DEP Triennial Review of Maine's Water Quality Standards- 2024 -2026
Written Testimony, Henry Sharpe, President, Frenchman Bay United

Contents

Introduction 1

1. Require Appropriate and Accurate 4D Hydrodynamic Modeling for all Aquaculture Discharge Permit Applications that Impact Tidal Estuaries 5

a. Essential requirements to make 4D Hydrodynamic Modeling appropriate, predictive, accurate and useful*:* 8

2. Eliminate the DEP's General Net Pen Finfish Aquaculture Permit 17

3. For "*Discharge Applications*" from ocean-based finfish farms (and potentially other discharges in tidal estuaries), eliminate the "Non-Eelgrass" Total Nitrogen (TN) Concentration Threshold in the DEP's Remaining Assimilative Capacity Calculations, and sample baseline nitrogen concentrations at locations where nutrients will be transported to, in addition to where they are discharged from 18

4. Include Climate Considerations as a Criterion in all Permitting Decisions 19

5. Maine, like Washington State, should recognize the adverse impact of ocean-based finfish pens on habitats and on wild Atlantic Salmon (listed as an endangered species), should recognize that proven, land-based, zero-discharge true -RAS alternatives exist, and ban all ocean-based finfish net pens. 21

6. In Compliance with Antidegradation Policy, Deny Leases That Would Lower the Existing Quality of Any Body of Water (Not Just an Entire Classified Body of Water) 24

7. Require the DEP to Incorporate Antidegradation Policy into Specific Regulations and Statutes that permit applications would need to comply with 25

8. Require that all the required DMR and DEP permits for a given project be filed and reviewed in advance, before an application is deemed complete, and before any review starts. 26

9. Require DEP to Regulate Closed Net Pens as Solid Waste Treatment Facilities, or, at a Minimum, as Wastewater Treatment Facilities 27

10. Regulate Open -Net Finfish Pens by Different Standards than Closed Pens 28

11. Revise the DEP Public Hearing Processes 28

12. Reconsider the requirements needed to ensure financial and technical capacity. 30

13. Reconsider Notice provisions. 31

APPENDICES 32

A. Summary of Preliminary FBU Analysis of American Aquafarms Project submitted to DEP in July 2022 32

B. Comparison of the License vs Lease Fees American Aquafarms would have paid in Norway vs Maine 35

Introduction

Maine should anticipate huge international economic pressure to develop finfish salmon farming. It's one of the few places in North America that still allows ocean-based finfish aquaculture projects. The entire North American west coast has banned Atlantic Salmon farming following 30 years of heavy investment. They've realized the cost and risks outweigh the benefits. Nova Scotia, recognizing similar concerns, has placed a moratorium on new ocean pens. Even Norway enacted a 35% tax on all salmon raised in ocean-based pens, in part to incent an industry move to more sustainable, proven, land-based true RAS (recirculating, zero discharge) operations. Maine's leasing fees are nearly four thousand times less expensive than territories like Norway (See Appendix). Maine is the closest territory to the world's largest (American) market. And, Maine's regulations are far more permissive than many regions (e.g. Washington State, and British Columbia) that have explored finfish aquaculture. So, for all these reasons, the eyes of the world are on Maine, and getting the regulations right matters.

As Maine considers this reality, it should take careful stock of the lessons learned in regions that have actively pursued and heavily invested in finfish aquaculture. Over and over, the lesson is to limit, if not ban ocean-based finfish farming projects outright. Why? Because land-based, recirculating, zero-discharge (true RAS, not the more prevalent flow-through or FTS technologies that have been promoted in Maine as RAS) technologies prove that it's possible to raise salmon sustainably without the large nutrient, pharmaceutical, pesticide, and diesel pollution produced by ocean-based farms that threaten the long-term abundance of our marine ecosystems and the diverse economies that depend on it. Sure, salmon produced by these true RAS technologies costs more than ocean farmed salmon, but the only reason that producers want to raise salmon in the ocean is that the ROI is fast, and they don't have to pay to remove the enormous waste and pollution that's produced; instead, over the long-term, the record worldwide shows that communities pay for ocean farming in declining marine habitats, fish populations, water quality, recreation, and diminished economies. Why would Maine be any different?

Many would agree that the huge American Aquafarms salmon project caught Maine's citizens and regulatory framework off guard. Many (including Patrick Kelliher and members of the Maine Aquaculture Association) are on record to say that it was inappropriate. And yet, our regulations don't do a good job of preventing equally problematic projects from occurring again soon. Certainly, both the economic conditions and regulatory framework that brought American Aquafarms to Maine persist, and we should anticipate others. We need to be better prepared when that happens.

One of the big issues is that in many locations (*e.g.:* **<u>all</u>** of Maine's existing net pen finfish aquaculture operations), the DEP's General Net Pen Aquaculture Permit allows large discharges from finfish aquaculture operations to adhere to significantly less scrutiny than the MEPDES permits that regulate many other wastewater discharges.

This General Net Pen Aquaculture Permit applies to locations from Brooklin Maine all the way to Canada, 90 miles as the crow flies. It includes locations with vastly differing flow regimes: from inland tidal estuaries with salt marsh eelgrass habitats, to large areas of Class SA-classified water, to remote offshore islands. Because these locations have vastly differing abilities to absorb and flush nitrogen nutrient, proposals for finfish aquaculture in this region should be evaluated on the merits of each site, and not be subject to a blanket permit. To protect existing uses and marine habitats, individual MEPDES wastewater discharge permits should be required for all finfish aquaculture sites. Unless a MEPDES review is done at each specific site, for each proposed discharge, there is no way to assure compliance with 38 M.R.S. §414-A.

> §414-A. Conditions of licenses
>
> 1. Generally. The department shall issue a license for the discharge of any pollutants only if it finds that:

> A. The discharge either by itself or in combination with other discharges will not lower the quality of any classified body of water below such classification
>
> B. The discharge either by itself or in combination with other discharges will not lower the quality of any unclassified body of water below the classification which the board expects to adopt in accordance with this subchapter;
>
> D. The discharge will be subject to effluent limitations that require application of the best practicable treatment. "Effluent limitations" means any restriction or prohibition including, but not limited to, effluent limitations, standards of performance for new sources, toxic effluent standards and other discharge criteria regulating rates, quantities and concentrations of physical, chemical, biological and other constituents that are discharged directly or indirectly into waters of the State. "Best practicable treatment" means the methods of reduction, treatment, control and handling of pollutants, including process methods, and the application of best conventional pollutant control technology or best available technology economically achievable, for a category or class of discharge sources that the department determines are best calculated to protect and improve the quality of the receiving water and that are consistent with the requirements of the Federal Water Pollution Control Act, as amended, and published in 40 Code of Federal Regulations. If no applicable standards exist for a specific activity or discharge, the department must establish limits on a case-by-case basis using best professional judgment, after consultation with the applicant and other interested parties of record. In determining best practicable treatment for each category or class, the department shall consider the existing state of technology, the effectiveness of the available alternatives for control of the type of discharge and the economic feasibility of such alternatives;

In opposition to the American Aquafarms project, our organization, Frenchman Bay Untied, hired Dr. Chris Kincaid, an esteemed oceanographer and Dr. Jason Krumholz a marine biologist. For 20+ years, they have been tasked by the Narragansett Bay Commission (the RI entity that oversees water quality and pollution reduction efforts in Narragansett Bay, the state's main tidal estuary and water body) to build 4D hydrodynamic models to evaluate the impact of nutrient loads in Narragansett Bay. We hired them to build similar models for Frenchman's Bay to evaluate the spatial and temporal distribution of the proposed nutrient discharge from the American Aquafarms project and to evaluate its potential impact. We also asked them the critique the DEP-approved American Aquafarms MEPDES application.

Other groups hired Kincaid and Krumholz to assess the Kingfish project in Jonesport.

Dr. Chris Kincaid is an esteemed oceanographer who for over 20 years has led studies about the impact, concentration, transport, and distribution of nutrient discharges for the Narragansett Bay Commission, the organization that manages RI's marine water quality. His has also developed hydrodynamic modeling of wastewater discharges to assess both the American Aquafarms salmon farm proposed for Frenchman's Bay, and for the Kingfish project proposed for Jonesport.

Those studies suggest that in both locations (where the DEP does require MEPDES Wastewater Discharge Permits), and thus, more generally, whenever MEPDES permits are required, specific regulations, as well as the analysis methods utilized by the DEP are unfortunately outdated and apply assumptions that are not applicable or appropriate to the water flow conditions routinely found in tidal estuaries. Existing regulations and the analysis methods they require therefore produce erroneous conclusions that overstate the ability of tidal estuaries to absorb nitrogen and that understate the adverse impact of proposed discharges.

Dr. Kincaid's work suggests that the DEP needs to eliminate the General Net Pen Aquaculture Permit and modernize MEPDES methodologies to ones that are more accurate, proven, cost-effective, and widely used in the scientific oceanographic community. The key technology to adopt would be 4D hydrodynamic modeling, and more specifically those adhering to the recommendations detailed below in **Section 1.a: Essential requirements to make 4D Hydrodynamic Modeling appropriate, predictive, accurate and useful:**.

By way of example of what such modernized modeling delivers, and as a case in point of what happens when existing, outdated regulations and modeling are applied, consider the American Aquafarms salmon project in Frenchman Bay. American Aquafarms applied for two nearby aquaculture leases, and two corresponding MEPDES wastewater discharge permits. American Aquaculture used methodologies from the DEP's MEPDES application process to conclude that nutrient waste would flush to the sea, and that their nitrogen concentrations would be below thresholds of concern. Further, even though the two sites were just 2.2 miles apart, neither application acknowledged (or was required to acknowledge!) the other nearby large (and simultaneous) proposed discharge. DEP regulations allowed the two applications to be considered in isolation, as totally independent, as though the other application and neighboring enormous discharge did not exist. Additionally, no cumulative impacts were considered from the addition of the two proposed American Aquafarms discharges to the previously approved MEPDES discharges from the Bar Harbor Waste Treatment Facility (3 miles away), or from another previously approved discharge from Acadia Aqua Farms site (7 miles away) that were in proximity to the American Aquafarms sites. The DEP accepted American Aquafarms' conclusions as complete and accurate, and as a result, they concluded that no public hearings were necessary despite widespread pushback from all the municipalities around the bay, from a majority of local citizens of all political stripes (63% of residents according to a poll), from scientists, fishermen, and from business and environmental groups. Instead of public hearings where the applicant's conclusions could be subjected to sworn testimony and cross examination, we got highly scripted public meetings amounting to PR sessions run by the applicant.

The DEP's existing aquaculture regulations made this process and the lack of appropriate scrutiny legal.

With regard to Dr. Kingcaid's actual hydrodynamic modeling, they determined:

- 90-95% of the waste discharged from the proposed American Aquafarms pens and barges would not flush from Frenchman Bay, and that previously discharged waste would not dilute, but instead, because of current gyres that are fixtures of many tidal estuaries, recirculate back to the lease discharge sites to concentrate over time.
- Nutrient waste (nitrogen) would be transported into higher embayment areas, threatening sensitive eelgrass populations that serve as nursery habitats critical to the bay's health. These areas and the marine ecosystems they support are already in jeopardy due to nitrogen concentrations that (currently before the proposed additional American Aquafarms discharges) are already at near-threshold levels.
- Within just 33 days of the 20-year lease terms, nitrogen concentrations in most of the inner bay (46 km^2) would use 100% of the bay's remaining assimilative capacity (0.45mg/L) for non-eelgrass areas. In lay terms, that the bay would have no more ability to absorb nitrogen, and therefore, that algal blooms and die-offs of marine organisms due to low oxygen conditions would be highly likely.

Many of Dr. Kincaid's conclusions were independently supported by another 4D hydrodynamic model created by Dr. Lauren Ross, a UMaine oceanographic researcher. Our summary of specific findings to the DEP is attached as an Appendix.

More generally, and more importantly, **Dr. Kincaid concluded that the methodology employed by the DEP's MEPDES application process *overstates the assimilative capacity* of tidal estuaries (the ability for those bodies to absorb nutrients, e.g., nitrogen) and *understates the adverse impact of the proposed discharges***. That's because current analysis methods use outdated, handbook-style approximations that are premised on a steady flow of clean water across the discharge site. While that assumption may work for certain discharges into rivers, it cannot and should not be used in waterbodies that lack this steady flow of new, clean water. In tidal estuaries where tides, Coriolis forces, temperature and salinity-driven density gradients, and strong bathymetry gradients cause recirculating current gyres and jets, and depth-stratified, unmixed water columns, this particular assumption is conspicuously not satisfied. In other words, application of the current, outdated analysis methods to water bodies in which they are not designed to be used begins with false assumptions that lead to erroneous conclusions. These outdated approximations also make it almost impossible to consider the impact of combined and cumulative impacts from multiple discharges over time across the entire affected water body.

The DEP's outdated resource management analysis methods need to be replaced with proven, more accurate, cost-effective, well-established 4D hydrodynamic modelling tools that are commonly used in the scientific oceanographic community. These modern tools deliver an understanding of the temporal and spatial distribution of pollutants from multiple sources across dynamically changing tidal estuaries that the DEP's currently used methodologies fail to resolve. As such, 4D modelling would lay the foundation to understand combined, cumulative impacts and deliver effective, graphical tools for quickly and effectively communicating highly technical results to both administrative regulators and lay stakeholders.

Kincaid suggests that the DEP should use more accurate modeling methods that can be validated against sub-tidal flow data acquired by moored ADCP measurements taken over a 45 day period followed by towed ADCP, and fixed tilt current meter measurements.

During our opposition to the American Aquafarms project, Frenchman Bay United learned many things that apply generically to all ocean-based finfish production. Here are selected recommendations gleaned from some of the many regulatory shortcomings we experienced. Updated analysis tools and assumptions are essential and required to avoid jeopardizing the DEP's delegated authority from the EPA. They are also required to meet their statutory and rulemaking obligations to the state.

1. Require Appropriate and Accurate 4D Hydrodynamic Modeling for all Aquaculture Discharge Permit Applications that Impact Tidal Estuaries

One of the fundamental problems with ocean-based finfish aquaculture and the discharge regulations that apply (38 M.R.S, §413, §414) is that enormous amounts of food (and therefore nutrients) are added to natural ecosystems that have no means to handle it without adverse impact. Finfish producers typically claim that these nutrient loads are flushed out of bays to the ocean with no consequence. For ocean-based salmon farming, the amount of food added to the ecosystem ranges from 0.9 to 1.25 times the biomass of fish raised. In the case of the proposed American Aquafarms project, approximately 66 million pounds of food pellets and the resulting nutrient would be added annually to an ecosystem that was never evolved or adapted to handle these unnatural nutrient loads. This nutrient load does not just magically disappear without consequence.

Salmon food pellets have a defined percentage of nutrient in the form of nitrogen, which in saltwater estuaries acts as fertilizer to promote algal growth. This algal growth leads to low oxygen events that cause die-offs of fish and other organisms critical to marine habitats, and over time, contributes to eutrophication and the demise of ecosystems in tidal estuaries.

When salmon metabolize food pellets, nitrogen nutrients appear as solids from uneaten food and feces; and in dissolved form, from urine and as a respiratory product emitted from gills. In general, it's the nutrients delivered via feces that settle beneath pens to create "dead zones" that get the most attention. However, it's the dissolved nitrogen that appears dissolved in the water as a respiratory biproduct from fish gills that's of more consequence. Why? First, the amount of dissolved nitrogen is 2X larger than the amount of nitrogen delivered in feces, and second, because that respiratory byproduct nitrogen is dissolved in sea water, it gets transported long distances, often to remote areas of ecological significance.

Management provisions currently used by the DEP to assess far-field contaminant discharge concentrations (particularly nitrogen) use outdated, inaccurate, handbook-style approximations that are premised on a steady flow of clean water across the discharge site. While that assumption may work for certain discharges into rivers, it cannot and should not be used in waterbodies that lack this steady flow of new, clean water. In tidal estuaries where tides, Coriolis forces, temperature and salinity-driven density gradients, and strong bathymetry gradients cause recirculating current gyres and jets, and depth-stratified, unmixed water columns, this particular assumption is conspicuously not satisfied. In other words, application of the current, outdated analysis methods to water bodies in which they are not designed to be used begins with false assumptions that lead to erroneous conclusions, ones that ***overstate the assimilative capacity*** **of tidal estuaries (the ability for those bodies to absorb nutrients, e.g., nitrogen) and** ***understate the adverse impact of the proposed discharges***.

The DEP's procedure evaluates near-field dilution using the Cormix modeling program. While Cormix has its place, it's a very static analysis that only provides 15-second snapshots of mixing gradients. It also has specific limitations that can make its applicability to the required analysis questionable. As a modelling program, it provides no insight into the temporal and spatial distribution of nutrients around the bay, and little insight about transport mechanisms, nutrient concentrations, or the resultant phytoplankton or zooplankton growth rates or distributions over time, and no insight about oxygen demand. Insight about those topics is essential for meeting the DMR's required understanding of impacts to fisheries, habitats, and their ecological viability.

The outdated approximations and very limited modeling tools that are currently used also make it almost impossible to consider the quantitative impact of combined and cumulative impacts from multiple discharge sources over time across the entire affected water body.

The DEP's resource management analysis methods need to be replaced with proven, cost-effective, well-established and appropriate 4D hydrodynamic modelling tools like the Regional Ocean Modeling System (ROMS) that are commonly used in the scientific oceanographic community. These more accurate tools deliver an understanding of the temporal and spatial distribution of pollutants from multiple sources across dynamically changing tidal estuaries that the DEP's currently used methodologies fail to resolve. It also provides insight about phytoplankton and zooplankton growth and distributions and the resulting oxygen demand. As such, this kind of 4D modelling would lay the foundation to understand combined, cumulative impacts and deliver effective, graphical tools for quickly and effectively communicating highly technical results to both administrative regulators and lay stakeholders.

In October of 2023, Maine passed LD 508, legislation directing the DEP to produce the Review of Regulation of Waste Discharge from Finfish Aquaculture Facilities ; Pursuant to Resolve 2023, ch. 59. In its **Recommendations**, the report says:

1) *"water quality models have been used as part of the application process for the three land-based finfish MEPDES/WDL, and one large proposed net pen facility" (Whole Oceans, Nordic, Kingfish, and American Aquafarms)."*
2) *"These models were primarily used to predict the relative influence of the proposed discharge on the ambient concentration of total nitrogen."*
3) *"As part of the MEPDES/WDL application submittal, the applicant shall provide a hydrodynamic model that specifically solves for the equations that govern water movement, such a, but not limited to the following models: ROMS, ECOM, FVCOM, EFDC, and SCHISM."*
4) *"These types of models reliably predict tide height, water level, temperature, salinity, and current speed and direction…"*
5) *"Ultimately, for the purposes of predicting the impact of nutrients, these models* ***can*** *provide necessary estimates of residence time, a parameter that estimates the amount of time a pollutant, in this case nitrogen, spends inside an estuary." [My bold and underlined emphasis on* ***can****.]*

While "modeling" was indeed used by American Aquafarms to predict nutrient loads, as noted near the beginning of this **Section1, RATIONALE AND BACKGROUD** discussion, in the case of the American Aquafarms project, the modeling itself was extremely rudimentary and premised on assumptions that were not met (*e.g.: that clean water flushed the site)*. **Nevertheless, and importantly, in deeming American Aquafarms' MEPDES application as complete, the DEP accepted this modeling as accurate and sufficient. That approval did not meet the DEP's or the DMR's statutory and rulemaking requirements.**

In their recent Review of Regulation of Waste Discharge from Finfish Aquaculture Facilities, the DEP's Recommendations say that "*models reliably predict tide height, water level, temperature, salinity, and current speed and direction",* and (in (5), above) that "*models* ***can*** *reliably predict … residence time…"****.*** The operative word here is ***can***. It's relatively easy for hydrodynamic models to predict tide height, water level, temperature, salinity and current speed and direction. Those parameters are primarily influenced by **tidal flows**, the movement of water forced by tides. What very few models resolve is **sub-tidal flows**, the motions of water that are driven by density gradients, and by wind events. So, while tidal flows move unit volumes of water in and out, in and out, in a periodic oscillation around a discharge point with relatively little overall net transport, it's the density driven, or wind-driven subtidal flows that transport unit volumes of water into or out of estuaries that really matter. So, while some models ***can*** accurately predict residence time, in practice, most do not.

As a case in point, the rudimentary model and calculations performed by American Aquafarms – which largely ignored or inappropriately applied residual flows and that also inappropriately assumed clean water would always flush the site -- predicted that nutrient discharges would flush to the ocean, while the much more detailed and higher resolution Frenchman Bay United / Kincaid model not only predicted that 90% of it would be retained in the bay, but was also able to forecast where and when those nutrient concentrations would occur. Subsequent work is forecasting where and when phytoplankton and zooplankton blooms would have occurred.

In fact, the American Aquafarms "model" for the most part was not so much as a model, as a set of handbook calculations. It completely failed to identify current gyres that continually spin around the bay, and jets that squirt deep currents into the bay's higher embayment regions. These features were independently forecast by 4D hydrodynamic models produced by UMaine researcher Lauren Ross.

Kincaid's Frenchman Bay model forecast that when waste was discharged into these large, deep current gyres, it would recirculate back to the discharge site to compound and concentrate over time without biological consumption until jets spun from the gyres injected highly concentrated nitrogen into shallower higher embayment areas that are most susceptible to these large nutrients loads.

The Kincaid Frenchman Bay model was also validated by the subtidal flows measured by moored current meters positioned in six locations around the bay for six-week deployments.

As another case in point, the model submitted to the DEP for the Kingfish project, while run on a 3D modelling platform, was run in only 2D mode that failed to resolve the vertical structure of sub-tidal flows. That model also drew a box around the discharge site and ignored any ocean currents that either flowed into or out of the box from offshore currents thereby failing to accurately resolve the lateral sub-tidal flows.

In summary, simply requiring "hydrodynamic modeling" as the DEP's report recommends is insufficient to understanding the nutrient load impact on wildlife and marine habitats and on other permitted uses. In lay terms, there is modeling that serves a PR purpose, and there is modeling that accurately, and scientifically characterizes what happens in the field well enough to be predictive. The DEP report says that modeling was required for four recent finfish aquaculture projects: Whole Oceans, Nordic, Kingfish and American Aquafarms. But, as the preceding discussion detailed, the hydrodynamic modeling done for at least the Kingfish and American Aquafarms projects was insufficient to the tasks. The results of those modeling efforts were not predictive.

a. Essential requirements to make 4D Hydrodynamic Modeling appropriate, predictive, accurate and useful*:*

1) **Full, 4-dimensional models capable of analyzing the impacts of both the barotropic flows (tides) as well as the baroclinic flows (due to density gradients) to detail the true residual flows and transports. People are very used to the twice daily tidal changes in water level, and the accompanying ebb and flood currents. However, it is the averaged motion of the water, the so-called sub-tidal, "residual" flow that is most essential for understanding longer term impacts of manmade inputs to our estuaries.**

2) **Spatial grid with high enough resolution to resolve both vertical and lateral structure of sub-tidal (residual, or net-non-tidal) flows.**

3) Boundary conditions around the defined area of interest that are not static but driven by larger resolution NOAA models of surrounding offshore ocean dynamics.

4) Transport and mixing dynamics must be forced by actual wind, wave, salinity, temperature, humidity, air pressure, and variable bottom topology data.

5) The model must be validated against and trained with actual, measured current data.

6) An optimal survey strategy to collect current data needed to inform subtidal processes should use a combination of underway ADCP; moored ADCP; and low-cost, tilt current meter deployments. (ADCPs are Acoustic Doppler Current Profiler instruments that measure current speed and direction throughout the entire water column from surface to bottom.)

a) Full tide cycle, ship-mounted (underway) ADCP surveys should be conducted with repeat lines at the primary area of interest and both landward and seaward of the proposed discharge site. Repeat ship-mounted data transects should be conducted over a full tide cycle, repeating at 1–2-hour intervals for each transect line. These allow tidal and sub-tidal circulation/transport patterns to be characterized, including prominent flow features like jets or gyres, or subtidal inflow/outflow regime boundaries (e.g., the median strip of the superhighway). Ship-mounted, underway ADCP full tide cycle surveys should be done during neap and spring periods. While they are best done in all 4 seasonal periods, they should minimally be done during periods when water quality issues are most common and most critical (e.g., summer-fall).

b) Moored ADCPs should be deployed for ~45-day windows during the periods of water quality concern, with numbers and placements guided by subtidal patterns revealed by ship-mounted underway surveys. The length of time should capture spring-neap cycles, and different wind/storm events. Placements should be in dominant inflow/outflow regions, and should avoid the transitional regions between inflow/outflow (e.g., don't bother using radar guns to find speeding vehicles in highway median strips).

c) Lastly, larger numbers of lower cost tilt current meters should be deployed across the transects landward from the area of interest to provide good spatial and temporal information on near-bottom currents capable of carrying permit applicant discharges landward in deeper, density driven inflows or intrusion currents.

7) Models complying with the previous points produce a temporal and spatial understanding of nitrogen loads. These models treat nitrogen conservatively, as though it were neither consumed nor added. They should be the minimum standard for evaluating discharges from any finfish projects. However, for larger-scale projects particularly, to understand the impacts of these nitrogen loads more fully, further modeling efforts are recommended. For example, the ROMS modeling platform predicts the temporal and spatial distribution of nitrogen as just a first step. There are additional modules within ROMS (e.g.: the Nitogen, Phytoplankton, Zooplankton, Detritus [NPZD] module, and the Fennel module) that forecast the actual growth of phytoplankton and zooplankton that consume this nitrogen, along with the eventual remineralization of the nitrogen after the zooplankton expire. Finally, the ROMS

Fennel model forecasts the oxygen demand produced by these organisms. As the scale (and therefore the risk) of projects increases, so should the modeling effort.

Existing methods used by the DEP to analyze nutrient discharges under-report nutrient loads (the purview of the DEP). This will cause an unexpected and adverse impact on marine habitats and the economies that depend on their abundance (the DMR's purview). To meet it's legal statutory and rulemaking requirements, the DMR should insist on analyzing potential discharges using 4D hydrodynamic modeling that meets the standards enumerated in the preceding 7) suggestions.

As examples of the information appropriate and accurate 4D hydrodynamic models like ROMS can provide – information that is conspicuously lacking in the analysis methodologies currently used and recommended by the DEP – please consider the following:

1) **Detailed data regarding the transport and distribution of simulated floats discharged over time from a proposed lease site.**

   For example, **click this link** to open up a browser window that shows a movie of simulated "floats" released from the Bald Rock site, one of the two proposed American Aquafarms lease sites in Frenchman's Bay. These simulated, neutral density floats drift passively and are transported by water currents to understand where proposed waste discharges are transported to.

   Figure 1

   Click this 2nd link for a video of floats discharged from the neighboring Long Porcupine site. The two proposed lease sites are indicated by the rectangular boxes. After you click Play, the floats begin to be discharged from the respective site.

   Figure 2

   Note that these "float" studies find (in contradiction to the claims by American Aquafarms that nutrients would flush), that in just a 27-day period (of a 20 year lease):

   a) 90+% of float releases (nutrients) are retained in the upper bay and do not flush.
   b) Waste is transported throughout the bay, demonstrating regional impact.
   c) Waste is quickly transported long distances, at rates of up to 10-15 km/day, far from the lease sites, into shallow embayment nursery regions where nitrogen is likely to adversely impact the most sensitive and critical eelgrass habitats.
   d) Waste is seen to recirculate back to the original discharge sites in gyres and eddies where it will concentrate as new waste is added.
   e) Waste recirculates between lease sites: there is combined impact between the sites.
   f) No equilibrium is seen to develop with these trends over multiple float releases.

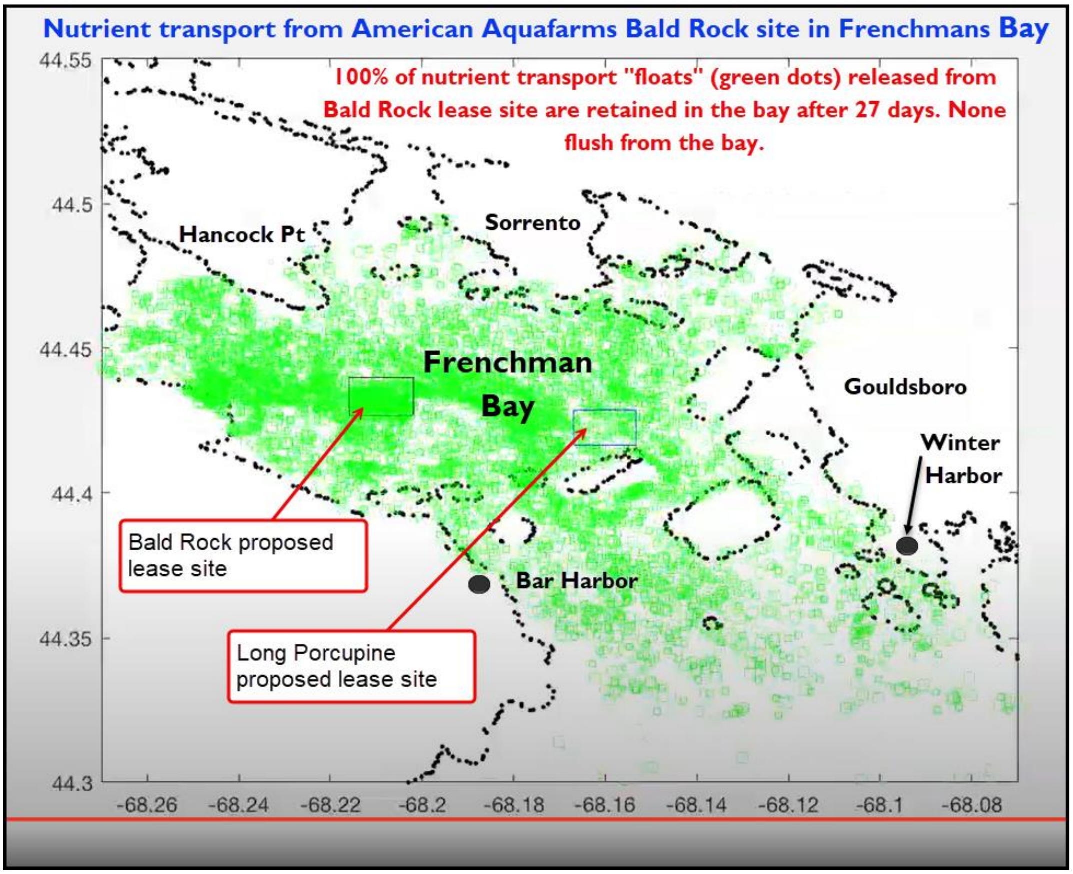

Figure 3– Bald Rock passive float model of nutrient transport dynamics that releases neutral density "floats" from the Bald Rock site every hour which drift with passing water currents. This model shows that 100% of discharges are retained in the bay after day 27 and do not flush.

2) **In addition to understanding where and when waste from aquaculture pens gets transported, ROMS 4D hydrodynamic modeling provides detailed understanding about *discharged pollutant concentrations* throughout the bay over time, especially nitrogen nutrient concentrations.** Nitrogen nutrient concentration, as mentioned earlier, is frequently described using a parameter called the ***remaining assimilative capacity***. Here's how it works.

   The EPA characterizes tidal estuaries by a threshold called the ***total assimilative capacity*** that is nothing more than a maximum allowable concentration of dissolved nitrogen in the water in units of mg/L. This threshold specifies a regulatory maximum nitrogen concentration above which bays no longer thrive because of the algal growth that's triggered by effectively fertilizing the bay with too much nitrogen nutrient. When too much algal growth occurs, oxygen gets consumed from the water, leading to low-oxygen events that cause mass die-offs of fish and other organisms and leading to eutrophication of the water body. As it turns out, the EPA and DEP currently specify two different thresholds: the lower, so-called ***eelgrass threshold*** (0.32 mg/L) nitrogen concentration that's used when eelgrass has been mapped in proximity to a potential discharge site, and a higher, so-called ***total nitrogen (or 'TN') threshold*** (0.45 mg/L) nitrogen concentration when no eelgrass is present. The lower eelgrass threshold is designed to protect sensitive eelgrass populations that are critical to diverse marine habitats that cannot tolerate nitrogen at the TN level.

To understand the impact of a potential nutrient discharge, the DEP's MEPDES permit process requires measurements of the so-called ***background (or sometimes 'baseline') nitrogen concentration*** at the proposed discharge site; this is nothing more than the current nitrogen concentration at the site, before any waste is discharged.

The ***remaining assimilative capacity****, the key parameter used to evaluate waste discharges* is just the difference between the appropriate threshold (*e.g.:* eelgrass or TN) and the current background (baseline) concentration.

Generally, the DEP grants wastewater discharge permits for projects that will use 20% or less of the remaining assimilative capacity. As a method, it's very simplistic: it's a point measurement at one site. It offers no insight of how nutrient concentrations spread from a discharge site to other locations in a bay over time. And, recall what the simulated float studies described in the previous section reveal: that nutrients are transported very quickly (before they can biologically decay) long distances from discharge sites to locations that are likely to have eelgrass populations. That means three things: first, that the TN threshold might have been inappropriately used instead of the eelgrass threshold in the remaining assimilative capacity calculation; second, that the background nitrogen measurement was likely taken in the wrong place, (*i.e.:* at the discharge site, not at the site where nitrogen gets transported to without any chance to decay), and third, and most importantly, that the current DEP methods to assess nutrient load therefore underestimate impacts to critical marine habitats.

All this is (an admittedly long) prelude to the insights 4D hydrodynamic ROMS modeling delivers regarding the impact of nutrient loading on an entire bay's ecosystem. Just as the internal fluid dynamics algorithms in the model provide information about where discharged water is transported to, it also provides data on the concentration and distribution of discharged pollutants around the bay over time. If the pollutant under study is nitrogen, the model provides clear pictures of where, when, and how the entire bay's remaining assimilative capacity is expended. Additionally, this data can be provided as a map that is understandable by non-scientist regulators and stakeholders. For example, consider ***Figure 2*** below that shows the remaining assimilative capacities throughout the bay after adding just 50 days of the nitrogen discharge proposed by the American Aquafarms project. The thick red contour line that fills the inner bay (the area with a bright yellow interior color) shows the area that would exceed 100% of the remaining assimilative capacity using the eelgrass threshold, a threshold that is appropriate considering the proximity to eelgrass populations (shown as green diamonds). The size of this area is 46km^2, an area that almost entirely fills the inner bay. This kind of data, and graphic presentation is simply not available using the DEP's current methodology.

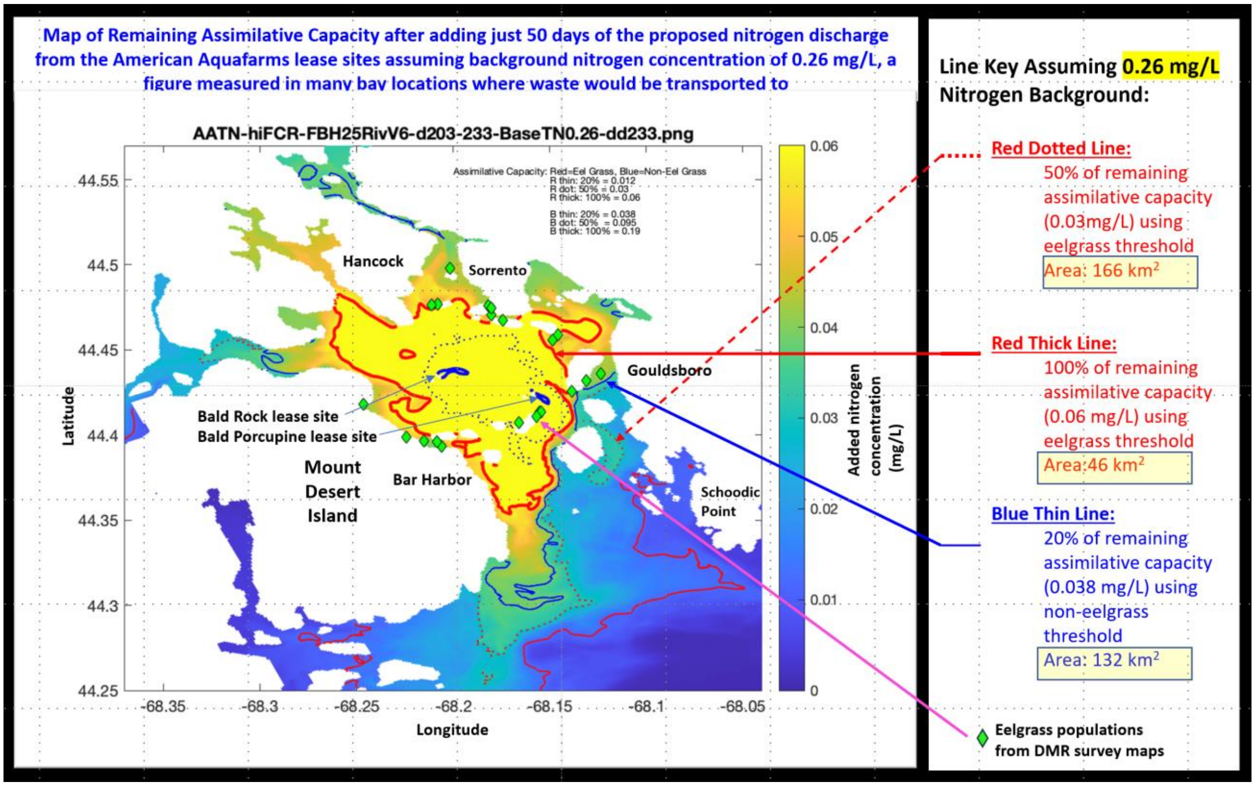

Figure 4

Data like the image above is not only available as a single snapshot, but as a continuous movie showing the spatial distribution over time. **Click this link to open a browser tab that plays a movie showing a 4D hydrodynamic ROMS model** of how the nitrogen concentration plume from the American Aquafarms project would grow over time and impact remaining assimilative capacity. This movie plays quickly, so please use the video slider control to more slowly move through the various days of the simulation to watch the discharge plume spread across the bay over time. Just as in ***Figure 4***, the yellow area surrounded by the thick red line shows areas that exceed 100% of the remaining assimilative capacity assuming that the eel grass nitrogen threshold applies, which since it encompasses many areas with eelgrass, is reasonable.

Figure 5

Next, as another selected example of the benefits of 4D hydrodynamic modeling, consider the following table derived from modeling data that shows area (in km^2) of regions exceeding various remaining assimilative capacities that would have resulted from the American Aquafarms project.

Conclusions:

- In just 50 days, concentrated waste is transported from the discharge sites into the upper embayment areas.
- This waste is injected into shallow areas where it will become bioavailable to trigger algal growth.
- These projected impacts occur within approximately two months in what would be a 20-year lease.
- No evidence of establishing an equilibrium is observed.
- Very large areas of the bay (36-166 km^2) exceed regulatory thresholds under all the model scenarios.

Regulatory Threshold	Assumed Background Nitrogen Concentration: ranging from 0.215 mg/L, as spec'd in AA permits to 0.26 mg/L which has frequently been measured in the bay	Area (km^2) Exceeding Threshold Concentration assuming Industry-Leading feed efficiency, FCR=0.9 as spec'd in applications. This FCR has not been demonstrated w/ mature salmon in these pens.	Area (km^2) Exceeding Threshold Concentration assuming Industry-Avg feed efficiency, FCR=1.25 . Produces 39% more nitrogen
100% of Remaining Assimilative Capacity using Eelgrass threshold	0.215 mg/L	4	12
	0.230 mg/L	6	19
	0.26 mg/L	22	46
50% of Remaining Assimilative Capacity using Eelgrass threshold	0.215 mg/L	28	71
	0.230 mg/L	41	98
	0.26 mg/L	115	166
20% of Remaining Assimilative Capacity using Eelgrass threshold	0.215 mg/L	169	212
	0.230 mg/L	187	237
	0.26 mg/L	249	303
20% of Remaining Assimilative Capacity using Non-Eelgrass threshold	0.215 mg/L	36	91
	0.230 mg/L	44	103
	0.26 mg/L	72	132

Figure 6

3) **Finally, ROMS can also model not only the temporal and spatial distribution of nitrogen but also the growth of phytoplankton and zooplankton resulting from that nitrogen distribution. Here's an example from Dr. Kincaid's Frenchman Bay ROMS model that predicts where and when these organisms will grow using the NPZD model. This should be required for all finfish discharges.**

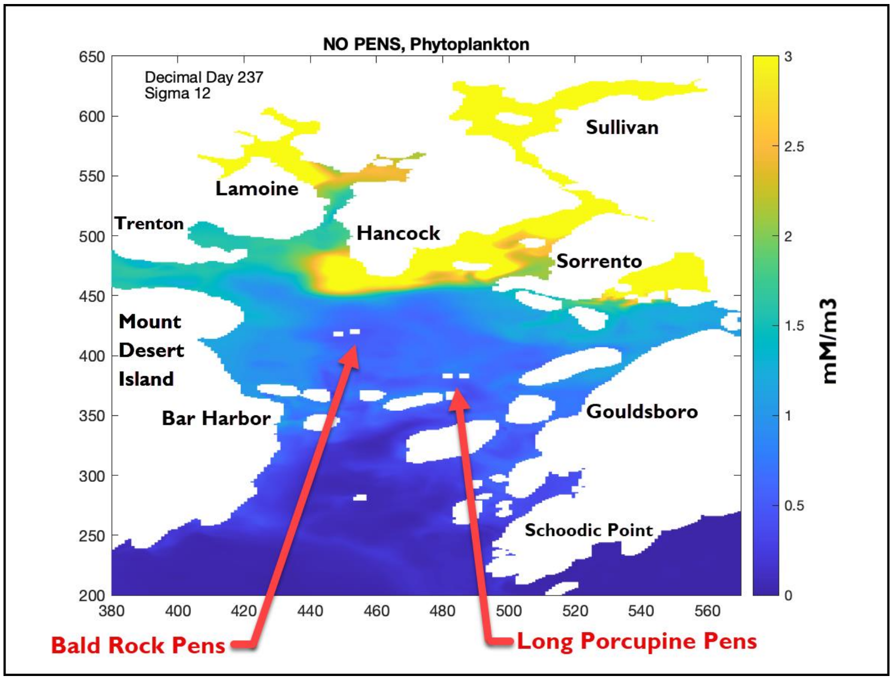

Figure 7

Phytoplankton growth in Frenchman's Bay assuming nitrogen sourced from natural freshwater watershed runoff, deep ocean currents, and the Bar Harbor waste treatment facility, but without the nitrogen from the proposed American Aquafarms salmon farm.

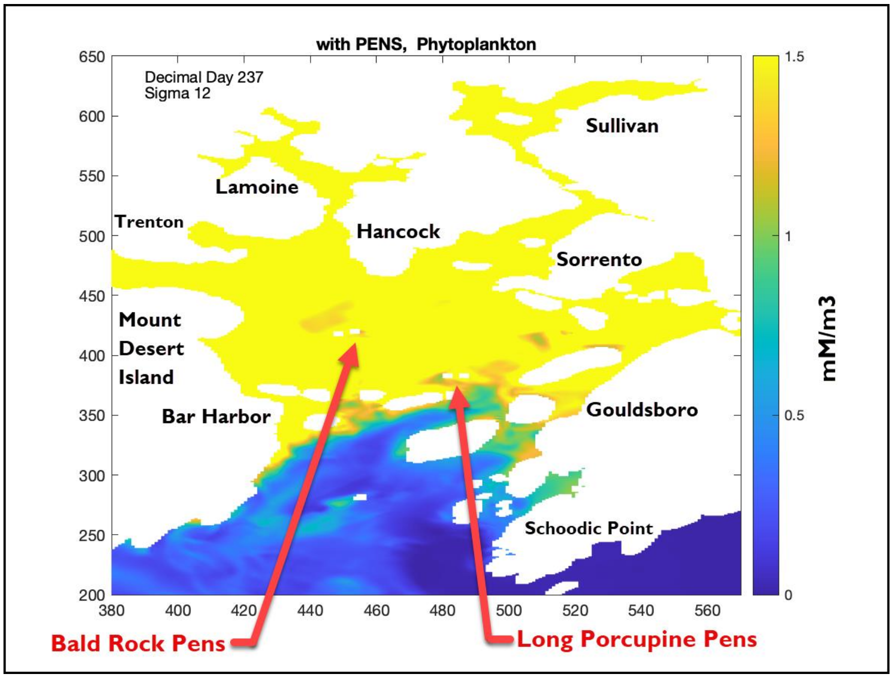

Figure 8

*Phytoplankton growth in Frenchman's Bay assuming nitrogen sourced from natural freshwater watershed runoff, deep ocean currents, and the Bar Harbor waste treatment facility, but **with** the nitrogen from the proposed American Aquafarms salmon farm.*

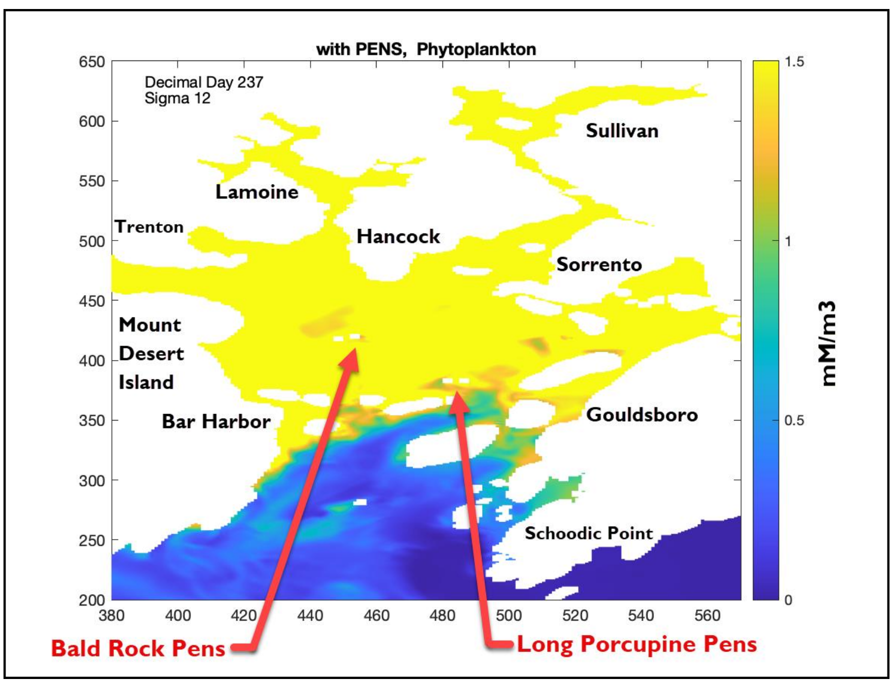

Figure 9

Differential Phytoplankton growth in Frenchman's Bay assuming just the nitrogen from the proposed American Aquafarms salmon farm.

Appropriate, accurate, predictive 4D hydrodynamic modeling like ROMS and the information described in *Figure 1* to *Figure 9* has huge relevance to the health of marine bays. To review:

- Current DEP analysis methods to evaluate waste discharges into tidal estuaries are premised on false assumptions that are not satisfied (clear flow of fresh water over aquaculture lease sites in tidal estuaries). These studies therefore do not provide the required evaluation of the proposed project on the site or surrounding areas.
- These methods assure erroneous conclusions that ***overstate the assimilative capacity*** **of tidal estuaries (the ability for those bodies to absorb nutrient nitrogen) and *understate the adverse impact of the proposed discharges on habitats.***
- Current DEP methods do not provide an accurate way to determine a baseline to monitor environmental effects of a lease activity. 4D models like ROMS would.
- 4D hydrodynamic models like ROMS that accurately characterize subtidal flows are cost-effective and proven to provide accurate results about nutrient loads in ways that are easy to communicate and accessible to regulators and stakeholders.
- These methods allow detailed, quantitative assessment to evaluate combined and cumulative impacts from multiple discharge sources. While such assessments are required under the statutes and regulations cited above, current methodologies make the analysis rudimentary, inaccurate, and highly error prone.

The DEP should require appropriate 4D Hydrodynamic Modeling like ROMS for all Aquaculture Discharge Permit Applications that Impact Tidal Estuaries. In contrast to the modelling requirements put forth in the DEP's Review of Regulation of Waste Discharge from Finfish Aquaculture Facilities**, modelling should adhere to the guidelines established in Section 1.a above: Essential requirements to make 4D Hydrodynamic Modeling appropriate, predictive, accurate and useful:.**

2. Eliminate the DEP's General Net Pen Finfish Aquaculture Permit

Even though finfish farms are well understood to discharge very large amounts of nitrogen nutrient (roughly equal to 3-4% of the biomass produced, and, for example, for the American Aquafarms project, more nutrient than the waste produced by Maine's 4 largest cities combined), the DEP's General Net Pen Aquaculture Permit gives approval to site finfish farms anywhere between Brookline Maine and the Canadian border without adequate consideration for the characteristics of the installation, *e.g.:* whether the site flushes waste; whether the project uses open or closed net pens; the project's scale (which is trending to be much larger in biomass, and therefore waste discharge), or the projects use of diesel fuel (80,000 gallons every 7-10 days in the case of the American Aquafarms project).

The DEP's General Net Pen Permit process policy has insufficient basis in science and therefore fails to provide adequate protections to support water quality, and existing permitted uses .

The General Net Pen Permit process also fails to provide a baseline to evaluate potential adverse impacts to marine habitats and ecologically significant flora and fauna before, during, or after the 20-year lease period.

Finally, to consider the impacts leases in the territory covered by the DEP's General Net Pen Permit would have on the protected activities, it is essential and necessary to also recognize the adverse impacts climate change will -- with or without the proposed lease -- force upon those protected activities, areas, and environments. Assessing baselines at only the start of a lease application project without consideration of the projected changes climate change will force on those baselines over the term of the lease assures that the DEP will fall short of its statutory and rule-based mandated requirements.

Currently climate change and the inevitable changes it will force on the abundance of our ecosystems is not a criterion, but to meet DEP's required protections to water quality and permitted uses, and to evaluate discharges from aquaculture leases in the area defined by the DEP's General Net Pen Aquaculture Permit, it needs to be.

For these reasons, the General Net Pen Permit should be eliminated to require, at a minimum, individual MEPDES applications for each proposed lease and additionally, at a minimum, climate change should be a required criterion for understanding the impact of waste discharges.

3. For "*Discharge Applications*" from ocean-based finfish farms (and potentially other discharges in tidal estuaries), eliminate the "Non-Eelgrass" Total Nitrogen (TN) Concentration Threshold in the DEP's Remaining Assimilative Capacity Calculations, and sample baseline nitrogen concentrations at locations where nutrients will be transported to, in addition to where they are discharged from.

The DEP and other regulating agencies are encouraged to eliminate use of the higher "non-eelgrass" Total Nitrogen (TN), concentration threshold of 0.45 mg/L for assimilative capacity in favor of using the lower "eelgrass threshold" of 0.32 mg/L.

Water current transport and diffusion studies by Dr. Kincaid show that in tidal estuaries, in many locations, intrusion currents are routinely capable of transporting nitrogen discharges (*e.g.: from ocean-based fish pens)* long distances at rates of 10-15 km/day with limited eddy diffusion and drawdown from biological activity. These results virtually assure that nutrients will be transported into regions likely to have eelgrass populations, and thus to have adverse impact on those populations and the habitats that depend on them, the more stringent and conservative eelgrass threshold should universally apply to all calculations of remaining assimilative capacity.

Similarly, in the same calculations of remaining assimilative capacity, the background or baseline nitrogen concentrations used in the calculations should not only be measured at the discharge site, but also at the sites 4D hydrodynamic models predict that nitrogen will be transported to. In other words, we need to be concerned not only with the remaining assimilative capacity at the discharge site itself, but at the typically more environmentally sensitive sites where nutrient discharges will be transported to.

As a further consideration, the most well-studied nutrient load associated with open net pens is related to the excrement that settles to the bottom. However, when fish food is metabolized, the largest source of nitrogen is not in the excrement or uneaten food (16%), but appears dissolved in water as a respiratory biproduct from fish gills and from urine (46%) with the remainder (38%) appearing in the fish biomass (see: Figures 5A, B, C Wang et al, Discharge of Waste from Salmon Farms). Uniquely, water quality studies around pens do not typically show nitrogen concentrations elevated much above background concentrations. That's misleading because of the high-volume flux of water currents passing through pens. What's more of a consideration is not the concentration, but the amount of nitrogen being added to the system, as well as the rate at which it can become consumed by phytoplankton. We believe these factors are significantly underrepresented. The point is, fish food contains a certain percentage of nitrogen. When that food is metabolized, all that nitrogen (think fertilizer) goes into the water. Most of it appears as dissolved nitrogen in the water, not in the excrement. That dissolved nitrogen gets transported long distances to areas likely to have eelgrass. It does not magically just disappear.

Finally, for closed pens (as proposed by American Aquafarms), there are typically two sources of nitrogen discharge that are not seen in open net pen projects. The first discharge comes from "dewatering" excrement in a process whereby, after squeezing the excrement, a very concentrated waste stream (containing ~240 mg/L of nitrogen) is discharged at the surface. This discharge is many, many times more concentrated than discharges from open net pens and (although never tested!) therefore highly likely to cause algal blooms. The second discharge is associated with the water that's pumped through the pens. In the American Aquafarms project, this nitrogen discharge is not too concentrated, just 0.116mg/L, although because of the staggering daily volume (4.1 billion (!!) gallons/day), the resulting nitrogen mass is very significant (2126 kg/day or 4687 lbs/day). This discharge occurs deep in the water column (at ~80 feet in the case of American Aquafarms) at depths below the photic depth where, accordingly, it is not biologically consumed. Further, this discharge is typically injected into deep, cold, salty water currents that hug the bottom topography of tidal estuaries where 4D hydrodynamic modeling shows it will be transported into higher, shallower embayment regions with eelgrass populations, just where it then becomes bioavailable and is likely to do the most harm.

4. Include Climate Considerations as a Criterion in all Permitting Decisions

Climate impact is not a criterion for evaluating DEP wastewater discharges. It should be. For aquaculture, climate impact is seen in at least two major areas: nutrient loading, and CO2 emissions.

1) **Climate impact from nutrient loading:**
   Climate change forecasts include wetter, warmer weather that will increase the amount of nitrogen entering bays from freshwater watershed runoff, and from the largest nitrogen source, deep ocean currents that move into bays along the bottom topography. That means natural sources that we cannot control will increase our bays' nitrogen nutrient baselines even before any waste is added by humans (*e.g.:* from sewage or finfish aquaculture). Since we cannot control these anticipated increases from natural sources, we should put more stringent limits on the man-made sources that we can control. Closed pens and open pens are likely to increase nutrient baselines, and with those increases, more harmful algal blooms and eutrophication.

   To consider the impacts all aquaculture leases would have on the protected activities, it is essential and necessary to also recognize the adverse impacts climate change will -- with or without the proposed lease and discharge -- force upon those protected activities, areas and environments.

Assessing baselines at only the start of a lease/discharge application project without consideration of the projected changes climate change will force on those baselines over the term of the lease assures that the DEP will fall short of its statutory and rule-based mandated requirements.

The existing DMR lease term for finfish aquaculture sites is 20 years. Nutrient loads for the DEP's MEPDES wastewater discharge permits for these facilities are evaluated using nitrogen baseline data at the beginning of the lease term. However, as climate changes occur, wetter and warmer weather will cause nitrogen baselines to naturally increase over this 20-year period. This in turn will naturally reduce the remaining assimilative capacity that is available in tidal estuaries and therefore should reduce the amount of nitrogen discharge a project could legally deliver to hold levels below the 20% of remaining assimilative capacity threshold used by the DEP. Without considering climate change, existing DEP procedures will ***overstate the assimilative capacity* of tidal estuaries (the ability for those bodies to absorb nutrients, e.g., nitrogen) and *understate the adverse impact of the proposed discharges.*** At a minimum, projections for the climate induced increased nitrogen baselines at the end of the lease term should be used in calculating remaining assimilative capacity. More prudently, the impacts of the anticipated CO_2 emissions from the entire enterprise (power generation, trucking, ship traffic, etc) on climate should also be acknowledged and considered, particularly in the context of understanding combined and cumulative impacts.

2) **Climate impact from CO_2 emissions:**
Finfish aquaculture requires lots of transportation by truck and ship, over long distances. The corresponding C02 emissions and spill risks are not adequately considered by the permit process.

As a case in point, the American Aquafarms project planned to produce 66 million pounds of salmon. Raising one pound of salmon requires approximately one pound of food. Therefore 66 million pounds of salmon, and 66 million pounds of food pellets would have been transported by truck ~230 miles across Maine, between Gouldsboro and Kittery and likely beyond. Large ships and barges burning low sulfur fuel would move fish and food from shore to the lease site crossing Class SA waters several times per day. The project planned to use more than 15 million gallons of liquid oxygen per year. It too would need transport over long distances. So too with the more than 16 million gallons of solid waste the project was anticipated to produce. The project also planned to pump and discharge (yes, this figure is accurate) 4.1 billion gallons of untreated waste water each day – dissolved nitrogen, urine, uncollected feces and uneaten food particles – that would be ~3-4 times larger than the 1.3B gal/day of **treated** waste discharged from the 14 municipal sewage treatment plants that serve Manhattan. The firm's DMR lease application indicated that pumping this discharge would have required burning 80,000 gallons of diesel every 7-10 days over a 20-year lease term. Simply transporting such large volumes of fuel over long distances demands consideration.

However, the adverse impact from actually burning the anticipated 80,000 gallons of fuel every 7-10 days demands even more consideration. According to the EIA's CO_2 emission coefficients, and emissions data the project would have produced annual CO_2 emissions of 30,000 to 42,000 MT. Comparing that to the 1.07 million MT of CO_2 produced from all electric power generation in Maine (according to 2018 data from the EIA, the US Energy Information Association) indicates that just **the generators used to power water pumping in the American Aquafarms project alone would have produced 4-6% of the CO2 produced in Maine from all electric power generation**.

Climate change will force huge changes on naturally occurring nutrient loads before aquaculture leases discharge any additional loads. Similarly, land-based finfish aquaculture operations, and ocean-based, closed-pen finfish operations will produce staggering amounts of CO2 to power water pumping.

Meeting the DEP's statutory and rulemaking requirements to uphold the existing permitted uses and water quality demands consideration of these climate impacts.

5. Maine, like Washington State, should recognize the adverse impact of ocean-based finfish pens on habitats and on wild Atlantic Salmon (listed as an endangered species), should recognize that proven, land-based, zero-discharge true -RAS alternatives exist, and ban all ocean-based finfish net pens.

To uphold permitted uses, and water quality that is essential to protecting the endangered and listed Atlantic Salmon, the DEP should recognize that land-based, true RAS zero discharge technologies that offer no adverse impacts to the other uses or habitats or flora or fauna.

The Clean Water Act sets unique regulatory standards. Instead of imposing specific pollutant discharge concentration thresholds for resource managers to adhere to, the Acts *codify the intent* to achieve zero discharge whenever technology is demonstrated that allows reduced pollutant discharge concentrations.

Companies like Sustainable Blue and AquaMaof have developed proven, true-RAS technologies that allow industrial scale finfish facilities to be built far from the ocean. These "true-RAS" technologies are very different from the supposedly RAS technologies proposed by the Nordic Belfast and Jonesport Kingfish operations. While branded as RAS, those technologies would more accurately be labeled Flow Through Systems (FTS) since they would continuously draw huge amounts of fresh groundwater from aquifers, and saltwater from nearby tidal estuaries, and then, subsequently, discharge polluted waste back into the ocean. True RAS systems do neither; they produce zero discharge. They draw groundwater once. Water is pumped and recycled using renewable power. Nitrogen and pathogens are removed with modern, full-scale recycling sewage treatment plants on both the fresh and saltwater loops. No discharge is emitted to either tidal estuaries or into aquafers. Solid waste is composted, then methane digested. They're located close to consumer demand, dramatically decreasing transportation carbon footprint.

It's why the State of Washington partnered with Sustainable Blue after banning net pens. Then, in March 2023, Norway proposed an additional 40% (soon negotiated down to a 35%) tax on all salmon raised in the ocean on top of a 22% corporate income tax. See also this article. Under political pressure, by the time the law went into effect in May 2023 the new tax was reduced to 25%. While the "*levy is* [primarily] *designed to ensure that coastal communities receive more of the value created by fish farming*", the article says "*Experts say such taxes on ocean resources, as well as supporting local communities, have the potential to limit destruction of the marine environment by making ocean-based activities that damage it – such as offshore drilling, freight shipping and deep-sea mining – more expensive.*" In adopting the tax, part of Norway's intent is to increase industry's cost, thereby motivating it to move production (and the pollution it produces) out of the ocean to proven, more sustainable, land-based operations.

Both governments recognized that continued extraction and pollution of finite ocean resources is untenable. That's what responsible, climate-friendly, aquaculture policy looks like – not ocean pens.

If Maine adopted this stance, Cooke's ocean-based open net pens and the huge nutrient pollution they nutrient would be eliminated. *It's worth noting that the DEP's General Net Aquaculture Permit exempts these* operations from publicly disclosing food usage and nutrient composition (and therefore total nutrient discharges). That lack of transparency means there is not even a benchmark to assess adverse impact. Maine truly turns a blind eye to these operations despite proven alternatives.

American Aquafarms proposed a finfish farm that used semi-closed pens that in terms of biomass were approximately six times larger than the open net pens previously used in Maine. They claimed the fish in these pens would be healthier than ever. Unfortunately, because six times the nutrient load would have been discharged from the pens, the surrounding tidal estuary would inevitably have been much worse off. Compounding this, the firm planned to burn 80,000 gallons of diesel fuel every 7-10 days to power the water pumps required by their closed pen operations. The application of BPT would suggest that using land-based RAS operations which produce no nutrient discharge to the oceans, nor constant diesel emissions to the air (let alone potential spills to the surrounding water) would be much more in keeping with the Clean Air and Water Acts.

Another reason to ban salmon farms altogether is the interaction between farmed salmon in open net pens and herring, a species critical to Maine's lobster industry. Alexandra Morton, a biologist who has studied salmon farming in British Columbia makes the strong case in this video that open net salmon pens actively attract wild herring. Because herring are small fish, small enough to pass through the mesh of open net pens, they are routinely seen to be inside salmon pens. Inside the pens, they become feed for the salmon. Morton says that while the resultant impact on herring population is a concern, the much greater concern is the interspecies transmission of disease. Evidence suggests that in the presence of salmon farms, herring populations decline and do not rebound for many years after. Additionally, sea-lice that are ubiquitous parasites in salmon farms now have a vector, via herring, to transport sea-lice, and the diseases that follow from inside open-net pens into the wild. Finally, while salmon pellets are too large for herring to feed on, dust that is produced as fish pellets move down feeding tubes are feeding wild herring. Morton notes that as soon as feeding starts, herring school to the pellet distributors to seek the dust. That means that in many ways, salmon farms have also become herring farms. Herring thus become addicted to this food source. The concern is, when the open pens are fallowed, do herring, who have become accustomed to easily available salmon feed, have the ability to survive in the wild when there is suddenly no source of feed?

Morton's research was instrumental to Washington State's ban on farming Atlantic Salmon. She makes the case that wild salmon are never seen in the numbers and density seen in ocean-based farms and that therefore, ocean-based farm conditions provide almost ideal circumstances to develop, spread, and transmit disease to wild populations.

Viral plumes flowing off the American Aquafarms project would be likely to have a dramatic adverse impact on wild salmon. Diseases like ISA salmon virus (endemic in the wild, rarely clinical because wild populations don't have the density for the disease to become communicable, no cure, no vaccine, but with incidence last year in eastern Canada 2X prior year due to larger farms) have been documented to decimate wild populations.

In Maine, wild Atlantic Salmon are federally listed as endangered species that therefore require mandated protection. The most recent 5-year review **for the Gulf of Maine (GOM) distinct population segment (DPS) of Atlantic** under the **Endangered Species Act of 1973**, found:

- The major threats to Atlantic salmon survival and recovery are **low marine survival**, the direct and indirect effects of dams and road stream crossings, the West Greenland harvest, **and climate change**.
- **The major threats to Atlantic salmon survival and recovery are low marine survival**, the direct and indirect effects of dams and road stream crossings, the West Greenland harvest, and climate change.

A 2018 NOAA/ US Dept of Interior document summarizing the Recovery Plan for Atlantic Salmon in the Gulf of Maine estimates that the annual funding flowing through the DMR to restore wild Atlantic Salmon is:

- •$24M/yr
- $120M between 2017-2021
- $120M between 2019-2023
- A high-priority task for the upcoming 15-yr period that's estimated at $446M

These funds are (and will be) for local construction and planning jobs associated with dam removal, culvert replacements, river flood mitigation, & fish passages. Ocean-based fish farms put wild Atlantic Salmon populations in jeopardy, undermine efforts to repopulate wild salmon, and squander the very significant funds and jobs brought into the Maine economy to support wild salmon populations.

Given:

- the threats of climate change on wild Atlantic Salmon as called out in the most recent ESA review;
- the threat of climate change and its likely adverse impact on nutrient loads, exacerbated by very high non-natural nutrient loads from open and closed finfish net-pens;
- low marine survival for wild Atlantic Salmon as called out in the most recent ESA review;
- the threats enumerated by Alexandra Morton regarding the adverse impact of viral loads from farmed salmon on wild Atlantic Salmon and herring populations;
- millions of dollars of funding flows into Maine from the Department of the Interior to promote wild salmon that provides good construction jobs to improve Maine's rural economy;
- That ocean-based finfish projects jeopardize, undermine, and act as threats to the purpose of each of the points above;

indicates that continuing ocean based finfish farming in Maine (particularly when there are proven land-based RAS solutions that do not compound these threats which therefore demonstrate Best Practicable Technology "BPT") indicates that to accomplish the protection of Maine's wild Atlantic Salmon under the ESA, ocean-based finfish farms should be banned.

6. In Compliance with Antidegradation Policy, Deny Leases That Would Lower the Existing Quality of Any Body of Water (Not Just an Entire Classified Body of Water)

For discharge applications, the DMR requires a DEP MEPDES permit. Applications for these permits evaluate proposed wastewater discharges from ocean-based finfish farms apply anti-degradation policy and how those discharges would impact permitted uses and the classification of marine water bodies. As a case in point, language from a **2022 Cooke Aquaculture MEPDES permit #MEG130029 for Sand Cove** says:

> (1) The discharge, either by itself or in combination with other discharges, will not lower the quality of any classified body of water below such classification.
>
> (3) The provisions of the State's antidegradation policy, 38 M.R.S. Section 464(4)(F), will be met, in that:
> (a) Existing in-stream water uses and the level of water quality necessary to protect and maintain those existing uses will be maintained and protected;
> (b) Where high quality waters of the State constitute an outstanding natural resource, that water quality will be maintained and protected;
> (c) Where the standards of classification of the receiving water body are met or not met, the discharge will not cause or contribute to the failure of the water body to meet the standards of classification;

Antidegradation policy is based on permitted uses in a body of water. While discharge concentrations at an aquaculture site may not be high enough to reduce the classification of an entire classified body of water (*e.g:*.in the American Aquafarms case, an "SB" classification), they may nevertheless be concentrated enough to reduce water quality in some of it, and thus to prohibit or curtail permitted uses in larger than expected areas and depths within proximity to a proposed site. The language in the DEP's permit cited above suggests that to deny a permit, proposed discharges would need to lower the classification of the entire water body, not just some of it.

Language in the antidegradation policy leaves room for interpretation. Consider **38 M.R.S. §414-A. Conditions of licenses**:

> ***1A***: *"The discharge either by itself or in combination with other discharges will not lower the quality of* ***any classified body of water****…"*
>
> *And*
>
> ***1C:*** *"The discharge either by itself or in combination with other discharges will not lower the* ***existing quality of any body of water****…"*

And the definition of **existing water quality** from the Antidegradation Policy:

> *"****Existing water quality****" means the water quality that would exist under critical water quality conditions. Critical water quality conditions include, but are not limited to, conditions of low flow, high water temperature, maximum loading from point source and non-point source discharges, and conditions of acute and chronic effluent toxicity.*

In other words, "existing water quality" means quality in worst case conditions, not the average or typical conditions.

The question is, **should discharges be denied** only if they lower the classification of **any classified body of water** (in other words, the *entire classified body*), or just when they lower the **existing quality of any body of water** (in other words, *some portion smaller than the entire classified body during worst case scenarios*)? Our interpretation, because of the definition of *existing water quality*, is that curtailing permitted uses in *any* portion of the water body satisfies the Antidegradation Policy suggesting that a license should be denied. This interpretation would be supported by the Clean Water Act which is explicit in its intent to strive for zero-discharge.

Finally, Maine's SB classified water body is largely interconnected, and exceeds 7,000 km^2. As you can see in ***Figure 4*** and ***Figure 6***, and the area of the waterbodies where the American Aquafarms project would have reduced remaining assimilative capacity range from tens of square kilometers to 300 square kilometers after just 50 days of anticipated discharge (depending on the threshold, eelgrass, or non-eelgrass, and depending on the amount of reduction in assimilative capacity (>20% of use, to 100% of use). Surely, in considering declines to permitted uses, these 10 to 300 km^2 declines in water quality are material and it should not be necessary to degrade the water quality along Maine's entire 7000 km^2 SB-classified total water body in order for the DEP to evidence concern?

7. Require the DEP to Incorporate Antidegradation Policy into Specific Regulations and Statutes that permit applications would need to comply with

The state's antidegradation policy requires consideration of the *additive or synergistic effects of a discharge under review in combination with other discharges and the cumulative lowering over time of water quality resulting from the proposed discharge in combination with previously approved discharges*. **The Antidegradation Policy should be enshrined in specific regulatory rules and/or statutory language.** Now it is just policy.

Despite these policies, and because of the lack of specific regulations, permit applications often provide no assessment of combined impacts.

For example, American Aquafarms filed two separate MEPDES discharge permit applications, one for each of their proposed lease sites. Neither application disclosed that the same (enormous!) nutrient discharge being applied for at one lease site would be discharged simultaneously just 2.2 miles away at the 2nd adjacent lease area. The applicant's analysis of nutrient concentration impacts in the applications looked only at discharges disclosed in one application while ignoring and obfuscating the fact that the overall project would produce twice the stated discharge into a relatively small bay. Incredibly, under DEP rules, this is completely legal. That should change. As another example, the applicant's analysis did not consider the combined potential impact of discharges from the Bar Harbor Wastewater Treatment Facility that's located just 3-4 miles from the two lease sites nor the Acadia Aqua Farms permitted discharge 7 miles from the same body of water.

Similarly, because the project was being regulated under a MEPDES permit that concerns itself solely with discharge from the fish and pens, the American Aquafarms applications ignored the risks associated with the fact that 40,000 gallons of diesel would be transported, stored, and burned at each of the two lease sites (*e.g.:* 80,000-gallon total) every 7-10 days just 2,000 feet from Acadia National Park.

And finally, the applications provided no discussion of discharge permits from the Prospect Harbor land-based facility.

Enshrining antidegradation policy into specific statutes and regulations would provide better consideration of combined and cumulative impacts.

8. Require that all the required DMR and DEP permits for a given project be filed and reviewed in advance, before an application is deemed complete, and before any review starts.

If all the required DMR and DEP permit applications associated with a given aquaculture project were filed and reviewed in advance, before any application is deemed complete, and before any review starts, the combined impacts for an entire project can be assessed as a whole, not serially, piecemeal. Unless all required permits are filed, this is impossible.

To use the American Aquafarms project as an example, "project" means the entire business enterprise including operations at all the proposed ocean-based lease areas, all the shore facilities, and all the ship and truck traffic.

For projects of regional impact, with many stakeholders, ones that use technology that's new or unproven in Maine, or ones that are large scale (in terms of biomass raised, or diesel consumed) a provision to file all required permits needed from a given agency (*e.g.:* DEP or DMR) together, in advance of acceptance would allow regulators and communities the best chance of understanding all the potential impacts. This requirement would also streamline review and improve efficiencies by the regulatory agencies.

As several examples of the need to consolidate approvals until all required permits are filed, consider the trajectory of the American Aquafarms project. It was a closed-pen project using technology that had never been successfully deployed anywhere worldwide. The only prior test to evaluate pens for raising harvest-size salmon ended precipitously due to poor water quality and high fish mortality. Additionally, no project had collected solid waste from mature salmon. And no project had tried to transport, store, and burn diesel at pens to pump water at anywhere near the same volume: 4.1 billion gal/day – yes, BILLION! That effluent of **untreated** waste – dissolved nitrogen, urine, uncollected feces and uneaten food particles -- would be ~3-4 times larger than the 1.3B gal/day of **treated** waste discharged from the 14 municipal sewage treatment plants that serve Manhattan. Again, into a small, non-flushing, pristine bay known for its robust lobster fishery and for the scenic beauty that makes it a tourist destination.

Closed pen projects require large amounts of power (typically supplied by diesel) to pump an enormous volume of water. These projects should be required to evaluate the impact of their diesel consumption.

Part of that impact includes the spill and pollution risks associated with the transport and storage of very large volumes of fuel (80,000 gallons every 7-10 days). Despite the massive amounts of diesel involved, lease applications filed with the DMR spoke only to "spill-kits" that would only be adequate to address 400-gallon spills, just 0.5% of a potential spill. The DEP expressed no public concern for this inadequacy despite its potential impact on permitted uses, water quality, fisheries, habitats, and environmentally sensitive flora and fauna.

Similarly, the air emissions and climate (CO2) impacts associated with burning that fuel, as well as the waterborne pollution associated with particulate matter from those emissions falling back into and acidifying the nearby water when ocean-based generators lack smokestacks were not adequately addressed since, to the extent the DEP would require "new-minor source" permits for full-time generators, those applications typically do not acknowledge or evaluate the *waterborne* discharges of settling particulate matter; they're all about the *airborne* emissions. Why? Because land-based generators regulated under so-called "new minor source" applications are typically required to use smokestacks to curtail settling of particulate matter. In ocean-based installations, smokestacks are claimed to be "not practicable" and therefore, they're unlikely to be required. Indeed, the American Aquafarms proposal did not plan to use them.

American Aquafarms filed two separate MEPDES discharge permit applications, one for each of their proposed lease sites. Neither application disclosed that the same (enormous!) nutrient discharge being applied for at one lease site would be discharged simultaneously just 2.2 miles away at the 2nd adjacent lease area. The applicant's analysis of nutrient concentration impacts in the applications looked only at discharges disclosed in one application while ignoring and obfuscating the fact that the overall project would produce twice the stated discharge into a relatively small bay. Incredibly, under DEP rules, this is completely legal. That should change.

Similarly, no permits for the land-based portion of the operation proposed for Gouldsboro were filed. The public was completely in the dark about potential discharges from hatcheries and fish processing plants, from operations to process solid waste that potentially included incinerators, or plans to store millions of gallons of liquid oxygen annually, or thousands of gallons of chlorine-based wash down chemicals the FDA mandates for fish processing plants.

Finally, the applicant's analysis did not consider the combined potential impact of discharges from the Bar Harbor Wastewater Treatment Facility that's located just 3-4 miles from the two lease sites nor the other permitted discharges to this same body of water.

A project, particularly large finfish operations should not be deemed complete, start public hearings, or departmental review until applications for all the required permits are filed as a complete package. Doing so would promote full disclosure, efficiently educate the public and stakeholders and streamline regulatory review.

9. Require DEP to Regulate Closed Net Pens as Solid Waste Treatment Facilities, or, at a Minimum, as Wastewater Treatment Facilities

American Aquafarms said it would deploy closed-pen technology to "*collect, process, handle, and transport*" solid waste. Since these are the exact criteria Maine uses to define **Solid Waste Processing Facilities**, these projects should be regulated not under a MEPDES framework, but as Solid Waste Processing Facilities. Maine prohibits locating Solid Waste Processing Facilities in tidal estuaries, suggesting that these closed net facilities should be banned.

Failing that, at a minimum, they should be regulated as **Wastewater Treatment Facilities** because they are not just *discharging* larger volumes of nutrient waste, but also *treating* it in-situ by processing solid waste and discharging a highly concentrated waste stream as a result of this process. However, Maine statues prevent the location of Wastewater Treatment Facilities in proximity to sites that grow products for consumption (like food, or fish).

The DEP should regulate all these concerns, but to date, the only permits typically required by the DEP for ocean-based finish aquaculture are MEPDES wastewater discharge permits. As the scale and technology of these projects has changed, that framework is no longer adequate. For consistency with existing Maine law, other regulatory frameworks should be applied.

10. Regulate Open -Net Finfish Pens by Different Standards than Closed Pens

For finfish aquaculture, the EPA has two established standards: one for ocean-based pens, and another for flow-through (FTS) / recirculating systems (RAS). Finfish aquaculture technology has advanced, so, in Maine (which with Florida, are the only US states that allow ocean pens currently), the DEP should consider additional standards to regulate "closed" and "semi-closed" pens.

Specifically, when the EPA standard was adopted, there were only "open net," ocean-based pens. Fish in them are literally immersed in the ocean environment, and they rely on ocean currents to deliver oxygen and remove waste.

Now however, finfish technology includes new "semi-closed," ocean-based pens. They are designed to isolate fish from the ocean into a more controlled, closed environment. Instead of relying on ocean currents to deliver oxygen or to remove waste, water in "semi-closed" pens is pumped to flow through the pens at rates designed to control temperature, oxygen delivery, waste removal, etc. In other words, they are designed and operate just like land-based, flow through FTS systems. Therefore, at a minimum, "semi-closed" ocean-based pens should be regulated not as ocean-based pens, but as flow through / recirculating systems.

If the standard of "Best Practicable Technology" for Flow-Through/ Recirculating Systems were applied consistently with the Clean Water Act's intent to strive towards zero-discharge, there is little doubt that "closed" and "semi"-closed ocean pens would be prohibited. It is well documented that it's possible to raise finfish on land in facilities that collect waste and produce as close to zero discharge (nutrient, pharmaceutical, pesticides, bacterial, viral, non-native species, CO2, particulate air-emissions, etc) as possible when raising finfish. In other words, for flow through systems, BPT happens on land, not in the ocean.

The only reason producers want to put finfish farms in the ocean is that, in the ocean, they don't need to practice (or pay for) waste removal. We all know, of course, that ocean- based finfish facilities produce waste discharges across the categories noted above, and that it does not just magically disappear. If the BPT standard were applied, Maine would certainly ban closed ocean-based finfish farming altogether (if not open net pens too) in favor of conventional land-based "FTS" systems, or (even better) true, land-based "RAS" facilities that come as close to BPT as possible.

11. Revise the DEP Public Hearing Processes

Current DEP procedures, at least for the American Aquafarms project, denied the opportunity for Public Hearings that would have provided expert testimony and cross examination from qualified intervenors.

Polling suggested that 66% of Hancock County voters opposed the American Aquafarms project. Municipalities around the bay (Gouldsboro, Sorrento, Lamoine, Hancock, Bar Harbor, etc.) publicly declared their opposition. Nearby, mussel, oyster and kelp aquaculture producers (DeKoening, Platner, Redmond) opposed it. Lobster fishermen from around the bay unanimously opposed it. Large, organized business groups (Bar Harbor Chamber of Commerce with 400 members) opposed it. Virtually all the conservation groups around the bay (Friends of Acadia, MCHT, Frenchman Bay Conservancy, The Sierra Club, NRCM, The National Parks Conservation Association, etc) opposed it. Hydrodynamic models from two independent academic researchers (Kincaid, and Ross) suggest that nutrient discharges would adversely impact towns around the bay. **All these make an indisputable case for regional significance.**

The project would have used multiple, novel, unproven and untested technologies (on a world stage, never mind Maine alone), on vast scale with consequent high risk. American Aquafarms pointed to trials of the technology in British Columbia, but those trials ended prematurely due to bad water quality and high fish mortality.

At an annual production of 66M pounds, the American Aquafarms project would have been the largest ocean-based salmon farm in North America (if not the world.) It would have discharged more nitrogen than Maine's four largest cities combined. It would have discharged more than 4.1 billion gallons of untreated waste per day, nearly 3X the treated waste produced by the 14 municipal sewage treatment plants that serve all Manhattan. Hydrodynamic models (Kincaid) suggest that nutrient levels would exceed the bay's assimilative capacity for nitrogen (e.g. the ability for the bay to absorb nitrogen without triggering low-oxygen algal blooms and fish die-offs) in just months with no equilibrium in sight. It would have burned over 80,000 gallons of diesel every 7-10 days to emit 4-6% of the CO_2 produced in Maine from electric power generation. It would have required enormous trucking activity to transport 66M pounds of fish each year, a similar amount of feed, and vast quantities of solid waste, liquid oxygen, and diesel fuel. **On many different levels, all of which impact discharges to the bay falling under the DEP's purview, the project would have had vast, unprecedented scale.**

The four criteria for DEP Environmental Board jurisdiction are: a project located in more than one municipality, regional significance, new technology, and large scale. We believe these criteria should also apply to public hearings. On three of the four criteria, there was overwhelming evidence to support public hearings, and yet, the DEP declared that public hearings were not warranted.

Regulations stipulate that for MEPDES applications, the burden of proof is on the applicant. To use another example from the American Aquafarm project, independent hydrodynamic modelling from two separate highly esteemed academic researchers suggested that nutrient levels would not flush from the bay, but instead would concentrate to exceed permitted limits in just months. When confronted with this evidence for more than half a year, the DEP never allowed public hearings where the applicant's unrealistic claims could be cross-examined by industry experts.

The process used to review and qualify the need for DEP public hearings is problematic and needs change. Thoughtful, well-informed, stakeholders from constituencies around the bay had no voice in a project with huge potential for adverse impact.

Finally, to the extent that public hearings are allowed, due process demands that the subject and scope of hearings should be for the full application, and that hearings are not limited to subsections of the application as determined by the DEP.

12. Reconsider the requirements needed to ensure financial and technical capacity.

As aquaculture projects increase in both scale and potential adverse impact to water quality and the habitats and permitted uses it supports, particularly ocean-based finfish projects that require Discharge Applications under **DMR Aquaculture Regulations 2.10 Application Requirements for Standard Leases, Section (2) Discharge Applications**, the DEP should do more to assess the financial and technical capacity of applicants.

The following are the minimum financial underwriting and vetting guidelines a financial institution would be likely to require from a commercial loan customer. The DEP should consider similar criteria:

i. Formal business plan, including Mission Statement, history, longevity of the company.

ii. All Operating Agreements, i.e. Articles of Incorporations, Certificate of Good Standing and any other documentation to support the operating structure of the entities involved.

iii. Corporate Federal Income Tax Returns - 3 years

iv. Audited Financial Statements - 3 years

v. Itemization and details of all company indebtedness.

vi. An understanding of how the investment will be collateralized.

vii. An understanding of whether working capital line of credit will be established for the project and whether monies will be held in escrow to support operations.

viii. If personal guarantees are required, for each guarantor:

  a) Personal Federal income tax returns - 3 years

  b) Current Personal Financial Statements

  c) Credit reports on all signors and guarantees

  d) International credit reports if international guarantors

ix. In determining eligibility, the financial institution would also:

  a) Conduct an investigation of the company giving consideration to tax issues, fraud history, criminal records, review of a company's website, perform a data base search using online tools to identify the operational integrity and reputation of the business.

  b) Conduct a comparison of the company to similarly situated companies.

  c) If shell companies are involved then a full investigation of each beneficial ownership of each company and its principals.

  d) Financial analysis resulting in an EBITDA of 1.5 greater. EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization). This metric focuses on the profitability of a company's core operations.

Note - If a company is raising capital for a project, they most likely partnered with a venture capital group, these groups would have performed research and the financial institution would request supporting documents from such venture capital group(s).

As to technical ability, the entrepreneurial commitment to risk new things is how innovation happens. But scale matters and the ensuing risk to ecosystems and communities that depend on them matter too. So do existing laws like the Clean Water Act with its requirement to comply with the intent of zero discharge. In the case of finfish farms, Best Practicable Technology (BPT) indicates that zero-discharge, land-based true RAS (not the Flow Through Systems (FTS) that Whole Oceans, Kingfish, and Nordic have co-opted to mislabel as RAS) are more appropriate than ocean-based systems that produce enormous discharges. As a further example, the closed-pen systems American Aquafarms proposed would have operated at enormous scale (as the largest ocean-based salmon farm in North America – if not the world), to raise fish in closed pens that not only had never been proven to raise mature salmon, but with technology that had failed by producing poor water quality and high fish mortality in its only test. Not only that, but the proposal to collect 90% of the solid waste used technology that had never been tried or tested at any scale, let alone at the enormous, proposed scale. Next, despite proposing to be one of the largest salmon farms worldwide, the American Aquafarms team had actually never raised or produced any salmon, anywhere, ever. What could go wrong? Finally, the project planned no smaller scale ramp up to test either the ability to raise mature salmon in closed pens, or to prove that the collection of 90% of the solid waste was feasible. Instead, the plan was to build out the ability to raise the full 66 million pounds of salmon annually with no testing or smaller annual production volume. Imagine if -- as happened at the one failed trial to raise mature salmon in British Columbia – all the salmon died at once, 66 million pounds of salmon in American Aquafarms case. No well boats are anywhere near large enough to transport that volume of dead fish. They would have decayed in Frenchman Bay. Or imagine if the totally untried ability to collect solid waste failed and the resultant increase nutrient load was discharged into Frenchman Bay. And yet, the DMR saw no issues or outsized risk with either the project scale, the unproven (and actually failed) technology to raise mature fish in closed pens, or its completely untested claim to collect 90% of the solid waste, or its totally inexperienced management team. Those technological risks seem not only unwarranted, but cavalier.

For example what might happen if a) 66 million fish died suddenly (as happened in the British Columbia trial of the closed pens, or b) solid waste was indeed not able to be collected, or c) if some significant portion of the 80,000 gallons of diesel stored at the pens spilled (keeping in mind that American Aquafarms only planned to have spill kits capable of containing 400 gallon spills),etc.

If a finfish operation fails, Mainers should not be left holding the bag.

If the DEP grants large wastewater discharge permits to commercial finfish producers, the financial and technical capacity of applicants deserves far more robust consideration. So does the pacing and scale of permitted projects. When scale is large or technology is new, trials should start slow to avoid catastrophic impacts if they fail.

13. Reconsider Notice provisions.

The 4D hydrodynamic modeling done by Dr. Kincaid in Rhode Island, and for Frenchman Bay United regarding the American Aquafarms proposal, and for the Kingfish Jonesport aquafarm project all illustrate that in tidal estuaries, nutrient discharges from aquaculture operations can easily be transported long distances up to 10-15 km/day, far more than 1,000 feet. These studies also illustrate how, because of tidally and density-driven current gyres that are typical in estuaries, nutrient discharges do not dilute as one may intuitively expect, but instead, can be transported long distances without being biologically consumed, and additionally, because of current gyres, can often actually concentrate due to the recirculating currents that bring previously discharged waste quickly back to discharge sites where new nutrients get added.

This body of science indicates that nutrients can be transported long distances, quickly (without biological decay), to adversely impact sites that are far removed from the initial discharge (lease) sites. Notice should be given to those adversely impacted by the discharges, not just those who are in immediate proximity to the initial discharge sites. The idea that impacted owners must only to be in immediate proximity to the discharge sites (leases) is no longer supported by the science.

For a marine aquaculture operations, especially finfish farms, providing notice to only riparian property owners within 1000' (as the DMR requires) is inappropriate. For the reasons above, we propose a tiered notice provision. Initially, notice could be provided to know riparian owners within 1000' of a lease site. However, if **appropriate** 4D hydrodynamic modeling were required before an application is deemed complete (where "**appropriate**" means that modeling complies with the recommendation discussed in **Section 1.a**: **Essential requirements to make 4D Hydrodynamic Modeling appropriate, predictive, accurate and useful:**), then before departmental review or public hearings, notice should be delivered to the additional riparian owners in proximity to discharges that would increase assimilative capacity above 20% of the remaining assimilative capacity. For example, those in proximity to the thin blue line shown in ***Figure 4*** (assuming the non-eelgrass threshold applied). After all its these riparian owners who would suffer more harm that the general public, thereby legitimately qualifying them as intervenors.

APPENDICES

A. Summary of Preliminary FBU Analysis of American Aquafarms Project submitted to DEP in July 2022

Executive Summary (7-27-22):

As of July 2022, Frenchman Bay United's research suggests these concerns, most of which were reviewed at the April 20 2022 meeting with DEP:

1) Nutrient transport models show **that 90-95% of the waste discharged from the pens and barges does not rapidly flush, and that previously discharged waste recirculates back to the lease sites to concentrate**. Much of this recirculation is shown to occur at, or close to the 30m discharge depth from the pens where it is largely below the euphotic zone, and therefore where transported nutrients are not readily bioavailable. The lack of flushing, the recirculating currents, and the fact that much of the circulation occurs below the euphotic zone all contribute to increasing nitrogen concentrations that are, in turn, delivered in concentrated jets into the shallow embayment areas just where the nutrients can become bioavailable to trigger algal growth.
2) Measurement data is presented that the nitrogen background baseline in many of these embayment areas where eelgrass is present is already close to or exceeding the appropriate total nitrogen threshold value of 0.32 mg/L that's widely recognized as the minimum threshold needed for the

protection of eelgrass and therefore affording little or no remaining assimilative capacity. The model indicates transport of discharged waste into these areas.

3) The applications' far-field dilution calculations for both the proposed nitrogen discharge concentrations, and for the so-called "Permitted Load" (loads that would use 20% of the bay's "remaining assimilative capacity"), are premised on the condition of constant discharge concentrations. That condition is not satisfied because of the aforementioned recirculation, which, in short timeframes, would cause an increase in the project's inlet water nitrogen concentration, and a corresponding increase in the effluent concentration, thereby compounding concentrations at the discharge sites over time.

4) The project comprises two applications, one for each lease area. Each application compares the nitrogen load its lease would discharge against the 'Permitted Load' without ever acknowledging the simultaneous nitrogen load contributed by the other application. Each application pretends the other simultaneous discharge was not occurring just 2.2 miles away. The combined impact from both discharges from both leases acting together is ignored.

5) The impact of the preceding four points is that the applications overstate the bay's assimilative capacity and understate the impact of the proposed discharges.

6) Conservative simulations of the Permitted Load (the discharge supposedly meeting anti-degradation requirements by using just 20% of the bay's remaining assimilative capacity for total nitrogen in non-eelgrass areas) proposed by American Aquafarms, ones that accept the applications' stated baseline concentration (0.215 mg/L), as well as the higher non-eelgrass total threshold (0.45 mg/L), as well as the stated constant (*e.g.:* non-compounding) discharge concentration, show that **within just 33 days, nitrogen concentrations in most of the inner bay would use 100% of the bay's assimilative capacity (0.45mg/L) for non-eelgrass areas.**

7) The applications' Proposed Discharge and the calculated Permitted Loads are premised on achieving an ***industry-leading*** feed efficiency, as measured by the Feed Conversion Ratio (FCR). We evaluate the impact of the more prudent case of achieving an ***industry-average*** FCR and conclude that performance would deliver 39% more nitrogen.

8) It's valuable to understand the size of areas in the bay where nitrogen concentrations are likely to exceed various regulatory thresholds. If you assume the 0.215mg/L background nitrogen levels specified in the applications. our model suggests that areas exceeding 20%, 50%, and 100% of the remaining assimilative capacity using the 0.32mg/L eel grass threshold would be 169, 28, and 4 km^2 respectively for the FCR=0.9 feed conversion ratio specified in the applications, and 212, 71, and 12 km^2 if you consider the industry average FCR=1.25 cases. However, measurements in many areas of the bay where modeling shows waste will be transported to often have higher documented nitrogen baselines of 0.26mg/L. **If the higher 0.26mg/L baseline is assumed, the corresponding areas exceeding 20%, 50%, and 100% of the remaining assimilative capacity using the 0.32 mg/L eel grass threshold would be 249, 115, 22 km^2 for FCR=0.9 cases, and 303, 166 and 46 km^2 for the more likely industry average FCR=1.25 cases.** These large areas above the eelgrass threshold include areas specified in the DMR eelgrass maps as areas with eelgrass populations and where therefore the lower eelgrass threshold should apply.

Finally, areas exceeding 20% of the remaining assimilative capacity of the higher 0.45mg/L higher non-eelgrass threshold, and assuming the 0.215mg/L baseline would be 36 and 91 km^2 for the FCR=0.9 and FCR=1.25 cases. Areas exceeding 20% of the 0.45 mg/L threshold increase to 72 and 132 km^2 if we assume a 0.26mg/L baseline.

By comparison, the rough area of the inner bay (but excluding the upper embayment regions like Flanders and Taunton Bay and the Skillings River area) above the Porcupine Islands on the south, below Hancock and Sorrento Points on the north, and from well into the MDI Narrows on the west to Stave Island in the east is 66 km^2.

And last, but not least, please note that these projected impacts occur within approximately two months in what would be a 20-year lease and that no evidence of the model establishing an equilibrium is observed.

9) **Because the proposed project would quickly produce nitrogen concentrations exceeding 100% of the remaining assimilative capacity in such large areas of the bay, other uses like future wastewater discharges to meet a growing population, existing and already permitted aquaculture and fishing operations (to say nothing of future aquaculture and fishing operations), as well as the wild habitats for most of the bay's organisms would be significantly impacted, curtailed, or more expensive.**

10) Our modeling investigates all the bay's natural sources of nitrogen: Wastewater treatment facilities, freshwater rivers, and sources from deep offshore currents. We find that in many areas, particularly the embayment areas, the bay is already close to, or in some cases exceeding the regulatory thresholds. By far the largest source of nitrogen is seen to be nitrogen delivered along the bottom of the bay's topography from deep offshore currents. These natural sources (rivers and offshore currents) are beyond our control, and yet are deemed likely to increase in the near future due to climate induced weather changes. These predicted adverse impacts beyond our control suggest additional caution in evaluating changes to the bay that we can control.

11) Because the bay is shown to flush poorly, and because waste largely recirculates to concentrate below the euphotic zone where it is unlikely to be consumed or bioavailable, a project of smaller scale is not advised. A project of smaller scale would be likely to produce similar outcomes, albeit at longer timescales.

12) We report conclusions from several marine biologists with expertise in Harmful Algal Blooms who suggest that 1) HABS are present near the proposed lease sites and seem to thrive on nutrient concentrations that already occur in the bay near the proposed lease sites, potentially due to the current gyres. If additional nutrients were added by the proposed American Aquafarms project, it's likely these populations would increase. The pseudo-nitzchia species in the region are linked to the presence of the neurotoxin domoic acid that "may result in Domoic Acid Poisoning in wildlife and can cause Amnesic Shellfish Poisoning (ASP) if consumed by humans".

13) Additionally, our HABs experts indicate that proposed discharges from each lease site have the potential to increase sea lettuce and epiphyte populations, to alter the community structure of phytoplankton/HAB species, and to jeopardize the organic rating of the nearby Springtide Seaweed LLC operation.

B. Comparison of the License vs Lease Fees American Aquafarms would have paid in Norway vs Maine

Comparison of License / Lease prices AA would pay in Norway vs Maine

1) **Prices paid for Norwegian standard salmon aquaculture licenses reported Aug 19 2020**

https://www.intrafish.com/salmon/here-are-the-winners-in-norways-670-million-salmon-farming-license-auction/2-1-860253

Conversions:			
exchange rate, NOK to USD:	1 NOK = $	0.115863070	http://www.floatrates.com/feeds.html
Metric Tonnes "MT" to pounds "lb":	1 MT =	2204.6 lb	
Atlantic Salmon Price 2021 (NASDAQ)	52 NOK/kg =	$2.7 /lb	See: Nasdaq Salmon Prices

Company	Size of licenses / company		Total paid by Co.s for licenses		Cost to license a MT or pound	
	Capacity MT	Capacity lb	NOK paid	USD paid	License $/MT	License $/lb
Ballangen Sjofarm	292	643,750	75,067,068	$ 8,697,501	$ 29,786	$ 13.51
Bremnes Seashore	527	1,161,836	99,929,740	$ 11,578,166	$ 21,970	$ 9.97
Cermaq Norway	1,774	3,911,001	451,346,521	$ 52,294,394	$ 29,478	$ 13.37
Eidesvik Laks	386	850,984	73,193,320	$ 8,480,403	$ 21,970	$ 9.97
Eidsfjord Sjofarm	1,984	4,373,971	462,895,641	$ 53,632,510	$ 27,033	$ 12.26
Emilsen Fisk	400	881,849	86,277,600	$ 9,996,388	$ 24,991	$ 11.34
Erviks Laks og Orret	455	1,003,103	110,115,005	$ 12,758,263	$ 28,040	$ 12.72
Finnoy Fisk	115	253,532	21,806,300	$ 2,526,545	$ 21,970	$ 9.97
Gratanglaks	130	286,601	33,420,270	$ 3,872,175	$ 29,786	$ 13.51
Grieg Seafood	527	1,161,836	99,929,740	$ 11,578,166	$ 21,970	$ 9.97
Knutshaugfisk	780	1,719,606	188,768,580	$ 21,871,307	$ 28,040	$ 12.72
Kobbvaglaks	1,000	2,204,623	218,792,000	$ 25,349,913	$ 25,350	$ 11.50
Kvaroy Fiskeoppdrett	1,000	2,204,623	218,792,000	$ 25,349,913	$ 25,350	$ 11.50
Leroy Seafood Group	355	782,641	70,680,855	$ 8,189,301	$ 23,068	$ 10.46
Lofoten Sjoprodukter	5	11,023	1,285,395	$ 148,930	$ 29,786	$ 13.51
Lovundlaks	623	1,373,480	136,307,406	$ 15,792,995	$ 25,350	$ 11.50
Midt-Norsk Havbruk	1,101	2,427,290	237,479,094	$ 27,515,057	$ 24,991	$ 11.34
Says	1,758	3,875,727	300,505,220	$ 34,817,457	$ 19,805	$ 8.98
Masoval Fiskeoppdrett	2,000	4,409,245	484,022,000	$ 56,080,275	$ 28,040	$ 12.72
Nordlaks Oppdrett	200	440,925	50,240,400	$ 5,821,007	$ 29,105	$ 13.20
Norway Royal Salmon	1,050	2,314,854	199,101,000	$ 23,068,453	$ 21,970	$ 9.97
Rogaland Fjordbruk	527	1,161,836	99,929,740	$ 11,578,166	$ 21,970	$ 9.97
Salaks	100	220,462	25,707,900	$ 2,978,596	$ 29,786	$ 13.51
Salmar Farming	8,057	17,762,644	1,760,276,652	$ 203,951,057	$ 25,314	$ 11.48
Seloy Sjofarm	650	1,433,005	142,214,800	$ 16,477,443	$ 25,350	$ 11.50
Sinkaberg-Hansen	300	661,387	64,708,200	$ 7,497,291	$ 24,991	$ 11.34
Sjurelv Fiskeoppdrett	93	205,030	20,414,430	$ 2,365,279	$ 25,433	$ 11.54
Vega Sjofarm	183	403,446	40,038,936	$ 4,639,034	$ 25,350	$ 11.50
Wenberg Fiskeoppdrett	192	423,288	42,008,064	$ 4,867,183	$ 25,350	$ 11.50
Oyfisk	625	1,377,889	159,792,675	$ 18,514,070	$ 29,623	$ 13.44
Total	27,189 MT	59,941,484 pounds	5,975,046,552 NOK	$ 692,287,237 USD $		

1 → Average 2020 Cost paid in $ to Norway to license a MT of biomass ($/MT): $25,700
Average 2020 Cost paid in $ to Norway to license one lb. of biomass ($/lb): $12

2)

Norwegian license payments American Aquafarms would pay based on 2020 auction prices. (Norwegian license fees are 1-time pmts, based on the max. allowable biomass liscensed.)		
AA biomass, MT & lb:	36,000 MT =	79,366,414 lb
AA annual production, MT & lb:	30,000 MT =	66,138,679 lb
AA annual revenue based on Nasdaq price:		$180,746,389
AA revenue over 20 yr lease (using price above):		$3,614,927,784
Cost AA would pay in Norway for a license for the same project they've applied for in Maine based on 2020 license prices		$925,217,887 ← 2

1200MT x 30 pens FB01 Long Porcupine Net Pen Aquaculture Supplemental Application Form with Attachments.pdf

3)

Maine lease payments for AA (annual rent, not 1-time pmt)	
Cost per acre for aquacutlture lease in Maine:	$100
AA lease size (2 projects):	120 acres
AA annual lease payment: $	12,000 ← 3a
AA lease payment to Maine over 20 years:	$240,000 ← 3b

4)

Multiple charged to American Aquafarms for license in Norway (in 2020) vs leases in Maine (20 yr):	3855 x ← 4

5) **Several things are worth noting. First, if AA could permit its 36,000MT project in Norway (and it could not since its biomass is ~20x larger than Norway allows for a project) it's biomass would be 4.5X the multiple licenses totalling 8,057MT purchased by the largest buyer, Salmar. The Salmar licenses alone represented 30% of the 2021 Norwegian licenses granted in 2021 and they were 4x larger than the next largest competitor (2000MT). Bottom line, the American Aquafarms project is huge, and if permitted in Norway, the license fees would be huge too. Finally, at 36,000MT the biomass American Aquafarms proposes is larger than all the biomass licensed to 30 corporations in the Norway auction above.** ← 5

6) **A Note about AA's Total biomass:** Page 1 of the DEP permit application file: **FB01 Long Porcupine Net Pen Aquaculture Supplemental Application Form with Attachments.pdf** indicates the maximum biomass per pen is 1,200,000 kg = 1,200MT. Since there are 30 pens, this suggests the total biomas would be 30x that amount or 36,000MT. However, the same page also says that the Maximum Biomass for the facility is 9,200MT, and since there are two facilities (e.g.: two lease areas), one could infer the total biomass is 2x that amount or 18,400MT = 40,565,056 lbs. However, that figure seems questionable since the well publicied annual production is 66,000,000 lbs of fish. After all, could the annual production really be less than the maximum biomass allowed in the water at agiven time, particualry when it takes 18 months to raise salmon? Becausse of this, the 36,000MT =~80,000,000 lb biomass figure is used since to produce 66M pounds/yr, it seems reasonable to require 80M lbs in the water at any one time. Nevertheless, if the MAB/lease is really 9200MT, and the project biomass is twice that (18,400MT), the equivalent license fee paid to Norway would be $472M, which is still 1970x larger than the lease fee paid to Maine over 20 years. ← 6