

STATE OF MAINE
BOARD OF ENVIRONMENTAL PROTECTION

IN THE MATTER OF

NORDIC AQUAFARMS, INC

Belfast and Northport
Waldo County, Maine

A-1146-71-A-N

L-28319-26-A-N

L-28319-TG-B-N

L-28319-4E-C-N

L-28319-L6-D-N

L-28319-TW-E-N

W-009200-6F-A-N

) APPLICATION FOR AIR EMISSION, SITE
) LOCATION OF DEVELOPMENT,
) NATURAL RESOURCES PROTECTION
) ACT, and MAINE POLLUTANT
) DISCHARGE ELIMINATION
) SYSTEM/WASTE DISCHARGE LICENSES
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PRE-FILED DIRECT TESTIMONY OF ELIZABETH M. RANSOM, P.G.
RANSOM CONSULTING, INC.

1. My name is Elizabeth Ransom. I work as a Principal and Senior Geologist with Ransom Consulting, Inc, (“Ransom”). I hold a Bachelor of Arts degree in geology from Carleton College and a Master of Science degree in geological sciences from the University of Southern California. I have more than 30 years of experience in environmental consulting, spanning a broad range of technical expertise including geologic investigation into groundwater resources, contaminant hydrogeology and remediation, design and implementation of monitoring plans, environmental permitting, alternatives analyses for permitting and remedial alternatives selection, and design and implementation of public involvement plans. I was chair of my local conservation commission for 5 years, and during my tenure I drafted wetland bylaws which were accepted by town vote. I am a licensed professional geologist. My professional experience and qualifications are further detailed by my resume, which is included as Addendum A.

2. My role on the Nordic Aquafarms, Inc. project is to oversee personnel with specific expertise who undertook a variety of tasks for the project including hydrogeologic investigation and water supply development, discharge modeling, and stormwater management. In addition, I coordinated with subcontractors with specific expertise in air permitting (Mainely Environmental), groundwater modeling (McDonald Morrissey Associates [MMA]) and wetlands delineations, vernal pool surveys, stream, wildlife and fisheries assessments, and benthic studies (Normandeau Associates) to provide information to the project team. As Ransom’s project manager for the Nordic Aquafarms project, I coordinated preparation of the Natural Resources Protection Act (NRPA) and Site Location of Development Act (SLODA) permits, and specifically prepared the Alternatives Analysis provided in the NRPA application and included as Nordic Exhibit 6.

3. In June 2017, Ransom was asked by Nordic Aquafarms to assist with site selection and environmental permitting for a proposed land-based aquaculture facility to be located somewhere between the Canadian border and Washington, D.C. Nordic Aquafarms’ market data indicated that seafood demand, including salmon, would be high in this region,

and the reasonably short driving distances in the northeast would allow fresh product to be shipped from the proposed facility by truck or train. Current U.S. consumption of seafood is among the highest per capita, yet the U.S. produces less than 10% of the seafood it consumes, resulting in a significant carbon footprint to import fish to meet demand. Nordic Aquafarms' proposed aquaculture facility will reduce the US seafood trade deficit and carbon emissions associated with air freighting seafood imports.

4. The purpose of the project is to provide 33,000 metric tons of high quality seafood to consumers in the northeastern United States.

5. Ransom conducted a geospatial desktop analysis utilizing available databases and maps to identify potential locations for development. Criteria for assessment included availability of sufficient land, access to clean and cold seawater, attractive workplace location, buildable lot size, available road and utility infrastructure, effluent impacts to local waterbody, construction impacts to natural resources, lack of adverse pre-existing environmental conditions, ground conditions favorable to construction, and access to abundant freshwater resource(s).

6. Nordic Aquafarms identified a number of objectives for siting the project to ensure that the project is economically viable and commercially sustainable. Specifically, these objectives included: production of 33,000 metric tons of salmon to meet 7% of the current U.S. demand, reducing the carbon footprint of fresh, farmed Atlantic salmon to 1/3 of that for imported salmon, producing a volume (33,000 metric tons) that would offset the high fixed investment costs to build the site infrastructure, having a production cost per unit of fish that is cost competitive with other suppliers, providing 100 direct jobs and other indirect jobs to the local community, provide opportunities for development of ancillary business opportunities (such as development of lobster bait or other uses from by-products), and limiting environmental impacts while still having commercial viability.

7. Ransom evaluated offshore temperature and water quality data for each state with coastline in the designated area. Access to suitable clean and cold seawater limited the project to three states, including Maine. Application of the criteria for assessment described in paragraph 4 above resulted in Maine being the only viable option. Up to 534 potential properties in Maine were identified through geospatial analysis, and individual desktop assessment of these sites by Ransom staff reduced this list to 40 locations. I conducted site visits to the most favorable locations, and the results of the site visits and the potential to acquire property rights were used to further narrow the list. Erik Heim of Nordic Aquafarms visited sites with the highest potential to meet project objectives.

8. Developing the alternatives analysis involved summarizing the scoring of four remaining locations in a site selection matrix. These potential sites included Belfast, an alternative mid-coast site, a northern site, and a southern site. Based on a potential score of 50 points, Belfast scored highest at 45 points. The next closest site was the northern site, at 35 points. Based on this assessment, the Belfast site was selected for potential development.

9. The alternatives analysis included four potential site layouts designed by Nordic and their U.S.-based engineering team for the upland portion of the project. Specifically, the

potential site layouts included Option 1, 6 modules on 39 acres of land; Option 2, 3 modules on 39 acres of land; Option 3, 6 modules on 54 acres of land, and Option 4, 5 modules on 54 acres of land. These options were evaluated in accordance with NRPA guidance for the following criteria: regulatory requirements, environmental impacts, construction/engineering/operational feasibility, and financial feasibility, and scored in a weighted matrix.

10. Criteria were scored with values 1 to 5 for each option. Regulatory requirements and financial feasibility were weighted higher than engineering feasibility, resulting in a total of 60 possible points for regulatory requirements, 60 possible points for financial feasibility, 45 possible points for environmental impacts, and 15 possible points for engineering feasibility. Out of 180 possible points, Option 3, 6 modules on 54 acres of land, is the preferred alternative, with a score of 116. Options 1 and 2 do not legally meet applicable regulatory requirements, and although these options scored 93 and 67 points, respectively, could not be built as they do not meet city setback and fire code requirements. Options 1 and 4 are not feasible due to technical, logistical or financial constraints. There are no practicable alternatives to the preferred alternative.

11. The alternatives analysis also considered layout alternatives for the three intake/outfall pipeline routes from Nordic Aquafarms proposed facility. Evaluation of the three pipeline routes independently from the project layouts used an approach that was similar to the one used to analyze the potential site layouts for the upland portion of the property. As shown on the figure in Appendix 2-F of Nordic Exhibit 6, the pipeline routes included the Little River (Option 1), the Eckrote Property (Option 2), and Tozier Road (Option 3). The Eckrote property option included three possible configurations of the pipeline from the shoreline to the discharge and intake points, including a straight, slightly curved, and double curved route. Criteria assessed for each pipeline route included regulatory requirements, construction considerations, engineering design, challenges and risks, and financial feasibility.

12. As noted in Nordic Exhibit 6,

“Option 1 would involve numerous property owners, a lengthy pipeline and pipeline construction process that has significant environmental impact to the Little River and associated infrastructure and the intertidal area, and substantial cost and uncertainty.

Option 3 has significant impacts to coastal wetlands, including sensitive coastal bluff ecosystems, extensive slope stabilization measures, potential impacts to transportation infrastructure and nearby structures, numerous property owners, construction within a drainage way and loss of vegetation, deep excavation and pipe alignment at the crossing of Route 1. Lack of engineering feasibility and at least one property owner who refused access for the project make this alternative impracticable. Additionally, this option would pose significant financial burdens on the project both during installation and operation.

Option 2 achieves the purpose of transporting seawater to the proposed facility site and discharging treated water from the proposed facility in the lowest risk, fewest impacts to

natural resources, and least costly method. Based on environmental, engineering, constructability analysis conducted to date, Option 2 is the preferred option. Within Option 2, the curved route is the preferred alternative for its logistical and technical advantages.”

13. The results of the Alternatives Analysis indicated that a 6-module facility located on 54 acres of land in Belfast, Maine, with a curved pipeline through the Eckrote parcel, meets the project purpose to provide 33,000 metric tons of high quality seafood to consumers in the northeastern United States. There is no practicable alternative.

14. Materials disturbed during the proposed pipeline construction include marine sediments which will be excavated and excess sediment that doesn't fit back into the pipeline trench will be removed from the site for upland disposal. As a preliminary step in evaluating potential disposal options, Normandeau collected samples from the marine sediment in the vicinity of the proposed pipeline routes under evaluation. Sediment samples were collected using a Vibracore and EPA/United States Army Corps of Engineers Regional Implementation Manual guidance on November 29, 2018 and submitted to Alpha Analytical Labs in Westborough, MA for laboratory analysis of multiple parameters. Multiple samples were collected for grain size analysis, while two samples, B3 and A6/A7 composite (See Figure 18-1 of the application shown on Nordic Exhibit 7), were submitted for chemical and physical characteristics analysis.

15. Mercury concentrations for these two samples, which were 0.267 mg/kg for sample B3 and not detected (at a detection limit of 0.103 mg/kg) for sample A6/A7 can be compared to Maine Remedial Action Guidelines (RAGs) for mercury, shown below. The recreational use/sediment exposure pathway standard is considered applicable to these samples.

CAS Number	Chemical	Soil RAG (milligram per kilogram, mg/kg)					
		Leaching to Groundwater	Residential	Commercial Worker	Park User	Recreator Sediment	Construction Worker
7439-97-6	Mercury (elemental)	1.8	3.1	3.1	3.1	100,000	3.1

The mercury concentrations in the sediments in the area of the piping route are more than an order of magnitude below the applicable RAGs.

16. Mercury concentrations at the sample locations in the area of the piping route are comparable to available data for this part of the bay from regional mercury studies such as those conducted for the Penobscot Bay Mercury Study (PRMS) released in 2013 as part of the Mallinckrodt, Inc. cleanup and litigation regarding the liability for contamination associated with the former Holtrachem site. As noted in the PRMS, mercury concentrations decrease substantially with distance from the former Holtrachem facility, and are in the 0.200 to 0.300 mg/kg range in the vicinity of the northwestern end of Islesboro and the mouth of Belfast Bay.

16. Ransom reviewed the laboratory results in the context of disposing sediments excavated during construction at a solid waste facility. As noted in the Site Location of Development Application,

“Crossroads Landfill, where construction waste would potentially be disposed of for this project, is licensed by the State of Maine to dispose of non-hazardous waste. 40 CFR 261.24 identifies toxicity characteristics (standards) in solid waste and is used to determine whether solid waste is characterized as hazardous or non-hazardous. Landfill waste is tested and compared to toxicity characteristics based on EPA Method 1311 “Toxicity Characteristic Leaching Procedure,” or TCLP analysis, which is used for simulating the leaching potential from landfill waste. Method 1311 TCLP analysis specifies an extraction fluid equivalent to 20 times the total weight of a waste sample for evaluating the leaching potential of the sample. However, if a total sample concentration, as determined from a conventional analytical test (e.g. versus the TCLP test), is less than 20 times the toxicity characteristic concentration, then the waste can be considered non-hazardous and no further testing is required.”

17. Ransom compared laboratory results (analyzed with conventional methods for total concentration) for which there were detections above laboratory reporting limits to the 40 CFR 261.24 toxicity characteristics (multiplied by 20) to determine whether the samples met the criteria for non-hazardous waste. The summary of our detections and the 40 CFR 261.24 Guidelines are reported in **Table 18-3** of the Site Location of Development Application, as shown on Nordic Exhibit 7. These results do not indicate exceedance of any of the toxicity characteristics in 40 CFR 261.24. Based on the laboratory results and using the “rule of 20” for evaluating waste samples, no further sediment testing (e.g. EPA Method 1311 TCLP testing) is warranted and marine sediments from the project site can be accepted as non-hazardous waste for disposal at a RCRA Subtitle D landfill.

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Dated December 10, 2019

By 
Elizabeth M. Ransom, P.G., Principal, Senior Geologist
Ransom Consulting, Inc.

STATE OF NH
County of Rockingham, ss.

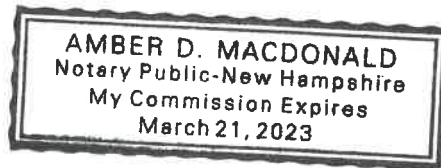
December 10, 2019

Personally appeared the above-named Elizabeth Ransom and made oath as to the truth of the foregoing pre-filed testimony.

Before me,



Notary Public / Attorney at law



EDUCATION

M.S. Geological Sciences, University of Southern California, 1990
B.A. Geology, minor in Media Studies, Carleton College, 1986

PROFESSIONAL REGISTRATIONS

- Professional Geologist, New Hampshire, 2002, #505; Pennsylvania 1995, PG-003213-G
- 40-hour OSHA Hazardous Waste Operations and Emergency Response Training, 8-hour Annual Refreshers
- 8-hour, OSHA 29 CFR 1910.120 Hazardous Waste Supervisor Health and Safety Course

GENERAL BACKGROUND

Elizabeth has over 30 years of experience in environmental consulting. She has managed environmental, permitting, and solid waste consulting services for multiple clients while balancing technical requirements, deadlines, budgets, regulations, and client service. She is highly skilled in developing field investigation programs; producing technical reports, studies, permit applications and proposals; and in communicating with clients, subcontractors, and regulators. Her technical specialties include: hydrogeological and contaminant investigations, remedial investigations/feasibility studies; subsurface investigations at dense non-aqueous phase liquid and other hazardous waste sites; groundwater system design, installation and sampling; geologic interpretation; design of remedial actions at petroleum and chlorinated solvent sites; proposal and budget preparation for Federal, State, municipal and private clients; landfill closures; community relations; and public participation.

REPRESENTATIVE PROJECT EXPERIENCE

- **MBTA/Fort Point Channel Transitway Alignment Permitting, Boston, Massachusetts.** Designed and managed implementation of drilling and sampling program to assess sediment quantity and quality within proposed transitway alignments. Conducted a review of treatment and disposal options for contaminated sediments as part of Environmental Impact Report/Statement (EIR/EIS). Assessed impacts of disposal and treatment options to environment. Collaborated with project team to prepare EIR/EIS and final state and federal permitting documents.
- **Boston Children's Museum Expansion, Boston, Massachusetts.** Responsible for the preparation of Massachusetts state permitting under environmental affairs, wetlands and waterways, and the historical commission for the expansion of the Boston Children's Museum. Project included the filing of Chapter 91, PNF, ENF, and NOI applications. Coordinated with project team members to assess potential project impacts and compliance with environmental regulations.
- **Major Petroleum Retailer, Maine and other New England States.** Principal in charge of all aspects of environmental work related to development, investigation and remediation projects for convenience retail locations located throughout Maine and other New England states. Work includes permitting and planning of new locations and site upgrades, compliance with UST regulations during upgrades, site operation and maintenance, and soil and groundwater investigation and remediation where applicable.
- **Seacoast, New Hampshire Former Manufacturing Facility, Soil and Groundwater Investigation and Remedial Design, Dover, New Hampshire.** Conducted detailed source zone soil and groundwater investigation of chlorinated solvents; prepared remedial action plan evaluating thermal remediation technologies and/or soil excavation of chlorinated solvent source zone; conducted groundwater modelling to assess effects of various source zone remedial alternatives; evaluated technical suitability and cost effectiveness; prepared remedial action plan and performance monitoring sampling and analysis plan; oversaw wetland restoration work; and prepared permits and site closure documents for NH DES submittal.

2.0 ATTACHMENT 2 - ALTERNATIVES ANALYSIS

2.1 Introduction

The proposed project location in Belfast, Maine was selected by Nordic Aquafarms, LLC (Nordic) following a six-month search process. This process began with a geospatial desktop analysis, utilizing publicly available datasets, of coastal land extending from Washington D.C. to the Canadian border. This initial analysis along with Nordic's need for clean and cold fresh and salt water determined that the proposed project should be located in the State of Maine. This decision was bolstered by the comparative availability of coastal land and clean groundwater in Maine and national recognition and branding of the state as a producer of high-quality seafood.

As required under the State of Maine's Natural Resource Protection Act (NRPA), this section describes how the preferred project design presented herein will avoid and minimize impacts to protected natural resources to the maximum extent possible while remaining logistically, technically, and economically viable.

2.2 Project Need

Ocean health globally is increasingly challenged by pollution, oxygen depletion, rising sea temperatures, microplastics, ocean acidification, and demand for wild caught seafood. At the same time, there is increasing demand for healthy protein to feed a rapidly growing world population. The Food and Agriculture Organization (FAO) of the United Nations projects world population will grow by two billion within the next three decades and require a 70 percent increase in the global food supply to match the projected population growth ¹.

According to the most recent outlook of world fisheries and aquaculture reported by the FAO, world aquaculture production must double in the three next decades to meet demand for sustainable protein, as wild caught fisheries have not increased substantially in the past two decades and cannot meet the projected demand in the coming decades ².

According to the National Oceanic and Atmospheric Administration (NOAA) ³, the US is a minor aquaculture producer, ranked 16th in 2016 excluding seaweed on a global scale – but it is the leading global importer of fish and fishery products. The NOAA-National Marine Fisheries Services 2017 annual report ⁴ indicates the US seafood market grew by 7.4 percent, with shrimp and salmon as the highest growth products. Fifty percent of seafood imports into the US are sourced from aquaculture. In 2017, NOAA Fisheries statistics ⁵ indicate the US imports of fresh and frozen *salmon* were 356,385 tons valued at \$3.5 billion. For comparison, US imports of fresh and frozen salmon were 329,845 tons valued at \$2.5 billion in 2015 ⁶. Local production of fresh seafood in the US is imperative to achieve food security, a reduced environmental footprint, and to and meet consumer demand. This belief is consistent with

¹ FAO. 2017. The future of food and agriculture – Trends and challenges. Rome. <http://www.fao.org/3/a-i6583e.pdf>

² FAO. 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome. License: CC BY-NC-SA 3.0 IGO. <http://www.fao.org/3/i9540en/i9540en.pdf>

³ <https://www.fisheries.noaa.gov/national/aquaculture/us-aquaculture>

⁴ National Marine Fisheries Service (2018) Fisheries of the United States, 2017. US Department of Commerce, NOAA Current Fishery Statistics No. 2017. <https://www.fisheries.noaa.gov/feature-story/fisheries-united-states-2016>

⁵ <https://www.st.nmfs.noaa.gov/Assets/commercial/trade/Trade2017.pdf>

⁶ <https://www.st.nmfs.noaa.gov/Assets/commercial/trade/Trade2015.pdf>

findings in US-funded research ⁷. Nordic is confident that “Made in the USA” seafood products (and especially “Made in Maine” seafood) have high consumer acceptance and will contribute to reducing the US seafood trade deficit. Seafood production in the US also will support consumer and regulatory desire for a full and transparent seafood traceability standard applicable to seafood products sold in the US.

In addition, production of fresh seafood at the proposed project location will contribute to lowering the carbon dioxide (CO₂) footprint associated with air freighted seafood imports, which currently dominate the US seafood consumer market. Carbon footprints of seafood products are increasingly important in sustainability assessments of seafood products, particularly with respect to eco-labels, sustainability certification, and consumer seafood sustainability guides ⁸. A seafood product’s carbon footprint represents the amount of greenhouse gas (GHG) emissions released during its production, transport, and any construction allocated over the lifetime of equipment/buildings calculated as carbon dioxide equivalent (CO₂e), calculated via established methodologies ⁹. The proposed project in Belfast will have a significantly lower CO₂ footprint relative to the comparable footprint associated with current trans-ocean air freighted seafood imports¹⁰. The Nordic Belfast project is calculated to save the CO₂ equivalent of over 1.5 million barrels of oil per year compared to airfreighted alternatives. Airfreight of two pounds (≈1 kilogram) of air freighted seafood adds between 18-26 pounds (≈8-11 kilograms) of CO₂. For recirculating aquaculture system (RAS) production, the CO₂ profile is most favorable with a clean local energy mix. Maine has a favorable energy mix with less than one percent coal. An alternatives analysis of the relative CO₂ emissions as conducted by SINTEF and the Freshwater Institute is illustrated below ¹¹. While the economics have changed dramatically for land-based farms in recent years, the CO₂ equations remains unchanged.

⁷ See e.g., Kite-Powell, H.L., Rubino, M.C. and Morehead, B., 2013. The future of US seafood supply. *Aquaculture Economics & Management*. 17(3):228-250.

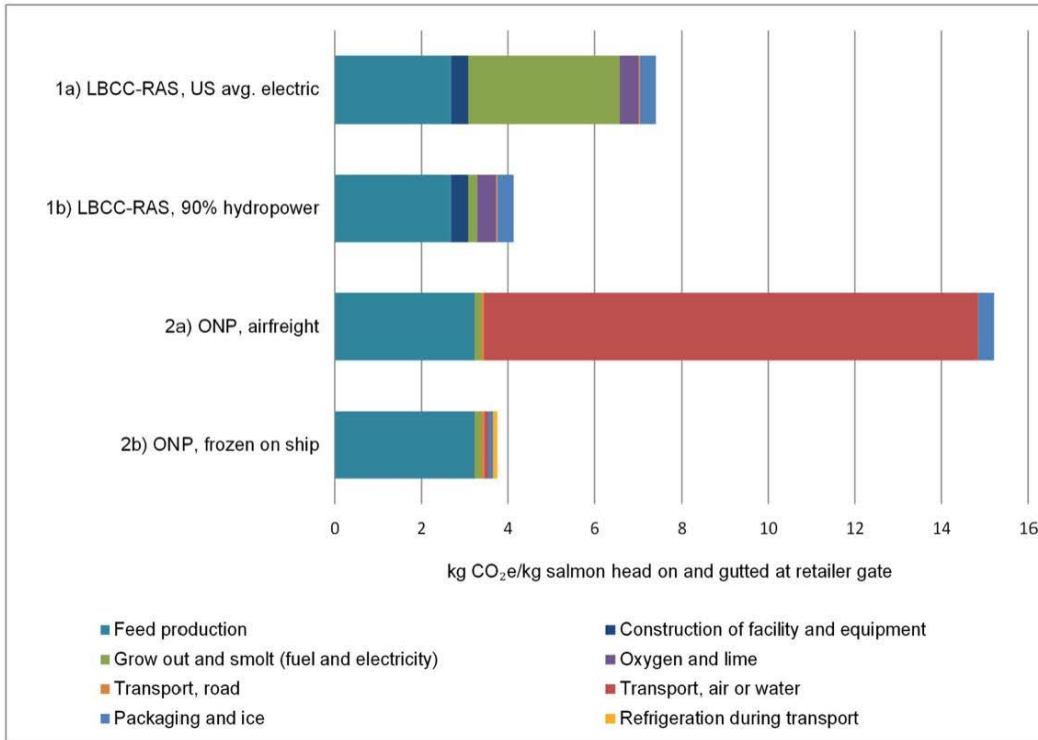
⁸ Madin, E.M. and Macreadie, P.I., 2015. Incorporating carbon footprints into seafood sustainability certification and eco-labels. *Marine Policy*, 57, pp.178-181

⁹ Madin, E.M. and Macreadie, P.I., 2015. Incorporating carbon footprints into seafood sustainability certification and eco-labels. *Marine Policy*. 57:178-181.

¹⁰ See e.g., Farmery, A.K., Gardner, C., Green, B.S., Jennings, S. and Watson, R.A., 2015. Domestic or imported? An assessment of carbon footprints and sustainability of seafood consumed in Australia. *Environmental Science & Policy*. 54:35-43; Ziegler, F., Winther, U., Hognes, E.S., Emanuelsson, A., Sund, V. and Ellingsen, H., 2013. The carbon footprint of Norwegian seafood products on the global seafood market. *Journal of Industrial Ecology*. 17(1):103-116.

¹¹ See e.g. Trond Rostein, Steve Summerfelt 2016. Comparative economic performance and carbon footprint of two farming models for producing Atlantic salmon (*Salmo salar*): Land-based closed containment system in freshwater and open net pen in seawater.

Figure 2-1: Carbon Footprint of Salmon Production by Different Methods and Power Sources



Carbon footprint for RAS-based salmon farming running (1a) on typical US electricity and (1b) on hydropower compared to Norwegian open net pen salmon farming transported (2a) by airfreight and (2b) by ship.

As part of the proposed project, Nordic has also analyzed alternatives for food production on the proposed site in terms of resource efficiency. We have specifically analyzed land and water use efficiencies with examples. This contributes an important perspective on alternative uses of the property in question.

Average land use in beef, corn, wheat, and Nordic’s proposed production are compared in **Table 2-1**. The comparison is based on listed US information sources ¹², against our proposed design and production data from existing facilities. Annual edible yield is used to compare types of food production. In the case of salmon, head-on-gutted yield is applied for the proposed Belfast farm. We have assumed an effective area of 35 acres in the benchmark for all products (set-backs and buffers not included). Note that figures may vary by source and location for agriculture, but the general conclusions remain the same.

¹² Various US references used to calculate land and water use:
<https://farmdocdaily.illinois.edu/2018/07/international-benchmarks-for-wheat-production.html>
<https://foodtank.com/news/2013/12/why-meat-eats-resources/>
<https://www.oda.state.ok.us/food/fs-cowweight.pdf>
<https://farmdocdaily.illinois.edu/2018/09/exceptional-2018-corn-and-soybean-yields-and-budgeting-for-2019.html>
<https://water.usgs.gov/edu/activity-watercontent.php>

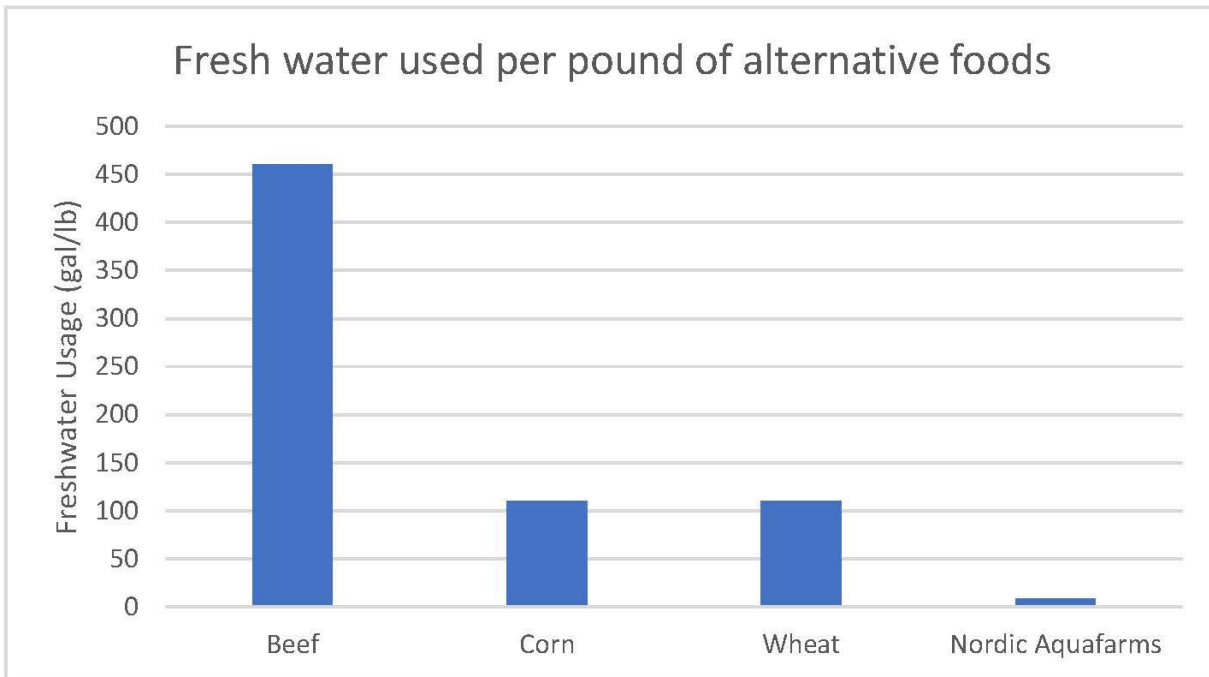
Table 2-1: Yield Footprint Comparison of Different Food Sources

Annual yield benchmark for various food production on proposed site		
Food	Food yield per acre/pounds	Total yield on 35 acres/pounds
Beef	360	12 600
Corn	12 936	452 760
Wheat	4 008	140 280
Nordic Aquafarms	1 742 857	61 000 000

The Nordic design and footprint are highly efficient in terms of food produced per acre, and more efficient than other typical agricultural products produced on land in the US. The depth of tanks, innovative approach to optimal tank volume utilization, the high edible yield from salmon, and the continuous movement of fish through the production cycle enable a high yield of quality seafood per acre facility footprint on this property.

Local water use is another important benchmark. Most foods require more water to produce than people are aware of. We have benchmarked the same foods based on US statistics noted in footnote 12 above in terms of their average water use per pound of food. The results are listed below (in gallons) in **Figure 2-2**.

Figure 2-2: Comparison of Freshwater Usage of Different Food Production Sources



The proposed Nordic facility would use 8.7 gallons of local fresh water per pound of fish. The proposed water use is significantly lower than typical RAS farms due to use of de-nitrification technologies.

The conclusion from this analysis is that Nordic’s approach provides an efficient local fresh water use and yield compared to many alternatives.

2.3 Project Purpose

The proposed project located in Belfast, Maine, is an optimum location compatible with Nordic's business, environmental, and social objectives. **The purpose of the project is to provide 33,000 metric tons of high quality and sustainable seafood to consumers in the northeastern United States.** This project is poised to become a significant new commercial driver for the mid-coast and State of Maine with local, regional and national benefits. Being at the forefront of the aquaculture industry expansion, Nordic is providing Maine with a unique position as an innovator and environmental leader in commercial fish production, propelling the iconic Maine seafood industry into the next generation and ensuring it remains a part of the Maine economy, culture and identity for generations to come.

The standardized designs Nordic has developed in Europe are based on one smolt module supporting three grow-out modules, or our two production module design (see **Figure 2-3** below for illustration of this design). Combined, these four modules comprise one production unit. The proposed Belfast project consists of two such production units, to be phased in over time. These standardized units have undergone extensive development, engineering and verification over the past two years in our European organization.

A pair of production units provides optimal scale for a long-term facility development in Belfast. This site lay-out enables the facility to grow in phases, along with new jobs, secondary business opportunities for Maine businesses, and tax benefits to Belfast.

Figure 2-3: 1+3 Production Unit Design Concept Rendering



To achieve the project purpose, the preferred alternative must meet the following goals to ensure that the project is both commercially viable and environmentally sustainable:

1. Production of 33,000 metric tons of salmon to meet approximately 7% of current US demand.
2. Reduce the carbon footprint compared to imported, fresh, farmed Atlantic salmon to 1/3 of the current footprint from the imported fish.

3. High fixed investments necessary to support infrastructure requires production of sufficient volume to achieve competitive capital expenditures per kilogram of fish. In other words, a volume of 33,000 mt is needed to justify construction and related capital costs.
4. Production cost per unit produced needs to be competitive to ensure access to market and profitability (commercial viability). In other words, a volume of 33,000 mt is needed to justify local production cost versus other suppliers in the market.
5. Provide 100+ high quality direct jobs to Belfast and mid-coast Maine; with potential for a significant indirect job impact as well.
6. Provide opportunities for development of ancillary business opportunities by utilizing 100% of the fish, for example, the facility could provide 20-25% of lobster bait for Penobscot Bay fishermen, in addition to numerous other by-product business opportunities (human supplements, specialty foods, green energy).
7. The project must make as little impact to the environment as possible while supporting the commercial considerations that make the project viable.

In order to be economically viable, the Belfast location needs an ultimate 33,000 metric tons capacity potential. Significant connecting infrastructure investments must be made in this location, including power grid connection and intake/discharge infrastructure, which costs must be offset by a corresponding required scale of production.

2.4 Site Selection Alternatives Analysis

Nordic's initial goal for the site selection was to find a location on the eastern coast of the United States that would reduce the need to air freight farm-raised salmon from Europe to the US market. The ideal location would reduce the transport and carbon footprint of the product through its proximity to the market, including cities such as Portland, Boston, New York and Philadelphia. Access to major transportation hubs would also increase the ability to bring fresh product to market with a lower environmental footprint. With Nordic's current business based in Europe, it would not be possible to meet these goals through expansion of one of these existing facilities.

2.4.1 Criteria for Assessment

Based on the initial search criteria, a desktop geospatial assessment from available public datasets identified 534 potential properties in Maine. As available geospatial datasets could not account for all variables involved, staff assessment of the generated solutions brought the list to approximately 40 locations that were further evaluated by personnel and compared to criteria presented in the decision matrix presented below and shown in the map presented in **Appendix 2-A**. Site visits were conducted on the most favorable locations, and results were narrowed further based on site evaluations and potential to acquire property rights. The pros and cons of four of the remaining locations have been compared and contrasted below. Although the specific location of these options is not being shown they are considered representative of the scenarios encountered.

1. **Availability of property.** Each site was evaluated based on the potential to acquire sufficient land for both the land-based development and supporting infrastructure. Acquisition and leasing were both considered. Based on the need for the project to have proximity to the coastline and seawater/freshwater access,

availability of tracts of land large enough to be suitable for the development became an important consideration. Locations where land could be secured, and that also had favorable water access received higher scores.

2. **Access to clean and cold seawater.** Access to clean and cold seawater is essential to our production approach for salmon. A seawater pipeline is one of the costlier pieces of infrastructure for the overall facility, so limiting the distance of the intake pipeline for the seawater supply is critical. Nordic's European facilities have a maximum run of 700 meters to seawater, so this distance was used as a baseline to score the available access of the proposed site options. 5 = existing access nearshore. 4 = no existing access but nearshore resource. 3 = no existing access and farther resource. 2 = near resource but questionable water quality. 1 = far away and poor quality. 0 = deal breaker, too far away or potential water quality issues. Achieving consistently cold water is a function of **depth**, with deeper water being colder and more consistent in temperature, along with having more consistent water quality parameters and less biologic activity. A limiting factor would be the overall **cleanliness** of the waterbody (bay, etc.) as a whole. Nearby pre-existing pipelines were viewed as a negative because of the potential risks.
3. **Attractive workplace location.** Land-based farms need to draw on a mix of skilled and highly educated labor and lower-skilled labor. Proximity to a town and/or city where Nordic could engage the local work force and also attract high-level talent from beyond Maine is necessary to achieve a world-class operation. Towns with an attractive place to work and live were rated more highly than rural areas more than 50 miles from a cosmopolitan town center.
4. **Buildable lot size.** The six-module layout requires a minimum of 50 acres to accommodate the size of the buildings and the associated process piping and infrastructure for the facility. Properties greater than 30 acres were initially considered, and as due diligence and design considerations progressed, the 50-acre minimum became apparent given set-back and fire code requirements in relevant property areas.
5. **Available road and utility infrastructure.** Transportation of fresh product relies on good roads, and the facility needs to be located in an area with reliable transportation in all seasons, including winter weather and tourist traffic. Location on paved US Highways were rated more favorably than local or secondary roads. In addition, the facility requires 3-phase power. Proximity to required 3-phase power was rated highly, and increased distance from a 3-phase power connect was rated poorly. Distances greater than 6 miles from 3-phase power are infeasible. Sufficient capacity was also a key consideration. Proximity to city sewer for domestic waste was also important.
6. **Effluent impacts to local waterbody.** This criterium was applied to evaluate whether the effluent from the facility could have an impact on the surrounding marine environment. Confined water bodies, such as estuaries with limited circulation, Maine protected water bodies (SA waters), and similar features were scored negatively. SA waters were given a buffer, and areas within SA waters were scored with a 0. In addition, waters that were already impaired were scored negatively, as existing bacteria and/or contamination have the potential to affect the health and quality of the fish.

7. **Construction impact to natural resources.** Online resources were evaluated to look at mapped wetlands, vernal pools, and species of special concern. Sites such as Belfast where no vernal pools were mapped were scored more highly than sites with state-mapped natural resources.
8. **Lack of adverse pre-existing environmental conditions.** Sites with known environmental impacts were scored lower than sites that didn't have impacts. In addition to the potential cost of environmental clean-up, historic impacts have the potential to affect the water supply for the facility and pose unknown risks, and therefore were scored negatively.
9. **Ground conditions favorable to construction.** Topography, geotechnically suitable soils, and degree of land preparation needed for construction were all considered when ranking suitable sites. Flat lands with firm soils were considered most favorable. Elevation change from seawater was also scored as part of this evaluation, with limited elevation change being most favorable, while future sea rise was also considered.
10. **Access to Abundant Freshwater Resource.** Sites were evaluated based on their potential to provide fresh water. Areas with potential for production wells and/or other sources of water that could be used for fish production were scored highly. Sites with limited water supply options were scored poorly. If clean fresh water without contamination could not be obtained, the site received a 0 for this criterion.

Table 2-2 summarizes the scoring for the four remaining locations following application of the review criteria discussed above and extensive site visits.

Table 2-2: Site Selection Decision Matrix

	Belfast	Alternative Mid-Coast Site	Alternative Northern Site	Alternative Southern Site
Access to clean and cold seawater	4	4	4	5
Access to abundant clean and cold freshwater	5	2	3	0
Potential for effluent impact to local waterbody	4	4	4	5
Lack of adverse pre-existing environmental conditions	5	5	5	3
Buildable lot size	5	4	4	4
Favorable road and utility infrastructure	4	2	2	3
Attractive workplace location	5	2	3	3
Probable Acquisition of Property	5	3	3	4
Ground conditions favorable to construction	4	4	5	4
Anticipated Construction Impacts	4	3	3	4
Score (out of 50)	45	33	36	35

It was evident from Nordic's assessment that the proposed location in Belfast, Maine scored high on all assessment criteria and clearly stood out as the preferred location for Nordic's proposed project.

2.5 Project Layout Alternatives Analysis

Nordic carefully considered whether the project purpose could be met by changing the project size, scope, configuration or density at the Belfast site in order to avoid or minimize the impact to natural resources. Four site layout alternatives were considered for upland portions of the project. Five routing alternatives were considered for the intake and outfall pipes. A discussion of these alternatives is presented below.

2.5.1 Description of Upland Site Layout Alternatives

Changes in the layout of necessary infrastructure has evolved over time due to constraints encountered with the original 39-acre site. For each alternative a discussion is provided regarding technical and logistical feasibility, cost, and potential environmental impacts. As discussed more thoroughly below, the preferred alternative is the only practicable alternative.

The following four upland site layout options were considered for project development in the order in which they are presented:

Option 1: 6 Modules on 39 Acres

The initial project design for the Site entailed the construction of the two production module layout on 39 acres of land owned by the Belfast Water District (BWD), excluding the 250-foot buffer zone along the Little River and Lower Reservoir, and land owned by an abutter (Cassida). This design placed infrastructure, including grow-out modules, smolt units, fish processing facility and utilities, on the majority of the Cassida parcel and western portions of the BWD parcel. The eastern portion of the site would be improved with the intake and wastewater treatment plant while the existing BWD office building would be renovated and converted into a visitor center. A conceptual site plan is presented on **Appendix 2-B**.

Option 2: 3 Modules on 39 Acres

Following a revision to the local zoning requirements and redesign to address setbacks and cleared area requirements in conjunction with buffering, a revised facility design was explored, comprising just one production unit situated on 39 acres of land owned by the BWD, excluding the 250-foot buffer zone along the Little River and Lower Reservoir, and Cassida land. The design placed the majority of infrastructure, including grow-out modules, smolt units, fish processing facility and wastewater treatment plant on flatter, upgradient portions of the two properties. The eastern portion of the site would be improved with the intake water treatment plant and office space, while the existing BWD office building would be renovated and converted into a visitor center. A conceptual site plan is presented on **Appendix 2-C**.

Option 3: 6 Modules on 54 Acres

Following the acquisition of rights to additional land owned by Goldenrod Properties, LLC ("Goldenrod"), the two production unit design could be placed on 54 acres of land owned by the BWD, excluding the 250-foot buffer zone along the Little River and Lower Reservoir, but including portions of the Cassida and Goldenrod properties. This design placed infrastructure, including grow-out modules, smolt units, fish processing facility and utilities, on the majority of the Cassida parcel, the Goldenrod parcel and western portions of the BWD parcel. The eastern

portion of the site would be improved with the intake and wastewater treatment plant while the existing BWD office building would be renovated and converted into a visitor center. A conceptual site plan is presented on **Appendix 2-D**.

Option 4: 5 Modules on 54 Acres

In an attempt to reduce the development footprint, a design for five modules was explored on 54 acres of land owned by the BWD, excluding the 250-foot buffer zone along the Little River and Lower Reservoir, but including portions of the Cassida and Goldenrod properties was developed. This design places infrastructure, including grow-out modules, smolt units, fish processing facility and utilities, on the majority of the Goldenrod parcel and western portions of the Cassida and BWD parcels. The eastern portion of the site would be improved with the intake and wastewater treatment plant while the existing BWD office building would be renovated and converted into a visitor center. A conceptual site plan is presented on **Appendix 2-E**.

2.5.2 Criteria for Assessment of Upland Layout Alternatives

The evolutionary process of site layout design was evaluated using the following criteria:

Regulatory Requirements

Regulatory requirement criteria refer to the ability to obtain rights to property for development, compliance with City of Belfast ordinances, fire codes, and all Maine Department of Environmental Protection (MEDEP) requirements. Applicable City of Belfast ordinances influencing site layout include property line setbacks and fire codes. The three setback requirements include a 40-foot property line setback for all development, a 50-foot property line setback for all development excluding utilities, and a 75-foot property line setback at Route 1. The applicable fire codes require fire truck access to all sides of the buildings, and a 100-foot buffer is provided to meet the “open yard” concept for fire protection. Taken together, these requirements allow Nordic to preserve an uncut property line setback (which buffers the project from neighbors) followed by an additional open yard for fire protection.

Environmental Impacts

MEDEP requirements include wetland delineations completed on all properties considered for development. This natural resource identification work included the assessment of vernal pool presence, NRPA jurisdictional streams, and coordination with the Maine Department of Inland Fisheries and Wildlife to identify essential and significant wildlife habitats and endangered, threatened or special concern species that could be impacted by the project. Specific analysis criteria include impacts and proximity to wetlands, streams and all other natural resources protected by the NRPA. The functional assessment of these features was also considered.

Construction /Engineering/Operational Feasibility

The degree of difficulty and technical feasibility of construction and engineering is a necessary consideration for all development. The facility must be constructed in a way that allows for geotechnical, structural and operational feasibility for Nordic’s RAS designs, appropriate access to buildings, and stormwater control and treatment. Aspects considered include existing site geology and topography in relation to land preparation and regrading, and utility corridor design for the network of water distribution pipes. Nordic’s proprietary RAS design has a fixed building size for grow-out modules and smolt units. These proprietary designs are key to the function and competitiveness of the aquaculture facility in the marketplace. The site layout is further

constrained by key operational features such as a process piping network that connects smolt, grow modules, and processing.

Financial Feasibility

Chapter 310 of the MEDEP rules, 06-096 CMR § 310(3)(R), defines “practicable” as “[a]vailable and feasible considering cost, existing technology and logistics based on the overall purpose of the project. This criterion includes budget estimates of construction and operation costs per unit produced based on investor expectations and seafood industry metrics. These cost considerations are further assessed relative to the anticipated market value of the product and how well these metrics meet Nordic’s business model.

2.5.3 Site Layout Analyses

Option 1: Two Production Units on 39 Acres

Regulatory requirements

Due to the fixed size of the layout and the shape of the property originally available through agreements with the BWD and Cassida, by the exclusion of the 250-foot shoreland zone, infrastructure cannot be arranged in a manner that satisfies all applicable City of Belfast building and fire ordinances. The conceptual layout shows the placement of all buildings and infrastructure within the property boundaries. Reducing the buildable area through the insertion of setbacks causes the presented arrangement to be out of compliance.

Because appropriate setback requirements cannot be met with Nordic Aquafarm’s proposed two production module layout on 39 acres, Option 1 is not viable.

Environmental Impacts

Due to the maximized development of the property for the placement of infrastructure, the environmental impacts to on-site natural resources would be significant. Expanding the construction design to consider grading and stormwater control and current infrastructure and design needs, the facility would be anticipated to impact all protected habitat and natural resources located on the central and western portions of the site. In addition, due to the necessary building and infrastructure, it would have significant impacts to the eastern stream and associated wetlands.

Construction / Engineering/Operational Feasibility

Based on the maximization of the layout on the given property, additional construction requirements and costs would be incurred. These would include a grading plan that results in a need for retaining walls along the boundaries abutting the shoreland zone. Due to the narrow 39-acre lot shape, the two production unit layout cannot fit within the property boundaries and include necessary supporting utilities and process piping. This layout on 39 acres would not provide space for fish processing or an office building.

Option 1 is not feasible from the perspective of site engineering or operations, as critical site functions do not fit.

Financial Feasibility

The two production unit layout is financially feasible.

Option 2: One Production Unit on 39 Acres

Regulatory Requirements

Due to the fixed size of two production unit layout and the shape of the property originally available through agreements with the BWD and Cassida, by the exclusion of the 250-foot shoreland zone, production modules and infrastructure cannot be arranged in a manner that satisfies all applicable building and fire ordinances. In addition, this alternative cannot use Nordic's two production module design layout. The conceptual layout shows the placement of site buildings and infrastructure within the property boundaries; however, when applicable zoning requirements and setbacks are applied, the presented arrangement of buildings is out of compliance.

Option 2 is not viable because it does not allow for Nordic to use their two production module design layout, nor does it meet appropriate setback requirements.

Environmental Impacts

Due to the centralized development of the property and the need for supporting infrastructure, the environmental impacts to on-site natural resources would be significant. Expanding the construction design to consider grading and stormwater control and current infrastructure and design needs, the facility would be anticipated to impact all protected habitat and natural resources located on the central and western portions of the site.

Option 2 would have significant environmental impacts.

Construction /Engineering/Operational Feasibility

The site layout is constrained by the shape of the 39-acre lot. The narrow and elongated shape of the main portion of the site only allows one production unit. Facility operations are hindered by lack of centralized processing and utilities. Site grading results in a need for retaining walls along the boundaries abutting the shoreland zone.

Option 2 is infeasible because engineering that meets operational requirements is not possible.

Financial Feasibility

The one production unit layout is not financially viable and does not warrant the construction of the facility. The construction costs and production cost per unit produced would result in a facility that would operate at a loss for years. In addition, the commercial production, jobs, and byproducts available to market would all be cut in half.

Option 3: Two Production Units on 54 Acres: PREFERRED ALTERNATIVE

Regulatory Requirements

Acquisition of rights to the Goldenrod parcel provided a site shape which allows for compliance with applicable regulatory requirements. All applicable City of Belfast zoning and fire code requirements can be met.

Two production units can be configured to meet regulatory requirements.

Environmental Impacts

Due to the density of development in the center of the property in order to comply with regulatory requirements and other considerations discussed herein, the environmental impacts to on-site natural resources will be centralized. Expanding the construction design to consider grading and stormwater control and current infrastructure and design needs, the facility will limit impact to protected natural resources located on the central and western portions of the site, as shown on **Table 2-5** and **Table 2-6**.

Table 2-5: Impacts to Wetland Resources by the Option 3 Design

Wetland ID	¹ Temporary Impacts (SF)	Permanent Impacts (SF)	Impact Total (SF)	Impact Characterization
W1	0	115,674	115,674	Direct, Fill
W2	0	24,612	24,612	Direct, Fill
W3	0	5,057	5,057	Direct, Fill
W4	0	692	692	Direct, Fill
W5	0	18,672	18,672	Direct, Fill
W6	1,766	3,120	4,886	Direct, Fill
² W11	2,611	0	2,611	Direct, Excavation
W13	0	556	556	Direct, Fill
W15	0	708	708	Direct, Fill
W16	1,245	0	1,245	Direct, Excavation
Totals	5,622	169,091	174,713	

1. All temporary impacts are restored in place
2. W11 consists of 2,125 square feet (SF) of temporary impact to Salt Marsh and 486 SF of temporary impact to Cobble Beach

Table 2-6: Direct Impacts to Stream Resources by the Project

Stream ID	¹ Temporary Impacts (L.Ft.)	Permanent Impacts (L.Ft.)	Impact Total (L.Ft.)	Impact Characterization
S3	0	635	635	Direct, Fill
S5	0	459	459	Direct, Fill
S6	0	86	86	Direct, Fill
S9	145	0	145	Temporary Culvert
Totals	145	1,180	1,325	

1. All temporary impacts are restored in place.

This alternative preserves the eastern intermittent stream and wetlands, including restoration and a deed restricted 75- foot wetland buffer. The additional lot size allows for improved stormwater control and treatment, and incorporation of additional site buffers.

Construction/Engineering/Operational Feasibility

Development of the site for construction of this alternative will require the same amount of infrastructure as Option 1, but with additional land available, bank stability issues are reduced, stormwater treatment areas are expanded, and final grading can be achieved with fewer retaining walls. In addition, the acquisition of additional land facilitated a shorter sewer line connection to the north where the Mathews Brothers facility has a connection on Perkins Road. Retaining walls along the shoreland zone would no longer be needed for this option. Buffers and setbacks would be met and expanded on by this option. This option allows for buffers of 100+ feet from most property lines, which results in a 350+ foot setback from the Lower Reservoir. The enhanced buffers provide larger wildlife corridors, enhanced resource protection, and a more pleasing visual setting for the site development.

Financial Feasibility

The two production unit layout is financially viable from a business perspective and warrants the construction of the facility.

Option 4: 5-Module Design on 54 Acres

Regulatory requirements

Acquisition of rights to the Goldenrod parcel provided a site shape which allows for compliance with applicable regulatory requirements. City of Belfast zoning and fire code requirements can be achieved.

The 5-module design on 54 acres meets regulatory requirements.

Environmental Impacts

Due to the density of development in the center of the property in order to comply with regulatory requirements and other considerations discussed herein, the environmental impacts to on-site natural resources would be similar to those of Option 3, with the exception of Stream 6.

Construction /Engineering/Operational Feasibility

Development of the site would require the same amount of infrastructure as Options 1 and 3 (the preferred alternative) but would marginally decrease bank stability issues and expand stormwater treatment areas. This option would also allow for final grading to be achieved with fewer retaining walls. Option 4 would result in only 66% utilization of the second smolt module, as it would be supporting two rather than three grow-out modules. This option does not operationally support Nordic's proprietary design and results in inefficient site operations.

Financial Feasibility

The 5-module production design would not be financially viable from a business perspective and does not warrant the construction of the facility. All commercial evaluation criteria will not be met in this alternative, specifically:

1. The lay-out differs from Nordic's proprietary design concept for production units. It would leave unused smolt capacity in the facility and result in other

process inefficiencies. Redesign of Nordic’s production units would be a costly and time-consuming activity.

2. This alternative does not meet the project production goals. Volumes are reduced to 27,400 mt and 5.5% of market respectively.
3. High fixed investments in supporting infrastructure are not supported by sufficient volume to achieve competitive capital expenditure per kilogram of fish.
4. Production cost per unit produced increases.
5. This alternative would produce approximately 83 jobs, thus the goal of 100 jobs is not met.
6. Byproducts volume is reduced by 17%.

2.5.4 Comparative Analysis of Site Layout Alternatives

Table 2-7: Weighted Scoring of Site Layout Alternatives

Decision Criteria	Weighting Factor	Layout Alternatives			
		6 Modules on 39 Acres	3 Modules on 39 Acres	6 Modules on 54 Acres	5 Modules on 54 Acres
Legal Requirements	4				
Title, Right and Interest		4	4	4	4
Building Code Setbacks		0	0	4	4
Fire Code Setbacks		0	0	4	4
Environmental Impact	3				
Wetlands		2	3	1	2
Streams		2	3	1	2
Forest		2	3	1	2
Engineering Feasibility	1				
Land Preparation		4	4	3	3
Piping Layout		4	4	4	3
Operational Flow		3	4	4	2
Financial Feasibility	4				
Capital Investment		4	1	4	2
Operational Costs		4	1	4	2
Business Model		4	1	4	1
Totals		93	67	116	94

Although Options 1 and 2 receive a score, they are not possible given regulatory limitations on the site.

Selection of the Preferred Site Layout

As outlined in **Table 2-7**, the Option 3 is the preferred alternative. There are no practicable alternatives. Options 1 and 4 are not feasible due to technical, logistical or financial constraints, while Options 1 and 2 do not legally meet applicable requirements.

2.6 Pipeline Route Selection

Similar to Sections 2.4 and 2.5 above, this section addresses whether the project purpose can be met by changing the size, scope, configuration or density of the activity, thereby avoiding or minimizing the impact to natural resources. In this section, the review is related to the siting of the project seawater intake and discharge pipes and is independent of the analysis of the remainder of the site.

Since the inception of the project, several options for pipe routing have been considered as a result of challenges and opportunities related to constructability; engineering design; potential environmental impacts; and other regulatory concerns. In all cases, the pipe layouts include a combination of both buried and surface pipe as described in more detail below, as well as a system of intake structures raised approximately 10 feet above the seabed, and a series of duck-billed diffusers for discharge. These elements are common for all options as they will be utilized to maintain acceptable flows for the intake and assist in maximizing diffusion of the discharge.

For each layout alternative a discussion is provided regarding technical and logistical feasibility, cost, and potential environmental impacts. As discussed more thoroughly below, the preferred layout alternative is the only practicable option.

2.6.1 Description of Site Layout Alternatives

Each of the proposed pipeline alternatives propose a seawater intake structure at a depth of 55 feet (-55 feet NAVD88), approximately 7,000 feet east of the Little River Bridge and Belfast Water District Facility. A pair of parallel intake pipes connecting the intake to shore would be anchored on the seafloor, spanning from the intake structures to a depth of approximately 25 feet (measured from mean lower low water (MLLW), where the pipes would transition underground. In approximately the same location as the transition to underground, a multi-port diffuser at the end of the discharge pipe would be placed to discharge treated wastewater from the facility.

The following intake/outfall routing options were considered:

Option 1: Little River

Description

As shown on **Appendix 2-F**, Option 1 proposes a seawater intake structure at a depth of 55 feet (-55 feet NAVD88), approximately 7,000 feet east of the Little River Bridge and Belfast Water District Facility. A pair of parallel intake pipes connecting the intake to shore would be anchored on the seafloor, spanning from the intake structures to a depth of approximately 25 feet (measured from MLLW, where the pipes would transition underground. Both the intake and discharge pipes would be laid in a common trench following the Little River channel, under the US Route 1 bridge, and to the shoreline in the vicinity of the Belfast Water District building. The pipes would extend from the bank of the Little River to the north to a proposed pump station connected with the facility's Water Treatment and Wastewater Treatment Plant. Due to wide tidal ranges and limitations on suction capacity of pumping operations, the pumps must be set near a high tide level or at an approximate elevation of 8 feet NAVD88. Ground surface elevation in the location of the proposed pump station is approximately 35 feet NAVD88.

Regulatory Requirements

Once the intake/outfall lines leave the project site it would follow the Little River, which is the line between the City of Belfast and the Town of Northport. Rights within this option would involve numerous property owners because this route is the longest of the alternatives considered. This option would require an extensive submerged lands lease with the Maine Bureau of Parks and Lands. Furthermore, multiple approvals would be required for crossing under the US Route 1 bridge, which would include blasting activities to remove bedrock.

Environmental Impacts

As the longest of the pipeline routes evaluated, Option 1 would have the most significant environmental impacts, including impacts to coastal wetlands, and sensitive river and bank ecosystems. Benthic and other studies of the intertidal and subtidal area suggest that bivalves and other sea life may be more abundant in the area where the Little River discharges than areas immediately to the north. Approximately 1,800 linear feet (estimated 27,000 square feet) of area within the intertidal and Little River channel and bank would be temporarily disturbed during pipeline installation of this option. Permanent impacts to the intertidal zone at the mouth of the Little River would be minimal, as the trench would be backfilled with native material. Impacts to the channel and bank of the Little River may be more substantial, as armoring would be required for slope and channel stabilization. Placement of armoring material may impose a negative impact on wildlife habitat.

Above the mean high-water line, approximately 250 linear feet (estimated 3,750 square feet) of vegetated area would be impacted. The upland portion of the pipeline route would require clearing during construction and long-term maintenance to prevent root growth from affecting intake and discharge pipes.

Construction Considerations/Engineering

Bridge Considerations

Little River Bridge plays a critical role in the region's transportation needs. Along this corridor, US Route 1 is part of the National Highway System (NHS), which means the Federal Highway Administration (FHWA) has determined it is important to the nation's economy, defense, and mobility. The bridge also functions as a key crossing for emergency responders to serve those in the surrounding communities. According to Maine Department of Transportation (Maine DOT) records, the current Average Annual Daily Traffic (AADT) over this bridge is 8,040. For this reason, proper protection of the bridge integrity at all phases of construction is paramount.

The bridge was constructed in 1944 and was rehabilitated in 1987 to incorporate a new wearing surface and curb/guardrail system. The channel consists of clean bedrock noted to be badly weathered and loose where exposed on the edges. The river bottom now contains various-sized stones and blocks of granite randomly scattered along the channel above the bedrock. The banks near the bridge have been carefully armored with heavy riprap. Construction of this alternative has a high risk of impact to the Little River Bridge and construction of a bypass would be infeasible.

Trenching Procedures

Option 1 would require approximately 3,600 linear feet of trenching, including below MLLW, through the intertidal zone, along the Little River channel, and upland. Review of NRCS Web Soil Surveys indicates soils in this area to be primarily Boothbay silt loam with an estimated depth to restrictive feature of greater than 80 inches. Excavation within the Little River channel is anticipated to require bedrock removal because bedrock is visible.

Water depth beneath the bridge varies due to tidal effects, from only inches deep during low tide to approximately 13 feet deep during high tide. The minimum depth is affected by seasonal changes. Clearance between bedrock and the low chord of the bridge is approximately 20 feet. For blasting in this area, drilling would be limited to low tide because of the low clearance. Access for the drill rig would be by barge (grounded out during low tide) or by a rock causeway

in the channel starting from the northwest side of the bridge, currently owned by the Belfast Water District. A crane set up near the water district building could also be used to set the drill rig in the river during low tide and remove the drill before the tide begins to fill back in. However, the overhead power lines running along the upstream side of the bridge would be an obstacle and hazard for cranes operating in this location. Because drilling operations in this area could only commence during low tide, the trenching operation would be very time consuming.

Assuming bedrock is encountered, blasting would likely be required to achieve necessary depths. Overburden soils would be removed by excavator, and depending on the depth and extent of bedrock, the edges of the trench would be line drilled to establish the trench section. Line drilling entails predrilling closely spaced vertical holes into the bedrock to just below the bottom of trench elevation with a track-mounted hydraulic drill. Once the edges of trench have been predrilled, the boreholes would be drilled within the trench, loaded with explosives, and detonated in a linear progression to break up the rock within the trench. The blast material would then be removed by excavator and hauled offsite. Overburden soils would likely be stored onsite for use as backfill.

Challenges and Risks

Primary challenges and risks for Option 1 include environmental impacts, habitat loss, channel and bank stability, impacts to nearby structures and property, specifically the bridge crossing the Little River and the dam impounding the Belfast reservoir, general blasting and heavy construction risks, and property owner concerns.

Excavating a trench beneath the bridge may cause vibration-related damage to the river channel. Blasting could cause cracks to propagate from the trench toward the abutments weakening the bedrock beneath the concrete leveling slabs. Blasting and trenching in the vicinity of the dam may also pose a risk to the structural and hydraulic integrity of the impoundment. A detailed analysis of this risk would be required if Option 1 were pursued.

The banks of the Little River in this area have slumped. Vibrations due to blasting may cause further instability and slumping of the banks. Construction activities beneath the bridge would likely restrict the hydraulic opening, which could lead to increased water depth and velocity. This could also adversely affect the riverbanks and channel bottom.

Engineering analysis indicates the trench would need to be approximately 15 feet wide to facilitate the three intake and discharge pipes. If centered in the channel, this only provides a buffer of approximately 15 feet between the existing abutments and the blasting zone. Potential damage to the granite blocks and concrete stem walls of the abutments is a concern. Currently the substructure has a condition rating of 6/10 with minor deterioration noted. Vibration may cause shifting of the granite blocks and cracking of the nearly 75-year old concrete stem walls. Since the superstructure is rigidly connected to the substructure at the north end, the vibrations experienced by the substructure would be amplified as they are transferred to the superstructure. Similar to the concrete stem walls, the concrete superstructure is nearly 75 years old. The superstructure and deck have condition ratings of 5/10 with minor section loss noted. Further damage is possible due to blasting-related vibrations.

According to the Maine DOT Public Map Viewer, the bridge has an inventory load rating factor of 0.78 and an operating load rating factor of 1.01. Rating factors less than 1.0 indicate the structure does not satisfy the current American Association of State Highway and Transportation Officials (AASHTO) standards. Damage or section loss from blasting directly adjacent to the bridge would likely cause these rating factors to reduce.

Soil stability where Option 1 crosses the mean high-water line is a challenge due to the steepness of the slope and the composition of the soil. Boothbay silt loam is considered highly erodible at slopes greater than 15%. Steep, unstable soils, in combination with the general vulnerability of coastal vegetation creates a substantial challenge to environmentally responsible construction.

Financial Feasibility

Due to the challenges and risks described above, this option entails significant costs. Significant resources would be required to mitigate these risks and these costs would reflect a greatly increased investment over other, lower risk alternatives. Furthermore, the longer route when compared to the preferred alternative, would be more time consuming and costly for installation.

Option 2: Eckrote Property

Description

As shown on **Appendix 2-F**, Option 2 from the Eckrote property includes three potential pipeline routes. In each case, intake and discharge pipes would be laid in a common trench to the shoreline. The pipes would extend from the shoreline perpendicular to Route 1, under Route 1, and to a proposed pump station associated with the facility Water Treatment and Wastewater Treatment Plant, approximately 100 feet west of Route 1. Due to wide tidal ranges and limitations on suction capacity of pumping operations, the pumps must be set at an elevation of approximately 8 feet NAVD88. Ground surface elevation in the location of the proposed pump station is approximately 35 feet NAVD88.

One route, the straight route, would head slightly northeast across the intertidal area and out to the discharge and intake points. A second route, with a slight curve (the preferred alternative), heads generally east from the Eckrote high tide line. The third route heads east and slightly south before turning more northerly to the discharge location. Each of these routes is evaluated further below.

Regulatory Requirements

Option 2 crosses one parcel of land with a single owner. Nordic has an option to obtain an easement to cross the Eckrote's property. The route across the Eckrote's complies with local requirements and will include the natural resource protections.

The straight route crosses intertidal outside of the Eckrote's parcel, while the curved route and the southern route both stay within the intertidal in front of Eckrote's parcel. The intertidal portion of the curved route is within the City of Belfast as is the discharge point and the curved route requires a smaller submerged land lease than the southern route.

Environmental Impacts

The Option 2 alignments are associated with environmental impacts; however, each of the possible alignments from the Eckrote parcel reduce impacts in comparison to Option 1. The curved route (the preferred alternative) is shorter than the southern route, further reducing the potential impacts to the benthic community and ocean environment during and after construction.

Approximately 500 linear feet (estimated 7,500 square feet) of intertidal zone would be temporarily disturbed during pipeline installation. Permanent impacts would be minimal, as the trench would be backfilled with native material.

Above the mean high-water line, approximately 325 linear feet (estimated 4,875 square feet) of vegetated area would be permanently impacted, including crossing of an unnamed stream. The orientation of the Option 2 pipe layout is nearly perpendicular to the stream, minimizing impacts. This portion of the pipeline would require clearing during construction and maintenance to prevent root growth from affecting intake and discharge pipes.

Construction Considerations/Engineering

Trenching Procedures

Option 2 would require approximately 2,800 linear feet of trenching, including below MLLW, through the intertidal zone, and upland. Trench depths would vary from very shallow at the transition from pipe laid on the seafloor to underground pipe to approximately 30 feet deep at the upland pump station. Based on current data, typical trench depths are expected to be approximately 9 feet to provide a minimum of 5 feet of pipe cover. Review of NRCS Web Soil Surveys indicates soils in this area to be primarily Boothbay silt loam with an estimated depth to restrictive feature of greater than 80 inches. Given the necessary depth of excavation and nearby exposed bedrock, it is likely that bedrock will be encountered and some removal by blasting may be required.

Assuming that bedrock is encountered, blasting would be required to achieve necessary depths. Overburden soils would be removed by excavator, and depending on the depth and extent of bedrock, the edges of the trench would be line drilled to establish the trench section. Line drilling entails predrilling closely spaced vertical holes into the bedrock to just below the bottom of trench elevation with a track-mounted hydraulic drill. Once the edges of trench have been predrilled, the boreholes would be drilled within the trench, loaded with explosives, and detonated in a linear progression to break up the rock within the trench. The blast material would then be removed by excavator and hauled offsite. Overburden soils would likely be stored onsite for use as backfill.

Challenges and Risks

Primary challenges and risks for Option 2 include the stream crossing, soil stability and revegetation, crossing Route 1 at a depth of greater than 25 feet and general blasting and heavy construction. Further discussion of each challenge, probable approach, and associated risks is provided below.

The stream crossing can be accomplished with minimal impacts using standard construction methods and best management practices for erosion and sedimentation control. Trench depths in this area will be approximately nine 9 feet. Stream banks in this area are a combination of exposed beach and vegetation with slopes up to 16%. Permanent impacts to the stream quality and channel stability are not anticipated for this option.

Maximum slopes in the direction of the pipeline are approximately 16%, and vegetation and stabilization following construction are not expected to be concerns. However, the combination of increasing trench depth and Boothbay silt loam soil characteristics, which is considered highly erodible at slopes greater than 15%, may pose a challenge to excavation stability. Use of engineered shoring and excavation protection systems will likely be required to minimize potential erosion and stability risks during excavation.

Crossing Route 1 has been carefully planned. Open excavation in this area would be accompanied by the abovementioned possibility of encountering bedrock, the risk of unstable

soils in a deep excavation, and the logistical challenge of keeping Route 1 open during the crossing. Interruption of traffic on Route 1 will require a short-term detour that is planned for, as shown in **Appendix 2-F**, and additional site impacts, including temporary impacts to Stream 9, will occur as part of the detour. The established construction approach mitigates these risks and is feasible.

Financial Feasibility

Option 2 is the shortest route, as well as the route requiring the least risk mitigation procedures; therefore, it provides the most cost effective and lowest risk option for the project. Cost impacts including potential ledge removal, wetland restoration, and Route 1 temporary re-alignment are all relatively predictable costs and are within acceptable cost and risk. The curved Option 2 alternative is the preferred alternative.

Option 3: Tozier Road

Description

Option 3 is a pipeline that extends from the shoreline to the northwest along an existing drainage way to Tozier Road, west along Tozier Road to the intersection with Route 1, across Route 1, and south-southwest to a proposed pump station associated with the facility Water Treatment and Wastewater Treatment Plant approximately 100 feet west of Route 1. The last 600 feet of pipeline would be installed along the edge of the southbound lane of Route 1. Due to wide tidal ranges and limitations on suction capacity of pumping operations, the pumps must be set at an elevation of approximately 8 feet NAVD88. Ground surface elevation in the location of the proposed pump station is approximately 35 feet NAVD88.

A conceptual plan and profile for Option 3 is shown in **Appendix 2-F**. The figure shows the proposed alignment and profile of the intake and discharge piping in relation to local topography, bathymetry, land use, and infrastructure elements.

Regulatory Requirements

Option 3 entails multiple property owners at least one of whom was not interested in allowing use of their land for the project. The many owners potentially complicate the planning and construction process. Furthermore, construction between lots 34 and 35 on City of Belfast Tax Map 29 would likely eliminate all buffering vegetation between residences. Option 3 also requires a pump station in the residential neighborhood, which is not compliant with City regulations. Permission from the City of Belfast would be required for crossing and use of US Route 1 for installation of portions of the pipeline.

Option 3 does not meet regulatory requirements.

Environmental Impacts

The Option 3 alignment comes with environmental impacts, particularly above the mean high-water mark. Approximately 300 linear feet (estimated 4,500 square feet) of intertidal zone would be temporarily disturbed during pipeline installation. Permanent impacts to the intertidal zone would likely be minimal, as the trench would be backfilled with native material.

Above the mean high-water line, approximately 1,400 linear feet (estimated 21,000 square feet) of vegetated area would be permanently impacted, including approximately 300 feet (estimated

4,500 square feet) along which the pipeline would be within or near the banks of an existing drainage way with side slopes of approximately 20%. The existing drainage way is currently vegetated with trees. Option 3 also would require excavation and restoration of a coastal bluff with a slope of approximately 33%. The upland portion of the pipeline would require clearing during construction and long-term maintenance to prevent root growth from affecting intake and discharge pipes.

Construction Considerations/Engineering

Trenching Procedures

Option 3 would require approximately 3,600 linear feet of trenching, including below MLLW, through the intertidal zone, and upland. Current analysis indicates that a trench approximately 15 feet wide is required to accommodate seawater intake and discharge piping. Trench depths would vary from very shallow at the transition from pipe laid on the seafloor to underground pipe to approximately 30 feet deep at the upland pump station, with a maximum depth of nearly 40 at the intersection of Tozier Road and Route 1. Review of NRCS Web Soil Surveys indicates soils in this area to be primarily Boothbay silt loam and Swanville silt loam with an estimated depth to restrictive feature of greater than 80 inches. Given the necessary depth of excavation and nearby exposed bedrock, it is likely that bedrock will be encountered, and significant quantities of rock will require removal by blasting. However, further geotechnical investigation is required to confirm presence and depth of bedrock.

Assuming bedrock is encountered, blasting would likely be required to achieve necessary depths. Overburden soils would be removed by excavator, and, depending on the depth and extent of bedrock, the edges of the trench would be line drilled to establish the trench section. Line drilling entails predrilling closely spaced vertical holes into the bedrock to just below the bottom of trench elevation with a track-mounted hydraulic drill. Once the edges of trench have been predrilled, the boreholes would be drilled within the trench, loaded with explosives, and detonated in a linear progression to break up the rock within the trench. The blast material would then be removed by excavator and hauled offsite. Overburden soils would likely be stored onsite for use as backfill.

Challenges and Risks

Primary challenges and risks for Option 3 include soil stability and revegetation, crossing Route 1 at a depth of up to 40 feet, impacts to nearby structures and property, access to property for construction and maintenance, general blasting and heavy construction risks, property owner concerns, and changes in pipeline direction. Further discussion of each challenge, probable approach, and initial risk estimation is provided below.

Soil stability where Option 3 crosses the mean high-water line is a challenge due to the steepness of the bluff and the composition of the soil. Boothbay and Swanville silt loams are considered highly erodible at slopes greater than 15%. Steep, unstable soils, in combination with the general vulnerability of coastal vegetation creates a substantial challenge to environmentally responsible construction.

The crossing of Route 1 proposed as part of Option 3 introduces a significant logistical and construction challenge. Due to the alignment, approximately 100 linear feet of trench is required to make the crossing over the course of a roughly 70-degree sweep, at an intersection. Traffic control for Route 1, access for Tozier Road, which is a dead end, and excavation stability in a deep trench would complicate and extend the duration of pipeline construction. Furthermore, the

sweep precludes the use of directional boring as an alternative method intended to minimize impacts to Route 1.

As noted on the attached figure, Option 3 positions the centerline of the trench less than 30 feet from a residential structure and within 65 feet of three additional structures. At the depths required for installation of this alignment, protection of the structure at Tax Map 29, Lot 34 would be a significant consideration.

This route is considered infeasible with regard to construction/engineering feasibility.

Financial Feasibility

Option 3 represents the costliest option for the pipe installation. The route is significantly longer than Option 2, and most of the route is located in ledge, requiring significant rock removal. Additionally, because of the length and elevation changes in the pipe, a pump station along Tozier Road would be required, adding additional costs. This option is impracticable.

2.6.2 Summary of Pipeline Options

Option 1 would involve numerous property owners, a lengthy pipeline and pipeline construction process that has significant environmental impact to the Little River and associated infrastructure and the intertidal area, and substantial cost and uncertainty.



Option 3 has significant impacts to coastal wetlands, including sensitive coastal bluff ecosystems, extensive slope stabilization measures, potential impacts to transportation infrastructure and nearby structures, numerous property owners, construction within a drainage way and loss of vegetation, deep excavation and pipe alignment at the crossing of Route 1. Lack of engineering feasibility and at least one property owner who refused access for the project make this alternative impracticable. Additionally, this option would pose significant financial burdens on the project both during installation and operation.

Option 2 achieves the purpose of transporting seawater to the proposed facility site and discharging treated water from the proposed facility in the lowest risk, fewest impacts to natural resources, and least costly method. Based on environmental, engineering, constructability analysis conducted to date, Option 2 is the preferred option. Within Option 2, the curved route is the preferred alternative for its logistical and technical advantages.

APPENDIX 2-A

Possible Site Locations

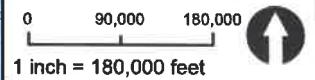
Legend & Notes

-  **Towns
Containing
Potential Sites**
-  **Coastal Towns
of Maine**

Notes

1. Map data based on ESRI World Ocean Basemap and Maine Coastal Atlas.
2. Some features are approximate in location and scale
3. This plan has been prepared for Nordic Aquafarms, Inc. All other uses are not authorized unless written permission is obtained from Ransom Consulting, Inc.

Scale & Orientation



Prepared For

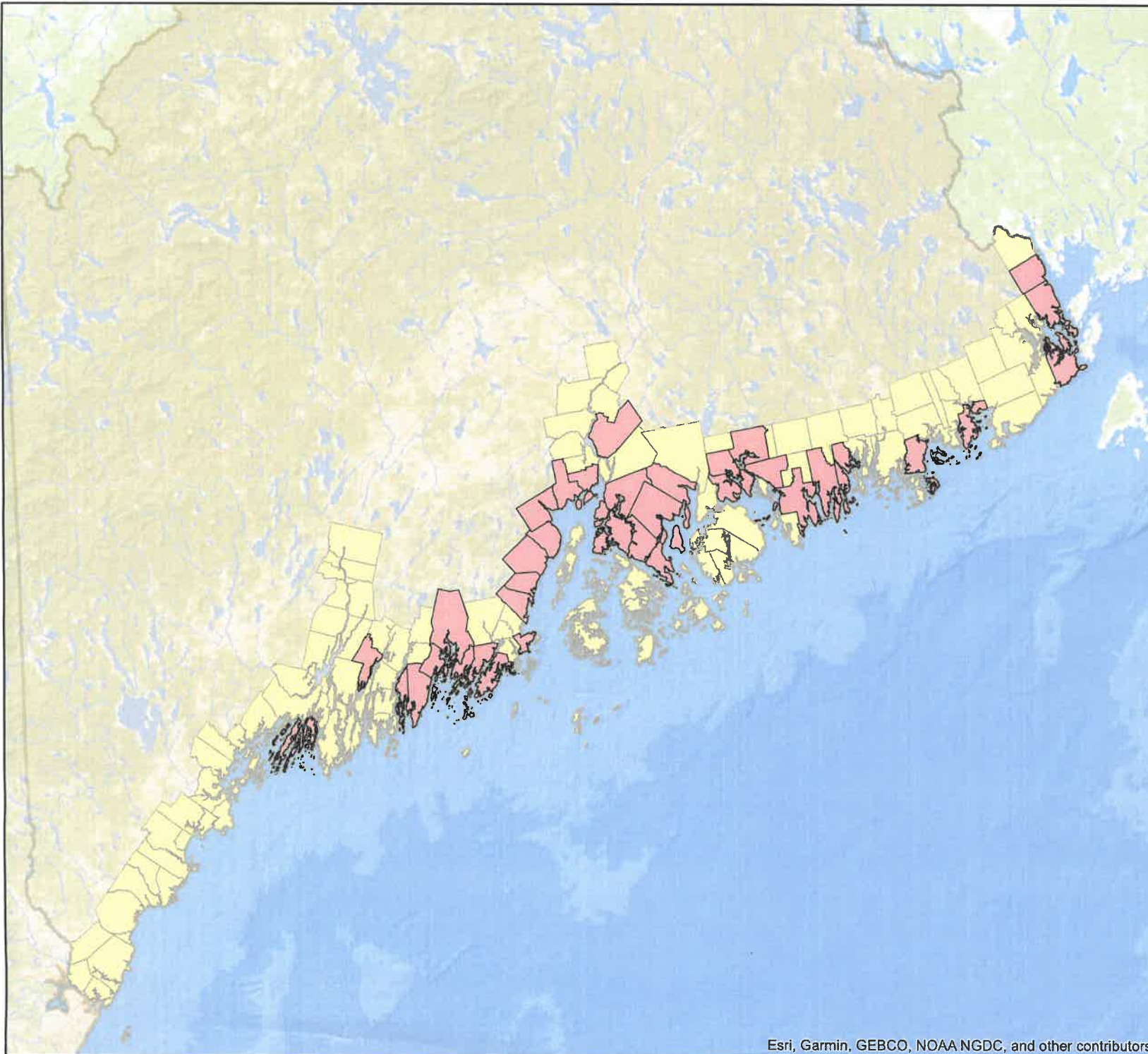
Nordic Aquafarms, Inc.
159 High Street
Belfast, Maine

Site Address

Proposed Aquaculture Facility
285 Northport Ave
Belfast, Maine

171.05027 | Mar 2019

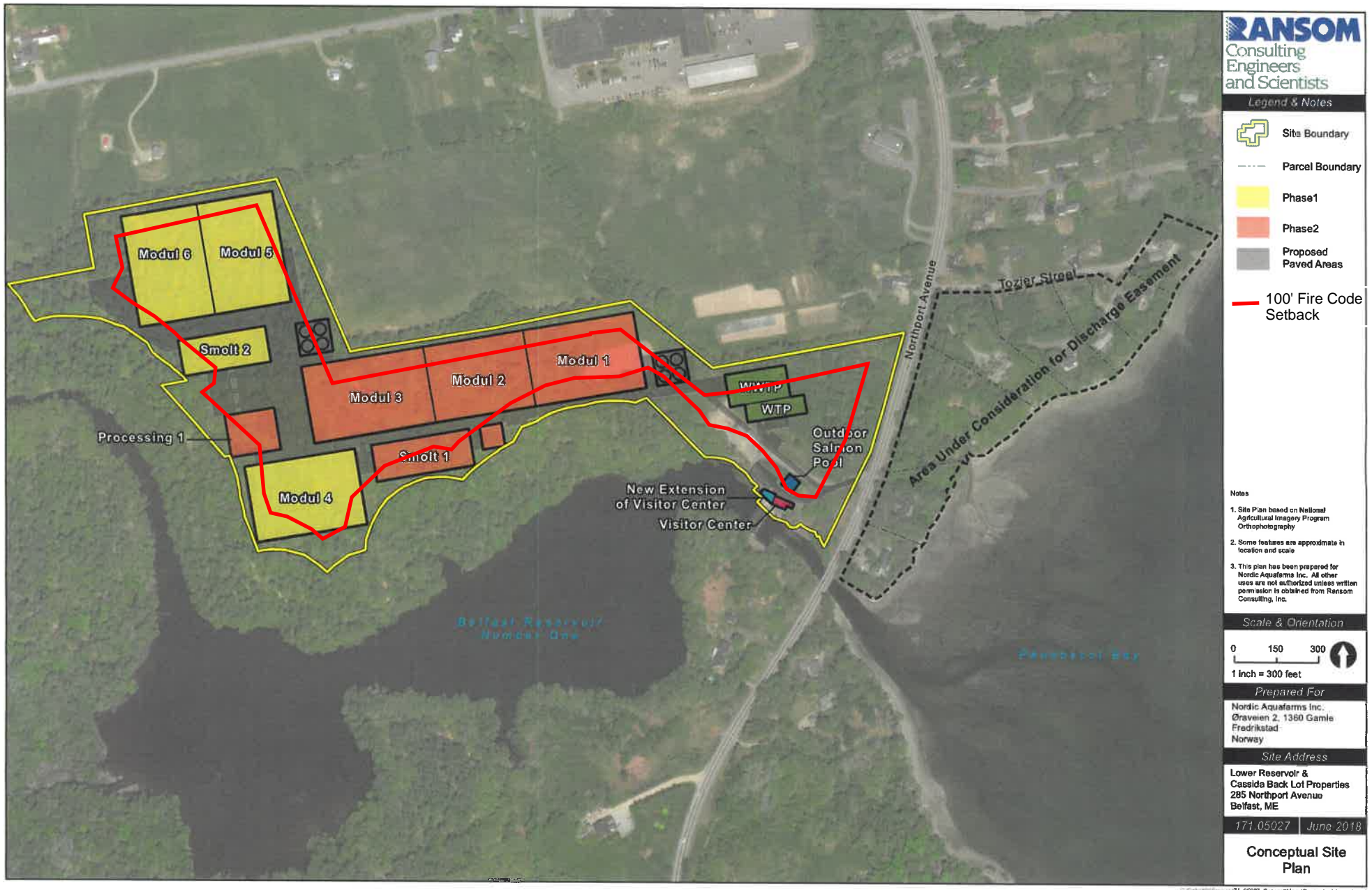
**Figure 2-1
Potential Aquaculture
Sites by Town**



APPENDIX 2-B

Option 1 Site Plan

Figure 2-2



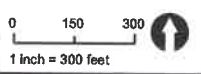
RANSOM
Consulting
Engineers
and Scientists

Legend & Notes

-  Site Boundary
-  Parcel Boundary
-  Phase1
-  Phase2
-  Proposed Paved Areas
-  100' Fire Code Setback

- Notes**
1. Site Plan based on National Agricultural Imagery Program Orthophotography
 2. Some features are approximate in location and scale
 3. This plan has been prepared for Nordic Aquafarms Inc. All other uses are not authorized unless written permission is obtained from Ransom Consulting, Inc.

Scale & Orientation



Prepared For
Nordic Aquafarms Inc.
Ørsvæien 2, 1360 Gamle
Fredrikstad
Norway

Site Address
Lower Reservoir &
Cassida Back Lot Properties
285 Northport Avenue
Belfast, ME

171.05027 June 2018

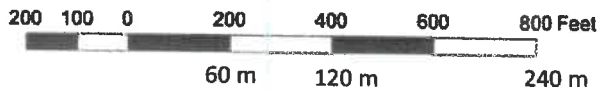
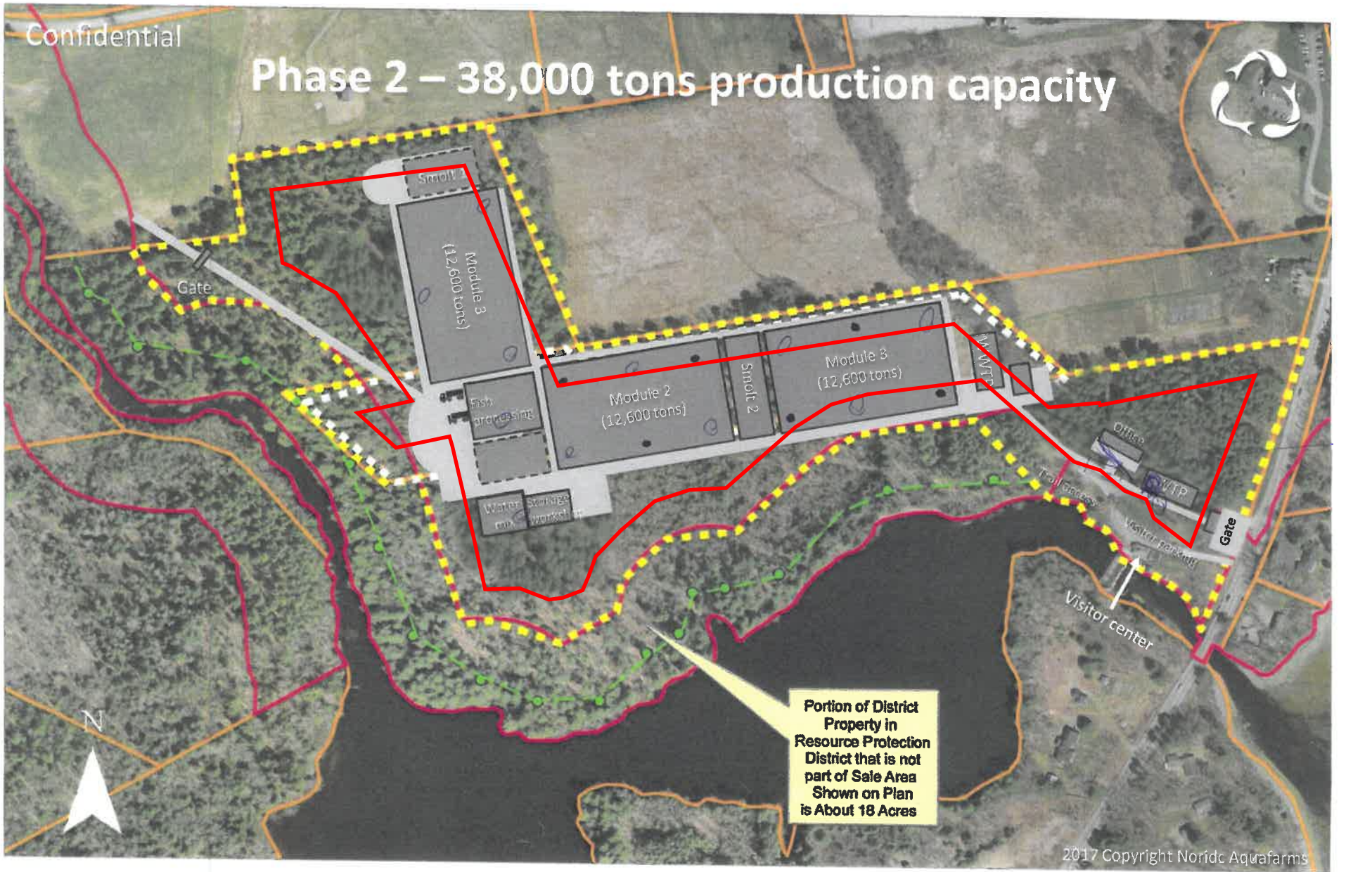
Conceptual Site Plan

© Ransom Consulting, Inc. 171_05027_ConceptMsoConceptual_LayOut.mxd

APPENDIX 2-C

Option 2 Site Plan

Figure 2-3



District Land - @ 30 Acres
Cassida Land - @ 14 Acres (white dash)
Total Land - @ 44 Acres (yellow dash)

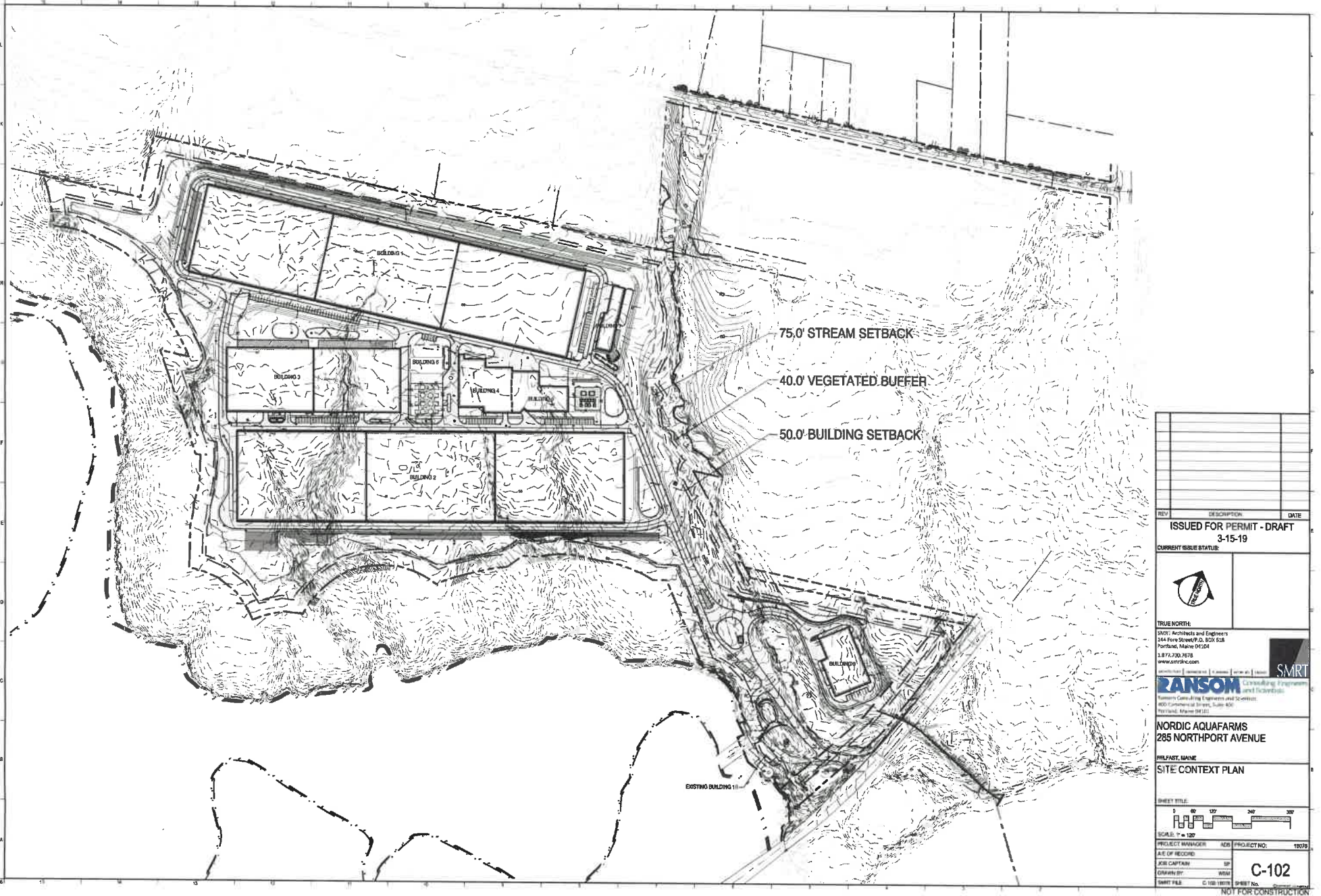
Red Line - Shoreland Zone - 250' from HAT
Green Line - 100' Structure Setback in Resource Protection Shoreland Zone

— 100' Fire Code Setback

APPENDIX 2-D

Option 3 Site Plan

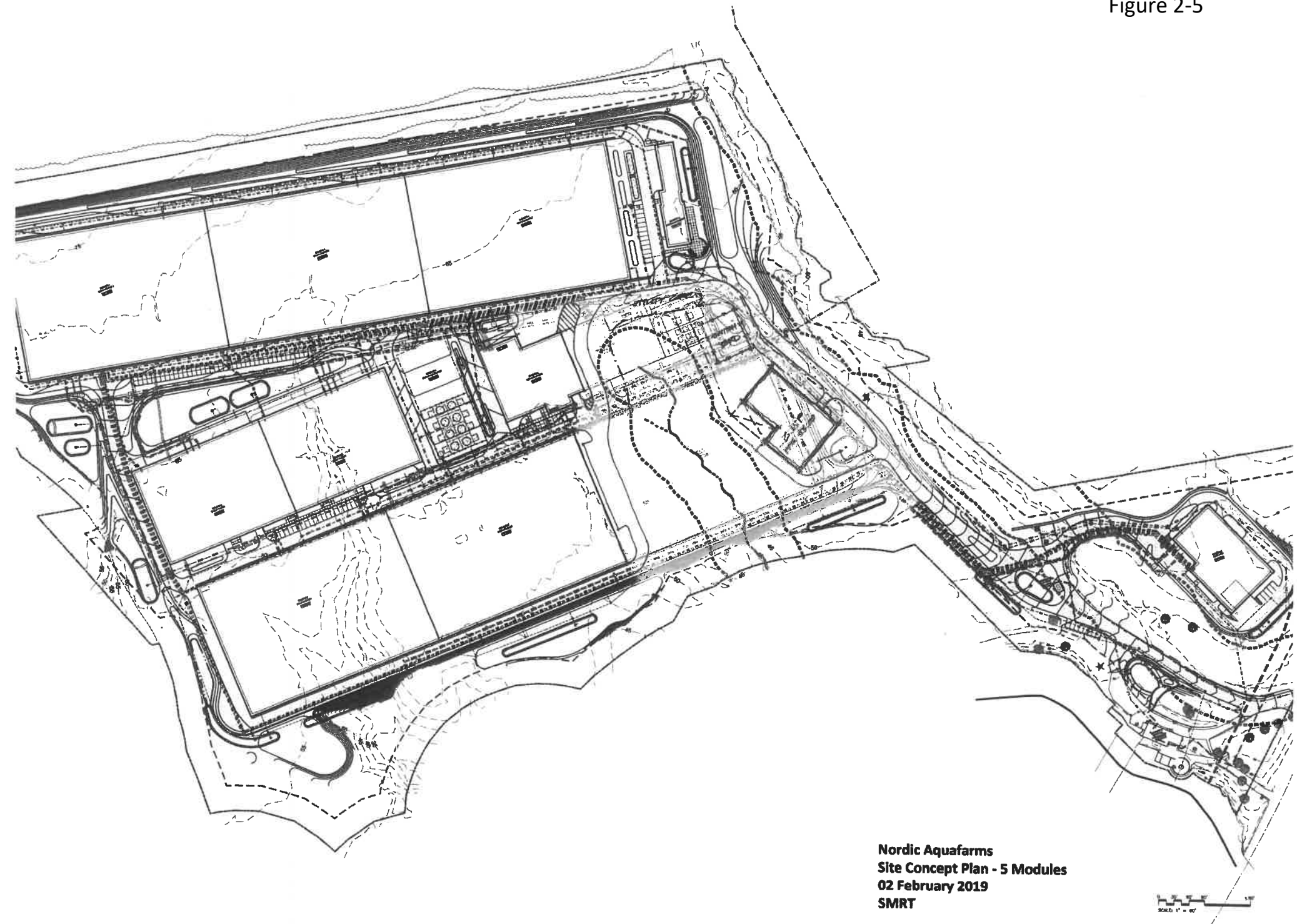
Figure 2-4



APPENDIX 2-E

Option 4 Site Plan

Figure 2-5



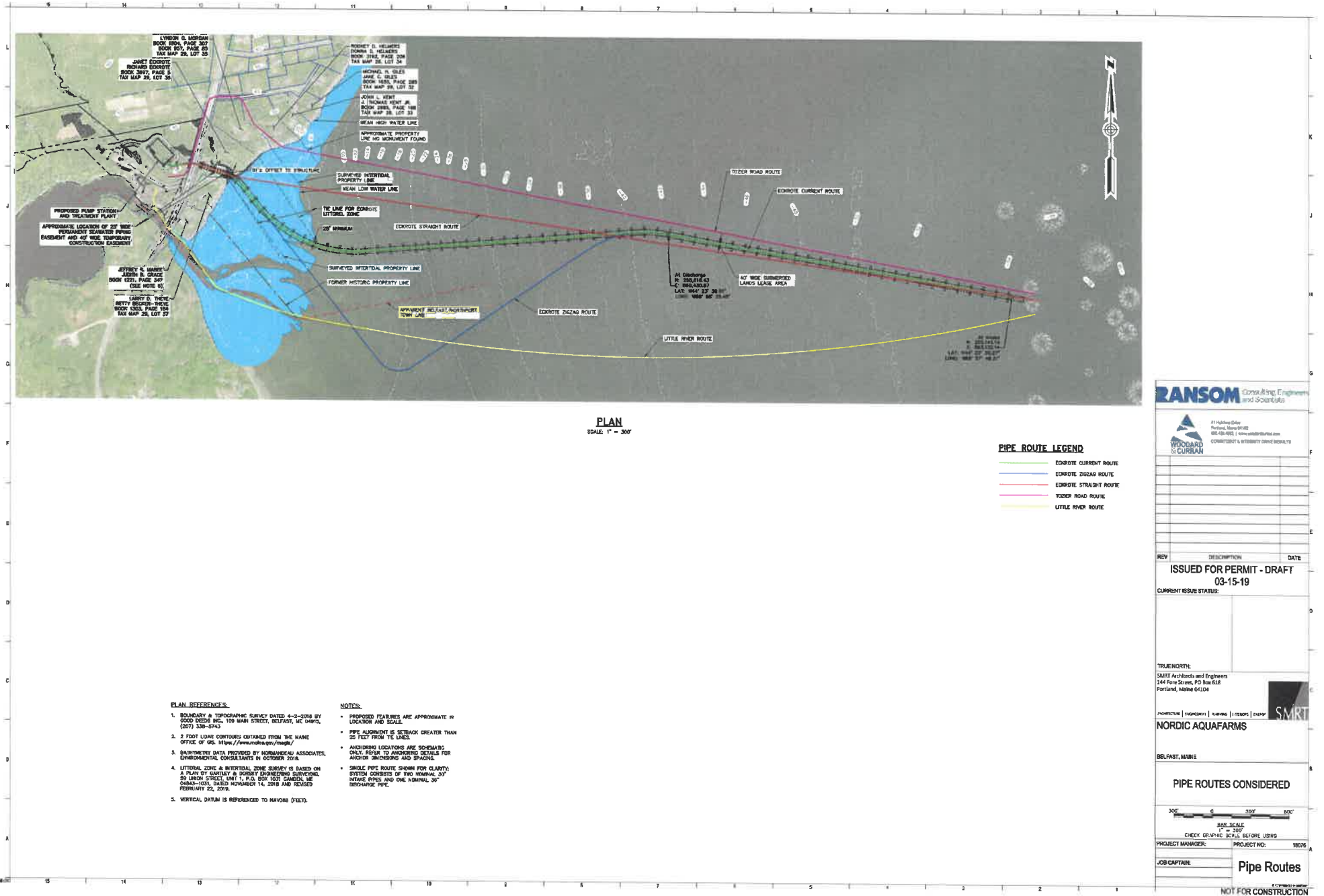
**Nordic Aquafarms
Site Concept Plan - 5 Modules
02 February 2019
SMRT**

SCALE: 1" = 60'

APPENDIX 2-F

Possible Pipeline Routes

Figure 2-6



RANSOM Consulting, Engineering and Scientists

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CORPORATE & SITE-SPECIFIC CONSULTING

WYOMING & CURRAN

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CORPORATE & SITE-SPECIFIC CONSULTING

REV	DESCRIPTION	DATE
	ISSUED FOR PERMIT - DRAFT	03-15-19

CURRENT ISSUE STATUS:

TRUE NORTH:

SMRT Architects and Engineers
144 Fore Street, PO Box 618
Portland, Maine 04104

PROJECT: | ENGINEER: | DRAWING: | CHECKED: | DATE: |

NORDIC AQUAFARMS

BELFAST, MAINE

PIPE ROUTES CONSIDERED

300' 0 300'

BAR SCALE
1" = 300'
CHECK GRAPHIC SCALE BEFORE USING

PROJECT MANAGER: PROJECT NO.: 18076

JOB CAPTURE: **Pipe Routes**

NOT FOR CONSTRUCTION

18.0 SOLID WASTE

Project construction and operation will produce a variety of temporary and permanent waste streams. The variable volume of each waste stream will closely coincide with the construction schedule and slow operational increase to 50% capacity during Phase I development and slow increase to 100% capacity during Phase II development. In the interest of meeting Nordic's operational zero-waste objective, management options for the fish-related organic waste streams have been evaluated for beneficial reuse opportunities. Nordic has initiated efforts with the Maine Department of Marine Resources (MDMR) to have salmon cut-offs from the processing facility used as lobster bait. A copy of Nordic's letter to MDMR and their response is included in **Appendix 18-A**. While final contracts for Nordic's waste streams will be finally awarded during the construction phase, commitment letters covering the transport and off-take of all solid waste streams through construction and the first five years of operation have been provided in **Appendix 18-B**. These waste streams, estimated quantities and generation schedule, along with potential collectors and disposal facilities are discussed below and summarized in **Table 18-1** and **Table 18-2** presented at the end of this document.

18.1 Construction

Construction activities for the project will generate a standard assortment of solid waste consisting of construction and demolition debris, special waste, and land clearing debris. The land clearing debris will include timber, brush and stumps, as well as soil and ledge that cannot be reused on Site based on final grading design plans. Cleared vegetation will be harvested and removed as merchantable forest products, as it already has been on this property in recent years. Marketable timber/pulp will be sold by the clearing contractor or donated locally to an organization such as the Waldo County Woodshed which provides firewood to those in need. A timber inventory conducted by Comprehensive Land Technologies, Inc. in January 2019 for the approximately 30 acres of forest within the project area estimated the total volume of marketable standing timber to be 1,146 cords; this timber inventory report has been included in **Appendix 18-B**. Smaller woody debris and grubbing material will be chipped or mulched and used on-site for erosion control or as a soil amendment. Any excess wood waste, including stumps, generated during vegetation clearing that cannot be reused, marketed or donated will be hauled off-site to an appropriate management facility. Commitment letters have been provided by Comprehensive Land Technologies, Casella/Pine Tree Waste Services and Waste Management to manage these construction-related waste streams.

Construction activities pertaining to the renovation of the existing office building and former pump house are anticipated to generate small volumes of special waste including asbestos insulation, asbestos roofing, and localized polycyclic aromatic hydrocarbon (PAH) impacted soils, as documented in environmental due diligence investigations. Casella and Waste Management have provided Nordic with letters of commitment to manage these special wastes.

Additionally, construction of the ocean pipelines is anticipated to generate a net surplus of sediment removed from Belfast Bay during pipeline burial. Casella and Waste Management have provided letters of commitment to manage this sediment; analytical testing for waste characterization will be provided to the final waste management contractor to ensure appropriate disposal within the Maine Solid Waste Management Rules. Initial sampling and analytical testing of marine sediment along the pipeline route indicate the marine sediment will not have to be classified as hazardous material. Further discussion of marine sediment composition and presentation of analytical results is below.

18.1.1 Marine Sediment Composition

Materials disturbed during construction include marine sediments which will be excavated and removed from the site during construction activities. Marine sediments are to be disposed of on

land at a solid waste facility; therefore, Maine regulations require waste characterization in advance of disposal. Further, if there is existing sediment contamination at the site it should be documented prior to construction activities so that proper procedures can be followed before any sediment disturbance. Therefore, to evaluate excess marine sediments remaining from construction following pipeline burial and to assess whether sediment contamination is present at the project site at concentrations that warrant further waste characterization testing, sediment samples were collected, and laboratory analyzed as part of this SLODA application effort.

Vibracore sediment samples were collected in Belfast Bay on November 29, 2018 and submitted to Alpha Analytical Labs in Westboro, MA for laboratory analysis of multiple parameters. Multiple samples were collected for grain size analysis, while two samples, B3 and A6/A7 composite (See **Figure 18-1**), were submitted for chemical and physical characteristics analysis. Sediment core samples were collected using standard vibracoring techniques and cores were sampled from the sediment surface through the unconsolidated layers to the depth of vibracore tool refusal (typically a compacted layer or bedrock). Note that vibracore sampling relies on the tool weight and mechanical vibration to penetrate marine sediments and does not employ impact forces (as with other sampling techniques) that would allow potentially deeper penetration into the sediment layers. Sample B3 was a depth composite sample collected at station B3 to a sediment penetration depth of 6 ft. 5 in. Sample A6/A7 composite was a two-sample composite from stations A6 and A7. Station A6 was sampled to a sediment penetration depth of 1 ft. 0in. while station A7 was sampled to a sediment penetration depth of 3 ft. 9 in.

Figure 18-1. Location of Sediment Samples



Samples B3 and A6/A7 composite were tested for:

1. Volatile Organics by method 8260
2. Semivolatile Organics by method 8270

3. Polychlorinated Biphenyls
4. Pesticides
5. Chlorinated Herbicides
6. Total Metals (RCRA 8: As, Ba, Cd, Cr, Pb, Hg, Se, Ag)
7. Ignitability
8. Total solids
9. pH
10. Reactive cyanide
11. Reactive sulfide
12. Paint filter liquid

We reviewed the laboratory results in the context of disposing sediments excavated during construction at a solid waste facility. Crossroads Landfill, where construction waste would potentially be disposed of for this project, is licensed by the State of Maine to dispose of non-hazardous waste. 40 CFR 261.24 identifies toxicity characteristics (standards) in solid waste and is used to determine whether solid waste is characterized as hazardous or non-hazardous. Landfill waste is tested and compared to toxicity characteristics based on EPA Method 1311 “Toxicity Characteristic Leaching Procedure,” or TCLP analysis, which is used for simulating the leaching potential from landfill waste. Method 1311 TCLP analysis specifies an extraction fluid equivalent to 20 times the total weight of a waste sample for evaluating the leaching potential of the sample. However, if a total sample concentration, as determined from a conventional analytical test (e.g. versus the TCLP test), is less than 20 times the toxicity characteristic concentration, then the waste can be considered non-hazardous and no further testing is required. We compared our laboratory results (analyzed with conventional methods for total concentration) for which there were detections above laboratory reporting limits to the 40 CFR 261.24 toxicity characteristics (multiplied by 20) to determine whether the samples met the criteria for non-hazardous waste. The summary of our detections and the 40 CFR 261.24 Guidelines are reported in **Table 18-3**. These results do not indicate exceedance of any of the toxicity characteristics in 40 CFR 261.24. Based on the laboratory results and using the “rule of 20” for evaluating waste samples, no further sediment testing (e.g. EPA Method 1311 TCLP testing) is warranted and marine sediments from the project site can be accepted as non-hazardous waste for disposal at a RCRA Subtitle D landfill. The full laboratory report is included with this application as **Appendix 18-C**.

Table 18-3. Vibracore sediment samples laboratory results summary. Analytes with one or more detections above laboratory reporting limits are presented. Toxicity characteristic and 20 x Toxicity Characteristic (“rule of 20”) also presented.

Compound	Concentration	Sample B3	Sample A6/A7 Comp	40 CFR 261.24 Toxicity Characteristic	20 x (40 CFR 261.24 Toxicity Characteristic)
Acetone	mg/kg	0.040	0.017	NA	NA

Compound	Concentration	Sample B3	Sample A6/A7 Comp	40 CFR 261.24 Toxicity Characteristic	20 x (40 CFR 261.24 Toxicity Characteristic)
Carbon Disulfide	mg/kg	0.036	ND (<0.013)	NA	NA
Fluoranthene	mg/kg	0.095	0.078	NA	NA
Pyrene	mg/kg	0.093	0.070	NA	NA
Arsenic	mg/kg	13.2	6.7	5	100
Barium	mg/kg	22.9	11.9	100	2000
Chromium	mg/kg	33.4	21.0	5	100
Lead	mg/kg	14.20	7.85	5	100
Mercury	mg/kg	0.267	ND (<0.103)	0.2	4

NA – not applicable

ND – non-detect, result was less than the laboratory reporting limit

Based on the history of mercury contamination in the Penobscot River and Penobscot Bay, additional research was conducted to evaluate the potential of the mercury impacts to affect sediment within the proposed project pipeline area. A chlor-alkali plant formerly operated in Orrington, ME which had a history of mercury contaminated releases to the Penobscot River that occurred primarily between 1967 and 1970 (see <http://www.penobscotmercurystudy.com>, accessed February 27, 2019 for the full mercury study repository) is located up-estuary of the project site in Belfast Bay.

We reviewed the Penobscot River mercury study for relevant information on sediment quality and mercury contamination in the Belfast Bay area (The Penobscot River Mercury Study Panel, 2013). A preliminary review of the comprehensive study did not indicate any data specific to Belfast Bay or the project area; however, Chapter 17 of the study provides a review of the background concentrations of mercury in central Maine estuaries, which encompasses Belfast Bay. The Penobscot River Mercury Study indicates that natural background concentrations of mercury in surface sediments varies from about 28 – 51 ng/g dry weight mercury as measured in the Narraguagas and St. George estuaries and the East Branch of the Penobscot River according to Bodaly, 2013¹. NOAA considers levels below 51 ng/g dry weight mercury concentration in sediment to be the present background concentration or natural abundance (i.e. where the primary contamination source is atmospheric deposition) and the Penobscot River mercury study by Bodaly, 2013 concludes that modern regional background concentrations of total mercury in surface sediments in central Maine estuaries is approximately 55 ng/g (Bodaly, 2013).

The Bodaly, 2013 Penobscot River mercury study determined that in the contamination zone of the Penobscot River, near the historic contamination source in Orrington, the mean sediment mercury concentration was about 800 ng/g, while upstream in the Old Town – Veazie reach (above the head of tide) the mercury concentration was about 78 - 145 ng/g in surface sediments.

Several sampling sites are located in the lower estuary in the area between Sears Island and Isleboro Island and east of Belfast Bay including stations ES 7A, ES 8A, ES 8C, and ES 15A

¹ Bodaly, R.A. 2013. Penobscot River Mercury Study Chapter 17 Background concentrations of mercury in central Maine estuaries. Submitted to Judge John Woodcock United States District Court (District of Maine). April 2013.

(Yeager, 2013²). These stations, which are the closest stations to the project site for which sediment mercury data were reasonably available, indicate mercury concentrations of 290 – 383 ng/g in surface sediments and sediment mercury concentrations of 111 - 145 ng/g as a column average (total column depth 90 cm). The Bodaly, 2013 Penobscot River mercury study and Yeager, 2013 study indicate that mercury concentration varies by depth in the affected marine sediments with the highest concentrations typically located at depths of 10-30 cm in the sediment column with lower values in surface sediments and lower values approaching background concentrations at depths below 40-60 cm.

The two sediment samples collected, and laboratory analyzed in support of this SLODA application were depth composite samples, as explained previously. These samples were found to have mercury at a concentration of 267 ng/g in the B3 sample and at a concentration that was less than the laboratory reporting limit of 103 ng/g in the A6/A7 composite sample.

Results indicate that low levels of certain compounds, including mercury, are present at the project site. However, the results also indicate that the presence of low-level contamination is not uniform at the project site and the majority of compounds tested were not detectable at typical laboratory reporting limits. Mercury levels in the tested samples were comparable to other sample sites in the lower Penobscot River estuary and well below the high values measured in the mercury contamination zone in the upper estuary. Samples collected for this study were depth composites which we believe to be a valid and representative sampling technique (i.e. versus testing discrete depths) to indicate the potential impacts from construction activities at the site. Construction and disturbance of marine sediments will expose and mix multiple depth layers concurrently which will tend to reduce the risk of exposing any single strata or other area of potentially concentrated contamination. In addition, construction methodologies will be used that minimize risk of sediment exposure and mobilization and construction impacts will be temporary.

18.2 Operation

Nordic has worked to establish markets for operational by-products including salmon processing solids such as heads, viscera, and mortalities and wastewater treatment filtrate high in organics and nutrients. While production of these by-products will likely lead to a range of recycling opportunities in the future, multiple businesses have provided letters of commitment and capacity to reflect their interest and ability to manage the volume and content of these organic by-product resources. Interested partners include Agri-Cycle Energy, Casella Organics, Channel Fish Co., Inc., Coast of Maine Organic Products, Inc., Compost Maine LLC, and Waste Management as presented in **Table 18-2** and **Appendix 18-B**. With MDMR approval for re-use of heads and racks for lobster bait, agreements will be pursued with the lobster industry to provide high quality bait resource.

Organic solids are managed by dewatering into a filtrate with multiple beneficial reuses, including biogas. This filtrate comes from the wastewater treatment process where solid feces and feed particles in the water are filtered out. Solids are removed by drum filters in the production modules, and membrane bioreactors in the wastewater treatment plant. Filtrate from the production is dewatered indoors and stored in sealed tanks before being transported off-site for further recycling re-use by by-product partners. By-products from fish processing, including salmon heads, viscera, bones, carcasses and smaller cut-off pieces are frozen or refrigerated and shipped out for sale to a variety of customers for uses such as bait, pet food, nutritional supplements and fish meal.

² Yeager, K.M. 2013. Penobscot River Mercury Study Chapter 5 Total mercury sedimentary inventories and sedimentary fluxes in the lower Penobscot River and estuary, Maine. Submitted to Judge John Woodcock United States District Court (District of Maine). April 2013.

In addition, commitment letters for the management of office waste (i.e. municipal solid waste), universal wastes, and recyclable products, have been provided by Casella/Pine Tree Waste Services and Waste Management.