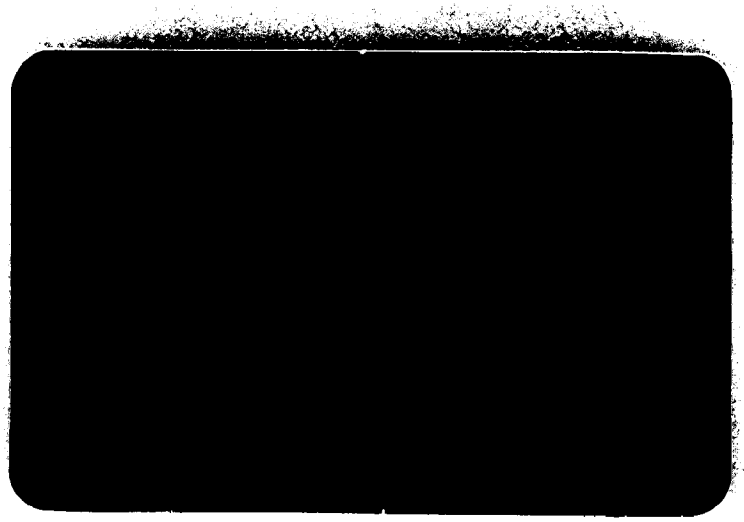
WORK TASK 5.2.16 NAOEAA-D-C2080

New Hampshire: Coastal Zone Management Program



NORMANDEAU ASSOCIATES INC.
a unit of Thermo Water Management Inc.

PHASE III REPORT:

TOPOGRAPHICAL SURVEY AND HYDROLOGICAL ANALYSIS

OF THE

WALLIS SANDS AND PHILBRICK BROOK MARSHES -

ASSESSMENT OF DRAINAGE IMPROVEMENT IMPACTS

Submitted to

THE TOWN OF RYE, NEW HAMPSHIRE

Prepared by

NORMANDEAU ASSOCIATES INC.
25 Nashua Road
Bedford, New Hampshire 03102

R-4119C

August 1988

TABLE OF CONTENTS

1.0 INTRODUCTION

Normandeau Associates Inc. (NAI) has completed Phases I - III of the Topographical Survey and Hydrological Analysis of the Wallis Sands and Philbrick Brook salt marshes in the Town of Rye, New Hampshire.

The objective of the current study is to provide the physical basis for tidal restoration in two of Rye's salt marshes located in the Wallis Sands and Philbrick Brook watersheds. Phase I is an evaluation of existing conditions in the two study areas, including hydrology, topography and engineering features, and general recommendations for achieving marsh restoration. Phase II recommends specific engineering and drainage improvements to achieve optimal tidal flushing and flood protection. Phase III assesses the impacts of drainage alterations on surrounding development, including properties, septic systems, structures, and roadways.

This report is a presentation of Phase III results, including 1) an overview of ecological impacts and benefits, and 2) a general assessment of the impacts of drainage improvements on surrounding development.

The New Hampshire Coastal Program provided a grant for the preparation of this report, which was funded in part by the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration.

2.0 ASSESSMENT OF IMPACTS

2.1 OVERVIEW OF DRAINAGE IMPROVEMENTS

Drainage improvements recommended in Phase II were targeted toward: 1) improving tidal exchange for salt marsh restoration; 2) improving stormwater runoff management; and 3) protecting developed areas from the impacts of flooding due to tidal storm surge. Of these, improving tidal exchange required the most extensive improvements, whereas stormwater runoff management required only minor upgrading of existing structures. In general, improvement of primary channels to increase tidal flushing will have the added benefit of increasing stormwater runoff capacity.

Where feasible, flood protection devices were recommended for installation seaward of low-lying developed areas subject to tidal storm surge. Many parts of coastal Rye currently have development in zones of high flood hazard. While it was beyond the scope of this study to develop a comprehensive plan for protection of such areas over the long-term, the recommended improvements were designed to minimize flooding given the present configuration of existing roads and structures.

2.2 ECOLOGICAL IMPACTS

A primary objective of the Town of Rye in pursuing this project is to restore and maintain natural hydrologic conditions of the salt marshes. The following discussion briefly describes current ecological trends, and ecological changes anticipated as a result of implementing these improvements.

Previous studies of Rye's coastal marshes stressed the need for tidal restoration in several areas, including the Wallis Sands and

Philbrick Brook salt marshes (Simpson 1986, NEI 1986a, NEI 1986b). These reports noted the invasion of former salt marsh areas by brackish water plant communities, salt marsh vegetation die-off, peat erosion and subsidence, and an areal increase in unvegetated pannes (shallow tide pools on the marsh surface). Left unchecked, these trends could be expected to result in the eventual replacement of large salt marsh areas by brackish plant communities and large, shallow ponds (Burdick and Mendelssohn 1987, Roman *et al*. 1984). In Parsons Creek, attempts were made to improve tidal flushing by dredging the channel at Concord Point and removing stones from the creek, with at least partial success (Simpson 1986).

An alternative to such attempts, expressed by some Town residents, is that nature should be allowed to take its course in the restoration of Rye's salt marshes. It is believed that because human interference with the system caused the problem, further tampering must also go awry. Unfortunately, nature's course has been largely obstructed by the impacts of development. In Rye's salt marshes this has included filling, dredging, ditching, burning, haying, and criss-crossing with roads, highways, and bridges. Aside from outright destruction, the most apparent affect has been restriction of the twice-daily exchange of tides.

Had the public been more aware of the long-term effects of such actions, these impacts may have been avoided, and a restoration program might never have been necessary. Underlying this study is a need to carefully document existing conditions, and propose restoration measures, to correct past mistakes and prevent further marsh degradation. This is a reflection of the awareness and concern among Rye's citizenry today.

Examination of the scientific literature shows that all the complexities of salt marsh ecology and restoration are not fully understood at this time. However, the simple factor of tidal water

passing unobstructed in and out of these systems has proven to be essential in the restoration and creation of salt marshes elsewhere in the Northeast. Examples include the successful restoration efforts of the Town of Fairfield, Connecticut (Steinke 1974, Steinke 1986, Roman *et al.* 1984), and elsewhere (Cowan *et al.* 1986, Woodhouse 1979).

Restoring natural tidal exchange to artificially restricted marshes in Rye is, in fact, allowing nature's course to proceed. This is the primary objective of the recommended improvements.

The most noticeable changes resulting from the recommended alterations will be ecological, and will reflect the transition toward a New England saltmarsh community. Several changes can be expected, including:

1) A gradual decline in invading plant species intolerant of high salinity (e.g., purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), cattail (*Typha* spp.), and bulrushes (*Scirpus* spp.), in favor of salt marsh plants. Because of the peat subsidence and erosion that has occurred as a result of tidal restriction, initial salt marsh invaders will probably be those most tolerant of saturated conditions (e.g., short cordgrass, *Spartina alterniflora*).

2) A shift from brackish to marine fish and shellfish using tidal creeks and ponds.

3) Improved flushing of organic matter (e.g., algae), increased tidal scour, and reduced siltation in tidal creeks.

4) A more pronounced wet-dry cycle on the marsh surface due to periodic tidal flooding and improved drainage between flood periods.

5) Die-off of salt intolerant woody vegetation at the marsh/upland boundary as a result of higher salinities during flood events.

6) A shift from brackish and freshwater fauna, especially insects (e.g., mosquitoes) and other invertebrates,

toward more salt tolerant species. This may simplify mosquito control efforts by resulting in more distinct, uniform broods rather than patchy, mixed breeding.

7) Improved tidal exchange will make possible the experimental application of Open Marsh Water Management (OMWM) for ecologically sound mosquito control (Hruby and Montgomery 1986, Cowan *et al.* 1984).

These expected changes are based on earlier observations of restoration work on the Wallis Sands marsh (Simpson 1986), and elsewhere in the Northeast (Portnoy *et al.* 1987, Steinke 1974, Steinke 1986).

2.3 IMPACTS TO SURROUNDING DEVELOPMENT

2.3.1 Overview

The following section describes potential impacts to surrounding development that may result from the recommended drainage improvements. The net impact of changes is expected to be positive. It should be noted, however, that the present high potential for flooding in low-lying areas during extreme events will not be completely eliminated. Most of the areas surrounding Rye's salt marshes are classified as 100-year flood zone up to an elevation of 9.0 feet NGVD (Zone A) on Flood Insurance Rate Maps (FIRMs) based on 1976 data (FEMA 1986). This elevation is approximately 1.0 foot lower than actual measurements taken following the February 1978 flooding (Gadoury 1979). Extensive development occupies many areas within these zones.

As discussed in the previous section, the recommended improvements will result in generally drier conditions on the marshes. Freshwater presently backed-up in marsh basins keeps many areas flooded for prolonged periods. With improved drainage, this excess water will be allowed to flow out during low tides. Surface water will thus have a greater tendency to infiltrate the marsh peat.

During high tides, marsh creeks and ditches will be filled by more saline water. Salt water will flood the marsh surface only during spring and storm tides, on average about every two weeks. In between spring tides the marsh surface will tend to dry more quickly than is presently the case.

This pronounced wet-dry cycle, rather than constantly wet, will result in a slight drop in the water table in the marsh and in immediately adjacent low-lying areas. Hence, a reduction in chronic basement floodings and septic failures is expected. Such instances would not be eliminated, however, since spring tides would still temporarily raise the water table. Spring tides vary in height, but generally occur over a 3-4 day period with each full and new moon. Flooding will depend on the spring-neap tidal cycle, weather conditions, and the operation and maintenance of flood control devices.

Under most circumstances, the removal of stormwater runoff will be enhanced by the recommended improvements. The increased pipes and channels will direct runoff out of the marshes more rapidly than the existing structures, thus reducing flooding of roads, bridges, structures, and properties. Greater basin capacity will generally be available for stormwater storage due to improved drainage, particularly during low tides. During high tides, stormwater outflow can be expected to be restricted to the same degree as under existing conditions. Spring and storm high tides will occupy, and possibly exceed, the capacity of existing marsh basins. If this coincides with high volumes of runoff, local flooding can be expected to occur much as it presently does.

The most substantial increase in tidal flushing will be in Parsons Creek marsh, particularly areas north of Old Wallis Road. However, development surrounding Parsons Creek north of Wallis Road and north of Marsh Road is not expected to experience significantly greater

tidal surge during storm events than is presently the case. This is based on records of the February 1978 storm (100-year frequency tidal flood) in the vicinity of Marsh Road and Fairhill Manor (Gadoury 1979). At its highest, tidal surge reached 8.84 ft. in these areas, compared to heights of 8.53 ft. and 9.91 ft. in areas south of Wallis Road. These data suggest that Wallis Road, acting as a dike at approximately 7.5 ft., and Marsh Road at approximately 6.5-7.0 ft., do not offer substantial flood protection to development to the north. Although the recommended improvements would not be expected to alter this fact, the larger pipes and channels would be expected to allow a tidal surge to recede more rapidly. Thus, although flood height may not be decreased, the duration of each flood event would be expected to be shorter.

2.3.2 Self-regulating Tide Gates

To minimize the potential impacts of flooding, self-regulating tide gates have been recommended. These devices are designed to be installed at culverts or similar structures through an existing road or dike. The gates allow free flow of tides below flood levels. During a tidal flood, the gates close automatically when the rising water reaches a predetermined height. When the tide recedes, the gate re-opens to allow normal tidal exchange.

Ideally, self-regulating tide gates can only offer protection where a road or dike limits extreme flooding across the marsh surface. Few such opportunities exist along Parsons Creek, as discussed above. Installation of a gate at Wallis Road would offer some protection from flooding by moderate storm tides that peak at approximately 8.0 feet or less. Storm tides of 10-year, 50-year, and 100-year frequency all exceed 8.5 feet (COE 1980), which calls to question the cost-effectivness of such an alternative. Self-regulating tide gates have been recommended for Culverts # 3A and # 3B because of the substantial protection offered by Ocean Boulevard in their vicinity.

In contrast to Parsons Creek marsh, Ocean Boulevard in the vicinity of Philbrick Brook Marsh appears to have a high potential for providing tidal flood protection to low-lying areas to the west. Road elevations at Culverts #7 and #8 are 8.6 and 10.4 feet, respectively. With the existing structures in place, tidal storm surge was recorded as high as 9.35 feet west of Ocean Boulevard on Locke Road during February 1978 (Gadoury 1979). With self-regulating tide gales installed, and set to close when tides exceeded approximately 7.5 feet, Ocean Boulevard would act as a dike during extreme high tides. Flood hazard would thus be decreased while restoring tidal flushing to the salt marsh.

2.3.3 Sea Level Rise

Independent of the recommended improvements, the elevation of tidal flooding is expected to increase in the foreseeable future due to accelerated sea level rise. Sea level rise for the period 1983-2000 is expected to be between 3.5 and 5.2 inches. By 2025, an additional rise of 6.9 to 10.3 inches is expected, for a total rise in sea level of between 10.3 and 15.5 inches for the period 1983-2025 (Hoffman *et al.* 1983).

While the recommended alterations are expected to mitigate flooding impacts in specific areas, a more comprehensive approach seems to be in order. In this regard, NAI recommends that State and Town agencies move toward a broad-based planning effort in New Hampshire's coastal zone that integrates natural resource management (e.g., salt marsh restoration) and development concerns (e.g., flood protection) in light of accelerating sea-level rise.

2.3.4 Summary

The net impact of the proposed improvements is expected to be positive, both environmentally, with regard to salt marsh restoration and for flood protection and stormwater management.

Improved tidal flushing is expected to encourage the restoration of a New England salt marsh community in the Wallis Sands and Philbrick Brook marshes. This is the primary objective of the project.

Great consideration has also been given to minimizing continued impacts of coastal flooding due to tidal storm surge into the marshes, and stormwater runoff from surrounding uplands. Improving tidal flushing is generally compatible with stormwater management because the same pipes that convey tidal water in and out of the marsh also carry stormwater runoff out to sea. In each case, larger capacity pipes and channels are preferable.

Protection from tidal storm surge is a more complex issue. Drainage improvements of the scale recommended in this study cannot be expected to fully protect Rye's coastal zone from the impacts of storm flooding. Extensive development presently occupies zones of high flood hazard surrounding the marshes. Further, the anticipated rise in sea level over the next several decades (and beyond) can be expected to extend flood hazard zones in a landward direction. Where practicable, this study recommends the installation of self-regulating tide gates to help control flooding due to tidal storm surge. A comprehensive planning effort to address the issues of sea level rise, coastal wetland preservation, and flood protection is recommended.

The recommended improvements are designed to 1) improve tidal exchange to encourage marsh restoration, 2) improve stormwater removal under most circumstances, and 3) not increase, and in some areas decrease, the risk of tidal flooding during extreme events relative to existing conditions.

3.0 LITERATURE CITED

Burdick, D.M. and I.A. Mendelssohn. 1987. Waterlogging responses in dune, swale, and marsh populations of *Spartina patens* under field conditions. Oecologia 74(3):321-329.

COE. 1980. New England Coastline Tidal Flood Survey. U.S. Army Corps of Engineers, Waltham, MA.

Cowan, D.P., T. Hruby, T.S. Litwin, and R.A. Lent. 1986. Open marsh water management on Great South Bay, Islip, New York. Baseline study: 1984-1985. Cornell Laboratory of Ornithology, Seatuck Research Program Technical Report. Seatuck Research Program, P.O. Box 31, Islip, N.Y. 101 pp.

Cowan, D.P., T. Hruby, T.S. Litwin, and R.A. Lent. 1987. Long Island Region tidal wetlands planning manual. Part I: Site Inventory. Cornell University Laboratory of Ornithology, Seatuck Research Program Technical Report. Seatuck Research Program, P.O. Box 31, Islip, N.Y. 60 pp.

Federal Emergency Management Agency (FEMA). 1986. Flood Insurance Rate Maps, Town of Rye, New Hampshire, Rockingham County. Community-Panel Numbers 330141 0002B and 330141 0003B.

Gadoury, R.A. 1979. Coastal flood of February 7, 1978 in Maine, Massachusetts and New Hampshire. U.S. Geological Survey, Water-Resources Investigations 79-61.

Hoffman, J.S., D. Keyes, and J.G. Titus. 1983. Projecting future sea level rise. Methodology, estimates to the year 2100, and research needs. U.S. EPA Office of Policy and Resource Management. Washington, DC. EPA 230-09-007. 121 pp.

Hruby, T. and W.G. Montgomery. 1986. Open marsh water management for open tidal marshes in the Northeast. A manual of methods. Revised 1988. Massachusetts Audubon Society, Environmental Sciences Department.

Normandeau Associates Inc. 1986a. Phase 2 Report. The Coastal Wetlands Mapping Program, New Hampshire. Prepared for the New Hampshire Office of State Planning Coastal Program.

Normandeau Associates Inc. 1986b. Tasks 2 and 3 Final Report. Summary of field investigations of coastal wetlands and associated road crossings in the Town of Rye, New Hampshire. Prepared for the Town of Rye and the New Hampshire Office of State Planning Coastal Program.

Roman, C.T., W.A. Niering, and R.S. Warren. 1984. Salt marsh vegetation change in response to tidal restriction. Environmental Management 8(2):141-150.

Simpson, M. 1986. Restoration of Parsons Creek Marsh, Rye, NH. Antioch New England, M. Sc. Thesis.

Steinke, T.J. 1974. A proposal concerning the restoration of the Pine Creek estuary, Fairfield, CT. Fairfield Conservation Commission, Fairfield, CT. 84 pp.

Steinke, T.J. 1986. Restoration of degraded salt marshes in Pine Creek, Fairfield, CT. Northeast workshop on wetlands and water courses: Hydrologic manipulation and wetland values. Association of State Wetland Managers.

Woodhouse, W., Jr. 1979. Building salt marshes along the coast of the United States. Special Report No. 4. Department of the Army Coastal Engineering Research Center, Ft. Belvoir, VA.