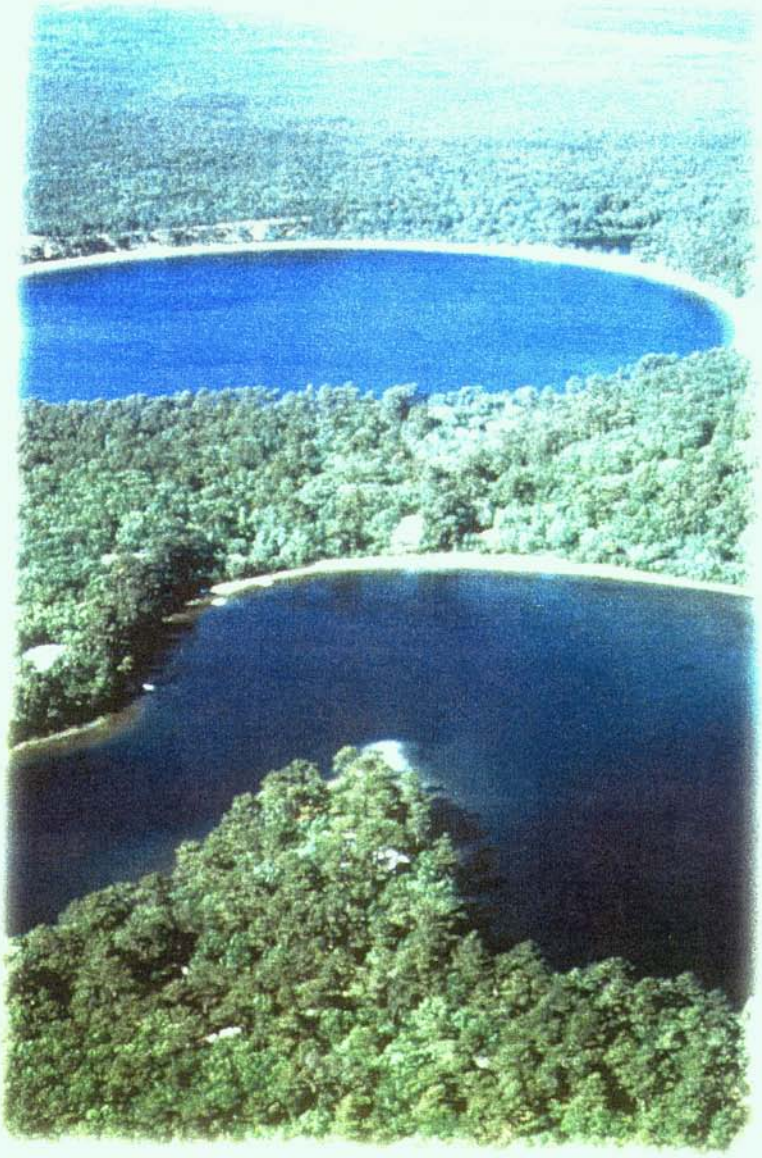
Water Resources Management Plan



CAPE COD

National Seashore • Massachusetts

WATER RESOURCES MANAGEMENT PLAN

CAPE COD NATIONAL SEASHORE
MASSACHUSETTS

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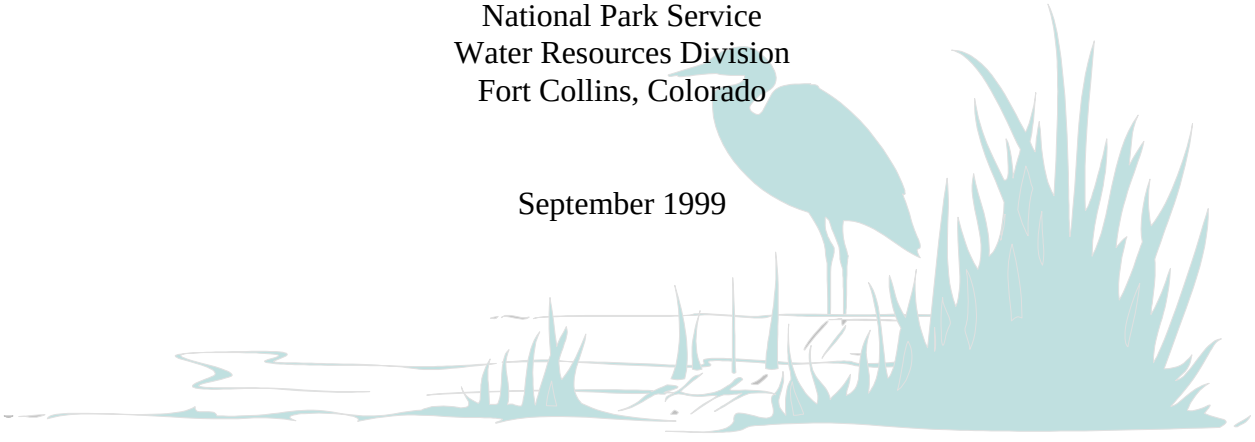

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Approved by:

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EXECUTIVE SUMMARY

This plan charts a course for Cape Cod National Seashore water resources management and planning for the next 10 years. The overall goal is to resolve many of the uncertainties regarding the interaction between people and the National Seashore water resources in ways that sustain or restore the environmental health.

In 1981, the first Water Resources Management Plan was developed for the Cape Cod National Seashore. Its intent was to: 1) describe the state of information available at that time; 2) encourage a spirit of cooperation between the National Park Service and local municipalities and residents; and, 3) clearly articulate water resources management goals for the National Seashore. Eighteen years later, the present report attempts to update those goals with new information to create an action plan for public involvement in the protection of Cape Cod's freshwater resources. This action plan comprises two broad goals: first, the protection of ground and surface water quality and quantity, and second, the restoration of the natural hydrography and estuaries. It further includes six objectives:

1) to provide a detailed survey of existing information on the National Seashore's water resources;
2) to identify and discuss current and potential water resource problems and issues;
3) to clarify the legislative mandates of the National Park Service in the local and regional context;
4) to improve and encourage communication with appropriate state and regional agencies;
5) to identify and discuss viable management actions to address water resource management issues; and,
6) to develop an overarching water resources management program.

The first step, developing an up-to-date overview of the current state of National Seashore water resource information, is presented in Chapters One through Four of this report. Chapter One develops the context for National Seashore water resources concerns. Chapter Two summarizes the state of our knowledge regarding climate, soils, geology, and ground water. Chapter Three focuses on surface biotic and abiotic features with emphasis on the ponds, streams, and estuaries. (The report does not attempt to summarize knowledge on environments that are considered marine, i.e., neither freshwater nor brackish.) Chapter Four describes the human uses of the environment and how those uses affect the natural environment.

In defining this plan, six water resource areas of concern were identified. These are: 1) ground water withdrawal impacts; 2) water resource contamination from non-point pollution sources; 3) confirmed and potential contamination sites; 4) cultural impacts to pond water quality and biota; 5) park infrastructure management; and, 6) impacts from tidal restrictions. Chapter Five investigates ground water withdrawal issues from the perspective of impacts on surface waters and their biota and of human supply needs. Chapter Six examines non-point source pollution in both a local and regional context. Chapter Seven focuses on potential contamination from underground storage as well as other localized sources of toxic contamination. Chapter Eight examines the critical conflict between recreational demand for the unique resources of the National Seashore and the need to protect those resources from overuse or abuse. Chapter Nine assesses existing water supply and wastewater disposal within the National Seashore for their impact on water quality and quantity. Lastly, Chapter Ten reviews the efforts and remaining uncertainties in restoring tidal flow to historically restricted estuaries.

From this review of the natural and human environment and the more detailed examination of six specific major issues, Chapter Eleven sets forth a plan for developing the information necessary to continue to safeguard the environment, while recognizing the needs surrounding human participation in that

environment. This plan provides a complex matrix of information gathering and implementation of programs that enhance National Park Service operation in the National Seashore; informs and encourages agencies and municipalities to also improve their practices as they relate to National Seashore water resources; and, informs and encourages the general public, residents and visitors to take an active part in the protection of these resources.

Cape Cod National Seashore is unusual within the national park system in that it was established after the area had been settled for more than 300 years; therefore, the opportunity to set aside wilderness or to assume responsibility for a large private holding was not an option. In creating a viable water resource management plan, park management must deal with many jurisdictions including those of the six outer Cape towns, Provincetown, Truro, Wellfleet, Eastham, Orleans, and Chatham, and of the state.

While 59 percent of the land is owned by the National Park Service, more than 30 percent within the National Seashore boundary is under the jurisdiction of other public entities, and nearly four percent is privately owned. Preserving the National Park Service mandate can, therefore, be challenging among so many other jurisdictional and management objectives. This plan provides a review of those jurisdictional interests and historical precedents and suggests methods for improved education and communication among the many land management interests.

Environmental research and management have shown that National Seashore water resources are both fragile and complex. Increased understanding of the complexity and sensitivity of the ecosystem is critical to wise management. Therefore, another major thrust is to maintain and expand the knowledge of National Seashore water resources.

Surface freshwater resources on the Cape include kettle ponds, seasonally-flooded wetlands, bogs, freshwater marshes, and dune ponds. Kettle ponds are permanently-flooded water bodies formed in ice-block depressions left in the landscape after the last glaciers melted about 12,000 years ago. There are 20 permanently-flooded kettle ponds within the National Seashore that range from 3 to 90 acres and 6 to 60 feet deep. There are 55 documented seasonally-flooded wetlands (vernal ponds) within the National Seashore that vary in size from small habitats to larger systems that occupy several acres. Freshwater marshes are located in river drainages, pond shores, and wetlands that were once salt water, but are now fresh water due to the placement of dikes and tide gates that prohibit tidal influences in the marsh. Dune ponds are small, shallow depressions that form between dunes on barrier spits and extend below the water table. These ponds are part of a larger wetlands complex that includes bogs, marshes, and floating peat islands. Bogs are poorly drained wetlands that have a floating mat of vegetation on their surface made up of sphagnum moss and cranberries, for example. The Atlantic white cedar community, which is a tree swamp, establishes itself under specific conditions that are rare on the Cape.

Very little is known about the interdunal bogs and vernal ponds. Wetland mapping and classification are outdated, and the impacts of water level change have not been evaluated. The National Seashore needs to update geographic information system maps of existing wetlands and develop a monitoring program for seasonally-flooded wetlands and for water level changes in the Atlantic white cedar swamps, interdunal ponds and ephemeral wetlands.

The Herring and Pamet rivers represent the two major stream systems on the lower Cape. The Herring River estuary has been greatly altered by 20th century diking and drainage for the purposes of mosquito control, flood protection, and improved travel corridors. The upper Pamet River, located in Truro, was a salt marsh estuary until it was diked around 1860.

Pilgrim Lake, once a coastal lagoon, was diked off from tidal flow by railway construction about 1870. This action transformed this body of water from a salt water bay to the present 344-acre brackish, shallow, eutrophic lake.

Estuarine salt marshes are one of the most valuable and productive ecosystems found anywhere, providing important nursery habitat to fish and shellfish. Almost all of the estuarine systems on the National Seashore have been altered to some extent by dikes and tide gates, reducing their productivity and habitat values. Salt marshes on the lower Cape are located at Hatches Harbor, Pamet River, Nauset Marsh, Provincetown's West End, and the lower Herring River (Wellfleet).

The Cape's water resources support a wide variety of plants, fish, reptiles, amphibians, and mammals. There is a need for baseline surveys of the biotic and abiotic water resource environment including an inventory of aquatic macrophytes, amphibian and reptile populations, and kettle pond benthic invertebrates.

Most surface water resources on the lower Cape depend directly upon ground water. The Cape Cod aquifer system consists of six distinct ground water lenses or flow cells, which support both coastal and inland resources. Inland resources, such as kettle ponds, vernal pools and bogs, depend entirely on yearly and seasonal ground water levels to maintain their particular ecosystems. Fluctuations in the water table, due to either natural recharge variation or ground water withdrawals, are directly felt by these resources. Coastal resources, such as streams and estuaries depend on aquifer discharge to maintain yearly and seasonal flow rates and to regulate water chemistry.

Water withdrawals and water pollution can threaten the natural and human environment. Population growth and development are major considerations in maintaining water quality and quantity on Cape Cod. Population densities in America's coastal areas are growing faster than the rate of the general population, and Barnstable County, which encompasses Cape Cod, is growing faster than any of the mainland Massachusetts counties. The human population of the lower Cape is also entirely dependent on the ground water for private and municipal water supply. For this reason, the U.S. Environmental Protection Agency has designated this water source a "sole source aquifer", that is a water source which supplies greater than 50 percent of the drinking water to its service area, with no alternative should the source become contaminated.

Population and housing density increases in lower Cape communities have increased demand and simultaneously degraded local ground water quality to the extent that some communities are considering new public supply well locations. Only two of the lower Cape aquifers presently contain public water supply wells. The Pamet lens supports four permanent, large volume, public water supply sites. Chequesset lens has no large volume public water supplies and only one small volume public well supplying approximately 30 households. National Seashore lands are often viewed as prime sites for withdrawing high quality drinking water; however, the National Park Service mandate to "preserve and protect" may cause the National Seashore to have a different perspective on appropriate use than other entities. Current drinking water planning focuses on salt water intrusion; the National Seashore and the Massachusetts Department of Environmental Protection would prefer that all impacts resulting from ground water withdrawls be considered.

There are three, primary ground water withdrawal concerns facing the National Seashore as development continues and the demands for new private and public water wells increases. First, excessive ground water withdrawals can lower the local water table, potentially depleting pond, wetland, and vernal pool water levels. Second, large-scale, sustained pumping can decrease aquifer discharge, impacting streams and estuaries. Finally, under extreme cases, the ground water volume may be depleted to a point where salt water

intrudes and contaminates the fresh ground water.

While much is known, more study is needed to assess the consequences of current or future development, particularly for maintaining adequate water quality for human consumption or adequate water quantity and quality for surface water resources. Efforts should be made to analyze existing ground water modeling to determine areas of increased water quantity and quality data needs, as well as test the feasibility of using models for investigating local impacts and evaluating the entire outer Cape ground water system.

The National Seashore as well as the Commonwealth of Massachusetts and local agencies recognize that the contamination of water resources by septic system leachate poses a great threat to the long-term health of the hydrologic environment of the Cape. Organic, inorganic, and biological pollutants can enter ground water through septic system leach fields. On the lower Cape, homes and businesses generally rely on private septic systems for wastewater disposal. Increases in housing density and the number of actively used on-site septic systems have been directly linked to increases in nitrate concentrations in the ground water on the lower Cape. Due to the proximity of private water supply wells and septic systems and the nature of the porous sand and gravel aquifer, there is great concern that as population growth on the outer Cape continues and the use of on-site wastewater disposal systems increases, occurrences in cross contamination of clean drinking water supplies will also increase. There needs to be a balance between the human impacts of development and the health of the environment.

Ponds and estuaries can also be degraded by pollutants that come from septic effluent. Eutrophication, the increased production of plants, phytoplankton, and macroalgae in surface waters, can result from nutrient loading. Eutrophication not only alters the native ecosystem, but also decreases its recreational value to humans. The addition of phosphorus to freshwaters via contaminated ground water discharge is a primary management concern ecologically, although it presents no major human health concern. Phosphorus introduced to the ponds via septic system runoff has the potential to increase algal production and reduce the natural clarity of the pond waters. Similar effects result from nitrogen discharge to estuaries.

To reduce nutrient loading and eutrophication, alternative wastewater treatment technologies need to be researched and tested on a case study basis. Some alternative wastewater disposal methods include: alternative technologies for private septic systems; cluster or package treatment plants for selected areas; and, increased on-line sewerage.

Additionally, underground storage tanks pose a threat to the quality of both ground and surface waters on the outer Cape. The majority of the tanks hold fuel oil and range in size from 200 to 2,000 gallons. Organic pollutants derived from landfills and leaking underground storage tanks as well as urban and septic leachate pose a serious threat to the integrity of clean drinking water supplies and natural resources.

Atmospheric deposition of acidity and metals is another significant source of non-point pollution. Cape Cod ponds are naturally very low in pH and therefore acid neutralizing capacity. Forty percent of Barnstable County ponds have little to no acid neutralizing capacity, a higher percentage than any other county in Massachusetts. Although a survey of mercury in National Seashore ponds has not been completed, preliminary results show a strong relationship between low pH and elevated methyl mercury levels in fish tissue. A recent study shows that sport fish in some ponds have mercury accumulations. These preliminary findings suggest that atmospheric deposition of mercury is a threat to the National Seashore's surface waters. The National Seashore should monitor mercury deposition at specific sites and evaluate mercury levels in sediments of freshwater ponds. Top predator fish tissue should be monitored in both fresh and estuarine environments. Information collected should be used to evaluate mercury pathways and determine

management alternatives.

Road runoff, including salt and petrochemicals, as well as surface runoff and infiltration from lawns and golf courses may also be important sources of contamination. These non-point sources are presently a minor threat, but may become significant with increased development of the outer Cape.

The plan identifies two areas with regard to potential major contamination. The first involves historic landfills in the vicinity of the National Seashore. The proposed action focuses on understanding the continuing pollution from those landfills and their impact on surface and ground waters. The second concerns heightened preparation for and awareness of potential toxic contamination from National Seashore or private facilities and operations.

Inorganic and organic pollutants derived from landfills, leaking underground storage tanks, septic effluent, and urban runoff on the lower Cape pose a serious threat to clean drinking water and to ponds, rivers and estuaries located within the National Seashore. The intimate connection between the Cape's ground water and surface water compounds the difficulty of managing these problems, as does the permeability and generally poor contaminant adsorption characteristics of the region's sand and gravel aquifer. There are five landfills located on the lower Cape, all of which have the potential to impact the freshwater resources within the National Seashore. Four of these (Truro, Wellfleet, Eastham, Orleans) are inactive landfills; the fifth (Provincetown) is capped. Both Provincetown and Truro landfills are located within the National Seashore boundaries and have contamination plumes emanating from their containment areas. The Wellfleet landfill abuts the National Seashore boundary and has a plume that travels southwest toward the Herring River.

Water that enters a landfill, usually in the form of rain and snow, comes into contact with buried wastes and forms leachate or dissolved waste. This leachate can contain toxic chemicals from commercial and household wastes. Often, the leachate leaves the landfill and follows the ground water flow, potentially entering recharge zones for water wells or surface water resources.

The five landfills on the Cape are monitored by wells and the contamination plume at each site has been mapped. According to reports generated from this monitoring, surface and ground waters both inside and outside of National Seashore boundaries may have been impacted. Landfill contamination may have negatively affected waters in Duck and Bennet ponds, the Pamet River, Provincetown Harbor, as well as several of the aquifers. National Seashore personnel need to continue to monitor landfill plumes, as well as review and evaluate the study design of past plume monitoring. Literature on landfill capping should be reviewed and the best techniques identified in preparation for capping the uncapped landfills. Contaminant discharge into surface waters should be assessed and a forum for dialogue on contamination issues should be established.

To be better prepared for potential hazardous waste spills, National Seashore personnel should conduct an inventory of septic systems and storage tanks on homes located on or near surface water resources and should also prepare an emergency response plan in case of spills or leakages of contaminants within National Seashore boundaries.

Recreational impacts continue to threaten the water quality of kettle ponds in the National Seashore, nearly all of which are used for recreation and have shoreline residences. The highly permeable nature of the sand and gravel aquifers on the Cape combined with septic system runoff of nutrients, particularly phosphorous, has the potential to cause eutrophication of the ponds.

Historic fisheries management, including stocking and liming, have affected pond waters. For example, an anadromous fish run between Gull Pond and Higgins Pond is maintained by artificial means to promote recreational fishing. The impacts of this on other pond organisms and water quality are unknown. National Seashore managers must gain an understanding of the ecological impact of the Gull Pond sluiceway before it can be managed. A study should be completed which will model the trophic structure and nutrient status of Gull Pond with and without river herring.

On some kettle pond shorelines, foot traffic has caused soil erosion and damaged rare plants. In most cases, revegetation is the most practical method of mitigating problems of heavy soil erosion around pond shorelines. However, the 20 kettle ponds within the National Seashore suffer from impacts related to multi-jurisdictional ownership and access which cannot be mitigated completely by revegetation. The area that surrounds the kettle ponds contains roads and access points that are maintained by both the National Park Service and local communities, as well as ones that have been informally created by visitors seeking alternative access to remote portions of the ponds.

No plan currently exists that provides an integrated approach to the recreational management of the kettle ponds within National Seashore boundaries. A kettle pond recreational management plan needs to be developed by a pond management committee which would consist of all involved organizations. Outreach programs should be developed which would inform the public as well as continue public participation.

The National Seashore is encouraging and collaborating on restoring the natural tidal environment of estuaries, reversing many decades of well-intentioned but environmentally damaging efforts to drain and alter these systems. In the process of restoration, there are many issues regarding how these systems originally functioned; how best to arrive at restored systems that resemble the unaltered systems as closely as possible; and, how to make the transition in an environmentally safe and culturally sensitive manner.

Salt water marsh estuaries are a primary natural resource feature of Cape Cod National Seashore. Since the early 1900s, intertidal and estuarine resources on the Cape have been greatly altered by diking and drainage, turning brackish waters with a marine influence into freshwater wetlands and upland habitats. Diking affects over 10 percent of the remaining coastal marshes in New England as well as a portion of nearly all the salt marshes on the lower Cape. Salt marsh diking degrades and eliminates estuarine habitat for many native plant and animal species, including fish, shellfish and crustaceans. Restoration has been proposed for each of these diked areas; however, development within the diked areas makes restoration more complicated. Actual restoration of tidal flow has begun in Hatches Harbor in Provincetown, with research and discussion continuing for Herring and Pamet rivers, and Pilgrim Lake.

Ponds, streams and estuaries are often ground water discharge points, and because of this connection, estuaries, rivers, and ponds are susceptible to contamination from ground water discharge that contains pollutants. Ground water discharge containing high concentrations of nutrients, predominantly from septic leachate, has led to the eutrophication of portions of Waquoit Bay, Cape Cod, and many other coastal ecosystems worldwide. Tidal flushing is the primary mechanism for removal of nutrients, specifically nitrogen from coastal surface waters. In the absence of tidal flushing, nutrients introduced to coastal water bodies can remain in the system, increase algal production, and promote eutrophication.

Limited supplies of fresh water on the Cape make water conservation an important part of water resource management for the park as well as for towns on the lower Cape. Further, the National Seashore, in its role as an environmental steward and educator, has a responsibility to lead the way in development, use and demonstration of water conservation techniques.

It is critical that the National Seashore improve its own facilities to reflect long-range water resource management goals and objectives. Analyzing ages and types of septic systems as well as the amount of use that each facility receives is essential to determining the efficiency of the park's water usage. Also, there are private properties within the National Seashore boundary that have underground storage tanks and septic systems that can add to the contamination threat within the park.

Regardless of ownership, all development in the National Seashore has the potential to impact public water resources. For this reason, it is important to assess the contamination potential of all properties, regardless of ownership status, within the park.

The National Park Service needs to continue to fill a critical role as educator by modeling water conservation strategies at the National Seashore. Water conservation within the park has occurred to some degree. Low flow shower heads have been installed in all of the houses that are owned and occupied by the National Park Service and low flush toilets have been placed in some of the seasonal homes. Funding is a major barrier to park wide implementation of water conserving devices. The National Seashore could use their properties to showcase water conservation for the public. The homes could include alternative septic systems, modern water conservation devices, xeriscaping, pervious outdoor surfaces and rooftop rainfall collectors. Alternatively, a model home could be created which does all of the above, plus serves as a location for public education programs about water conservation.

This Water Resources Management Plan focuses on the protection of outer Cape freshwater resources including ponds, ground water, and estuaries. Without the cooperation and participation of Cape residents in the solution for these complex problems, effective management of water resources is impossible.

Information exchange with the public could provide a critical tool for the park to promote water resource solutions. The park could publish a newsletter, as well as create an interactive web page. A Cape Cod Institute could be established, which would be patterned after the successful Yellowstone Institute. This institute would provide classes and the opportunity for scientists and the general public to work together to understand and solve water resource management issues.

This plan proposes the establishment of a water resources management program which includes residents and local governments. The four components of this programs are to establish: 1) a cooperative forum among local government agencies and the National Park Service; 2) a community extension program that involves education, research and planning; 3) a comprehensive database that improves the accessibility of water resources information; and, 4) a research program that increases knowledge of the water resources on the National Seashore.

In conclusion, this Water Resources Management Plan updates the previous effort of 1981; identifies priority issues for continued research, management and outreach for the next decade; and, suggests a number of specific projects to address all of these issues.