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Computation of Long-Term Three-Dimensional Hydrodynamics of New York Bight

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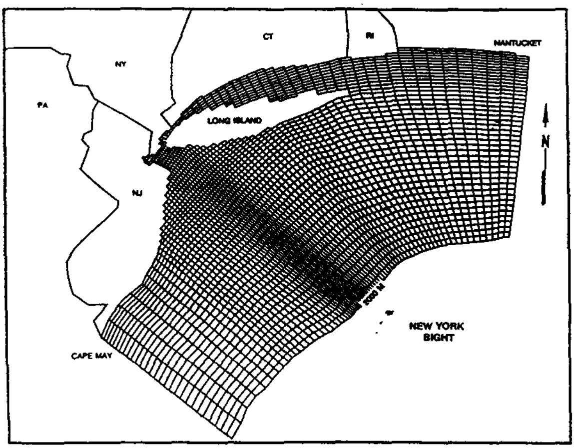
A time-varying three-dimensional (3D) numerical hydrodynamic model has been applied to the New York Bight to provide flow fields to a 3D water quality model. The spatial computational domain extends from Cape May, New Jersey at its south-west end and Narragansett Bay, Rhode Island, at the north-east end and seaward to the shelf-break. As illustrated below, the numerical model has more than 2500 active horizontal cells and ten vertical layers. Features of the hydrodynamic model include coupling of temperature grids to better represent geometric features, and an algebraic vertical turbulence model based upon the assumption that turbulence production and dissipation are in equilibrium. Using historical forcing data, flow fields for the period of September 1975 - October 1976 have been computed. These results demonstrate that the numerical model is able to accurately reproduce the observed salinity field.

Figure 1. Numerical grid of New York Bight



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Behavior of Thermal Wedges in Oscillating Reservoir Flow: A Case Investigation

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Abstract

Observation and measurement of thermal wedges upstream of a thermal plant discharging condenser cooling water into a run-of-the-river reservoir are made. Measurements indicate that the upstream extent and the local thickness of the thermal wedge in the vicinity of the plant intake depend highly on the operation at the hydroelectric dams above and below the plant. During revered flow conditions the wedge has been observed to travel many miles upstream and create recirculation of the heated discharge.

Introduction

Keulegan (1966) published a summary of his experiments on saline wedges and provided the framework for better understanding of this subject and further research. Many others including Harleman (1961), Arita and Jirka (1987), and Grubert (1990) have investigated various aspects of saline wedges and two-layered flows. However, most of the published literature seems to address arrested wedges in relatively steady flows where a balance between the interfacial drag and the inertial force is achieved.

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and Q_{brf} are the Clinch River and Bull Run cooling water flows, respectively. This definition of Froude number does not include the flow area or the flow depth, both of which are relatively constant within the accuracy of the method.

A plot of the Froude number and flow ratio for given days is shown as Fig. 3. A low flow ratio and low Froude number combination indicates potentially excessive intake temperatures. A rectangular "critical zone" was developed on the plot covering combinations of Froude number and flow ratios which have resulted in problems in the past. For a measured temperature profile at the intake, the flow ratio may be adjusted, via Norris release, in order to move the combination outside the critical zone.

Two additional adjustments were made to improve the predictions. A meteorological coefficient to adjust flows based on the expected average air temperature was included. Also, a multiplier was incorporated in the Norris release to allow a closer operation to the intake temperature limit.

Application and Limitation

The approach described above has been computerized in a user friendly fashion for use at the plant and by the reservoir operation planners. The interactive screen requires current temperature profile at the plant intake, plant flow, and forecasted air temperature as input. The user is then presented with a daily flow schedule at Norris to keep the plant intake temperature below the limit. The method was used successfully in assisting flow scheduling for Norris and Melton Hill dams during the late summer period of 1991 and will be tested again in 1992.

Within the general limitations of the parametric approach the method seems to be useful in this particular application. However, the method somewhat overestimates the required flow in order to ensure operation well outside the critical zone. This limitation can be costly, as unnecessary off-peak releases may be proposed by the method. Additional testing is planned to further reduce the size of the critical zone used by the method to schedule flows past the plant.

Appendix

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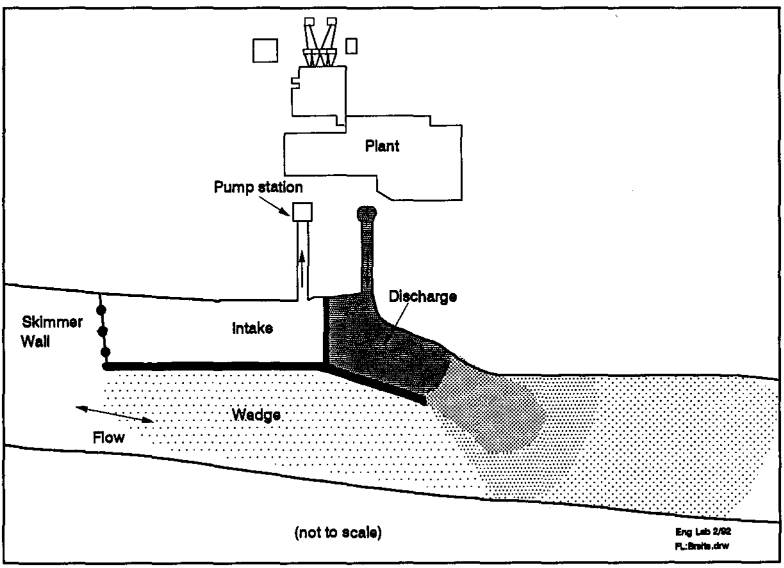

Figure 1. Schematic of Bull Run Thermal Plant Intake and Discharge

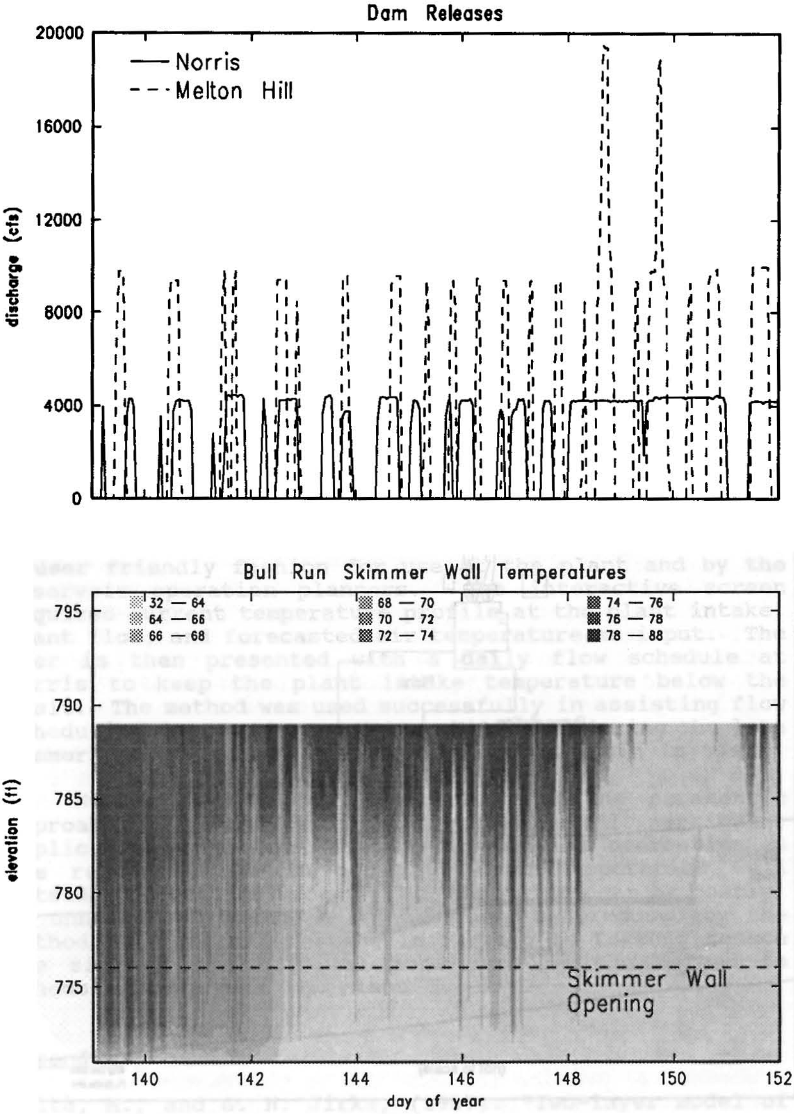

Figure 2. Dam Releases and Consequent Wedge Oscillations at the Plant