Attachment B

Dilution Factors

Applicable dilution licensing criteria

Maine law, 38 M.R.S. §451 *Enforcement generally* states in part:

> After adoption of any classification by the Legislature for surface waters or tidal flats or sections thereof, it is unlawful for any person, firm, corporation, municipality, association, partnership, quasi-municipal body, state agency or other legal entity to dispose of any pollutants, either alone or in conjunction with another or others, in such manner as will, after reasonable opportunity for dilution, diffusion or mixture with the receiving waters or heat transfer to the atmosphere, lower the quality of those waters below the minimum requirements of such classifications, or where mixing zones have been established by the department, so lower the quality of those waters outside such zones, notwithstanding any exemptions or licenses which may have been granted or issued under sections 413 to 414-B.
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> The department may establish a mixing zone for any discharge at the time of application for a waste discharge license. The department shall attach a description of the mixing zone as a condition of a license issued for that discharge. After opportunity for a hearing in accordance with section 345-A, the department may establish by order a mixing zone with respect to any discharge for which a license has been issued pursuant to section 414 or for which an exemption has been granted by virtue of section 413, subsection 2.
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> The purpose of a mixing zone is to allow a reasonable opportunity for dilution, diffusion or mixture of pollutants with the receiving waters before the receiving waters below or surrounding a discharge will be tested for classification violations. In determining the extent of any mixing zone to be established under this section, the department may require from the applicant testimony concerning the nature and rate of the discharge; the nature and rate of existing discharges to the waterway; the size of the waterway and the rate of flow therein; any relevant seasonal, climatic, tidal and natural variations in such size, flow, nature and rate; the uses of the waterways in the vicinity of the discharge, and such other and further evidence as in the department's judgment will enable it to establish a reasonable mixing zone for such discharge. An order establishing a mixing zone may provide that the extent thereof varies in order to take into account seasonal, climatic, tidal and natural variations in the size and flow of, and the nature and rate of, discharges to the waterway.

> Where no mixing zones have been established by the department, it is unlawful for any person, corporation, municipality or other legal entity to dispose of any pollutants, either alone or in conjunction with another or others, into any classified surface waters, tidal flats or sections thereof, in such manner as will, after reasonable opportunity for dilution, diffusion, mixture or heat transfer to the atmosphere, lower the quality of any significant segment of those waters, tidal flats or sections thereof, affected by such discharge, below the minimum requirements of such classification, and notwithstanding any licenses which may have been granted or issued under sections 413 to 414-B.

06-096 CMR Chapter 530 – *Surface Water Toxics Control Program,* §4(A) (calculation of dilution factors) states in part as §4(A)(2)(a):

> For discharges to the ocean, dilution must be calculated as near-field or initial dilution, or that dilution available as the effluent plume rises from the point of discharge to its trapping level, at mean low water level and slack tide for the acute exposure analysis, and at mean tide for the chronic exposure analysis using appropriate models determined by the Department such as MERGE, CORMIX or another predictive model.

Modeling for Near-field and Far-field Dilution

The United States Environmental Protection Agency (USEPA) supports the use of the CORMIX model for calculating near-field dilution factors. Page 76 of the *USEPA Technical Support For Water Quality Based Toxics Control, March 1991*, states in part

> "The first model, CORMIX may be the most useful to regulators since it is an expert system that guides the user in selecting an appropriate modeling strategy for rivers or estuaries."
>
> and:
>
> "CORMIX is a series of software elements for the analysis of a submerged buoyant or nonbuoyant discharge containing conventional or toxic pollutants and entering into stratified or unstratified watercourses, with emphasis on the geometry and dilution characteristics of the initial mixing zone."

Near-Field Dilution

Near-field dilution factors are applicable to pollutants that have the potential for an immediate adverse effect on the flora or fauna of a marine ecosystem. For example, marine organisms react to elevated levels of toxic pollutant such as total metals with hours or days of being exposed. Therefore, estimating acute and chronic dilution factors with a steady state model such as the CORMIX model is supported by Department rules and USEPA technical support documents.

In a letter dated August 14, 2019, to the Department, the applicant indicated it had utilized the CORMIX model to determine the near-field dilution factors for the proposed discharge from the Nordic facility. The input parameters included, but were not limited to, a full flow rate of 7.7 MGD that would be discharged via an outfall pipe measuring 36 inches in diameter with a multi-port diffuser discharging at 11.5 meters below mean low water approximately 3,600 feet off of the shoreline. The applicant calculated worst case near-field dilution factors of 10:1 (acute) and 15:1 (chronic).

Far field dilution

Far-field dilution factors are applicable to pollutants that have the potential for a more subtle and or systemic types of effects on the flora or fauna of a marine ecosystem, and or pollutants that exert their influence on broader time scales. For example, biochemical oxygen demand (BOD_5) decays over time and takes five days to exert its implied influence on ambient dissolved oxygen. Eutrophication associated with excessive nitrogen loadings happens on significantly broader spatial and time scales in this type of marine system, due in large part to the very dynamic nature of the bay.

Unlike the CORMIX model that is supported by Department rules and USEPA technical support documents for estimating near-field acute and chronic dilution factors, there currently are no rules or statutes that establish methodologies to model far-field dilution. Therefore, modeling personnel must use best professional judgment to select modeling tools that are most appropriate for a particular receiving water and discharge characteristics.

Maine law 38 M.R.S. §451 provides some guidance regarding dilution factors that may be considered by the Department: "In determining the extent of any mixing zone to be established under this section, the department may require from the applicant testimony concerning the nature and rate of the discharge; the nature and rate of existing discharges to the waterway; the size of the waterway and the rate of flow therein; any relevant seasonal, climatic, tidal and natural variations in such size, flow, nature and rate; the uses of the waterways in the vicinity of the discharge, and such other and further evidence as in the department's judgment will enable it to establish a reasonable mixing zone for such discharge."

In this proceeding, the applicant utilized a hydrodynamic model referred to as the ADvanced CIRculation (ADCIRC) model to estimate the far-field dilution factors for the proposed discharge to Belfast Bay. The ADCIRC model was originally developed for coastal flood hazard studies in the larger Penobscot Bay and has many of the dynamic physical attributes of the bay already built into the model. The applicant evaluated a particle tracking output from the model to evaluate the far field dilution factor in close proximity to the proposed discharge over 4 tide cycles (two days) and determined that a far-field dilution factor for

assessing impacts to dissolved oxygen is 300:1. For potential impacts to the closest eelgrass bed located 4 kilometers (2.5 miles) to the southwest of the proposed discharge along the southern shore of Northport as mapped by the Department (see Department sampling station PB02 on the attached aerial photograph entitled *Fig.1: Belfast Bay and Penobscot Bay)*, the dilution factor of 1,000:1 was based on the Department's best professional judgment.

Department staff's review and analysis of the applicant's modeling to date

The Department staff has reviewed the applicant's modeling efforts and believes that the proposed near-field and far-field dilution factors utilized for the proposed discharge are based on a sound scientific rationale and would, if the discharge is permitted, meet the dilution licensing criteria established in Maine law, §451 and 06-096 CMR Chapter 530.

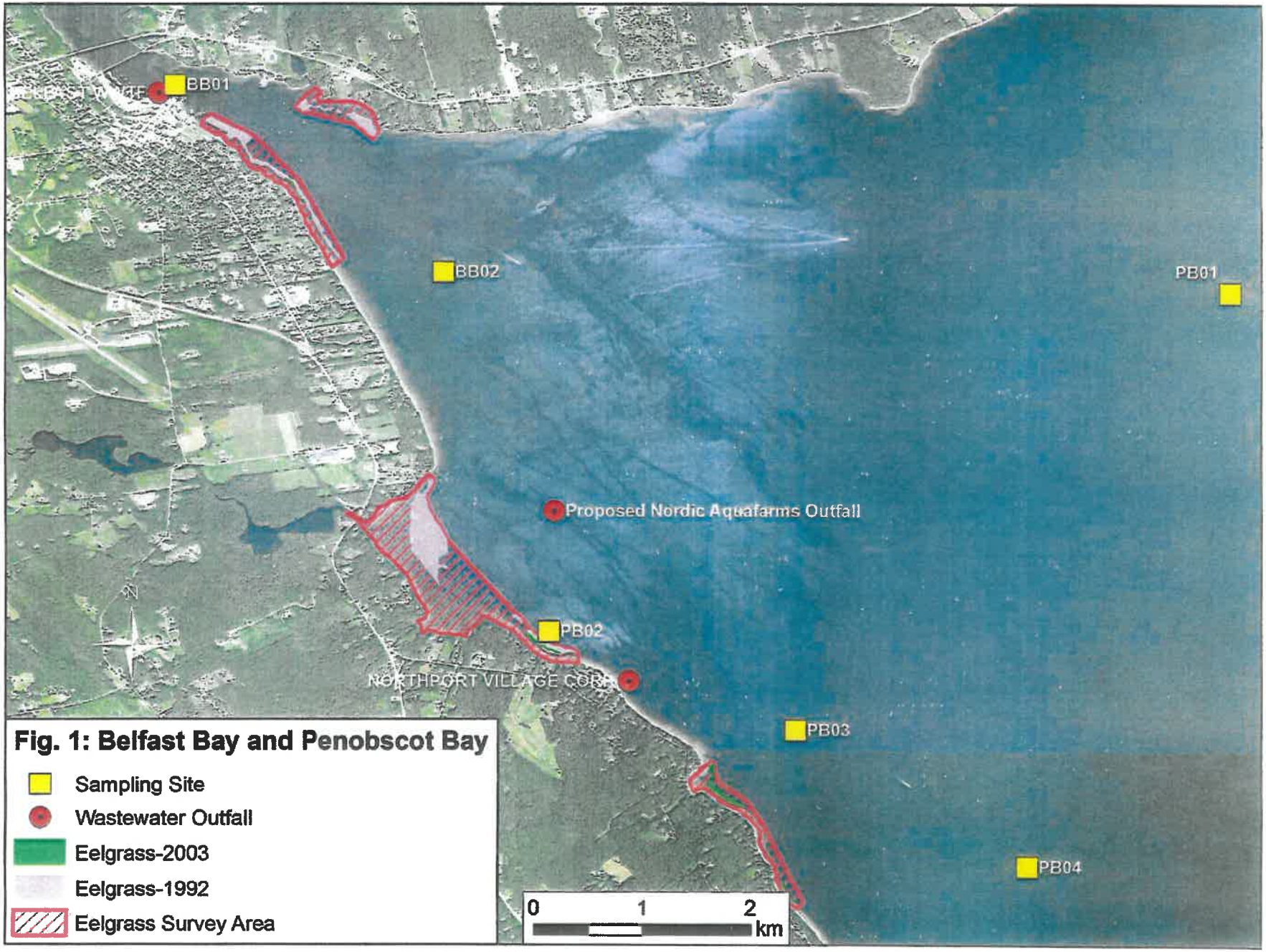

Fig. 1: Belfast Bay and Penobscot Bay

- Sampling Site
- Wastewater Outfall
- Eelgrass-2003
- Eelgrass-1992
- Eelgrass Survey Area