Sent via email to address shown below

February 18, 2022

Planning Director John Ford
Humboldt County Planning & Building Department
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Dear Planning Director Ford,

On behalf of Humboldt Baykeeper, the Coalition for Responsible Transportation Priorities, Surfrider Foundation, the Northcoast Environmental Center, 350 Humboldt, the Environmental Protection Information Center, Friends of the Eel River, Save California Salmon, and the Sierra Club Redwood Chapter North Group, please accept these comments on the Draft Environmental Impact Report (DEIR). The project proponent has been receptive to criticism and open to suggestion and these comments are presented in that same spirit.

I. LEGAL FRAMEWORK

At its heart, the California Environmental Quality Act (CEQA) mandates that government decisionmakers understand the environmental ramifications of their decisions. CEQA serves "to demonstrate to an apprehensive citizenry that the agency has, in fact, analyzed and considered the ecological implications of its action."[1] If CEQA is "scrupulously followed," the public will know the

[1] *Laurel Heights Improvement Ass'n v. Regents of Univ. of Cal.* 47 Cal. 3d 376, 392 (1988)

basis for the agency's action and "being duly informed, can respond accordingly to action with which it disagrees."[2] Thus, CEQA "protects not only the environment but also informed self-government."[3]

CEQA further strives to result in better environmental decisionmaking. Critical to that is a full understanding of the way that project impacts can be avoided, minimized, or mitigated, either through alternatives to the proposed action or project mitigation measures.

A project should not be approved if environmentally superior alternatives exist "even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly."[4] The Project must be rejected if an alternative available for consideration would accomplish "most [not all] of the basic objectives of the project and could avoid or substantially lessen one or more of the significant effects."[5] "An EIR need not consider every conceivable alternative to a project. Rather, it must consider a reasonable range of potentially feasible alternatives that will foster informed decision making and public participation."[6] The CEQA Guidelines expressly provide that a feasible alternative may impede achievement of the project objectives to some degree, or may be more costly.[7] This is reasonable because if applicants could thwart consideration of all potentially feasible alternatives simply by adopting overly narrow objectives, CEQA would be rendered meaningless.[8] Accordingly, the EIR must consider a range of alternatives that would achieve the basic objectives of the project while avoiding or substantially lessening significant environmental effects, and it is essential that the "EIR shall include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed project."[9]

CEQA Guidelines section 15126.2(a) provides that:

> Direct and indirect significant effects of the project on the environment shall be clearly identified and described, giving due consideration to both the short-term and long-term effects. The discussion should include relevant specifics of the area, the resources involved, physical changes, alterations to ecological systems, and changes induced in…other aspects of the resource base.…

CEQA mandates that government agencies must deny approval of a project presenting significant adverse effects when feasible alternatives or feasible mitigation measures can substantially lessen such effects.[10] Only when feasible mitigation measures have been exhausted may an agency find that overriding considerations exist that outweigh the significant environmental effects.[11] This mandate—to avoid, minimize and mitigate significant adverse effects where feasible—has been described as the "most important" provision of the law.[12]

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[2] Id.

[3] Id.

[4] Pub. Res. Code §§ 21002; CEQA Guidelines §§ 15021(a)(2), 15126.6.

[5] Guidelines § 15126.6(c).

[6] Guidelines, § 15126.6(a).

[7] *See* Guidelines, § 15126.6(a), (b).

[8] *See Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 736-37 (holding that applicant's prior commitments could not foreclose analysis of alternatives).

[9] CEQA Guidelines § 15126.6.

[10] Pub. Resources Code 21002.

[11] Pub. Resource Code 21081; *see also* CEQA Guidelines 15091(a).

[12] *Sierra Club v. Gilroy City Council*, 222 Cal. App. 3d 30, 41, 271 Cal. Rptr. 393 (Ct. App. 1990).

To effectuate this "most important" provision, the government is tasked with investigating the potential adverse effects and all feasible alternatives and mitigation measures that decisionmakers may adopt.[13] CEQA likewise requires alternatives and mitigation measures to be sufficiently detailed to "to foster informed decision-making and public participation."[14]

Feasibility, as used by CEQA and the Guidelines, is where a mitigation measure is "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors."[15] "In keeping with the statute and guidelines, an adequate EIR must respond to specific suggestions for mitigating a significant environmental impact unless the suggested mitigation is facially infeasible. While the response need not be exhaustive, it should evince good faith and a reasoned analysis."[16]

The ultimate determination of the sufficiency and feasibility of mitigation measures is the province of the action agency. These determinations must be supported by findings supported by substantial evidence.[17] Averments by project developers concerning the financial feasibility of mitigation are not dispositive of the question; rather, that is one piece of information that may be considered by the action agency.

II. GREENHOUSE GAS EMISSIONS

We believe that the only reasonable conclusion from the CEQA record is that this project will result in significant impacts from greenhouse gas emissions associated with electricity usage and transportation-related emissions. Additionally, we have concerns with the sufficiency of the analysis related to refrigerants. Additional mitigation measures are necessary, either to bring the project below a threshold of significance *or* in conjunction with a statement of overriding consideration. We have suggested additional mitigation measures in this document although we are happy to work with the county and the developer to identify other measures that would accomplish similar reductions in greenhouse gases.

A. Emissions from Electricity

The DEIR is flawed in two related but independent ways. First, the modeling of likely greenhouse gas emissions from electricity use utilizes an estimate from 2019 concerning the "carbon intensity" of existing energy. However, the 2019 estimate used is widely known to undercount actual greenhouse gas emissions from electricity. If the analysis was completed using more accurate data, the associated greenhouse gas emissions would increase significantly and above the threshold of significance employed by the project. Second, the DEIR employs the wrong threshold of significance. With the correct threshold, even utilizing the lower emissions estimate contained in the DEIR, the project would surpass this threshold of significance. Either way, both errors work in the same direction as underreporting or mischaracterizing the significance of project-related emissions. Additional mitigation measures are necessary and some are provided for consideration

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[13] Pub. Resources Code 21100; CEQA Guidelines 15126.

[14] *Save Round Valley Alliance v. County of Inyo*, 157 Cal.App.4th at pp. 1456, 1460 (2007).

[15] Public Resources Code 21061.1; CEQA Guidelines, § 15364.

[16] *Los Angeles Unified School District v. City of Los Angeles*, 58 Cal. App. 4th 1019, 1029 (1997) (internal citation omitted).

[17] *See Federation of Hillside & Canyon Associations c. City of Los Angeles*, 83 CAl. App. 4th (2d Dist. 2000); *Concerned Citizens of South Los Angeles v. Los Angeles Unified School District*, 24 Cal. App. 4th 825 (2d Dist. 1994).

1. Greenhouse Gas Modeling Assumptions Flawed

The Initial Study/Mitigated Negative Declaration (IS/MND) published for the project in April 2021 estimated that the energy used by the project would produce 15,293 MT CO2e/yr.[18] This calculation was purportedly based on "existing PG&E carbon intensity factors," although no year was specified.[19] The DEIR used 2019 PG&E carbon intensity factors and concluded that greenhouse gas (GHG) emissions from energy use would only be 340 MT CO2e/yr at full build-out—a nearly 50-fold decrease from the IS/MND estimate, and an unrealistically low number based on the project's electricity consumption.[20] Appendix B of the DEIR, which shows modeling results, contains the explanation on p.94: the assumed carbon intensity of PG&E delivered energy is 2.68 lb. CO2e/MWh, derived from PG&E reporting in 2019.[21] However, the 2019 figure is an aberration resulting from a change in calculation methodology developed by the California Energy Commission (CEC). As explained in Von Wald et al., the new method of carbon intensity calculation which took effect in 2019 "preferentially decrements first (1) specified natural gas and then (2) other fossil fueled purchases before (3) non-fossil purchases."[22] Because PG&E in 2019 (and subsequent years) had purchased substantially more electricity than they supplied, this allowed them to artificially lower their carbon intensity figure by failing to include their high-carbon sources in the calculation, despite those sources contributing substantially to the actual electricity delivered. As Von Wald et al. put it: "[O]ver-procured LSEs—most notably PG&E—are subject to preferential accounting rules. If these LSEs remain over-procured for the next few years, it is possible that some will report artificially low GHG intensities associated with the fact that they have procured a surplus of zero-carbon resources relative to their loads and may be selling these resources to other LSEs on the spot market."[23] This is exactly what happened. As Von Wald et al.'s Figure 3 very clearly shows, this artificial lowering of PG&E's carbon intensity factor will gradually correct itself over the course of several years, and the carbon intensity in the years of the Nordic project's actual operation will be comparable to the pre-2019 factors, if not higher.

The DEIR must use the best available science, and therefore must use a pre-2019 carbon intensity factor for estimating the GHG emissions from PG&E-supplied electricity. The reported 2018 carbon intensity of PG&E's electricity was 206 lb. CO2e/MWh.[24] At the 2018 carbon intensity level, the project's CO2e emissions would be over 22,000 MT CO2e/yr, well above any applicable significance threshold.

In a recent news article, Nordic Aquafarms Vice President of Commercial Operations Marianne Naess tacitly admits that the DEIR's estimate of GHG emissions from electricity is wrong. She states that the company has "committed to follow RCEA's goals with regards to non-carbon and renewable energy…The GHG levels in the EIR therefore reflects the actual emission levels."[25] In other words, she argues that using a carbon intensity factor of essentially zero is justified because the company has promised to "follow RCEA's goals" of achieving zero-carbon electricity by the time of the project's

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[18] IS/MND at 4-99.

[19] IS/MND at 4-98.

[20] DEIR at 3.7-13.

[21] https://www.pgecorp.com/corp_responsibility/reports/2021/pl02_climate_change.html#pl2_fnm2

[22] Von Wald, Gregory, Michael D. Mastrandrea, Danny Cullenward and John Weyant. 2020. Analyzing California's framework for estimating greenhouse gas emissions associated with electricity sales. The Electricity Journal 33. p.3.

[23] Von Wald et al. p.5

[24] https://www.pgecorp.com/corp_responsibility/reports/2021/pl02_climate_change.html#pl2_fnm2

[25] Burns, Ryan. February 15, 2022. With just days left for public comment, enviro groups seek more detail, assurances in Nordic Aquafarms' EIR. Lost Coast Outpost. https://lostcoastoutpost.com/2022/feb/15/one-week-left-public-comment-enviro-groups-seek-mo/

operation. However, the promise to "follow RCEA's goals" cannot be relied upon in the DEIR because: (a) the DEIR fails to actually contain any commitment, in either the project description or any mitigation measure, to purchase renewable energy; (b) the DEIR offers a completely different explanation for the estimate of GHG emissions from electricity, namely that it is an accurate representation of the carbon intensity of recent PG&E-delivered electricity (which as demonstrated above is inaccurate). In order for Nordic's promise or "goal" to purchase electricity of a given carbon intensity to have any bearing on an EIR's conclusions, it must be incorporated in a binding fashion into the EIR itself.

Furthermore, in failing to commit to purchase of any particular energy mix, the DEIR leaves open the possibility of direct power purchases, which could have a substantially higher carbon intensity factor than the available utility energy mixes and result in even higher annual emissions for the project. There does not seem to be any reason, for example, why Nordic could not contract for electricity directly with a gas-powered power plant, like the Humboldt Bay Generating Station. If the 195 GWh per year at buildout were purchased directly from the PG&E gas plant, the emissions would be 468.4 kg of CO2e for each of 195,000 MWh, or a total of 91,338,000 kg, or 91,333 MT CO2e. For illustration, 91,333 MT of emissions is equivalent to the emissions of 19,863 automobiles. This is obviously, under any standard, a significant greenhouse gas impact. However, it could be worse. Nordic could contract with the Humboldt Sawmill Company for biomass power from its Scotia power plant, since it can produce 32 MW of power, which would be enough for the Nordic facility. However, this biomass plant has roughly four times the CO2e emissions per MWh (2,201) as does natural gas (468).[26]

2. Choice Threshold of Significance Flawed

As noted in the DEIR, the North Coast Unified Air Quality Management District (NCUAQMD) has not adopted significance thresholds for project-level GHG emissions and instead recommends using the Bay Area Air Quality Management District (BAAQMD) adopted thresholds.[27] The DEIR purports to use the BAAQMD guidelines, but in fact adopts the wrong threshold. The DEIR argues that the "stationary source" threshold applies, because the majority of the project's emissions will not be mobile.[28] However, in the context of air pollution, the term "stationary source" derives from federal law and refers to "any building, structure, facility, or installation which emits or may emit" a regulated pollutant - in other words, a project where the emissions come from the facility itself.[29] In this case, the bulk of the project's emissions will be off-site, from the burning of fossil fuels used to produce the electricity consumed on-site. Therefore, while the power plants that produce the electricity would be considered stationary sources, the project itself is not a stationary source, and the relevant BAAQMD threshold is the land development threshold. BAAQMD establishes this threshold at either 1,100 MTCO2e/year or 4.6 MTCO2e/employee/year, which would equate to 690 MTCO2e/year for this project.[30] Applying this threshold to the project, we see that the project will exceed significance thresholds, and thus, the impact must be considered significant.

Inexplicably, the DEIR also invents a number of additional and completely unsupportable significance thresholds. These include a threshold of 25,000 MTCO2e/year, which it identifies as being derived from

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[26] https://findenergy.com/ca/humboldt-county-electricity/#production

[27] DEIR at 3.7-10.

[28] DEIR at 3.7-9 and 3.7-11.

[29] 40 CFR 51.165(a)(1)(i)

[30] BAAQMD CEQA Air Quality Guidelines 2017. https://www.baaqmd.gov/~/media/files/planning-and-research/ceqa/ceqa_guidelines_may2017-pdf.pdf?la=en

a 2010 National Environmental Policy Act guidance from the federal Council on Environmental Quality.[31] This source, however, is in no way relevant to the CEQA process in 2022.

The DEIR also proposes two qualitative significance thresholds: comparison to an adopted Climate Action Plan (CAP) in Yolo County,[32] and comparison to the Humboldt County General Plan. Both of these are inappropriate. The former is "justified" by citing the fact that there is not yet a local adopted CAP, and that the two counties are "similar." However, emissions sources and conditions in Yolo County are dramatically different from those in Humboldt County. For example, by far the largest source of GHG emissions in Yolo County is agriculture, while Humboldt County's predominant source is transportation. In addition, the Yolo County CAP is from 2011 and uses the goal of 27% reduction from 1990 levels when the state goal is 40% reduction. Thus the Yolo document the DEIR proposes is not consistent with current California emissions goals. The resulting comparison of the project with Yolo County's CAP is irrelevant to any reasonable attempt to quantify significance. The use of Humboldt County General Plan consistency is equally absurd, as the DEIR admits that the General Plan itself was found to have a significant impact on GHG emissions.[33]

If the DEIR is to apply the CAP standards of another county, then Sonoma County should be considered instead. The DEIR should have started by looking for a county with basic similarities and therefore look for a county on the North Coast. A great deal of the nature of each county along the coast (Marin, Sonoma, Mendocino, Humboldt, Del Norte) stems from our common geography. Notably, this is reflected in our legislative districts which have long recognized our commonalities. However, Marin is not a good comparison because most of the inhabitants are part of the San Francisco bedroom community. Del Norte is also not appropriate because it is very small (pop=27,000) and has one large distorting industry, the Pelican Bay prison. Mendocino shares a logging history with Humboldt, but also has not yet completed a CAP with goals and actions to achieve a 40% or greater reduction in greenhouse gas emissions by 2030, in line with state law. Sonoma has a larger population than Humboldt, but is in most other ways close to Humboldt, especially regarding sources of emission.

Table 1 in the appendix shows comparisons between Yolo, Sonoma and Humboldt counties both with respect to the character of each county and the greenhouse gas emissions and energy source for each county. Yolo shares very little with the two north coast counties, while in contrast the coastal counties share broad characteristics and emission-specific characteristics with each other.

A 2015 emissions inventory for Sonoma is available, which matches the latest Humboldt inventory – also from 2015. While somewhat different categories are used, in both counties the majority of emissions in 2015 were from transportation: 58% in Sonoma and 53% in Humboldt. Agriculture was 10% in Sonoma and 12.6% in Humboldt. Wastewater treatment and solid waste were 7% in Sonoma and 4.9% in Humboldt. Emissions from energy use are 25% for Sonoma and 22% for Humboldt. Both counties have an ambitious Community Choice Aggregator as electricity provider.

However, unlike Yolo with its superannuated goal of 27% emissions reductions by 2030, Sonoma has set itself a goal of 80% emissions reductions by 2030 and achieving net-zero by 2030. This exceeds the

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[31] DEIR at 3.7-8.

[32] The DEIR standard is: Would the Project generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment? With minimal analysis, the DEIR concludes that the Nordic facility is consistent with the Yolo CAP. Given how far away from the current and likely state goals the Yolo plan is, this consistency stands as an indictment not a recommendation.

[33] DEIR at 3.7-10.

state's current goal of 40%, but anticipates a likely change to set 2035 as the date by which the state will achieve net-zero.[34] The Sonoma CAP[35] has other goals which are relevant to Humboldt and to the Nordic project.

- It sets a goal of carbon neutral buildings by 2030 (all buildings, not just new ones) and will provide $20 million to facilitate meeting the goal.[36]
- It sets a goal of carbon-free electricity by 2030.

In this context, the Nordic project is clearly out of line with standards for emissions. The large indirect emissions created by adding a new electricity requirement equal to a fourth of the total county demand seriously interfere with the possibility of reducing Humboldt County emissions by 40%, much less the more appropriate 80% Sonoma has chosen as a goal.

Suggested Mitigation Measures or Project Design Features

The DEIR must correct its estimate of GHG emissions from electricity consumption and compare the project's corrected GHG emissions estimate with the adopted BAAQMD threshold for land use developments. This process will inevitably result in a finding of significant impact, and thus require the adoption of mitigation measures. Alternatively, new analysis that incorporates similar project design features may reduce impacts below a threshold of significance. Feasible mitigation measures or project design features include but are not limited to the following:

- Increasing the size of the on-site solar electricity system, including solarizing parking areas and including an energy storage system;
- Committing to purchase 100% renewable energy;
- A commitment to purchasing local, carbon free, renewable electricity, whenever it is available and feasible to purchase.

B. Emissions from Refrigerants

Existing analysis of greenhouse gas emissions related to the use of refrigerants would benefit from clarification.

In the DEIR discussion of greenhouse gasses, perfluorocarbons and sulfur hexafluoride are mentioned. These are damaging to the environment because of extremely high global warming potential (GWP) and a lifetime of thousands of years. No description of whether they will be used in this facility is provided, but given their normal uses,[37] it seems highly unlikely. Note that neither of these gasses is a refrigerant,

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[34] "To meet the urgency of the climate crisis, Governor Newsom has requested the California Public Utilities Commission (CPUC) and California Air Resources Board (CARB) to accelerate California's progress toward its nation-leading climate goals. At the Governor's request, CARB will evaluate pathways for the state to achieve carbon neutrality by 2035 – in advance of the 2045 target – including strategies to reduce fossil fuel demand and supply. The CPUC will work to establish a more ambitious greenhouse gas emissions target for electricity procurement by 2030, stepping up the state's pace in achieving zero carbon electricity." https://environmentcalifornia.org/news/cae/statement-gov-newsom-announces-he-accelerating-california%E2%80%99s-progress-climate-goals

[35] To access this CAP go to rcpa.ca.gov/projects/Sonoma-climate-mobilization and under Resources and Events, on lower right select Sonoma Climate Mobilization Strategy (adopted 3/8/21)

[36] https://socostrategicplan.org/climate-action-and-resiliency/

[37] No PFCs are approved by the EPA as refrigerants. They are used in making aluminum and in making semi-conductors. SF6 is for certain equipment in generating electricity. Again, it has nothing to do with refrigeration.

so refrigerant regulations do not apply. SF6 has its own very stringent California regulations, some of which went into effect in January 2022.[38] Perfluorocarbons are regulated by the EPA.

HFC refrigerants are also discussed. Nordic has explained that final design on refrigeration will wait until the project is permitted but has said that it will attempt to maximize cooling from water and that Humboldt is particularly well-suited to this due to the stability of water-temperature year-round. However, approximately 25% of the energy usage (5.7 MW) is designated for "Chilling, est."[39] The AIM Act cited in the DEIR does not directly apply to an aquaculture facility since it only limits the manufacture and import of HFCs. It is, however, highly relevant to operations of the facility that the EPA is proposing to eliminate at least 85% of HFCs by 2035, well before the end of the project. The remaining 15% are likely to be HFCs with highly specialized uses, such as in anesthetics. Thus, HFCs will not be available, and it would be far better to design the system using the very low GWP refrigerants we know will be available (like natural refrigerants).

The current CARB refrigerant regulations cover two types of refrigeration equipment that Nordic might use: stationary refrigeration and chillers. Stationary refrigeration, as used in supermarkets, is equipment that uses one refrigerant to cool or freeze. A subtype of stationary refrigeration is industrial process refrigeration, which "means to cool process streams at a specific location in manufacturing and other forms of industrial processes and applications. These are complex, customized systems that are directly linked to the industrial process."[40] Chillers involve a two-stage process, with the chiller used to cool a refrigerant that then transfers the cooling to a second system, often water for cooling large buildings.[41] All HFCs are regulated both by the EPA and CARB.

As of January 1, 2022, CARB requires that new installations of stationary refrigeration use refrigerants with a GWP of less than 150. This is mentioned in the DEIR. The GWP level of refrigerants for chillers currently is unregulated but CARB regulates them in other ways. A chiller regulation that will be in effect starting in 2024, however, has three GWP levels, 750, 1500, and 2200 based specifically on how cold the chiller has to make the fluid as it leaves the chiller.

Emissions (leaks) for stationary refrigeration are commonly 25% annually and chillers may leak up to 15% annually, although it is usually less. Chillers are typically smaller systems. About 80% of chillers use ammonia as a refrigerant, and others use CO2 or propane. All three of these are "natural refrigerants" with extremely low GWP. The average GWP of HFCs is around 2000 times that of CO2. Since the Nordic aquaculture cooling is anticipated to use 25% of the energy, refrigerants could be used in very large quantities. Unless we are certain refrigerants will be very low GWP, this could add a massive amount to the greenhouse gas emissions of the facility that is not accounted for in the DEIR. *The EIR should explain in detail the estimated 25% of energy that is intended for "chilling."* A very

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[38] https://ww2.arb.ca.gov/our-work/programs/elec-tandd

[39] DEIR 3.5-04. This graph is the only specific mention of refrigerants in the DEIR.

[40] CARB Final Regulation Order: California Code of Regulations, Title 17, Division 3, Chapter 1, Subchapter 10 Climate Change, Article 4.

[41] "The way to distinguish between a chiller and a non-chiller refrigeration system is that a secondary heat transfer fluid is necessary for the former. The primary heat transfer fluid in a chiller is a synthetic (or natural) refrigerant which operates in a smaller closed loop and does not directly cool products/occupied spaces. It cools a secondary fluid, usually water, CO2, glycol, or air, which traverses a much larger closed loop generally and directly cools the product/occupied space. In a standard refrigeration system, there is only one heat transfer fluid, e.g., an HFC, which directly cools the product/occupied space as is common in supermarkets." Personal correspondence with Aanchal Kohli, Ph.D. California Air Resources Board staff member.

specific definition of what a "chiller" is can be found on the CARB website.[42] The EIR should employ this definition, in conjunction with Nordic, to characterize accurately the refrigeration system to be used and to be sure applicable regulations for chillers are applied.

Suggested Modifications

The Final EIR should include the following provisions:

- Explain whether SF6 and Perfluorocarbons will be used, and if so for what purpose.
- Explain how their use will be consistent with all pertinent laws and regulations.
- Explain the measures Nordic will take to keep them from being emitted into the atmosphere.
- Leaks of refrigerants from refrigeration/chilling equipment should be listed as a significant but mitigatable environmental effect.
- The mitigation should specify that refrigeration/cooling must be accomplished using refrigerants with the lowest possible GWP, with a maximum of no more than 150 GWP.
- Every effort should be made to use "natural" refrigerants, that is CO2, ammonia, or hydrocarbons, which have GWP of less than 10 and do not need to be reclaimed.

C. Life-Cycle Analysis

The state has explained the rationale for certain changes to CEQA Guidelines in part as follows:

> "[A] new subdivision (b) cautions that the analysis of energy impacts is subject to the rule of reason, and must focus on energy demand caused by the project. This sentence is necessary to place reasonable limits on the analysis. Specifically, it signals that a full "lifecycle" analysis that would account for energy used in building materials and consumer products will generally not be required."[43]

However, scientists consistently state that lifecycle analysis (LCA) *is* required for understanding the effects of aquaculture,[44] since overwhelmingly the emissions stem from energy used to run the facility and food used to grow the fish, both inputs which are ongoing operational emissions directly caused by the project—not one-time inputs like the materials in a building.

The life cycle assessment of aquaculture is the method used by the IPCC[45] and all scientific studies of greenhouse gasses and aquaculture. It makes possible the comparison of aquaculture using different

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[42] https://ww2.arb.ca.gov/our-work/programs/california-significant-new-alternatives-policy-snap/chillers

[43] California Department of the Interior. Final statement of reasons for regulatory action amendments to the state CEQA guidelines OAL notice file no. Z-2018-0116-12. Our emphasis.

[44] Cao, Ling, James S. Diana, and Gregory A. Keoleian. "Role of life cycle assessment in sustainable aquaculture." *Reviews in Aquaculture* 5, no. 2 (2013): 61-71. ["Life cycle assessment (LCA) has become the leading tool for identifying key environmental impacts of seafood production systems.]"; Bartley, Devin M., Cecile Brugere, Doris Soto, Pierre Gerber, and Brian Harvey. *Comparative assessment of the environmental costs of aquaculture and other food production sectors: Methods for meaningful comparisons: FAO/WFT Experts workshop 24-28 Apr 2006 Vancouver, Canada*. FAO, Roma (Italia)., 2007. [See the chart from this paper with pros and cons of different methods.]

[45] IPCC 2013 100a in IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi:10.1017/CBO9781107415324.

methods (a pen in the ocean vs. a land-based system, for example) and the comparison of emissions from different species of fish; it also allows comparison of aquaculture to raising cattle or chickens or catching wild fish. An explanation of why and how this method is used is available in *Nature: Scientific Reports* in 2020.[46]

It is impossible to analyze the cumulative effects of the project on climate change over the 30 years or more the facility operates, as required by CEQA, without including energy use and the CO2e emissions attributable to the fish food to be used in large quantities over the life of the project.

In a 2009 article on global aquaculture, production of fish food drove 93% of energy use and 95% of greenhouse gas emissions.[47] Because the use of wild fish products in feed has declined considerably and because open pen aquaculture uses less electricity, the balance between food production and electricity has changed. But they are still the two major sources of greenhouse gas emissions associated with aquaculture.

For understanding the Nordic facility, we need studies that focus on land-based closed containment recirculating aquaculture systems (LBCC-RAS), which is how the proposed Nordic facility is classified.[48] A few of these kinds of studies are reported below:

- A 2016 study compared a hypothetical RAS facility in the United States with an open pen design in Norway.[49] Exclusive of transportation costs, the LBCC-RAS-produced salmon has a carbon footprint that is double that of the open pen-produced salmon, 7.01 versus 3.39 kg CO_2e/kg salmon live-weight, respectively.[50] The 7.41 kg CO_2e/kg salmon, when translated to the 25,000 - 27,000 metric tons of salmon production annually planned by Nordic, would equate to 185,250 - 200,070 MT CO2e/yr. If we assume, as the authors of this study did, that alternatively 90% renewable energy is available, then the kg CO_2e/kg salmon went to 4.1, which for Nordic translates to 102,500 - 110,700 MT CO2e/yr.

- A second LCA study, of a land-based RAS, was done in China by Norwegian, Swedish and Chinese researchers in 2019.[51] It is also far smaller than the Nordic facility since only 29,000 fish

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[46] MacLeod, Michael J., Mohammad R. Hasan, David HF Robb, and Mohammad Mamun-Ur-Rashid. "Quantifying greenhouse gas emissions from global aquaculture." Scientific reports 10, no. 1 (2020): 1-8.

[47] Pelletier, Nathan, Peter Tyedmers, Ulf Sonesson, Astrid Scholz, Friederike Ziegler, Anna Flysjo, Sarah Kruse, Beatriz Cancino, and Howard Silverman. "Not all salmon are created equal: life cycle assessment (LCA) of global salmon farming systems." (2009): 8730-8736.

[48] DEIR 2-1.

[49] Liu, Yajie, Trond W. Rosten, Kristian Henriksen, Erik Skontorp Hognes, Steve Summerfelt, and Brian Vinci. "Comparative economic performance and carbon footprint of two farming models for producing Atlantic salmon (*Salmo salar*): Land-based closed containment system in freshwater and open net pen in seawater." Aquacultural Engineering 71 (2016): 1-12.

[50] An earlier LCA study found a huge discrepancy in CO2e produced per ton of fish between open pen (2,073) and a closed circulation land based facility like the proposed Nordic design (28, 200). Ayer, Nathan W., and Peter H. Tyedmers. "Assessing alternative aquaculture technologies: life cycle assessment of salmonid culture systems in Canada." Journal of Cleaner production 17, no. 3 (2009): 362-373.

[51] Song, Xingqiang, Ying Liu, Johan Berg Pettersen, Miguel Brandão, Xiaona Ma, Stian Røberg, and Björn Frostell. "Life cycle assessment of recirculating aquaculture systems: A case of Atlantic salmon farming in China." Journal of Industrial Ecology 23, no. 5 (2019): 1077-1086.

"Results showed that 1 tonne live-weight salmon production required 7,509 kWh farm‐level electricity and generated 16.7 tonnes of CO_2 equivalent (eq), 106 kg of SO_2 eq, 2.4 kg of P eq, and 108 kg of N eq (cradle-to-farm gate). In particular, farm-

at 5kg each were produced in a year: 145 metric tons rather than 25,000. However, it is an operating version of a land based Atlantic Salmon RAS. We are hampered in assessing the proposed Nordic facility in that no facility of its type and size exists anywhere in the world. The energy source in China was 65% coal and 35% renewables, so it was more carbon intensive than the Nordic facility is likely to be unless Nordic contracts directly for biomass power. Electricity use and fish feed dominated eight of the environmental effects assessed by the study, including greenhouse gasses. For greenhouse gasses, electricity was the cause of 45% and fish food 30% of emissions. The total CO2e emissions were 16.747 kg per kg of salmon, or CO2e of 418,675 – 452,169 MT CO2e/yr for Nordic's proposed project.

- For comparison with LBCC-RAS, we present results from a life-cycle analysis for a Canadian open pen Atlantic Salmon facility:

  > Using IPCC methodology, one kg of salmon contributed to 2.26 kg CO_2e of GWP. Agricultural feed components include by-product poultry meal, wheat, corn gluten meal, canola seed and meal, canola oil, and soy meal, while marine-based ingredients include fish meal, by-product fish meal and oil, fish oil, and menhaden oil. Agricultural products lead impacts in GWP, acidification, eutrophication, and ecotoxicity, while impacts are more evenly distributed in ozone depletion and smog. Using the 25,000 – 27,000 metric ton annual production of the Nordic facility at buildout, this would be 56,500 to 61,020 MT CO2e emitted indirectly annually. It is attributable primarily to the feed because open pen facilities are much less electricity intensive — and so constitutes a minimum estimate.[52]

- In 2019,[53] a meta-analysis of LCA studies on salmonids (a much broader category than Atlantic Salmon) was performed with important conclusions. Twenty-four studies were found, nine dealing with Atlantic Salmon. The 24 studies were grouped into Open or Closed and Land vs Sea-based, forming four groups. Differences by production grouping are more important than differences by the fish type. The GHG impacts of land based recirculating systems are higher than other models. The three studies we presented above are in line with the averages shown in Figure 1 in the Appendix, with the LBCC-RAS studies showing in yellow. For 25,000 metric tons of fish from Nordic the metric tons of CO2e would be 150,000 if we use the average.

There are limitations in citing LCA studies for Atlantic salmon aquaculture. The most serious issue, when looking at this literature for guidance on the Nordic proposal, is that LCA studies are by nature individualized. What is required for *this* project in the context of CEQA is an estimate informed by the best available science of the GHG emissions directly resulting from the planned and reasonably foreseeable operations of the project, including the composition and use of fish food.

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level electricity use and feed product were identified as primary contributors to eight of nine impact categories assessed (54-95% in total)…."

[52] Sherry, Jesse, and Jennifer Koester. "Life Cycle Assessment of Aquaculture Stewardship Council Certified Atlantic Salmon (Salmo *salar*)." Sustainability 12, no. 15 (2020): 6079.

[53] Philis, Gaspard, Friederike Ziegler, Lars Christian Gansel, Mona Dverdal Jansen, Erik Olav Gracey, and Anne Stene. "Comparing life cycle assessment (LCA) of salmonid aquaculture production systems: status and perspectives." Sustainability 11, no. 9 (2019): 2517.

D. Emissions from Fish Food

"Most LCAs suggest that the majority of environmental impacts, probably in excess of 90%, are indirect, feed-related and thus occurring well away from the farm itself."[54] Below is a 2007 estimate of the carbon impact of each fish food ingredient. While proportions of different ingredients have changed so that grain-based rather than fish-based foods are increasingly common, the climate impacts of the individual ingredients has changed little. Therefore, it is clear from the wide range of ingredient impacts that the actual impact of the Nordic Humboldt facility will be directly related to the content of the feed.

The DEIR, however, is silent on how much food will be used annually and the actual proportion of ingredients. The section of the DEIR on fish food starts on 2-37. It assures us the fish food will be FDA approved (or the Canadian equivalent). It tells us they can't say much for sure because they haven't settled on a supplier yet. It tells us their aspirations:

> NAFC will aim to integrate the use of ingredients that are viable alternatives to harvest fisheries to the extent that it is practical such as: a. Vegetable proteins and oils. b. Insect meal c. Single cell proteins and oils (e.g., bacteria, yeast or microalgae-based products). NAFC will utilize byproduct trimmings from consumption fisheries. Today this can be as much as 20% of the fish meal utilized in the feed formulation.

We share those same aspirations.

What the DEIR doesn't do is discuss the greenhouse gas impacts of the food and give us a range based on what percentages of different types of ingredients might be used. It commits fairly strongly to environmental safety, but ignores the carbon footprint of the food. If the standard for a DEIR is a "reasonable" expectation of impact, then this DEIR is clearly insufficient, since it fails to describe one of the two largest contributors to greenhouse gasses from the facility.

The closest the DEIR comes to dealing with the greenhouse gas impact is this paragraph:

> For aquaculture farms, there are several sustainability indexes that are used to measure resource utilization or environmental impact. The Fish-In-Fish-Out ratio (FIFO) has been widely adopted to measure the ecological efficiency of feed. At the farm level, FIFO compares the tonnage of fish consumed via feed with the tonnage of fish produced. NAFC will initially set target limits for FIFO that are among the best in the industry and in line with standards for third party certification standards such as ASC, BAP, or Global GAP. These certification standards are regularly adjusted to match advances in feed and ingredient technologies.

These are all industry certifications, not government standards. The purpose of the DEIR should be to tell us which standard Nordic actually will commit to and what the greenhouse gas impact of that standard is. Notwithstanding professed "targets," Nordic has made no commitments and does not report the potential range of greenhouse gas effects associated with the different standards.

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[54] Little, David C., James A. Young, Wenbo Zhang, Richard W. Newton, Abdullah Al Mamun, and Francis J. Murray. "Sustainable intensification of aquaculture value chains between Asia and Europe: a framework for understanding impacts and challenges." Aquaculture 493 (2018): 338-354.

Furthermore, there is empirical evidence that with respect to salmon in particular, certifications like those Nordic cites do not reflect climate impact. A 2020 study open pen study examined, using life cycle assessments, "the environmental impacts of salmon raised to Aquaculture Stewardship Council (ASC) certification standards in order to determine if ASC certification achieves the intended reductions in [environmental] impact." It found:

> We find that environmental impacts, such as global warming potential, do not decrease with certification. We also find that salmon feed, in contrast to the on-site aquaculture practices, dominates the environmental impacts of salmon aquaculture and contributes to over 80% of impacts in ozone depletion, global warming potential, acidification, and ecotoxicity.[55]

Essentially, the conclusion is that ASC certification, one of the two largest certification organizations, doesn't encompass greenhouse gas emissions because the certification omits the carbon footprint of the fish food.

There have been recent studies on the GHG impact of fish food that actually test the commercially available feed products. A 2021 study in the Nature journal Scientific Reports says: "Importantly, we have used recent commercial feed formulations for the main species groups and geographic regions, thereby providing a more up to date and detailed analysis than is generally provided in academic literature."[56] To assess the impact of the commercial feed they used a standard model from the Food and Agriculture Organization of the United Nations (FAO).[57] The article is designed to compare aquaculture to other livestock:

> Production of crop feed materials (the green segments of Fig. 2) accounted for 39% of total aquaculture emissions. When the emissions arising from fishmeal production, feed blending and transport are added, feed production accounts for 57% of emissions…. For most of the finfish, the EI [Emissions intensity] lies between 4 and 6 kg CO2e/kg CW (carcass weight, i.e. per kg of edible flesh) at the farm gate….[T]he carnivorous salmonids have more emissions associated with fishmeal and higher crop land use change (LUC) emissions (arising from soybean production), reflecting their higher protein rations.[58]

With the production amount from Nordic and the energy intensity found in the above study, the range in GHG emissions annually would be between 100,000 and 162,000 MT CO2e. Here is the conclusion of the study with regard to commercial fish food. The Figure 2 referred to can be found in the Appendix to this document.

> The importance of feed is clear in Fig. 2 for all fed species. However, feed composition is constantly changing as nutritional knowledge and its application develop in response to commercial demand. This study was based on regional assumptions of feed formulations and raw material origins for the main species in the key regions. Data for this was obtained from a variety of sources (see "Methods") and updated in light of discussions

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[55] Sherry, Jesse, and Jennifer Koester. "Life Cycle Assessment of Aquaculture Stewardship Council Certified Atlantic Salmon (Salmo salar)." Sustainability 12, no. 15 (2020): 6079. Our italics.

[56] MacLeod, Michael J., Mohammad R. Hasan, David HF Robb, and Mohammad Mamun-Ur-Rashid. "Quantifying greenhouse gas emissions from global aquaculture." Scientific reports 10, no. 1 (2020): 1-8.

[57] FAO.GlobalLivestockEnvironmentalAssessmentModel(GLEAM)109(FAO,Rome,2017)www.fao.org/gleam/en/.

[58] MacLeod, op cit.

> with feed companies. Improved knowledge of feed formulation and raw material sourcing, combined with the overall feed efficiencies of conversion to edible seafood will help provide a more accurate picture of the overall emissions. Ultimately this would have to be done with primary data from feed companies and farmers on a case by case level.[59]

What is clear from the many studies we have cited is that a) climate science has a precise way of determining greenhouse gas emissions from aquaculture and it includes the emissions from fish feed; b) this impact is usually on the order of 40% or more of the total project greenhouse gas emissions; and c) ideally, the emissions would be calculated by using the actual feed that Nordic will be using. Nordic and the DEIR have embraced science when it comes to some aspects of the project. There is no reason that the science on greenhouse gas emissions from fish food should be ignored by the DEIR.

For the Final EIR, Nordic should supply the certifications and greenhouse gas profiles of their other (operating) facilities. And they could tell us which manufacturer will supply their feed so that its greenhouse gas impacts can be analyzed. It is not reasonable to avoid specifying, when it is easy to do so, the exact source of one of the two largest inputs to greenhouse gasses.

Assuming that fish feedstock will further contribute to the significant greenhouse gas emissions and thus require mitigation, we ask that the EIR quantify the carbon intensity of various feedstocks and include an adaptive management provision that maximizes the use of vegetable proteins and oils, insect meal, and single cell proteins and oils.

E. Emissions from Truck Traffic

The DEIR estimates that the project will generate 95 new truck trips per week. However, this number is based on adding together 40 "outgoing product delivery trucks," 32 "outgoing trucks…carrying waste streams," 20 "deliveries of fish feed," and 3 deliveries of other items.[60] Outgoing trucks must first travel to the facility, however, and delivery trucks must then leave. When assessing trip generation, a standard definition of a trip is "a *single or one-direction* person or vehicle movement with either the origin **or** the destination (exiting or entering) inside a study site" (emphasis added).[61] Based on the description of the 95 truck trips, it appears that the DEIR does not account for delivery trucks leaving or outgoing trucks arriving. Therefore, the actual number generated by the project will be twice the amount estimated, or 190 trips per week. Additionally, in modeling the emissions impacts from truck trips, Appendix B of the DEIR assumes 100 truck trips *per day*, or 700 trips per week,[62] a dramatic difference from the number stated in the text of the document. This discrepancy must be addressed.

It follows that the emissions from truck trips for the project are underestimated by a factor of at least 2, and perhaps as much as a factor of 7. However, there are additional inconsistencies in Appendix B which must also be addressed. The text of the DEIR does not specify the geographic extent of the analysis of trucking emissions. However, given that the document makes the argument that the project's emissions estimates are conservative as a result of its final trips to market being assumed to be shorter than other alternatives, we assume the intent was to include the entire length of the truck trips.[63]

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[59] MacLeod, op cit

[60] DEIR at 2-27.

[61] Institute of Transportation Engineers. September 2021. Trip Generation Manual: 11th Edition, Volume 1, Desk Reference. https://itetripgen.org/Content/TgmReference/Desk%20Reference%20Complete.pdf.

[62] DEIR Appendix B at pp.87, 111.

[63] DEIR at 3.7-14.

Inexplicably, however, the model inputs shown in Appendix B reflect an assumption that each truck trip would only be 18.5 miles long within county limits,[64] despite the fact that most of the truck trips will leave the county,[65] and no county line is less than 50 miles from the proposed facility.

Appendix B also assumes that each truck trip includes only 28 miles of driving outside of the boundaries of the NCUAQMD,[66] despite the fact that the document elsewhere states that many (if not most) of the truck trips will have destinations (and thus also presumably origins) in locations as far away as Seattle and Los Angeles.[67] These destinations would require driving distances outside of the boundaries of the NCUAQMD of approximately 500-600 miles—distances that are greater than the modeling input by about a factor of 20.

One final issue with Appendix B's modeling of emissions from truck traffic is that it divides truck trips into distances traveled within Humboldt County, and distances traveled outside of the NCUAQMD. However, the NCUAQMD is not conterminous with Humboldt County, but also includes Del Norte and Trinity Counties. Therefore, for trips going east or north, it appears that Appendix B has neglected to include emissions from distances driven in Del Norte and Trinity Counties.

Collectively, these discrepancies between the text of the DEIR and the modeling inputs in Appendix B, along with apparent internal errors in Appendix B, substantially call into question the results of emissions modeling for truck trips. Emissions could be, and indeed are very likely to be, many times higher than those cited in the text of the document, further contributing to the project's clearly significant level of GHG emissions. Mitigation measures must therefore be adopted, including adopting an adaptive management plan requiring adoption of zero emission trucks and other vehicles as they become commercially available.

F. Vehicle Miles Traveled (VMT)

The DEIR argues that the project's impact on VMT is not significant because per capita employee VMT will be more than 15% lower than the per capita work VMT in the county as a whole.[68] However, the countywide per capita work VMT is not an appropriate baseline for comparison. Countywide VMT data are skewed by relatively small numbers of commuters who travel very long distances in the rural parts of the county. The project site is located in Samoa, which is a suburb of Arcata and Eureka. Therefore, the baseline for comparison should be the per capita work VMT for the Arcata-Eureka area. If this comparison demonstrates a significant impact, the DEIR must identify VMT-reducing mitigations.

Without mitigations, the project as proposed is unlikely to stimulate any non-vehicular travel. For example, the project proposes to provide 115 parking spaces, despite the fact that the maximum number of employees ever expected on site at one time is only 100.[69] Excessive free parking is well known to incentivize commuting by personal vehicle. In order to reduce VMT (see below), the project should dramatically reduce the number of parking spaces and include a parking cash-out program for employees.

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[64] DEIR Appendix B at pp.87, 111.
[65] DEIR at 2-27.
[66] DEIR Appendix B at pp.91, 114.
[67] DEIR at 2-27.
[68] DEIR at 3.12-9 et seq.
[69] DEIR at 2-27.

The DEIR suggests that the project will be subject to an Operation and Construction Transportation Plan to be approved by the county as part of its Coastal Development Permit,[70] and that the Plan will help reduce VMT, but does not incorporate approval of such a plan as a mitigation measure. The DEIR identifies several measures which such Plan "may" include, such as carpooling incentives and providing on-site dining facilities and showering/changing facilities. The lack of commitment to any specific strategies to be included in the Plan makes it impossible to judge its likely effectiveness. However, the possible strategies described raise some issues. For example, while providing on-site showering facilities for bicycle commuters is great, they are not very useful without weather-proof secure bicycle storage. Even with bike storage, the high speeds, large trucks, and complete lack of bicycle facilities on surrounding roadways makes the likelihood of bike commuting low unless the Plan also includes funding of bicycle facilities on these roadways.

The DEIR also states that the Plan may include a new bus stop, and that "installation of a transit stop in proximity to the project can be used to satisfy this requirement [of bicycle shower facilities]."[71] However, local experience demonstrates clearly that public transit services to low-density areas such as the Samoa Peninsula are neither effective nor sustainable, and neither the DEIR nor the Plan should rely on the long-term success of the Samoa Transit System. Given the project's expected 2-shift work schedule, a much more effective mode shift strategy for employees would be to provide a free vanpool at shift changes, which could bring employees either to their homes or to the nearest high-frequency fixed-route bus line.

G. Potential Positive Emissions Benefits

The DEIR suggests that greenhouse gas analysis should consider the potential benefit from changes to the supply chain to reduce the distance traveled by fish to meet market need for West Coast consumers:

> The proposed Project will deliver product to local (west coast) markets, thereby lessening the need for these markets to import seafood from long-distances… This replacement of existing, higher-emitting sources of importing farmed salmon is not incorporated into the Proposed Project's quantitative analysis; therefore, the emissions analysis is overly conservative.

Are there actually offsetting climate savings from avoiding air transport? The DEIR is disingenuous and deficient by citing what is considered to be a major advantage without analyzing it. By stating that omitting such an analysis makes the actual analysis more conservative, it is assuming the truth of Nordic's interpretation of the study and the idea that a facility here will have a lower carbon footprint and will replace salmon from Norway and Chile. Instead the claim needs to be analyzed. Here is a beginning. We hope the final EIR digs into this issue in depth.

- In the 2016 study cited above[72], it was shown that fresh salmon produced in an LBCC-RAS system close to a US market that use an average US electricity mix have a much lower carbon footprint than fresh salmon produced in Norway in [open net pen] systems shipped to the same

[70] DEIR at 2-20.

[71] DEIR at 2-21.

[72] Liu, Yajie, Trond W. Rosten, Kristian Henriksen, Erik Skontorp Hognes, Steve Summerfelt, and Brian Vinci. "Comparative economic performance and carbon footprint of two farming models for producing Atlantic salmon (Salmo salar): Land-based closed containment system in freshwater and open net pen in seawater." Aquacultural Engineering 71 (2016): 1-12.

market by airfreight, 7.41 versus 15.22 kg CO_2eq/kg salmon [head on gutted], respectively. That is, the airfreight doubles the greenhouse gas effects.

- However, only 5% of US fish imports are carried by air freight, the rest are delivered frozen in ships.[73] NOAA makes available a table showing all types of salmon imported into different ports from Norway and Chile, the countries cited in the DEIR. Below we see data for Seattle from Norway. The fresh whole fish is only a small portion of the Norwegian salmon imports.[74]

Country Name	Product Name	Volume (kg)	Value (USD)
NORWAY	SALMON ATLANTIC FILLET FRESH FARMED	1,048,887	16,676,918
NORWAY	SALMON ATLANTIC,DANUBE FROZEN	23,459	105,825
NORWAY	SALMON ATLANTIC FRESH FARMED	48,620	447,585
NORWAY	SALMON ATLANTIC FILLET FROZEN	36,288	536,200

Source: NOAA Fisheries landings data available at https://www.fisheries.noaa.gov/foss/f?p=215:2:159351792464::NO:::

- The DEIR says Nordic will annually produce and distribute 25,000 to 27,000 metric tons of whole fish.[75] For comparison, we have put just the 2020 fresh farmed salmon imports from the two countries that Nordic mentioned, Norway and Chile, into the table below.

[73] https://eurofishmagazine.com/sections/trade-and-markets/item/173-freshness-and-quality-versus-environmental-and-climate-impact ; and only 15% of Norway's salmon exports go by air: https://salmonfacts.com/fish-farming-in-norway/transport-of-farmed-salmon/

[74] These data for Norway and Chile and all three cities, including the data in the table, are all available at: https://www.fisheries.noaa.gov/foss/f?p=215:2:159351792464::NO:::

[75] DEIR 2.13.

Whole Atlantic Fresh Farmed Salmon Imports 2020

NORWAY	Kilos	Metric Tons	$ Value
LA fresh	743,102	743.1	6,080,525
SF fresh	205,555	205.6	1,635,514
Seattle fresh	48,620	48.5	447,585
CHILE			
LA fresh	2,037,035	2,037.0	13,138,948
SF fresh	5,664	5.7	55,639
Seattle fresh	5,847	5.8	111,571

Notice that the 25,000 metric tons to be produced by Nordic in Humboldt is ten times the amount imported into Los Angeles. In fact, the total imported from Norway and Chile is only 3.04 metric tons. So even if Nordic replaced all this, it would only reduce transportation-related greenhouse gasses a small amount. (It would be great to have the DEIR figure out the difference between trucking and air.) However, even that amount might not be a reduction in greenhouse gasses since Norway and Chile sell most of their salmon to Asian markets and to 140 countries overall.[76] There is no reason to think either global production or air traffic would be reduced by Nordic's local production even if it replaced an equivalent amount of imports.

III. COMPATIBILITY WITH ENERGY PLANNING

CEQA guidelines command that "[a] lead agency should consider…[t]he extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of greenhouse gas emissions."[77] Further, the agency "may consider a project's consistency with the State's long-term climate goals or strategies…."[78]

The DEIR fails to provide the analysis required by CEQA for both statewide climate goals and plans and local renewable plans. As such, additional analysis is required.

A. Compatibility with State Climate Goals

Lead agencies may consider a project's consistency with the state's "long-term climate goals or strategies" when evaluating significance. Any finding of no significant impact predicated on consistency must be supported by "substantial evidence…of how those goals or strategies address the project's incremental contribution to climate change and its conclusion that the project's incremental contribution is not cumulatively considerable."[79]

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[76] https://www.lifeinnorway.net/norwegian-salmon140

[77] Guidelines § 15064.4

[78] Id.

[79] Jessica Wentz. Columbia Law Blog. http://blogs.law.columbia.edu/climatechange/2019/01/10/california-adopts-ceqa-guidelines-aimed-at-improving-consideration-of-ghg-emissions-and-climate-change-impacts-in-environmental-reviews/

The DEIR has no consideration of cumulative energy consequences over the next 30 years in the context of state plans and goals despite a finding of no significant energy impact. The question of the capacity to generate needed renewable energy is at the heart of this issue, in large part because of the very limited capacity for getting power into or out of Humboldt County. This section looks at Humboldt's current and future demand for electricity and capacity to provide it according to state and local goals and standards. For most potential projects such consideration would not be necessary, but the Nordic facility would add electric power demands equal to half of our residential use today, a scale of impact which demands serious consideration.[80]

California's strategy for countering climate change and reaching net-zero emissions in 2045 is to convert electric power generation to renewables and then to "electrify everything." In particular, vastly more electricity will be used as we convert to electric vehicles and as we convert our gas and wood stove powered housing and buildings to electric heat pumps. An official California strategic plan released in May 2021 estimates that in order to meet SB 100 goals in 2045 California will need three times the electricity that we use today.[81] A table from a report CAISO issued on February 3, 2022 showing greatly increased needs for renewable power sources and decreased natural gas is in the appendix as Table 2.[82]

We can get a minimal estimate for future Humboldt electrical needs by seeing how much more electricity Humboldt County would need if it converted all natural gas to electricity (which does not account for conversion to electric vehicles or converting wood stoves). The Humboldt Draft CAP says: "According to countywide estimates prepared for this CAP, there are currently around 34,000 homes powered by natural gas appliances and just over 5,000 powered by propane. If we are going to achieve carbon neutrality by 2045, these homes will need to decarbonize." More generally, in Section 3.52 the DEIR cites a CEC report saying we use 31.8 million therms of natural gas. If this load is converted to electricity, it means an extra 931.97 GWh, more than equal to our current total electrical use. In other words, conversion of gas to electricity would by itself double our annual electricity demands.

To a large extent our transformation to electricity will be mandatory. For example, no new cars will be sold in California after 2035 unless they are zero emission, which is anticipated to mostly mean battery-electric. New houses will have to include solar and completed EV hook-ups to make the houses all electric, including electric vehicle chargers. Many more such requirements will be enacted over the next 23 years. In July the Governor proposed moving net zero to 2035 if possible.[83] In other words, the SB 100 goals, plans and mandates for electrical energy between now and 2045 are indeed the relevant standard at the state level for whether the Nordic facility will have a significant impact on Humboldt energy utilization. However, the DEIR does not adequately assess the project's consistency with SB 100.

Humboldt County is greatly constrained as to electricity use. We currently have a 170 MW peak electricity demand. This is limited by the fact that only 70 MW of transmission from outside the county is available. The local renewable sources available now equal 54 MW. A possible 323 MW of renewable sources is conceivable according to RCEA, but 120 MW of this would be from planned but

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[80] CEC data show 392 GWhs or residential electricity use in 2020; Nordic proposes 195 GWhs.

[81] https://www.energy.ca.gov/news/2021-03/california-releases-report-charting-path-100-percent-clean-electricity

[82] https://www.pv-tech.org/californias-energy-transition-to-require-53gw-of-solar-pv-us30bn-for-grid-upgrades-by-2045-says-caiso/?

[83] https://environmentcalifornia.org/news/cae/statement-gov-newsom-announces-he-accelerating-california%E2%80%99s-progress-climate-goals

unimplemented offshore wind energy and 125 from unplanned onshore wind.[84] Offshore wind energy is not a sure bet, being dependent on new transmission lines; developers have made it clear they will not bid on the Humboldt Wind Call Area unless they can be assured of selling the 1.6 GW of electricity the area is expected to produce. BOEM has also made it clear they are only offering the entire Humboldt call area for bid, not a 120 – 150 MW "pilot."

In addition to the state requirements listed above, the most notable local plan is the Comprehensive Action Plan for Energy (CAPE). The CAPE plan makes some assumptions about changes in power demand and utilization for 2030:

- There will be 64,000 MW of rooftop solar added
- 20% less gas use so 18,000 MWh of electricity needed
- There will be 19% use of small electric vehicles, so additional load of 57,000 MWh

It also assumes that the CAPE low carbon, renewable goals will be met mostly by offshore and onshore wind. It assumes a capacity of 315 MW, but 120 MW of this will be offshore wind and 125 MW of (potential but unplanned) onshore wind.[85]

This 315 MW of renewable energy is approximately double the peak demand that we currently experience of 150 MW, roughly in line with the doubling of electricity demand if we convert all our gas to electricity. In short, with wind power—half of which is at least planned but half is unplanned—there will probably be sufficient sources of renewable energy for the county, including the 22.3 MW Nordic would add. If transmission lines are added with the offshore wind, electrical capacity and renewable capacity will not be problematic.

But what will be the situation if we do not get wind power? The gas-powered Humboldt Bay Generating Station has a capacity of 160 MW; the Humboldt Sawmill biomass plant is high carbon but classified as renewable and has a capacity of 15 MW, and we can import 70 MW, which we will assume is all renewable. The draft CAP lists 36.7 MW of additional renewable energy, some of which is currently unplanned, but we will assume goes ahead. Of the 300 MW (or more) we will need by 2045, 121.7 MW will be renewable, 160 MW will be gas (if the Humboldt Generating Plant is still operating; it is scheduled for decommissioning before 2045), leaving a gap of approximately 18 MW which might be made up by additional rooftop solar or other small renewable plants. In summary, if we don't get wind power, our local energy capacity is likely to be barely sufficient for our demand, and we will get less than half of our power from renewable sources. This is the situation if Nordic is *not* built. If it *is* built, it adds another 22.3 MW to the total capacity needed and to the demand for the insufficient supply of renewable energy.

One might think that Nordic, like American companies such as Amazon and Microsoft, could create a power purchase agreement with a large, off-site renewable energy supplier connected to the grid. In 2021, 17 gigawatts of renewable energy was purchased that way in the US.[86] However, this option is limited by the 70 MW capacity of our existing transmission lines. In effect Humboldt is an island, so the availability of ample renewable energy on the mainland does not solve the problem.

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[84] See page 4-34 of the Draft Climate Action Plan, October edition, for all renewable sources planned by RCEA.

[85] https://redwoodenergy.org/wp-content/uploads/2019/12/5.4-2-RePower-2019-Update-Draft3-CLEAN-app-A-B_NS.pdf

[86] Nathaniel Bullard, "Sparklines," in Bloomberg Green, Feb 3, 2022. https://www.bloomberg.com/news/articles/2022-02-03/the-growing-corporate-presence-in-global-power-markets

Given the easily anticipatable demands for more electricity throughout the county, and the fact that they are in effect mandated by state law and regulation and also assumed in the CAPE, it would be a significant detrimental impact on Humboldt's ability to meet SB 100 targets if it were to approve a single project that uses on average 22.3 MW every day—as much as Eureka and Fortuna together. This requires a finding of significant impact under CEQA.

B. Compatibility with Local Renewable Energy Plans

CEQA Guidelines require an EIR to assess whether a project would "conflict with or obstruct an adopted state or local plan for renewable energy or energy efficiency." As noted above, the most relevant local plan of this type is the Redwood Coast Energy Authority's CAPE (also called RePower Humboldt). The DEIR acknowledges the existence of the CAPE, and claims that the project will "support goals established" in the CAPE, but does not actually assess whether the project conflicts with or obstructs the CAPE. Instead, the DEIR chooses SB 100 as the only significance threshold for this impact, labeled Impact ER-b. While SB 100 consistency is an appropriate threshold at the statewide level, consistency with the CAPE must also be recognized as part of the significance threshold for Impact ER-b. Doing so would result in a significant impact, as the project would likely obstruct implementation of the CAPE and cannot demonstrate consistency with the CAPE in its current form.

The DEIR states that the project proponent "is committed to tie its goals and timeline of non-carbon and renewable use of energy to the goals of RCEA," but has not committed to purchasing electricity from RCEA. RCEA's renewable energy targets in the CAPE are substantially more ambitious than PG&E or statewide targets. For example, the CAPE calls for 100% zero-carbon energy by 2025, while SB 100 calls for a similar goal by 2045. Thus, if the project purchases energy from PG&E, it will almost guarantee non-compliance with the CAPE.

Furthermore, the CAPE calls for 100% local zero-carbon energy by 2030. The project will increase the county's electricity load by nearly 25%, substantially increasing the challenge of meeting the CAPE target with local energy sources and thus likely obstructing the plan. See the above analysis of local energy supplies and demands for additional detail.

Thus the CEQA standard of conflicting with or obstructing a state or local plan for renewable energy or energy efficiency is clearly met, both for the state plan and the CAPE plan, creating a significant impact.

In short, although not analyzed (as required) in the DEIR, Humboldt is only likely to have the capacity to accommodate the project if the offshore windfarm and/or transmission lines are implemented. Therefore, mitigation options are limited. Here are those we suggest:

- Increasing the size of the on-site solar electricity system;
- A commitment to purchasing <u>local</u> renewable electricity whenever it is available.

IV. SAFETY AND INCOMPATIBLE USES

As noted above, the DEIR estimates that the project will generate 95 new truck trips per week, while in fact the actual number of trucks trips generated by the project under the stated assumptions appears to be 190 trips per week. As also noted above, Appendix B of the DEIR assumes 100 truck trips *per day*, or 700 trips per week,[87] a dramatic difference from the number stated in the text of the document. This

[87] DEIR Appendix B at pp.87, 111.

discrepancy must be addressed. If the true number of truck trips per week is in fact 700 rather than 95, the dramatic increase in truck traffic on local roads will create an incompatible use for vulnerable road users which is undeniably significant.

The DEIR notes that New Navy Base Road and Highway 255 to either Eureka or Arcata constitute "the only two routes available" to the project site.[88] The DEIR further notes that, while bicycles are allowed on these roadways and there are hopes for a future separated bikeway, there are currently no dedicated facilities for either biking or walking on New Navy Base Road or Highway 255.[89] We note that despite the lack of facilities, these roads–including the Samoa Bridge to Eureka–are regularly used by people walking and biking for both transportation and recreation purposes. The substantial increase in truck traffic as a result of the project has the potential to pose significant increased hazards to non-vehicular road users due to what CEQA identifies as "incompatible uses," identified in the DEIR as Impact TR-c.[90]

The DEIR argues that the increase in truck traffic is not significant compared to existing levels of truck traffic on these roads. However, this analysis is flawed by the significant undercount of truck trips noted above. The DEIR further argues that "increases in traffic related to the Project would not affect the residential areas as truck traffic would utilize New Navy Base Road and SR 255."[91] However, Highway 255 bisects the communities of Manila and Arcata, and in the other direction enters downtown Eureka. In both directions, the only connecting truck route is Highway 101, which passes through much of Eureka as a city street and has a very high rate of bicycle and pedestrian-involved collisions and fatalities. Official collision data[92] show that for the 10 years ending December 31, 2020, there were 4 severe injury crashes involving bicyclists or pedestrians on Highway 255 in Arcata and Manila, 6 fatal or severe injury bike or pedestrian crashes on Highway 101 in Arcata, and 59 fatal or severe injury bike or pedestrian crashes on Highway 101 in Eureka. All truck trips to and from the project site will therefore travel through residential and other areas with many vulnerable users and severe existing impacts. The DEIR must more accurately analyze additional truck traffic, including reconciling the volume estimates in the document's text and in Appendix B. The impact of that traffic will create additional hazard for vulnerable road users, and almost certainly will cause an incompatible use under CEQA Guidelines with people walking and biking along the only available routes for trucks to travel to and from the project site—New Navy Base Road, Highway 255, and Highway 101 in Eureka and Arcata. Thus, the DEIR must mitigate impacts through bicycle and pedestrian safety improvements along New Navy Base Road, Highway 255 and Highway 101.

V. BIOLOGICAL RESOURCES

A. Noise Impacts on Birds

Noise generated by demolition activities would attenuate below 140 dBA (the threshold to avoid hearing damage in birds)[93] at 130 feet from the blast.[94] Appropriate thresholds should be set at levels low enough to avoid disturbing breeding and nesting birds, fledglings, and temporary hearing loss, tailored to bird species likely to be present in the vicinity.

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88 DEIR at 3.12-1.

89 DEIR at 3.12-1 to 3.12-2.

90 DEIR at 3.12-13.

91 DEIR at 3.12-14.

92 UC Berkeley Transportation Injury Mapping System, accessed January 2022. https://tims.berkeley.edu/.

93 Dooling, Robert & Popper, Arthur. (2007). The Effects of Highway Noise on Birds.

94 DEIR at 3.3-17.

B. Noise Impacts on Northern Elephant Seals

Seal haulouts are above low tide, and are not mapped in the DEIR, although Northern elephant seals are known to haul out to molt at unpredictable times of year, and often for days or weeks at a time.[95] Failure to assess Northern elephant seals' use of haul out sites in the project vicinity could result in significant harm from noise during soil densification, as well as demolition and other construction activities. Mitigation Measure BIO-6, which calls for soil densification construction during low tide conditions,[96] is not adequate to avoid these impacts.

C. Potential Impacts of the Bay Intakes

The project proponent proposes to intake seawater from Humboldt Bay for use at the facility. The DEIR states that the capacity of the Harbor District sea chests on the RMT II and Red Tank Docks is being expanded to provide up to 10 mgd saltwater supply to the Project.[97] Industrial installations using seawater for cooling, heating, or industrial processing must complete a Water Code Section 13142.5(b) determination to ensure "the best available site, design, technology, and mitigation measures feasible" are "used to minimize the intake and mortality of all forms of marine life."[98]

The DEIR, however, does not indicate whether the facility will be required to complete a section 13142.5(b) determination, despite that the intake structure has the potential to cause significant environmental impact. The facility cannot be approved until the intake structure is evaluated and either conditioned or approved by the Regional Water Board in accordance with Water Code Section 13142.5(b).

Potential impacts to Longfin Smelt (*Spirinchus thaleichthys)* are particularly concerning, since surveys have not been completed to evaluate the potential for this species to occur near the intakes, and in what numbers. The Longfin Smelt was listed as threatened under the California Endangered Species Act in 2009, and is known to spawn in Humboldt Bay tributaries.[99] Impacts and adequate mitigations to Longfin Smelt must be fully addressed in the DEIR, since the Project is reliant upon the intakes, which have not yet been permitted.
The DEIR states that off-site compensatory restoration, including piling removal and *Spartina* removal, is expected to be a condition of approval required under the Harbor District permits at a future date.[100] These conditions of approval for future permits are speculative at best, since site-specific surveys to quantify the extent of impacts from entrainment and impingement have not yet been conducted. The approach used to estimate impacts due to entrainment relied entirely on physical data on the intake and source water volumes without detailed biological survey data on the fish and invertebrate larvae potentially impacted.[101] Site-specific biological surveys are particularly important for evaluating impacts

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[95] Lynda Stockton, Northcoast Marine Mammal Care Center Stranding Coordinator. Pers. comm. Feb. 10, 2022.
[96] DEIR at 3.3-24.
[97] DEIR at 2-23.
[98] Cal. Wat. Code § 13142.5, subd. (b).
[99] Garwood, R. S. 2017. Historic and contemporary distribution of Longfin Smelt (*Spirinchus thaleichthys*) along the California coast. California Fish and Game 103(3): 96-117; 2017 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=152476&inline
[100] DEIR at 2-56.
[101] DEIR Appendix P at 1-7.

to longfin smelt, since little is known about their presence near the intakes, including both adults and larval stages.

The policies of the state with respect to water quality as it relates to the coastal marine environment are that "Independent baseline studies of the existing marine system should be conducted in the area that could be affected by a new or expanded industrial facility using seawater in advance of the carrying out of the development."[102]

An example of an important larval prey species that has not been addressed is Pacific sand lance (*Ammodytes hexapterus)*, which have been documented in the vicinity of the intakes.[103] A key forage species found along the coastal North Pacific Ocean from northwestern California to northern Japan, they are known to overwinter in sandy subtidal areas.[104] Sand lance constitute a major prey for birds, marine mammals, fishes, and some invertebrates, and variation in the availability of sand lance can have major effects on the breeding success and survival of their predators.[105] Direct impacts to eggs, larval, and adult Pacific sand lance from operating the bay-water intakes was not considered in the DEIR, but should be, considering their importance as prey for so many other species, including many protected under the State and Federal Endangered Species Acts, Marine Mammal Protection Act, and the Migratory Bird Treaty Act. Until surveys are completed, estimates of the impacts on Pacific sand lance are speculative at best.

D. Potential Impacts on Eelgrass from Mitigation Measures Related to the Intakes

The piling removal project proposed as off-site compensation for impacts to spawning longfin smelt is not appropriate, since the subject area is not known to be spawning habitat for the species. The DEIR states that the potential for entrainment of Longfin Smelt larvae can be mitigated on a 1:1 basis to ensure there would be no loss in number of individual larvae; therefore, the impact is less than significant.[106] However, the DEIR also states that "[t]he removal of pilings does not directly recreate habitat for the life stage of the larvae, but improving habitat will increase the number of Longfin Smelt resulting in an increased number of larvae."[107] It is not clear if or how improving non-spawning habitat will improve spawning. A mitigation measure that directly recreates or restores Longfin Smelt spawning habitat should be developed and incorporated, once the site-specific surveys quantify the extent of impacts on this species.

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[102] Cal. Wat. Code § 13142.5, subd. (d).

[103] Garwood, Rebecca & Mulligan, Timothy & Gleason, Erin. (2004). Fish Distribution in Humboldt Bay, California: A GIS Perspective by Habitat Type. https://www.researchgate.net/publication/287813293_Fish_Distribution_in_Humboldt_Bay_California_A_GIS_Perspective_by_Habitat_Type

[104] Greene, H. G., David A. Cacchione, and Monty A. Hampton. 2017. Characteristics and Dynamics of a Large Sub-Tidal Sand Wave Field—Habitat for Pacific Sand Lance (*Ammodytes personatus*), Salish Sea, Washington, USA. *Geosciences* 7, no. 4: 107. https://doi.org/10.3390/geosciences7040107

[105] Robards, Martin D.; Willson, Mary F.; Armstrong, Robert H.; Piatt, John F., eds. 1999. Sand lance: a review of biology and predator relations and annotated bibli- ography. Res. Pap. PNW-RP-521. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. https://www.fs.fed.us/pnw/pubs/pnw_rp521.pdf

[106] DEIR at 3.3-48.

[107] DEIR at 3.3-48.

The area proposed for piling removal is known to support eelgrass,[108] and yet potential impacts to eelgrass from activities related to off-site compensation restoration have not been evaluated. Eelgrass is protected under state and federal No Net Loss policies.[109] Eelgrass beds are considered Essential Fish Habitat under the Magnuson-Stevens Act and environmentally sensitive habitat areas (ESHA) under the California Coastal Act. Any impact to eelgrass generally requires mitigation in the form of transplanting the eelgrass and/or creating new eelgrass habitat.

We request the County condition the approval of the Project on the evaluation and approval of an intake permit that complies with Water Code Sections 13142.5(b) and (d) to ensure the facility uses the best available site, design, technology, and mitigation measures to minimize marine life mortality, and minimize any harm to fisheries that the communities surrounding Humboldt Bay rely on.

E. Impacts to Aquatic Ecosystems from Feedstock Demand

We may think of farmed fish as a way of taking pressure off wild fish, but farmed fish cannot provide the necessary micronutrients without being fed wild fish. In general, at least as much wild fish is turned into fish food as we get from farmed fish. The key issue in farming of salmon is the percentage of other fresh fish going into the feed, particularly wild fish, as they are under great pressure from fishing and could be used for eating directly much more efficiently:[110] "One of the most persistent debates in aquaculture is on the use of fishmeal and oil in fish feed and, above all, the quantity of wild-caught fish required to produce farmed fish. This debate has reached its peak in the area of salmon farming."[111] Over the last 30 years, the percentage of fish products used in feed has been reduced greatly.[112] A 2021 article in Nature shows the farmed salmon fish input to fish output (FIFO) worldwide to be 1.87 (see Table 3 in the Appendix).[113]A 2020 article says that it is now possible to get a 1:1 ratio of FIFO or even less.[114]

While the FIFO ratio has greatly been reduced in recent years, it is largely attributable to substitution of grains for fish and fish products, which have their own negative environmental effects:

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[108] Humboldt Bay Harbor, Recreation, and Conservation District. Eelgrass Distribution Map. http://humboldtbay.org/eelgrass-distribution-map

[109] NOAA Fisheries, West Coast Region. 2014. California Eelgrass Mitigation Policy and Implementing Guidelines. https://media.fisheries.noaa.gov/dam-migration/cemp_oct_2014_final.pdf

[110] "'Fed' aquaculture is reliant on wild-caught fish as a key feed ingredient, usually small 'forage fish', which are processed into two ingredients, fishmeal and fish oil: every year, around 15 million tonnes of wild fish from across the globe are used for this purpose. The omega 3 content in farmed salmon is obtained through feeding salmon with these ingredients, in particular fish oil. Many of the species used to make fishmeal and fish oil, such as herring, sprat and capelin, could be eaten directly by people, although they are not widely consumed currently. Fishing for these wild fish may have a negative effect on ocean ecosystems, but more than this, it is highly inefficient to feed wild fish to farmed salmon, to deliver nutrients to human diets which could be obtained by eating the wild fish directly In fact, globally, 90% of fish used in fishmeal and fish oil production comes from food-grade or prime food-grade fish(prime food-grade fish are almost never forage fish). And yet current evidence suggests that the omega 3 fatty acids in the world's remaining fish stocks are insufficient to meet the global population's daily requirement for omega 3 fatty acids" https://feedbackglobal.org/research/off-the-menu-the-scottish-salmon-industrys-failure-to-deliver-sustainable-nutrition/

[111] https://www.globalseafood.org/advocate/how-much-fish-is-consumed-in-aquaculture/

[112] Ytrestøyl, Trine, Turid Synnøve Aas, and Torbjørn Åsgård. "Utilisation of feed resources in production of Atlantic salmon (Salmo salar) in Norway." Aquaculture 448 (2015): 365-374.

[113] Naylor, Rosamond L., Ronald W. Hardy, Alejandro H. Buschmann, Simon R. Bush, Ling Cao, Dane H. Klinger, David C. Little, Jane Lubchenco, Sandra E. Shumway, and Max Troell. "A 20-year retrospective review of global aquaculture." Nature 591, no. 7851 (2021): 551-563.

[114] Kok, Björn, Wesley Malcorps, Michael F. Tlusty, Mahmoud M. Eltholth, Neil A. Auchterlonie, David C. Little, Robert Harmsen, Richard W. Newton, and Simon J. Davies. "Fish as feed: Using economic allocation to quantify the Fish In: Fish Out ratio of major fed aquaculture species." Aquaculture 528 (2020): 735474.

> Studies modeling fishmeal replacement with plant-based proteins (for example, soy protein concentrate) in shrimp and salmon show potential increases in ecotoxicity from fertilizer and pesticide use, rising pressure on freshwater and land resources, and heightened carbon emissions and biodiversity loss from forest clearing—particularly in Brazil.[115]
>
> Various studies have reported that higher inclusion of vegetable oils in aquafeed reduces the omega-3 fatty acid and increases monounsaturated fatty acid (MUFA) content in aquaculture products…. Consequently, the nutritional value of the farmed salmon is compromised, requiring larger portion sizes to satisfy recommended EPA + DHA intake… Additionally a shift from the ocean onto the land puts additional pressure on valuable agriculture resources, such as water, land and phosphorus, which have socio-economic and environmental implications as well as unknown trade-offs between terrestrial and aquatic ecosystem impacts.[116]

These various interdependencies in which solving one problem may exacerbate another have led one analyst to call fish feed in aquaculture a "wicked problem."[117]

We want transparency from the DEIR, which would include the specific fish feed to be used and its composition. If the FIFO and GHG effects are not known they should be calculated using the standard methods available. We would like a commitment from Nordic that their FIFO ratio will be 1:1 or less. Removing as many pounds of fish from their habitat as you produce obviously still has a large environmental impact[118], but it is better than the 10:1 ratios of 20 years ago, or the 5:1 ratios of 2009.[119] It is, however, an unavoidable, minimum effect that should be recognized by the DEIR. A potential mitigation measure is for Nordic to support an insect growing business in Humboldt County. With enough insects in the diet, no fish or fish products need to be in the food.[120]

While we have other outstanding concerns related to Biological Resources that have not been adequately assessed in the DEIR, not all of those have been included here since other stakeholders will be commenting on them in detail. These include the potential for viruses to impact native fish such as Chinook and Coho Salmon and other Threatened and Endangered species, and the level of treatment of fish processing liquids before discharge.

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[115] Naylor, Rosamond L., Ronald W. Hardy, Alejandro H. Buschmann, Simon R. Bush, Ling Cao, Dane H. Klinger, David C. Little, Jane Lubchenco, Sandra E. Shumway, and Max Troell. "A 20-year retrospective review of global aquaculture." Nature 591, no. 7851 (2021): 551-563.

[116] Kok, Björn, Wesley Malcorps, Michael F. Tlusty, Mahmoud M. Eltholth, Neil A. Auchterlonie, David C. Little, Robert Harmsen, Richard W. Newton, and Simon J. Davies. "Fish as feed: Using economic allocation to quantify the Fish In: Fish Out ratio of major fed aquaculture species." Aquaculture 528 (2020): 735474.

[117] https://feedbackglobal.org/research/off-the-menu-the-scottish-salmon-industrys-failure-to-deliver-sustainable-nutrition/

[118] … the sum of micronutrients from fish such as herring, anchovy, sprat and sardines currently fed to salmon is much larger than the micronutrients that end up on our plates in the form of farmed salmon. https://feedbackglobal.org/research/off-the-menu-the-scottish-salmon-industrys-failure-to-deliver-sustainable-nutrition/

[119] Jackson, A. N. D. R. E. W. "Fish in-Fish out." Ratios explained 34, no. 3 (2009);

[120] See the resources in this presentation: https://ras-n.org/wp-content/uploads/2021/01/10.-Allen-Place-Presentation.pdf

VI. Hazards and Hazardous Materials

The DEIR concludes there would be no significant impacts from hazardous materials related to the ocean discharge, and therefore no mitigations are necessary. However, we have concerns that have not been assessed, as follows.

Appendix N states that "even very low levels of leaching of PAHs from the weathered pilings in Humboldt Bay may still represent a risk to fishes and other marine organisms."[121] Creosote is derived from coal tars and was used as a preservative treatment for wood pilings up until 1993 when the CDFW prohibited its use in state waters.[122] Appendix R describes the sea chests as being constructed from creosote-treated lumber,[123] and given the era in which they were built, they may also have been treated with pentachlorophenol, a wood preservative that contained dioxins and furans. The treated lumber in the sea chests should be tested for pentachlorophenol and dioxins prior to construction. The potential impacts from mobilizing creosote or pentachlorophenol during construction should be assessed and mitigated, and if feasible, these materials should be removed, disposed of appropriately, and replaced with non-toxic materials. Since Humboldt Bay is on the 303(d) as Impaired by dioxins and furans,[124] any and all pentachlorophenol-treated materials in the sea chests should be removed.

Last September, a large fire at a salmon factory in Denmark resulted in a spill of iron chloride, a chemical used in wastewater treatment. Exposure to iron chloride can cause acute shortness of breath and rashes, according to an article about the incident.[125] In addition to being corrosive and irritating to eyes and lungs, according to the Material Safety Data Sheet for iron chloride, it releases a toxic gas when it comes in contact with water; users are warned to "Prevent, by any means available, spillage from entering drains or watercourses."[126] It is not clear whether iron chloride will be used in the Project in the wastewater treatment process, but the DEIR lists some caustic and chlorinated chemicals that will be used.[127] The potential effects on human health in the environment from either planned or accidental discharge of these chemicals is not addressed in the DEIR. The list of potential chemicals and drugs and rates of use are not sufficient to analyze potential harmful effects of regular use. Further, accidental release is not addressed. How will an accidental spill or release of hazardous chemicals in the effluent be contained? How will the public be notified in the event of an accidental spill or release? How will the environment and public health be protected, given the use of the area for surfing and other water recreation?

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[121] DEIR Appendix N, The Use of Piling Removal for Mitigating Effects of Entrainment Losses to Longfin Smelt and Other Marine Resources Resulting from Operation of the Proposed Samoa Peninsula Intakes in Humboldt Bay. Tenera Environmental, Dec. 13, 2021.

[122] Werne, C., J. Hunt, E. Beller, K. Cayce, M. Klatt, A. Melwani, E. Polson, and R. Grossinger. 2010. Removal of Creosote-Treated Pilings and Structures from San Francisco Bay. Prepared for California State Coastal Conservancy. Contribution No. 605. San Francisco Estuary Institute, Oakland, California.
https://www.sfei.org/sites/default/files/biblio_files/ReportNo605_Creosote_Dec2010_finalJan13.pdf

[123] DEIR Appendix R, Figure 2. Sea Chest Drawing D-12-226.

[124] North Coast Regional Water Quality Control Board. 2018 303(d) List For the North Coast Region.
https://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/303d/pdf/220203/2018%20303d%20List.pdf

[125] Large fire at salmon factory has created corrosive chemical emissions. Nord News, Sept. 16, 2021.
https://nord.news/2021/09/16/large-fire-at-salmon-factory-has-created-corrosive-chemical-emissions-2/

[126] Santa Cruz Biotechnology, Inc., 2010. Material Safety Data Sheet: Iron (III) Chloride

[127] DEIR at 3.9-18.

VII. Hydrology & Water Quality

A. Water Quality Data and Project Modeling

Ambient water quality data from closer to the discharge point than was used in the Numeric Modeling Report[128] should be obtained and used to better assess potential impacts of nutrients proposed to be discharged in the project's effluent. The dataset used in the modeling study was collected approximately 3.5 miles south-southeast of the Redwood Marine Terminal II diffuser, rather than in the area that will be affected by the discharge.

The Central & Northern California Ocean Observing System (CeNCOOS),[129] partnered with Humboldt State University and the Wiyot Tribe, measures hydrographic parameters at Trinidad Pier and several locations within Humboldt Bay and serves these data through the CeNCOOS Data Portal.[130] Comparing CeNCOOS data provides evidence that there are significant differences in water quality conditions in Humboldt Bay (measured at the Humboldt Bay Shoreline Station) compared to open ocean conditions (measured at the Trinidad Pier Station).

Ambient water quality conditions such as temperature (Fig. A), salinity (Fig. B), dissolved oxygen (Fig. C), and chlorophyll levels (Fig. D) are considerably different during different seasons in Humboldt Bay compared to the open ocean. These data do not support the assumption in the DEIR that ambient water conditions taken inside Humboldt Bay (Swanson, 2015) are adequate for modeling ambient conditions 1.55 miles offshore at the point of discharge.

Higher temperatures and lower salinity levels can be an attractant, can exacerbate Harmful Algal Blooms, and can encourage the growth of invasive species. For example, *Diplosoma listerianum*, a colonial tunicate that can outcompete indigenous colonial tunicates and benthic invertebrates for space, was one of several invasive fouling species which showed increased growth (% coverage) at temperatures 3.5 and 4.5°C above the ambient temperature in Bodega Harbor (13.5°C), while a native tunicate, *Distaplia occidentalis,* showed reduced survival.[131]

There is concern over further elevating the water temperature in the region as our oceans are already warming. In 2014 a large Marine Heat Wave (MHW) known as "the blob" was identified as it began dominating the northeast Pacific Ocean. Researchers documented many ecological effects associated with the blob, including unprecedented harmful algal blooms, shifting distributions of marine life, and changes in the marine food web.[132] Nordic needs to monitor how elevated ocean temperatures will affect the surrounding environment and mitigate any harmful effects.

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[128] Samoa Peninsula Land-based Aquaculture Project Numeric Modelling Report, Rev. 1. Feb. 2021. Humboldt County Initial Study/Mitigated Negative Declaration, Appendix E. Accessed at https://humboldtgov.org/DocumentCenter/View/95070/Appendix-E---Numeric-Modelling-Report-Dilution-Study-PDF

[129] Central & Northern California Ocean Observing System (CeNCOOS). https://www.cencoos.org

[130] CeNCOOS Data Portal. https://data.cencoos.org

[131] Sorte et al. 2010. Ocean warming increases threat of invasive species in a marine fouling community. Ecology, 91(8), 2010, pp. 2198–2204. https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1890/10-0238.1

[132] California Current Project. The California Current Marine Heatwave Tracker – An experimental tool for tracking marine heatwaves. https://www.integratedecosystemassessment.noaa.gov/regions/california-current/cc-projects-blobtracker

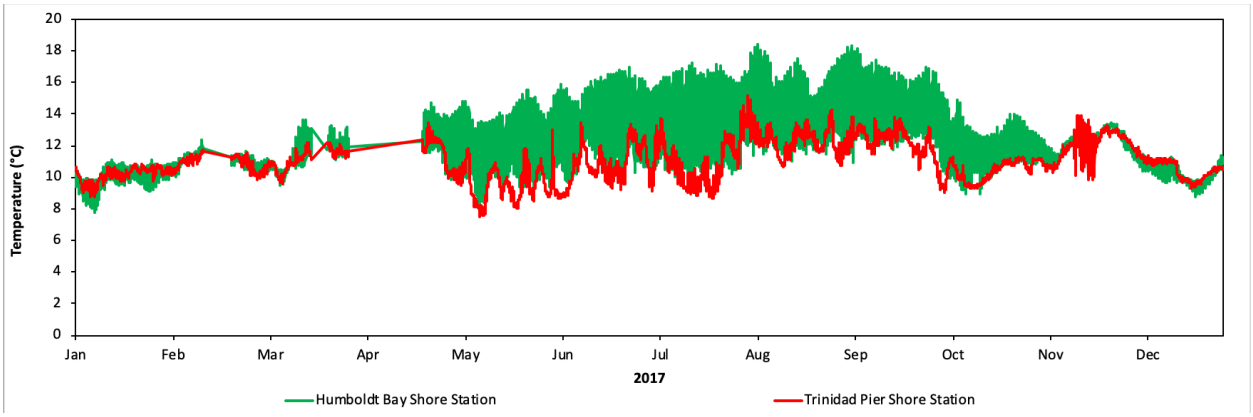

Fig. A. Water temperatures at the Humboldt Bay Shore Station were several degrees higher than at the Trinidad Pier Station between May and November, 2017. Source: CeNCOOS.

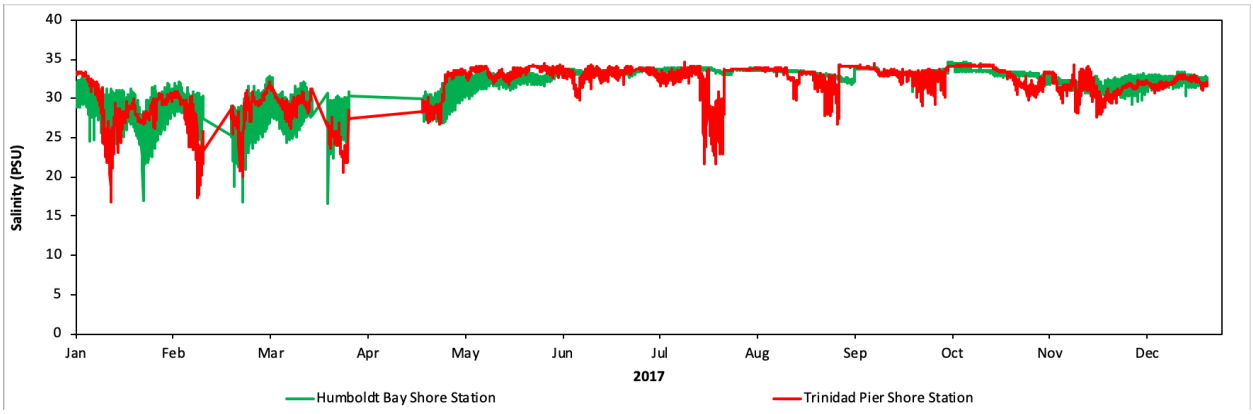

Fig. B. Levels of salinity at the Humboldt Bay Shore Station and the Trinidad Pier Station, 2017. Source: CeNCOOS.

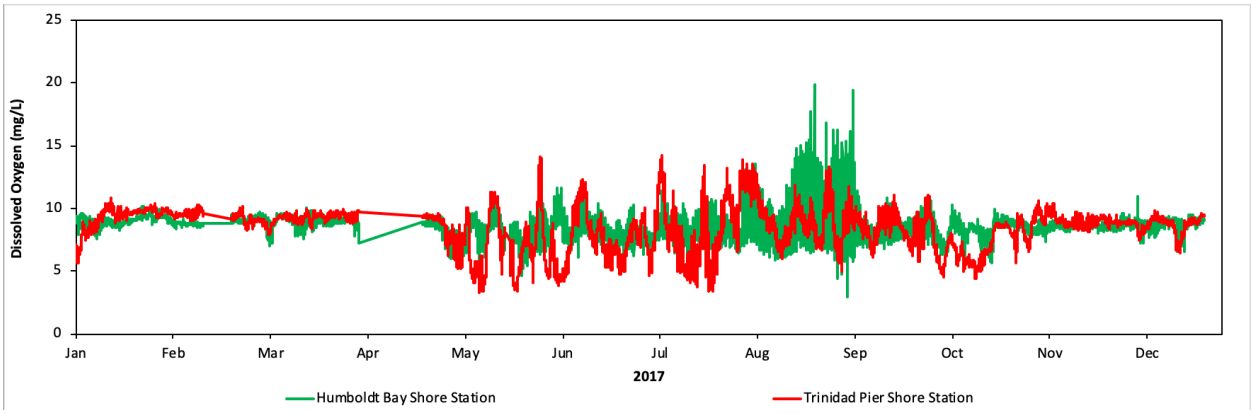

Fig. C. Dissolved oxygen levels at the Humboldt Bay Shore Station and the Trinidad Pier Station, 2017. Source: CeNCOOS.

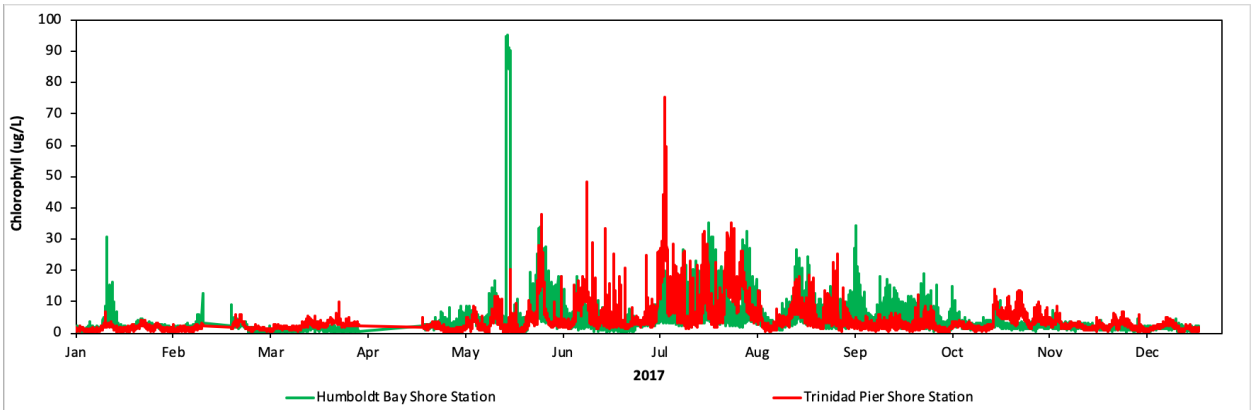

Fig. D. Chlorophyll concentrations at the Humboldt Bay Shore Station and the Trinidad Pier Station, 2017. Source: CeNCOOS.

B. Conditions in Entrance Bay are Not Indicative of Ocean Conditions

The Numeric Modeling Report[133] used to determine there would be no significant impacts from the ocean discharge relied on a hydrodynamic model done in 2010.[134] The author revised the model in 2019.[135] The findings strongly suggest that conditions in Entrance Bay are not reliable indicators of ocean conditions. The study showing age-of-water (residence time) of ocean versus Entrance Bay strongly suggests that Humboldt Bay water quality may not be representative of ocean conditions. In this study, the model domain encompasses Humboldt Bay and the adjacent ocean, as well as the Eel, Mad and Little Rivers and major bay tributaries (Elk River, Freshwater and Jacoby Creeks). The calibrated/validated model was used to predict basic physical processes in Humboldt Bay. Anderson's Figure 3 (below) shows the upper grid layer salinity distribution in Humboldt Bay and adjacent ocean during a large rainfall runoff event in 2017. Anderson's Figure 4 (below) shows the summer water temperature pattern with north and south bays having temperatures approximately 10 °C higher than the ocean. Entrance Bay has greater water age, or residence time, than adjacent ocean waters. The difference in temperature and residence time suggest that Humboldt Bay water quality may not be representative of ocean conditions and that further data collection and modeling need to be done at the site of discharge. At a minimum, a sensitivity analysis should be conducted to understand assumptions regarding ambient background data.

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[133] Samoa Peninsula Land-based Aquaculture Project Numeric Modelling Report, Rev. 1. Feb. 2021. Humboldt County Initial Study/Mitigated Negative Declaration, Appendix E. Accessed at https://humboldtgov.org/DocumentCenter/View/95070/Appendix-E---Numeric-Modelling-Report-Dilution-Study-PDF

[134] Anderson, J. 2010. A Three-Dimensional Hydrodynamic and Transport Model of Humboldt Bay. Poster Presentation presented at 2010 Humboldt Bay Symposium. Eureka, CA.

[135] Anderson, J. and A. Costello-Anderson. 2019. Three-Dimensional Modeling of Hydrodynamics, Salinity and Temperature in Humboldt Bay. Poster Presentation presented at Humboldt Bay Symposium. Eureka, CA.

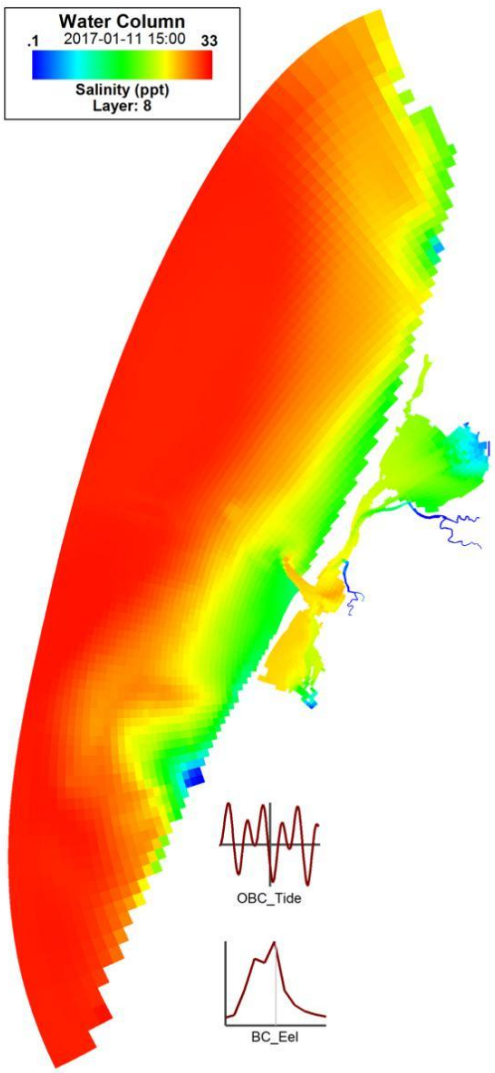

Figure 3. Predicted salinity distribution on 11 January 2017 runoff event (upper vertical layer).

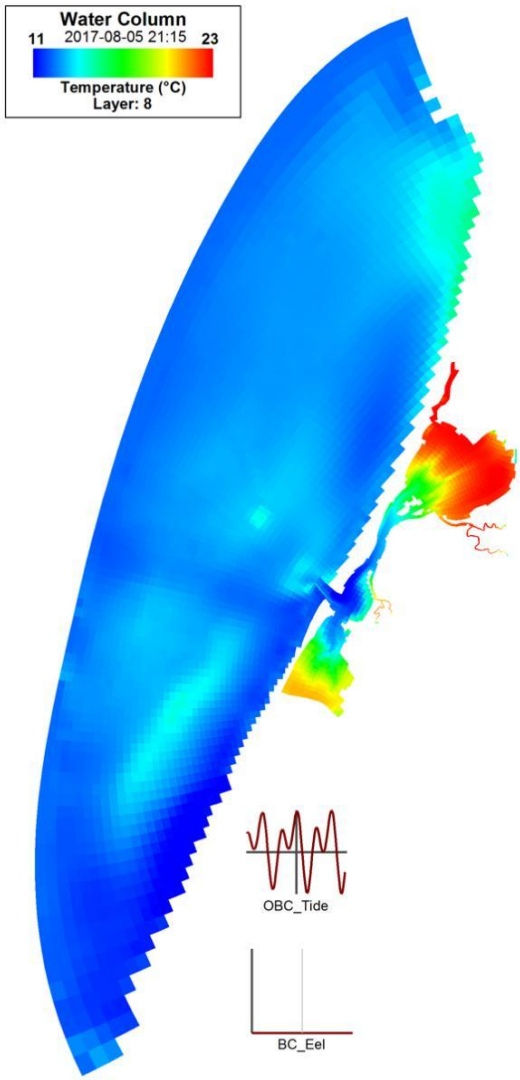

Figure 4. Predicted temperature distribution on 8 August 2017 low-flow period (upper vertical layer).

Figures 3 and 4 from Anderson and Costello-Anderson, 2019.[136]

According to the Central and Northern California Ocean Observation System's webpage on Humboldt Bay, HSU and NOAA's Southwest Fisheries Science Center have collaborated since 2006 to conduct monthly hydrographic and biological surveys along the Trinidad Head Line (THL). These surveys provide the only year-round, high-frequency ship-based ocean observations in the highly dynamic, strongly forced transitional zone between Cape Blanco and Cape Mendocino.

Since these data are already being collected monthly, the research team may be willing and able (with funding) to add a sample site or two closer to the discharge point to begin collecting data on the baseline

[136] *Ibid.*

conditions as suggested by the National Marine Fisheries Service.[137] The data should then be used to refine the model to assess potential impacts using an upwelling model as recommended by Dr. Joe Tyburczy of California Sea Grant.[138] These data are critical for accurately assessing the potential impacts of nutrients discharged into the nearshore marine environment.

C. Nitrogen Discharge and Harmful Algal Blooms

The estimated discharge of 1484 lbs. of nitrogen per day[139] reinforces the need for baseline ambient water quality assessment at the point of discharge and regular monitoring to accurately assess the impact of increased nutrients, including monitoring for Harmful Algal Blooms (HAB). The coast of Humboldt County has already experienced high levels of *Pseudo-nitzschia autralis*, which causes domoic acid and has led to fisheries closures in Humboldt County in 2016 through 2021.[140] *Pseudo-nitzchia* growth and domoic acid production benefit from nitrogen loading in the environment.[141] Given the potential risk to ecosystems and the local economy, it is important that NAF collect appropriate data to accurately conclude that the impacts of increased nitrogen are indeed "less than significant" and that regular monitoring of discharged nitrogen be conducted throughout all phases of production to ensure that it does not contribute to increased HABs. As is previously stated, ambient water quality data from closer to the discharge point than was used in the Numeric Modeling Report should be obtained and used to better assess potential impacts of nutrients proposed to be discharged in the project's effluent.

The potential for the effluent to exacerbate Harmful Algal Blooms, particularly in winter, should be assessed using an upwelling model as suggested by California Sea Grant Advisor Joe Tyburczy: "Simple calculations undertaken using a published model for ocean productivity (BEUTI, Biologically Effective Upwelling Transport Index) suggest that nitrate released by the Nordic facility (roughly 700 kg/day) may be substantial relative to natural, ambient nutrient supply – especially during the winter when upwelling is lower and when alongshore currents and resultant dilution is reduced."[142]

Baseline and post-project monitoring for toxic algae near the discharge point should be conducted and a threshold that would trigger adaptive management should be established as a condition of the project. Ongoing monitoring should include early detection of toxic algae such as *Alexandrium*, the dinoflagellate that produces PSP toxins, and *Pseudo-nitzschia*, the diatom that produces domoic acid, which caused devastating impacts to the marine ecosystem in 2014-15, including the Dungeness crab fishery, marine mammals, and seabirds from Alaska to Southern California. The California Harmful Algal Risk Mapping (C-HARM)[143] monitors ocean waters across the state for early detection of toxic algae; it may be a source of baseline conditions in the local nearshore environment and can provide

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[137] National Marine Fisheries Service. June 2, 2021. Comment to the North Coast Regional Water Quality Control Board on the Draft Waste Discharge Requirements for the Nordic Aquafarms California, LLC Humboldt County, Order R1-2021-0026.

[138] California Sea Grant. June 4, 2021. Comment to the North Coast Regional Water Quality Control Board on the Draft Waste Discharge Requirements for the Nordic Aquafarms California, LLC Humboldt County, Order R1-2021-0026.

[139] DEIR at 2-46 (Table 2.9)

[140] CDFW Director's Declaration Razor Clam Fishery August 2021, accessed at https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=193772&inline

[141] Martin-Jezequel et al. 2015. Effects of Organic and Inorganic Nitrogen on the Growth and Production of Domoic Acid by Pseudo-nitzschia multiseries and P. australis (Bacillariophyceae) in Culture. Mar Drugs. 2015 Dec; 13(12): 7067–7086.

[142] Tyburczy, Joe. California Sea Grant Extension. Comments on the Waste Discharge Requirements for the Nordic Aquafarms California, LLC Humboldt County, ORDER R1-2021-0026. June 4, 2021.

[143] Anderson, C. R. et al. 2016. *Initial skill assessment of the California Harmful Algae Risk Mapping (C-HARM) system.* Harmful Algae 59: 1-16. Accessed at https://www.sciencedirect.com/science/article/abs/pii/S1568988315301037

information on the types of monitoring that should be conducted to ensure early detection of toxic algae. Monitoring alone will not mitigate the impacts of a toxic algae bloom, but can help identify the problem before its impacts become widespread.

Adaptive Management Plan: An adaptive management plan should be adopted that sets thresholds that would trigger action to avert a toxic algae bloom once it is detected. The adoption of appropriate thresholds and implementation plan for adaptive management should include experts in detecting and managing Harmful Algal Blooms, as well as scientific experts from trustee agencies focused on protecting marine resources, including the California Coastal Commission, California Dept. of Fish & Wildlife's Marine Region, and National Marine Fisheries Service. We suggest that the following language be adopted to implement the Science Advisory Panel:

> Impacts to the ocean environment from nutrient pollution are anticipated to be below a level of significance based on modeling performed by the project proponent. If actual pollution released is above anticipated or permitted amounts or if the pollution may be a causal factor in a significant algal bloom, a Science Advisory Panel will meet to discuss the discharge and whether additional measures should be implemented to avoid significant impacts. The Science Advisory Panel shall consist of four voting members and one non-voting member: (1) CDFW scientist with expertise in ocean ecosystems; (2) NOAA scientist with expertise in ocean ecosystems; (3) Coastal Commission scientist with expertise in ocean ecosystems; and 4) an employee of the Humboldt County Planning Department or a designated representative of the Planning Department. Nordic Aquafarms shall send a representative to the Science Advisory Panel, although this person may not vote. The Panel should strive to produce consensus decisions, although any recommendation made by a majority of its members shall be considered a binding condition on the project. The Panel must be convened if actual discharges exceed permitted discharges or in the event of a significant algal bloom, as determined by at least one member of the Panel.

D. Antibiotic-Resistant Bacteria

The policies of the state with respect to water quality as it relates to the coastal marine environment are that "[w]astewater discharges shall be treated to protect present and future beneficial uses, and, where feasible, to restore past beneficial uses of the receiving waters. Highest priority shall be given to improving or eliminating discharges that adversely affect…[a]reas important for water contact sports."

The potential impacts of antibiotic-resistant bacteria (ARB) to human health need to be fully analyzed and mitigated. Antibiotic residues and ARB can be dispersed through air or water. It has been shown that people living in proximity to high-density land agriculture operations have an increased risk of MRSA (methicillin-resistant *Staphylococcus aureus*) infection.[144, 145] It has also been shown that "Airborne bacteria can disperse from the animal houses to a distance of 10 km." [146]

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[144] Beresin et al. Environ Res. 2017. Swine exposure and methicillin-resistant Staphylococcus aureus infection and colonization among hospitalized patients with skin and soft tissue infections in Illinois: a ZIP code-level analysis. 159: 46–60. doi:10.1016/j.envres.2017.07.037.

[145] Carrel et al. 2014. Residential Proximity to Large Numbers of Swine in Feeding Operations Is Associated with Increased Risk of Methicillin-Resistant Staphylococcus aureus Colonization at Time of Hospital Admission in Rural Iowa Veterans. Infection Control and Hospital Epidemiology, Vol. 35, No. 2 (February 2014), pp. 190-192

[146] Bai et al. 2022. Spread of airborne antibiotic resistance from animal farms to the environment: Dispersal pattern and exposure risk. Environment International

It is well-established that aquaculture is a major contributing source to the proliferation of ARB and ARG into the environment. After completing a large systematic review, Zheng et al (2021) found, "Aquaculture [is a] major pollution source of antibiotics and ARGs in estuarine and coastal environments."[147]

The risk of spread of ARB from fish feed that includes poultry byproducts poses a significant risk to surfers, other beachgoers, and fishermen. The threat comes from two partially-treated effluent streams generated by the Project and from any failures, tears, or degradation of the biofilters.

A study done by UCLA shows that surfers were over six times (odds ratio = 6.35, 95% CI 1.28 to 31.5, p=0.02) more likely to be colonized by MRSA (methicillin-resistant *Staphylococcus aureus*) than non-surfers, because of resistant bacteria carried into the ocean from stormwater runoff[148]. While this research looked at colonization and did not prove active infection/illness, colonization itself is the greatest risk factor for subsequent infection. An antibiotic-resistant infection can be extremely severe and even life-threatening depending on the type of pathogen (e.g. there have been cases of cholera, vibrio, hepatitis, and worse).

These potential impacts can be avoided by a condition of approval prohibiting the use of feed containing poultry byproducts, or at the very least, a condition requiring testing of the feed and effluent for known antibiotic-resistant bacteria (*Campylobacter* spp., *Escherichia coli*, *Enterococcus* spp., *Salmonella* and *Staphylococcus aureus)* and report the findings to the public in a timely manner. A plan for testing, removal, and replacement of the biofilm filters is essential to ensure they are successfully filtering the effluent and removing any bacteria before entering the ocean.

VIII. Conclusion

Our organizations are concerned with the size of the project and its potential for significant environmental impacts. We have tried through these comments to provide a useful roadmap to ensure compliance with CEQA and to reduce impacts associated with the project. Should you have any questions concerning these comments, please do not hesitate to contact us by writing to us at the email addresses provided below.

Sincerely,

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Volume 158, January 2022, 106927

147 Zheng et al. 2021. A systematic review of antibiotics and antibiotic resistance genes in estuarine and coastal environments. Science of The Total Environment Volume 777, 10 July 2021, 146009

148 Ben Burdick et al. 2019. Prevalence of MRSA Colonization in Surfers Following Exposure in Select Southern California Coastal Waters.pp 12-13

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APPENDIX

Appendix Table 1: Comparison of Yolo, Sonoma and Humboldt Counties

Characteristic	YOLO COUNTY	SONOMA COUNTY	HUMBOLDT COUNTY
Character of the county comparisons			
Location	Sacramento Valley	North Coast	North Coast
Senate and assembly district; us representative	Not shared	Shared	Shared
Population in 2018	221,270	503,332	136,002
Largest city	West Sac 54,163	Santa Rosa 178,488	Eureka: 26,348
Rural area in 2010	95.4%	90.9%	98.7%
Major university	UC Davis	Sonoma State	CalPoly Humboldt
Emissions-relevant comparisons			
Climate action plan	2011 (27% goal)	2020 (80% goal)	2022 Draft 40% goal
CCA electricity	Valley Clean Energy	Sonoma Power	RCEA
Emission source: transportation	25% (2009 inventory)	58% (2015 inventory) [1]	53% (2015 inventory)
Emission source: agriculture	48%	10%	13%
Emission source: solid waste and wastewater treatment	0.7%	7%	5%
Emission source: energy	22%	25%	22%

Data from Humboldt and Sonoma 2015 Emissions Inventory and Yolo's CAP

Appendix Table 2: CAISO Data on Electrical Demand and Diminished Natural Gas (https://www.pv-tech.org/californias-energy-transition-to-require-53gw-of-solar-pv-us30bn-for-grid-upgrades-by-2045-says-caiso/?)

Table 3.1-3: Resource assumptions in 2021-2022 transmission planning process for 2013 and the SB100 starting point scenario for 2040

Resource Type	2021-2022 TPP Base Portfolio for 2031 (MW)	2040 Starting Point Scenario (MW)
Natural gas fired power plants	0	(15,000)
Battery energy storage	9,368	37,000
Long-duration energy storage	627	4,000
Utility-scale solar	13,044	53,212
In-state wind	1918	2,237
Offshore wind	0	10,000
Out-of-state wind	2,087[16]	12,000[17]
Geothermal	651	2,332

[16] 1,062 MW on new transmission and 1,025 MW on existing transmission.

[17] 9,900 MW on new transmission and 2,100 MW on existing transmission.

Appendix Table 3: Naylor, Rosamond L., Ronald W. Hardy, Alejandro H. Buschmann, Simon R. Bush, Ling Cao, Dane H. Klinger, David C. Little, Jane Lubchenco, Sandra E. Shumway, and Max Troell. "A 20-year retrospective review of global aquaculture." Nature 591, no. 7851 (2021): 551-563.

Table 1 | Wild fish used in aquaculture feeds for 11 commonly farmed fed fish and shellfish

Farmed fish and crustaceans[a]	Total production (kilotons)[a]	Percentage produced with compound feed (by weight)[a]	Average FCR[b]	Percentage fishmeal in feed (wild)	Percentage fishmeal in feed (trimmings)	Percentage fish oil in feeds (wild)	Net wild fish used (kilotons)	FIFO[c] in 2017
Fed carps	13,986	57	1.7	0.4	0.6	0	0	**0.02**
Tilapia	5,881	92	1.7	0.5	1.5	0	0	**0.03**
Shrimp	5,512	86	1.6	5	5	2	3,034	**0.82**
Catfishes	5,519	81	1.3	0.5	1.5	0	0	**0.02**
Marine fish	3,098	80	1.7	8	6	3	2,528	**1.25**
Salmon	2,577	100	1.3	6	6	6	4,020	**1.87**
Freshwater crustaceans	2,536	60	1.8	5	7	1	548	**0.43**
ODF fish	2,491	43	1.7	3	8	2	728	**0.38**
Milkfish	1,729	55	1.7	2		0	0	**0.07**
Trout	846	100	1.3	5	4	6	1,320	**1.82**
Eel	259	100	1.5	25	10	5	389	**2.98**
Total	44,424						12,566	**0.28**

[a]Categories from Tacon[3], Table 4. ODF, other diadromous and freshwater fish. The calculations by the authors are based on data from the following sources: production, share of production and FCR were obtained from the FAO[2] and Tacon[3]; inclusion of fishmeal and fish oil data were from the National Resource Council report on Nutrient Requirements for Fish and Shrimp[54], Naylor et al.[59], and Ytrestøyl et al.[55]; and analyses of fish trimmings in fishmeal were from Green (SeaFish)[47] and Leadbitter[44]. We use conservative estimates of 24% fishmeal and 10% fish oil recovery from wild fish.
[b]FCR is defined as the estimated average species-group economic FCR (total feed fed/total species group biomass increase). Economic FCR (also known as EFCR)[3,55,58] is defined as total feed fed/total species group biomass increase and includes waste, escapes and other non-ingested feeds[55].
[c]FIFO, wild fish inputs to fed fish output.

Appendix Table 4: Sherry, Jesse, and Jennifer Koester. "Life Cycle Assessment of Aquaculture Stewardship Council Certified Atlantic Salmon (*Salmo salar*)." Sustainability 12, no. 15 (2020): 6079.

Table A2. Impact of 1 kg of salmon feed using TRACI.

Impact Category	Total	Fish Meal (Peru)	By-Product Fish Meal and Oil (British Columbia)	Fish Oil (Peru)	Menhaden Oil (U.S.)	By-Product Poultry Meal (British Columbia)	Wheat (Alberta)	Corn Gluten Meal (Ontario)	Canola Seed and Meal (U.S.)	Canola Oil (Alberta)	Soy Meal (Ontario)
Ozone depletion (kg CFC-11 eq)	2.79×10^{-8}	7.60×10^{-9}	2.65×10^{-10}	4.14×10^{-9}	1.64×10^{-9}	6.59×10^{-9}	1.92×10^{-9}	1.18×10^{-9}	2.23×10^{-9}	2.26×10^{-9}	1.11×10^{-10}
Global warming (kg CO_2 eq)	1.91	0.275	0.0223	0.150	0.0681	0.567	0.0540	0.158	0.298	0.303	0.0179
Smog (kg O_3 eq)	0.137	0.0434	0.00364	0.0237	0.0105	0.0116	0.00194	0.0132	0.0137	0.0140	0.00173
Acidification (kg SO_2 eq)	0.0192	0.00157	0.000124	0.000856	0.000379	0.00482	0.000737	0.00146	0.00454	0.00461	0.000114
Eutrophication (kg N eq)	0.0192	0.000133	1.18×10^{-5}	7.27×10^{-5}	3.38×10^{-5}	0.00243	0.00115	0.00128	0.00699	0.00711	3.73×10^{-6}
Carcinogenics (CTUh)	4.29×10^{-8}	4.24×10^{-10}	3.75×10^{-11}	2.31×10^{-10}	1.08×10^{-10}	5.51×10^{-9}	1.12×10^{-9}	2.86×10^{-9}	1.61×10^{-8}	1.64×10^{-8}	7.09×10^{-11}
Non carcinogenics (CTUh)	1.9×10^{-6}	2.74×10^{-9}	1.92×10^{-10}	1.50×10^{-9}	6.27×10^{-10}	3.29×10^{-7}	9.17×10^{-8}	2.70×10^{-7}	5.98×10^{-7}	6.08×10^{-7}	1.37×10^{-9}
Respiratory effects (kg PM2.5 eq)	8.37×10^{-4}	0.000115	8.99×10^{-6}	6.27×10^{-5}	2.74×10^{-5}	0.000181	2.98×10^{-5}	6.38×10^{-5}	0.000170	0.000173	4.95×10^{-6}
Ecotoxicity (CTUe)	8.86	0.0150	0.00124	0.00816	0.00366	2.52	0.968	0.681	2.28	2.32	0.0653
Fossil fuel depletion (MJ surplus)	1.91	0.466	0.0385	0.254	0.114	0.230	0.0451	0.232	0.257	0.261	0.0148

Appendix Figure 1: Comparison of GHG for 24 LCA studies of salmonids. Note: Studies are grouped by type of aquaculture. Closed Horizontal bars are averages by type. The left axis shows Kg of CO2eq per metric ton. (The right axis shows Feed Conversion Ratio, that is, weight of feed divided by weight gained by fish.)

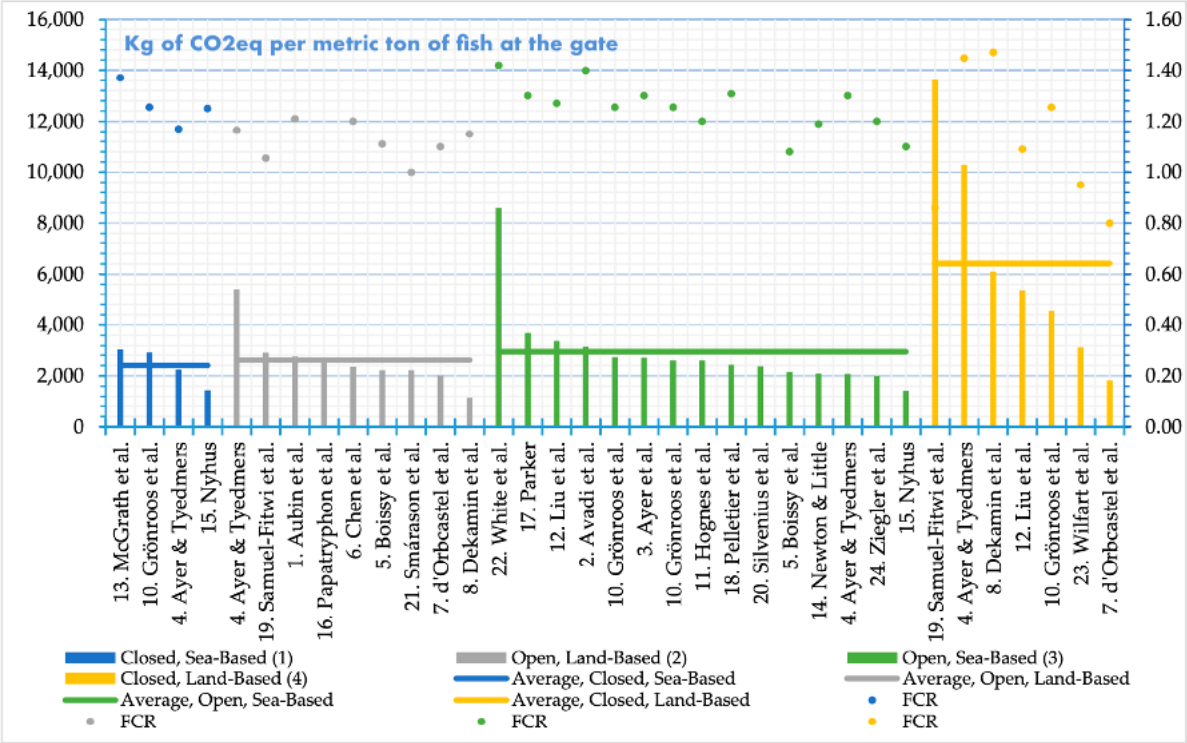
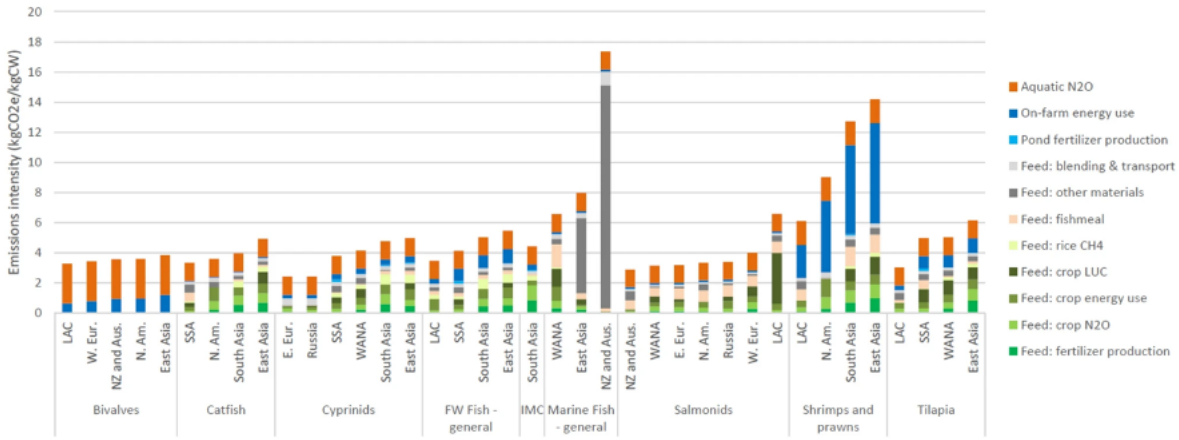


Figure 4. Salmonids global warming potential (GWP) impacts (kg CO2-e) and FCR based on production technology clusters.

Appendix Figure 2: Energy Intensity of Aquaculture Based on Feed

From: Quantifying greenhouse gas emissions from global aquaculture



Emissions intensity of the main aquaculture groups, 2017. *Source* calculated in this study. *IMC* Indian Major Carps, *E. Eur*, Eastern Europe, *LAC* Latin America and the Caribbean, *N. Am.* North America, *NZ and Aus.* New Zealand and Australia, *SSA* Sub-Saharan Africa, *W. Eur.* Western Europe, *WANA* West Asia and North Africa.

[1] https://rcpa.ca.gov/data-and-reports/sonoma-county-greenhouse-gas-inventory/