STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BOARD OF ENVIRONMENTAL PROTECTION

	IN THE MATTER OF
	:
NORDIC AQUAFARMS, INC.	: APPLICATIONS FOR AIR EMISSION,
Belfast and Northport	: SITE LOCATION OF DEVELOPMENT,
Waldo County, Maine	: NATURAL RESOURCES PROTECTION
	: ACT, and MAIN POLLUTANT
	: DISCHARGE ELIMINATION SYSTEM
	:(MEPDES)/WASTE DISCHARGE
A-1146-71-A-N	: LICENSE
L-28319-26-A-N	:
L-28319-TG-B-N	:
L-28319-4E-C-N	:
L-28319-L6-D-N	:
L-28319-TW-E-N	:
W-009200-6F-A-N	:

EXHIBIT NVC/UPSTREAM 9
TESTIMONY OF *MICHAEL LANNAN* WITH ATTACHMENTS

Odor Control

I. Permitting Requirements Needed for Odor Control

Odor is covered in the Site Law Statue in 38 M.R.S. §484 (3). It reads:

> "3. No adverse effect on the natural environment. The developer has made adequate provision for fitting the development harmoniously into the existing natural environment and that the development will not adversely affect existing uses, scenic character, air quality, water quality or other natural resources in the municipality or in neighboring municipalities."

Both the City of Belfast and DEP have specific ordinances and rules for permitting and compliance that must be addressed as part of the Application.

Site Law Rules, 06-096 Chapter 375 (17)

> NO ADVERSE ENVIRONMENTAL EFFECT STANDARDS OF THE SITE LOCATION OF DEVELOPMENT ACT
>
> *17. Adequate Provisions for the Control of Odors*
>
> *A.* ***Standard.*** *The applicant shall make adequate provision for controlling odors.*
>
> *B.* ***Submissions.*** *The application for approval of any development likely to be the source of offensive odors shall include* ***evidence that affirmatively demonstrates*** *that the applicant has made adequate provision for the control of odors, including, but not limited to, the following information:*
>
> *(1)* ***the identification of any sources of odors*** *from the development*
>
> *(2)* ***an estimation of the area which would be affected by the odor****, based on experience in dealing with the material or process used in the development, or similar materials or processes; or*
>
> *(3)* ***proposed systems for enclosure of odor-producing materials and processes, and proposed uses of technology to control, reduce or eliminate odors."***

In summary, there is no facility odor control plan and there is no demonstration that the facility could meet the requirement of "Adequate Provisions for the Control of Odors" based upon the

application. This is further compounded by a very distinct local odor ordinance in the City of Belfast that has not been considered as well.

> Belfast Zoning Sec. 102-1127 and Sec. 102-1258
>
> > Odors.
> >
> > > No land use or establishment shall be permitted to produce noxious or harmful odors **perceptible beyond the lot lines**, either at ground or habitable elevation.

There is no discussion about odor potential, odor control, and whether residual odor will be "perceptible beyond the lot lines".

II. Inconsistent, and Lack of Information making it Impossible for Proper Review

The Applicant's SLODA odor discussion in Section 22 of their application starts with a naïve and unreasonable statement. It starts with ***"The Belfast salmon farm will not generate noticeable odors."*** This single statement alone indicated that the Applicant really does not understand odor and what it means.

The next three sentences in the opening paragraph are even more of a concern. They essentially suggest that a facility that will produce 200,000 pounds of fish product per day, will maintain proper odor control through "free will". It reads: ***Modern fish production facilities capture and store byproduct streams in airtight and/or cooled storage, to protect their economic value. Odor in the seafood industry generally emanates from waste exposure to air; with the result of also destroying the value of potential byproducts. In our case, that would lead to economic losses."***

Suggesting that odor control will be sufficient because the fish byproducts have economic value is like saying Hannaford's supermarket fish section will prevent the fish from spoiling, because the fish have economic value and they would prefer to never have to dispose of it without selling it. The value may be an incentive, but economic drivers cannot "will away" natural biological decomposition mechanisms. Economic consideration is simply not an odor control plan, or Adequate Provisions for the Control of Odors.

In the SLODA Application Section 22.0 titled: ODORS, the permit application states that "Potential sources of odor in land-based aquaculture include:

1. Ensilage of mortalities;
2. Fish processing;
3. The Waste Water Treatment Plant; and
4. To a lesser extent, feed storage"

This list from the application is extremely incomplete, and should include at least:

1. Ensilage of mortalities
2. HVAC equipment at each and in every building
3. Chemical and fuel deliveries and charging of tanks or vessels with these materials
4. Fish hatchery and associated activities

5. Smolt operations and associated activities
6. Fish harvesting, slaughtering, and fileting operations
7. Wastewater treatment pumping operations
8. Storage of Fresh Feed and Spoiled Feed
9. Wastewater treatment operations
10. Water treatment operations
11. Wastewater residuals handling, storage, and disposal operations
12. Water treatment residuals handling, storage, and disposal operations
13. Fish harvesting waste handling, storage, and disposal operations
14. Doorways and garage doors that must remain open at times for operations
15. Power plant operations and exhaust stacks
16. All other exhaust stacks (including the odor control systems exhausts)

In the SLODA Application Section 22.0 titled: ODORS it also states:

> *"All processes with the potential for creating odors will take place in completely enclosed buildings….we will install proven equipment at key areas to ensure additional odor control. We will employ air filtration that may include carbon, biofilters, wet scrubbers, and media."*

For Odor Control to be successful, it must consider, quantify, and design for:

a. Cover/ Containment
b. Ventilation
c. Control Technologies
d. Dispersion
e.

Two of these parameters are mentioned above indirectly as *"completely enclosed buildings"* and "***may*** *include carbon, biofilters, wet scrubbers, and media"*, but with a ventilation discussion there is no understanding with respect to leakage or buildup of odor. It is simply not possible to enclose very, very large exposed tanks, agitate them, and not ventilate the headspace. The result would be condensation, biological slime, and unsafe conditions. I have seen this directly in wastewater plants that have attempted to "solve" their odor problems strictly through containment. It is not and odor control strategy. Furthermore, this facility will be processing 200,000 pounds of fish as day. Doors will continue to be open and closed, and if there is inadequate ventilation staff typically props open the doors for "fresh air" regardless of company policy, simply enclosing buildings does not account for the needs of normal use.

To suggest the facility will not generate odor potential, simply because the building are enclosed and the fish and fish waste will not be allowed to spoil, does not demonstrate compliance below the perception of odor.

III. Best Managing Practices

If Best Managing Practices had been considered, the facility would have acknowledged its odor potential, estimated its potential emissions, truly explored not only the enclosure, but minimum ventilation requirement, conveyance methods, performed an odor control technology assessment, provided design plans that actually locate the required odor control systems, and finally completed an odor dispersion assessment so it could demonstrate compliance with the city and Site law requirements.

While it is impossible to determine the odor potential from the applications as submitted, it is important to recognize that all aspects of this facility will have odor potential. While the wastewater and waste sludge will have obvious odors that have not been defined, it is important to note that the fish from beginning to end will have a myriad of potential odors that are compounded based on material age and storage quantities. In Attachment A, pages 60-61 of the book *Odors in the Food Industry*, Edited by Xavier Nicolay and published in 2006 as part of ISEKI Food Integrating Safety and Environment Knowledge into Food Studies towards European Sustainable Development series. SEKI Food is a thematic network on food studies, funded by the European Union. As one can see there are many different fish odors present in fresh fish, spoiled fish, oxidized fish, fish processing, and general environmental odors from fish. None of these have been considered.

In a large monoculture situation such as this proposed project, one should not lose site of the fact bacteria growth that can lead to odor emissions is not linear. It accelerates over time, and therefore the creation of odorous by-products from bacterial growth also accelerates over time. The simplest way to think of this process is the splitting of single cell organisms where: 10 bacteria becomes 20, which becomes 40, which becomes 80, which becomes 160, in four growth cycles the bacterial count is 16 times the original baseline. If you double the four cycles again, the count is now another 16 times as much, or 256 times the original count. This exponential growth will continue as long as there is food and oxygen available. Oxygen demand therefore is not linear either, if food is not limited, so the decomposition to nastier compounds occurs more rapidly too, and the simply oxygen sources are devoured.

Again, to suggest the facility will not generate odor potential, simply because the building are enclosed and the fish are fresh, does not take into account so many considerations that are necessary to demonstrate compliance below the perception of odor.

Again, they do not even define the odor potential. It is impossible for the DEP or intervenors to understand the odor potential without an uncontrolled odor emissions study from the facility, and therefore the facility cannot possibly has not met the burden of proof for “Adequate provisions for odor control” and certainly not a criteria of “odors perceptible beyond the lot lines.”

This topic can only be evaluated after substantial analyses is completed by the applicant.

NYC/UPSTREAM 9

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Date: 12/16/2019

Printed Name: Michael Lanna

Title: President

Parties Assisting:

Name: Address: Signature:_____

Name: Address: Signature:_____

NVC / UPSTREAM 9

STATE OF MASSACHUSETTS

COUNTY OF Middlesex

PERSONALLY APPEARED, Michael Lawrence, WHO, UNDERSTANDING THE MEANING OF AN OATH, SWORE THAT THE FORGOING TESTIMONY IS TRUE TO THE BEST OF HIS/HER KNOWLEDGE AND BELIEF, THIS 16th DAY OF DECEMBER 2019.

NOTARY PUBLIC

MY COMMISSION EXPIRES:

MELINDA GLADDEN
Notary Public
Commonwealth of Massachusetts
My Commission Expires January 23, 2026

Attachment A

Table 1. Classes of Odors in Fish and Examples of Compounds Contributing to the Odors (from Olafsdottir and Fleurence, 1998)

Fish odor	Class of chemical species	Examples of compounds	Aroma description	Odor threshold in water
Species-related fresh fish odor	C6-C9 alcohols and carbonyls	Hexanal / t-2-hexenal,	Green, aldehyde-like	4,5ppb / 17ppb [a]
		1-octen-3-ol, /1-octen-3-one	Mushroom Heavy earthy,	10ppb/ 0,009ppb[a]
		1,5-octadiene-3-ol	mushrooms	10ppb[a]
		1,5-octadiene-3-one	Geranium	0,001ppb[a]
		2,6-nonadienal	Cucumber	0,001ppb[a]
		3,6-nonadienol	Cucumber, melon-like	10ppb[a]
	Bromophenols	2,6-dibromophenol	Iodine- and shrimp-like	0,0005µg/kg[b]
		2,4,6-tribromophenol	Saltwater fish, brine-like.	0,6µg/kg[b]
		2-bromophenol	Sea, marine-like flavor	
	N-cyclic compounds	Pyrrolidine piperidine	Earthy	
	Short chain alcohols	ethanol, propanol, butanol, 3-methyl-1-butanol	Solvent like	1–100 ppm[c]
Microbial spoilage odor	Short chain carbonyls	acetone, butanone ethanal, propanal	Solvent like	
		3-methylbutanal	Malty	0,06ppm [d]
		2-methylbutanal	Malty	0,04ppm [d]
	Amines	ammonia,	Ammoniacal	110 ppm[c]
		TMA	fishy, ammoniacal	30 ppm[c]
		DMA		0,6 ppm[c]
		histamine, putrecine, cadeverine	Putrid, rotten	
	Sulfur compounds	hydrogen sulfide	Sulfury, boiled eggs	5–40 ppb [e]
		methyl mercaptan	Rotten, cabbage	0,05 ppb [e]
		methyl sulfide	Cabbage-like	0,9µg/kg[f]
		dimethyl disulfide	Putrid, onion-like	12 ppb [g]
		dimethyl trisulfide	Putrid, cabbage and onion-Garlic like	0.01ppb[g]
		bis-methylthio methane thioesters		0,3 µg/kg[f]
	Aromatics	phenethyl alcohol	Old roses	
		phenol,	Phenolic,	2 ppm
		p-cresol	Pigpen-odors ,horse manure	300 µg/kg[f]
	N-cyclic compounds	indole	Moth ball or fecal like	
		skatole		
		acetic acid,		34,2ppm[c]
	Acids	butyric acid isobutyric acid	Sour, rotten, old socks	32,8ppm[c]
Oxidized odor	Unsaturated aldehydes	hexanal	green, planty	4,5ppb[f]
		c4-heptenal	cardboard-like, potato-like	0,04ppb[h]
		2,4-heptadienal,	fishy oxidised flavor	
		2,4,7-decatrienal,	burnt, fishy, cod-liver oil-like	

(*Continued*)

Table 1. Classes of Odors in Fish and Examples of Compounds Contributing to the Odors (from Olafsdottir and Fleurence, 1998)—Cont'd

Processing odors	2,4-heptadienal and 3,5-octadien-2-one	ripened anchovies
	methional	boiled potato - like odor
	2-methyl-3-furanthiol	meaty odor in canned tuna
Environmental odors	methyl sulfide geosmin	petroleum odors
	2-methyl-iso-borneol	earthy, muddy odors

[a]Josephson (1991); [b] Whitfield *et al*. (1988); [c] Kawai T. (1996); [d] Sheldon *et al*. (1971); [e] Fazzalari (1978); [f] Whitfield and Tindale (1984); [g] Buttery *et al*. (1976); [h] McGill *et al*. (1974).

Species-related fresh fish odors have been attributed to long-chain alcohols and carbonyl compounds like 1,5-octadien-3-ol and 2,6-nonadienal, respectively, which are oxidatively derived from polyunsaturated fatty acids such as eicosapentaenoic acid 20:5ω3 (Josephson *et al*., 1984). Spoilage odors develop as a result of microbial activity and oxidative degradation of the fish components. Compounds such as trimethylamine (Oehlenschläger, 1992), short-chain alcohols (Kelleher and Zall, 1983; Ahmed and Matches, 1983), carbonyls, esters, and sulfur compounds like hydrogen sulfide, methylmercaptan, dimethyl disulfide, and dimethyl trisulfide are produced by microbial degradation of fish constituents (Herbert *et al*.,1975; Kamiya and Ose,1984). Oxidation of fatty acids contributes to the rancid odors of fish with the formation of aldehydes like hexanal, 2,7-heptadienal, and 2,4,7-decadienal (McGill *et al*., 1974). All these compounds are to some degree volatile and may be used to monitor freshness and spoilage of fish.

Both single compounds or a combination of compounds representing the different changes occurring during spoilage have been suggested as indicators for freshness and spoilage of fish (Lindsay *et al*., 1986). Ethanol, 3-methyl-1-butanol, 2-methyl-1-propanol, 3-hydroxy-2-butanone, ethyl acetate, and butanoic acid ethyl ester were the most abundant volatiles in the headspace of haddock stored in ice (Olafsdóttir, 2003). Similar volatile compounds were found in cold-smoked salmon during refrigerated storage (Joffraud *et al*., 2001; Jörgensen *et al*., 2001). This is expected since similar profiles of microflora emerge in different food products when subjected to the same conditions despite being heterogeneous initially (Gram *et al*., 2002). The volatile compounds detected in spoiled cold-smoked salmon were mainly alcohols produced by microbial activity. Some of the volatile compounds produced during spoilage of cold-smoked salmon contributed to the spoilage off-flavor of cold-smoked salmon as confirmed by gas chromatography-olfactometry. These were trimethylamine, 3-methyl butanal, 2-methyl-1-butanol, 3-methyl-1-butanol, 1-penten-3-ol, and 1-propanol (Jörgensen *et al*., 2001).

It is likely that the same set of sensors can be used for monitoring spoilage changes in different fish products because similar volatile compounds emerge