the assessment is being done only on sites that are being certified, the farms shall follow the GHG Protocol Corporate Standard and/or ISO 14064-1 requirements pertaining to:

- Accounting principles of relevance, completeness, transparency, consistency and accuracy
- Setting operational boundaries
- Tracking emissions over time
- Reporting GHG emissions

In regard to the operational boundaries, farm sites shall include in the assessment:

- Scope 1 emissions, which are emissions that come directly from a source that is either owned or controlled by the farm/facility.
    - For example, if the farm has a diesel generator, this will generate Scope 1 emissions. So will a farm-owned/-operated truck.
- Scope 2 emissions, which are emissions resulting from the generation of purchased electricity, heating, or cooling.

Quantification of emissions is done by multiplying activity data (e.g., quantity of fuel or kwh consumed) by an emission factor (e.g., CO2/kwh). For non-CO2 gases, you then need to multiply by a Global Warming Potential (GWP) to convert non-CO2 gases into the CO2-equivalent. Neither the GHG Protocol nor the ISO require specific approaches to quantifying emissions, so the SAD provides the following additional information on the quantification of emissions:

- Farms shall clearly document the emission factors they use and the source of the emission factors. Recommended sources include the Intergovernmental Panel on Climate Change (IPCC) or factors provided by national government agencies such as the United States Environmental Protection Agency (USEPA). Companies shall survey available emission factors and select the one that is most accurate for their situation, and transparently report their selection.
- Farms shall clearly document the GWPs that they use and the source of those GWPs. Recommended sources include the IPCC 2nd Assessment Report, on which the Kyoto Protocol and related policies are based, or more recent Assessment Reports.

References (relevant at time of publication of standard):

- GHG Protocol Corporate Standard Website: http://www.ghgprotocol.org/standards/corporate-standard
- GHG Protocol Corporate Standard Document: http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf
- ISO 14064-1 available for download (with fee) at http://www.iso.org/iso/catalogue_detail?csnumber=38381
- Some information on ISO 14064-1 is at http://www.iso.org/iso/pressrelease.htm?refid=Ref994
- IPCC 2nd Assessment Report: http://www.ipcc.ch/pdf/climate-changes-1995/ipcc-2nd-assessment/2nd-assessment-en.pdf
- All IPCC Assessment Reports: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml#1

Appendix V-2. GHG accounting for feed

The standard requires the calculation of the GHG emissions for the feed used during the prior production cycle at the grow-out site undergoing certification. This calculation requires farms to multiply the GHG emissions per unit of feed, provided to them by the feed manufacturer, by the amount of feed used on the farm during the production cycle.

The feed manufacturer is responsible for calculating GHG emissions per unit feed. GHG emissions from feed can be calculated based on the average raw material composition used to produce the salmon (by weight) and not as documentation linked to each single product used during the production cycle.

The scope of the study to determine GHG emissions should include the growing, harvesting, processing and transportation of raw materials (vegetable and marine raw materials) to the feed mill and processing at feed mill. Vitamins and trace elements can be excluded from the analysis. The method of allocation of GHG emissions linked to by-products must be specified.

The study to determine GHG emissions can follow one of the following methodological approaches:

1. A cradle-to-gate assessment, taking into account upstream inputs and the feed manufacturing process, according to the GHG Product Standard
2. A Life Cycle Analysis following the ISO 14040 and 14044 standards for life cycle assessments

Should the feed manufacturer choose to do a cradle-to-gate assessment:

1. It shall incorporate the first three phases from the methodology, covering materials acquisition and processing, production, and product distribution and storage (everything upstream and the feed manufacturing process itself).

Should the manufacturer follow the ISO 14040 and 14044 standards for Life Cycle Assessment:

1. Feed manufacturers may follow either an ISO-compliant life cycle assessment methodology or the GHG Protocol product standard.

Regardless of which methodology is chosen, feed manufacturers shall include in the assessment:

- Scope 1 emissions, which are emissions that come directly from a source that is either owned or controlled by the farm/facility.
- Scope 2 emissions, which are emissions resulting from the generation of purchased electricity, heating or cooling.
- Scope 3 emissions, which are emissions resulting from upstream inputs and other indirect emissions, such as the extraction and production of purchased materials, following the Scope 3 standard.

Quantification of emissions is done by multiplying activity data (e.g., quantity of fuel or kwh consumed) by an emission factor (e.g. CO2/kwh). For non-CO2 gases, you then need to multiply by a Global Warming Potential (GWP) to convert non-CO2 gases into CO2-equivalent. The SAD provides the following additional information on the quantification of emissions:

- Farms shall clearly document the emission factors they use and the source of the emission factors. Recommended sources include the IPCC or factors provided by national government agencies, such as the USEPA. Companies shall survey available emission factors and select the one that is most accurate for their situation, and transparently report their selection.
- Farms shall clearly document the GWPs that they use and the source of those GWPs. Recommended sources include the IPCC 2nd Assessment Report, on which the Kyoto Protocol and related policies are based, or more recent Assessment Reports.

References:

- GHG Product Standard: http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-product-standard-draft-november-20101.pdf
- Scope 3 Standard: http://www.ghgprotocol.org/files/ghgp/GHG%20Protocol%20-%20Scope%203%20Standard%20-%20Stakeholder%20Comments%20-%20November%202010.xlsx
- ISO 14044 available for download (with fee) at: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=38498
- Some information on ISO 14064-1 is at: http://www.iso.org/iso/pressrelease.htm?refid=Ref994
- IPCC 2nd Assessment Report: http://www.ipcc.ch/pdf/climate-changes-1995/ipcc-2nd-assessment/2nd-assessment-en.pdf
- All IPCC Assessment Reports: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml#1

Appendix VI: Transparency of Farm-Level Performance Data

The farm must provide evidence that it has submitted to ASC in the requested format the following information about its environmental and social performance. The SAD SC is aware that the ASC has not yet finalized their policies around transparency of data collected during audits. However, it is the intent of the SC for the information to be available via a centralized database available to the public. The SC recommends that the following farm-level data be released on an annual basis, except for any data that cannot be calculated prior to the end of a production cycle, or for exceptions noted in the table below. The SAD SC believes that data transparency is critically important. This high degree of transparency can be used by stakeholder and scientists to better understand actual performance of certified farms in a given area and to study interactions of farms with the environment. The data will also help the ASC track performance over time and will inform the revisions to the standard in the future.

Information pertaining to biomass and or stocking from which production volumes, timing and financial information can be extracted or inferred should be considered confidential in order to not put certified companies at a competitive disadvantage. Information related to production volumes or harvest timing may be made public with a time delay (e.g., if released post-harvest and sale).

Item	Option	Relevant Standard	Measurement	Units	Measurement Frequency	Calculations and Sampling Methodologies, Additional Notes
1			Species in production	species		
2	a	2.1.1	Redox potential	mV	production cycle	Appendix I-1
	b		Sulfide levels	microMoles/l	production cycle	Appendix I-1
3	a	2.1.2	AZTI Marine Biotic Index (AMBI)	AMBI score	production cycle	Appendix I-1
	b		Shannon-Wiener Index	S-WI score	production cycle	Appendix I-1
	c		Benthic Quality Index (BQI)	BQI score	production cycle	Appendix I-1
	d		Infaunal Trophic Index (ITI)	ITI score	production cycle	Appendix I-1
4		2.1.3	# of microfaunal taxa	#	production cycle	Appendix I-1
5		2.2.1	Average % DO saturation	%	weekly	Appendix I-4
6		2.2.2	Max % samples under 1.85 mg/l DO	%	weekly	Appendix I-4
7		2.2.4	Nitrogen monitoring		weekly	Appendix I-5
8		2.2.4	Phosphorous monitoring		weekly	Appendix I-5
9		2.2.5	Calculated BOD		production cycle	Footnote in 2.2.5
10		2.5.2	# days ADDs/AHDs	#	ongoing[186],	

[186] Ongoing: Logged as needed or as occurs. Data shall be logged such that it can be analyzed on both an annual and a production cycle basis. This definition of "ongoing" applies throughout Appendix VI.

11		2.5.5 and 2.5.6	Lethal incidents of marine mammals and birds	#, species and cause per episode	ongoing	To be made publicly available (e.g., on web) by farming company shortly after incident
12		3.1.1	Fallowing period	dates		
13		3.1.3	Maximum sea lice load set for the ABM	number	annual	Appendix II and III
14		3.1.4 and 3.1.7	Weekly, on-farm sea lice levels		weekly	To be made directly publicly available by farming company within a week
15		3.1.6	In areas of wild salmonids, monitoring of sea lice on out-migrating salmon juveniles or costal sea trout			Appendix III, to be made publicly available within eight weeks of completion of monitoring
16		3.4.1-3.4.2	Escapes data	# episodes	production cycle	
				date of episode	ongoing	
				cause of episode	ongoing	
				# escapees per episode	ongoing	
				# total escapees	production cycle	
17		3.4.2	Counting technology accuracy	%	production cycle	Footnote 58
		3.4.3	Estimated unexplained loss	#	production cycle	Footnote 59
18		4.2.1	FFDR fishmeal (during grow-out)	FFDRm	production cycle	Appendix IV
19	a	4.2.2	FFDR fish oil (during grow-out)	FFDRo	production cycle	Appendix IV
	b		Max amount EPA and DHA	g/kg feed	production cycle	Appendix IV
20		4.4.3	Transgenic feed ingredients	Y/N	production cycle	
21		4.6.1	Energy use	kJ/mT fish	production cycle	Appendix V-1
22		4.6.2	GHG emissions on farm		annual	Appendix V-1
23		4.6.3	GHG emissions of feed		production cycle (not immediately applicable)	Appendix V-2
24		4.7.1	Copper-based antifoulants	Y/N	production cycle	
25		4.7.3 and 4.7.4	Results of copper sampling (outside AZE and at reference sites), if required	mg Cu/kg sediment	production cycle	Appendix I-1

26		5.1.5	Total mortality of farmed fish	%	ongoing	
27		5.1.4	Cause of mortalities (post-mortem analysis)	# morts per cause or disease	ongoing	
28		5.1.6	Maximum unexplained morts	% of total mortality	production cycle	
29		5.2.1	Amount of each chemical/therapeutant used for each (antibiotics, parasiticides, etc.)	product name	ongoing	Also 5.2.9
				chemical name	ongoing	
				reason for use	ongoing	
				date	ongoing	
				kg	ongoing	
				mT fish treated	ongoing	
				dosage	ongoing	
				# of treatments	ongoing	
				WHO classification (antibiotics only)	ongoing	
31		5.2.5	PTI	PTI	production cycle	Appendix VII
32		5.2.6	Parasiticide load compared to two previous production cycles, if required		production cycle	Starting 5 years after the publication of the SAD
33		5.2.10	Antibiotic load compared to two previous production cycles, if required	kg	production cycle	Starting 5 years after the publication of the SAD
34		5.4.2	Unidentifiable transmissible agent	Date(s) concern raised, disease detected from monitoring (if applicable)	ongoing	Public disclosure of results of surveillance within 30 days of findings
35		5.4.4	OIE-notifiable disease detected on farm	Disease(s), exotic or endemic, and detection date(s)	ongoing	Public disclosure of detection and results of surveillance within 30 days of findings
36		Section 8	Type of smolt production system	Open, semi or closed	production cycle	
37		8.32 and 8.33	Monitoring results from water quality analyses	See Appendix VIII-2		

Appendix VII: Parasiticide Treatment Index

The PTI is a function of four components as outlined below: therapeutant used, treatment method used, timing of treatment with regard to wild species that are at greatest risk from parasiticides, and the consecutive use of therapeutants that increases risk of resistance developing.

PTI is calculated as follows:
The PTI for any individual treatment is calculated as:
PTI_i= [(therapeutant factor)*(treatment factor)*(resistance factor)*(sensitive time factor)]

The farm level PTI over the production cycle is the sum of individual PTIs from each treatment.
Farm level PTI= $\sum (PTI_1 \ldots..PTI_x)$

Component 1: Therapeutant factor (for the therapeutant used)
Factor per therapeutant is given in the following table. Therapeutant factor = (Toxicity Factor)*(Persistence Factor)*(Dosage Factor) based on the following rankings:

- 0 to 2 - toxicity to the environment (based on toxicity data for the indicator species of daphnia)
- 0 to 3 - persistence in the environment (based on publicly available data)
- 1 to 3 - typical dosage per unit of fish treated (based on relative data for the substances used within their main group and oral vs. bath treatment)

Parasiticide	Commercial Name	Treatment Mechanism	Toxicity Factor	Daphnia LC50 (µg/l)	Persistence Factor	Dosage Factor	Therapeutant Factor
Diflubenzuron	Releeze	Oral	1	Ranked as teflubenzuron	3	3	9
Teflubenzuron	Ektobann vet. /Calcide	Oral	1	2.8 µg/l	3	3	9
Cypermethrin	Betamax vet.	Bath	2	0.3 µg/l: high concern	2	1	4
Deltamethrin	Alpha max	Bath	2	0.56 µg/l: high concern	3	1	6
Azamethiphos	Salmosan	Bath	2	0.67 µg/l: high concern	1	3	6
Emamectin benzoate	Slice vet.	Oral	2	0.56 µg/l: high concern	2	1	4
Hydrogen Peroxide		Bath	0	Daphnia magna 7700 µg/l	0	3	0

Component 2: Treatment factor (for the method of treatment used)
Treatment methods were assigned weights taking into account risk of that method to the environment in terms of release of chemical to the environment and the degree to which the method allows greater precision in dosing.

- Bath treatment with an open skirt – factor 1 (default)
- In-feed treatment – factor 0.8
- Bath treatment in a closed waterbody (wellboat or tarpaulin) – factor 0.8

- Treatment with no active chemical released into environment[187]– factor 0.2

Component 3: Resistance factor (for repeat uses of the same therapeutant)
In order to reduce risk of development of resistance of sea lice to treatments, the PTI incorporates a factor for the repeated use of the same treatment.

- Default resistance factor = 1
- If the same therapeutant is used for more than one treatment within a period of 12 months, the resistance factor is 2 (factor of 2 is applied starting with the second treatment)

Component 4: Sensitive time factor (timing of treatment with regard to wild species)
The factor for timing of treatment with regard to wild species is intended to address concerns about use of parasiticides at times when populations of species potentially affected by the treatment are particularly sensitive. As noted in the report of the SAD Technical Working Group on Chemical Inputs, parasiticides present a greater risk to crustaceans than other species because of their modes of action. Scientific review and conversations with experts suggest that there is not a clear period that presents a greater risk at a population level for crustacean species other than lobsters. Therefore, only lobsters are addressed in this iteration of the PTI within the "sensitive timing" factor. Because there isn't a clear "riskier" period for populations of other crustaceans, the best way to address this is to reduce frequency of treatments by reducing the PTI.

- The default "sensitive timing" factor is 1.
- If the farm area (discharge area) contains lobsters, and if the species is in a time-limited phase where the population is known to be sensitive or are in a known sensitive period, the "sensitive timing" factor is 4.5. Whether lobsters are present in the farm area shall be considered in the environmental impact assessment in standard 2.4.1, as is outlined in Appendix I-3.
- Sensitive time periods for which the higher factor shall be used are:
    - For American lobster on the east coasts of the US and Canada: July 1 – August 31
    - For European lobster In Norway and the UK: July 1 – August 31

Example Calculation
In the example scenario below, the farm used four treatments of parasiticide over the course of the production cycle. The PTI for each treatment is calculated and then summed to determine the total PTI. None of the treatments in this scenario took place during a time denoted as especially sensitive to wild species in the area. The second treatment of emamectin benzoate is given the higher resistance factor as it, in the example below, took place within 12 months of the prior treatment of the same therapeutant.

Treatment	Therapeutant	Therapeutant factor	Treatment factor	Resistance factor	Sensitive time	PTI
1	Emamectin benzoate	4	0.8	1	1	3.2
2	Emamectin benzoate	4	0.8	2	1	6.4

[187] For example, a treatment in a production system where water is not released into the natural environment, or a bath treatment in a wellboat where the chemical is denatured and rendered inactive prior to release to the environment.

3	Azamethiphos	6	0.8	1	1	4.8
4	Deltamethrin	6	0.8	1	1	4.8
					Sum PTI	**19.2**

Updating PTI with new information

If new therapeutants become available for sea lice treatment, or if new treatment methods are developed, the Technical Advisory Group of the ASC may be asked to determine a therapeutant factor or treatment factor for that new parasiticide or new method, following guidelines for assignment of factors left by the SAD SC.

Appendix VIII: Methodologies Related to Water Quality and Smolt Systems

Appendix VIII-1. Calculation of Total Phosphorous discharged per ton of smolt produced

Standard 8.4 looks at how much phosphorus is discharged from the farm per unit smolt produced. The standard is set at 5 kg/mt for the first three years from date of publication of the standard, dropping to 4 kg/mt thereafter. Smolt facilities would calculate their discharge using a "mass balance" approach that calculates the discharge from the phosphorus in the feed and the phosphorus in the fish biomass. Farms would be able to subtract P that is physically removed in sludge (documented sludge removal with P levels tested).

To calculate P released to the environment, one must calculate the P used to produce one unit of fish and subtract the P taken up by the fish and P removed in sludge. The basic formula per time period, to be calculated for a maximum period of 12 months, is:

P released to the water body per unit of smolt produced = (P in – P out)/biomass produced

Where:

P in = Total P in feed

P out= (Total P in biomass produced) + (Total P in sludge removed)

Where the following definitions of the parameters apply in the basic formula:

1. *Total P in feed*
    a. ∑(Total amount of feed type (product) multiplied by content of phosphorus) $_{1.....X}$), where 1……..X represents the number of different feed types (products) used.
        i. The phosphorus content per feed type can be determined either by chemical analyses of the feed type, or based on declaration by the feed producer of phosphorus content in the feed type in jurisdictions where national legislation order phosphorus content of feed to be declared.
2. *Biomass produced*
    a. Biomass of fish produced over the specific time period is calculated as: (biomass harvested + biomass of mortalities + remaining standing biomass) – biomass at start of time period
3. *P content in biomass produced*
    a. P content in biomass produced = (biomass produced)*(% of P in fish)
        i. For purposes of calculating this standard, the following phosphorus percentages will be used for harvested fish or mortalities:
            1. Less than 1 kg: 0.43%
            2. More than 1 kg: 0.4%
4. *Total P in removed sludge*
    a. P content in sludge removed = (sludge removed) * (% of P in sludge)
        i. Phosphorus in sludge removed per unit shall be determined based on analytical values that are representative of the batch of sludge removed from the farm.
        ii. The smolt farm must demonstrate the sludge was physically removed from the farm site and that the sludge was deposed of according to the principles in standard 8.35.

Appendix VIII-2: Water quality sampling methodology and data sharing for land-based systems

Land-based farms (flow-through and recirculation systems) must measure dissolved oxygen in the effluent. They also must submit to ASC the results from the effluent monitoring they conduct to comply with their local regulatory requirements. In particular, the standard requires data on any sampling of phosphorus, nitrogen, TSS and BOD. This data will help to distinguish the performance of farms certified by this standard over time, and assist in revisions to the standard.

Oxygen saturation must be measured at least monthly in the early morning and late afternoon. A single oxygen reading below 60 percent would require daily continuous monitoring with an electronic probe and recorder for at least a week demonstrating a minimum 60 percent saturation at all times.

Farms shall use the following table to submit the results of effluent monitoring to ASC. Please list each analysis separately over the previous 12-month period.

Date	**Analysis** (*TP, TN, BOD, TSS, etc.*)	**Location** (*Effluent, Inlet, etc.*)	**Method** (*Single grab, 24-hour bulk, etc.*)	**Sampling by Third Party?** (*Yes/No*)	**Analysis by Third Party?** (*Yes/No*)	**Result** (*including units*)

Appendix VIII-3: Sampling methodology for benthic macro-invertebrate surveys

Land-based smolt production systems must conduct sampling of the benthic macro-invertebrate habitats in the receiving body of water downstream and upstream of the effluent discharge point. The standard requires that the downstream benthic status be similar or better than the upstream benthic status. To demonstrate this, the survey must demonstrate that the downstream location has the same or better benthic health classification as the upstream location.

Below are required components of the sampling methodology and classification scheme that a farm shall use. It is expected that a farm will use the faunal sampling regime in its own jurisdiction, as long as the regime includes the following minimum requirements.

This appendix also includes additional suggested ideas on conducting the surveys. The suggestions are intended as a guide only. The entity conducting the faunal survey should use its own discretion based on local knowledge, national fauna index systems, and expertise as to what specific sub-element or parameter will provide the best representation to document the status of the benthic macro invertebrates and the impact that the fish farm may have on this environment in the receiving water body.

Minimum requirements for faunal surveys:

Classification System

- The benthic health classification system must have at least five categories of benthic status.

Focus of the survey

- The survey must detect the composition, abundance diversity and presence of benthic invertebrate fauna in the receiving water body (upstream and downstream from farm outlet). The survey must focus on key sensitive indicator species for the region.

When and how often

- The samples must be collected once every year upstream and downstream from the farm outlet. In case the downstream survey drops a category according to the faunal index, two consecutive faunal surveys must be conducted during the following 12 months, using the same faunal index system, that demonstrate compliance with the standard.
- After three years of demonstrating consistent results, a farm may reduce sampling to once every two years.

Where to sample

- The samples must be taken from both midstream and near the bank and must also include marginal areas with slacker water flow.
- All efforts must be made to isolate the impact of the farm, for example by seeking similar conditions, such as type of bottom, water flow and/or substrate types present along the bank, in the upstream and downstream locations.
- The location of sampling sites downstream from the farm must reflect a scientific assessment of the most likely area of potential impact from the farm, with consideration to the mixing of water and the minimum and maximum distance from the farm outlet.

Number of samples

- The survey must collect samples in at least three transects (10 meters apart), with at least four samples in each transect across the river. This must be conducted both upstream and downstream from the farm outlet.

Analysis of the samples and how to samples

- All collected samples must be analyzed by an accredited laboratory and the sampling methodology must be approved by the laboratory conducting the analysis.

Further recommendations to sampling:

When and how

When collecting macro-invertebrates, consideration should be given to the seasonality of the presence of the macro-invertebrate species, namely insects in their larval stage of the life cycle. It is generally recommended that samples are conducted during summer and/or winter. In geographical regions like Scandinavia, spring and autumn are recommended as the best times for sampling.

Sampling gear

The sampling should be undertaken using standard equipment such as surber sampler, handnet and grab. More detailed sampling guidelines can also be found in ISO standards ISO 8265, 7828 and 9391.

References:

- Common Implementation Strategy for the Water Framework Directive (2000/60/EC) *Guidance document no. 7.* Monitoring under the Water Framework Directive.
- Biological assessment of running waters in Denmark: introduction to the Danish Stream Fauna Index (DSFI) Skriver et al.; 2000.
- The performance of a new biological water quality score system based on macro-invertebrates over a wide range of unpolluted running-water sites. Amitage, P.D. et al., 1982.
- Common Implementation Strategy for the Water Framework Directive (2000/60/EC) *Guidance document no. 13.* Overall approach to the classification of ecological status and ecological potential.
- UN/ECE Task Force on Monitoring & Assessment under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992) Volume 3:Biological Assessment Methods for Watercourses.

Appendix VIII-4: Sludge BMPs for closed and semi-closed smolt systems

Methods to mitigate the impacts from fish metabolic wastes on water can range from the employment of simple settling ponds to the use of advanced technology filters and biological process. Dealing responsibly with the waste (sludge, liquid slurry, biosolids) from these processes is a critical element to responsible smolt facility management. The SAD acknowledges that BMPs related to other principles such as correct feed composition and texture as well as good feed management practices—such as not storing feed for too long—can also influence the effectiveness of biosolids capture, however this section deals with practices for cleaning, storage and disposal that will minimize the potential impacts of sludge/biosolids being released into the environment.

All closed and semi-closed smolt systems shall employ/undertake the following in relation to sludge/biosolids:

1. A process flow drawing that tracks/maps the water and waste flow of a farm including treatment of waste, transfer of wastes, waste storage and final waste utilization options. Flow diagram should demonstrate the farm is dealing with biosolids responsibly.
2. Farm shall have a management plan for sludge/biosolids that details cleaning and maintenance procedures of the water treatment system. The plan must also identify and address the farm's specific risks such as—but not limited to—loss of power, fire and drought. The management can be evaluated in relation to maintenance records.
3. Farm must keep detailed records/log of sludge/bio-solid cleaning and maintenance including how sludge is discarded after being dug out of settlement ponds/basins.
4. Biosolids accumulated in settling ponds/basins shall not be discharged into natural water bodies.

Appendix VIII-5: Assimilative capacity assessment for cage (net-pen) smolt systems

Under 8.26, all open smolt farms in lake or reservoir settings must demonstrate that an assimilative capacity assessment has been conducted to determine if there is sufficient capacity from a water quality perspective to allow for the level of additional loading to the system.

Many suitable models exist that can help determine assimilative capacity, such as Dillon and Rigler (1975), Kirchener and Dillon (1975), Reckhow (1977), and Dillon and Molot (1996). The standard does not favor one existing model over another but it is important to outline key elements of a credible assimilative capacity study.

At a minimum, the study must do the following:

- Undertake assessment as to allocation of capacity for the whole water body
- Undertake assessment as to land use, slope, sewage, other discharges, stream input
- Account for retention in lake and mixing
- Predict total phosphorus concentration
- Classify trophic status
- Undertake impact assessment of fish farm

The study must pay particular attention to the nature and morphology of the lake basin where the farm will be established. The study must analyze at a minimum:

1. mixing of the surface and bottom waters
2. whether bottom waters are isolated within the water body
3. the naturally occurring oxygen levels in the surface and bottom waters
4. whether the water forms part of an enclosed basin, or an area with isolated bottom waters

Appendix VIII-6: Receiving water monitoring for open (net-pen) smolt systems

Sampling Regime for Receiving Water Quality Monitoring

Location of sampling stations: Stations will be established at the limit of the cage farm management zone on each side of the farm, roughly 50 meters from the edge of the cages and at reference stations located approximately 1-2 kilometers (km). All sampling locations will be identified with GPS coordinates on a schematic outline of the farm operations and on available satellite imagery.

Sampling methods: All water samples testing for total phosphorus shall be taken from a representative composite sample through the water column to a depth of the bottom of the cages. Samples will be submitted to an accredited laboratory for analysis of TP to a method detection limit of $\leq$ 0.002 mg/L. Dissolved oxygen measurements will be taken at 50 centimeters from the bottom sediment.

Frequency: At least once every three months during periods without ice, including at peak biomass.

**NOTE: Some flexibility on the exact location and method of sampling is allowed to avoid farms needing to duplicate similar sampling for their local regulatory regime.

	Boundary Stations (Note: if the farm is attached to land via a walkway, only three stations would be used)				Reference Stations	
	North	South	East	West	Upcurrent	Downcurrent
TP (mg/L)	X	X	X	X	X	X
DO profile (mg/L)	X	X	X	X	X	X

Appendix VIII-7: Trophic status classification and determining baseline trophic status

Standard 8.30 requires a farm to determine a baseline trophic status for the water body and demonstrate through monitoring that the status is maintained. The SAD standards use a modified version of the trophic status system developed by the Organization for Economic Cooperation Development (OECD) (Vollenweider and Kerekes, 1982). Trophic status is determined by the concentration of total phosphorus.

Trophic Status	**Range of Total Phosphorus Concentration (≤ 20 μg/l)**
Ultra-oligotrophic	< 4
Oligotrophic	4-10
Mesotrophic	10-20
Meso-eutrophic	20-35
Eutrophic	35-100
Hyper-eutrophic	> 100

(Note: these ranges are identical to ones described in an Environment Canada report titled "Canadian Guidance Framework for the Management of Phosphorus in Freshwater Systems, Science-based Solutions Report 1-8, February 2004")

Determining Baseline

Basic approach: Use the concentration in the most pristine area of the water body as possible, i.e., far from point sources of nutrients such as stream inflows, wastewater runoff, the farm or other fish farms. If the regulatory body has determined a historical baseline for the water body, that baseline shall be used.