Plan for Watershed Management for the Pamet Groundwater Lens

DRAFT PLAN

Updated September 3, 2008

for
The Pamet Lens Oversight Group

Gary Palmer, Truro
Austin Knight, Provincetown
Kevin Kuechler, Truro
Kathie Meads, Provincetown

Prepared by:

The Cape Cod Commission
Water Resources Program
3225 Main Street, PO Box 226
Barnstable, MA 02632
508-362-3828

CAPE COD COMMISSION

Plan for Watershed Management for the Pamet Groundwater Lens

DRAFT PLAN

Updated July 23, 2008

Prepared by

WATER RESOURCES PROGRAM

Scott C. Michaud, Hydrologist & Project Manager

The Cape Cod Commission
3225 Main Street, PO Box 226
Barnstable, MA 02630

Paul Niedzwiecki, Executive Director
Thomas C. Cambareri, Water Resources Program Manager
Ben Smith, GIS Program Manager
Gabrielle Belfit, Hydrologist
Donna McCaffery, Project Assistant

This project was funded, in part, through the Massachusetts District Local Technical Assistance Fund under a grant agreement between the Cape Cod Commission and the Massachusetts Department of Housing & Community Services.

Table of Contents
Plan for Watershed Management for the Pamet Groundwater Lens

Executive Summary

This Watershed Management Plan represents a joint effort between the Towns of Provincetown and Truro to establish an approach for protecting the drinking water aquifers in Truro for both current and future generations. The water that lies beneath Truro is the sole source of drinking water for both Truro and Provincetown.

The Watershed Management Plan was prepared by Scott Michaud of the Cape Cod Commission, who worked closely with the Pamet Lens Oversight Group (PLOG) over a 4-month period of time during 2008. The Pamet Lens Oversight Group was established in 2000 after the Boards of Selectmen of Provincetown and Truro agreed upon a new Inter-municipal Agreement ("IMA") that governs the taking of ground water in Truro by Provincetown for use as drinking water by both Provincetown and Truro rate payers. The IMA required that the PLOG be comprised of members from both towns and that it would create a Watershed Management Plan. Truro's consulting engineer at Weston & Sampson also assisted in the development of this plan as did representatives from the National Seashore who attended meetings and provided input and data.

During a series of monthly meetings over a 4-month period of time, the PLOG met with Scott Michaud and established an outline for the Plan, collected and delivered background information to Scott, and reviewed several revisions of the Plan.

The Plan is considered a "working document" and will evolve over time. There are several recommendations in the plan covering a wide range of topics. The PLOG has agreed to focus on the following short-term priorities:

- Develop a process for implementing this plan's recommendations,
- Develop a stormwater and spill-prevention and -response plan, and
- Secure ownership (Truro) of potential well fields within the Town of Truro and evaluate land uses necessary for appropriate Zone I and Zone II management.

The Plan also includes a longer list of medium-to-long term priorities that will be revisited by the PLOG over time. Since the PLOG is not a regulatory body, all PLOG recommendations must be approved by the Boards of Selectmen in Provincetown and Truro and the implementation of these recommendations will require resources that extend beyond the PLOG and include other Boards, Committees, and volunteers in each Town.

- The Pamet Lens Oversight Group

Introduction

This draft plan comprises the first phase of the watershed planning process for the Pamet groundwater lens. A land use-water resource overlay map was prepared to accompany the plan.

The plan recommends future actions by the Towns of Provincetown and Truro (the Towns) - prioritized as short-term and long-term actions - for the management of the Pamet lens based on findings that herein describe previously-identified land-use and water-quality management issues and efforts undertaken to manage existing drinking-water supplies and identify and develop future water supplies. The implementation of the recommended actions will comprise the second phase of the plan.

Inter-Municipal Cooperation

Appropriate land-use guidelines can serve to protect drinking- and surface-water quality while impacts of municipal water withdrawals on surface-water levels important to ecological function can be minimized if water supplies are carefully managed. These two considerations are central to integrated watershed management planning envisioned by the Inter-municipal Agreement (IMA) extended by the Towns in 2004. The agreement established the Pamet Lens Oversight Group (PLOG) to steward water resources of the Pamet lens.

The Town of Provincetown is currently seeking additional municipal water supplies in the Pamet groundwater lens to create redundant water supplies and to potentially replace existing supplies in the Cape Cod National Seashore (CCNS) that could become unavailable (see land use-water resource overlay map). The Pamet lens, located entirely within the Town of Truro, supplies drinking water exclusively to both towns and is one of six groundwater lenses comprising the Cape Cod Aquifer, a *Sole Source Aquifer* designated by the Environmental Protection Agency. The north portion of the adjacent Chequesset lens supports private wells in Truro south of the Pamet River.

Watershed Management Considerations

The primary goals of this plan are to provide guidance to the Towns in the following areas:

- The siting of new municipal water supplies and management of supplies such that impacts on water quality, water levels and habitat are minimized, and
- Adoption of appropriate land-use planning guidelines, policies and regulations that address water-quality concerns.

Pond water levels, stream flows and wetlands are supported by the Pamet lens. Limited water withdrawals from numerous locations (multi-straw) and set-backs from sensitive surface-water resources can minimize impacts on ecological function and limit the intrusion of salt water into the aquifer. These considerations need to be weighed in the context of complicated factors such as the cost and availability of land.

The Pamet groundwater lens, as an important source of drinking water for the Towns, also serves as receiving waters for Truro's wastewater discharges. On-site septic systems are used exclusively in the Town of Truro to manage wastewater generated by residential and commercial development and constitute non-point sources of groundwater contamination. Other non-point sources of contamination that threatens water quality include leaking fuel-storage tanks and other hazardous-waste disposal sites, agriculture,

stormwater runoff and road salt. Water quality is also threatened by point sources of contamination such as landfills and stormwater outfalls.

Ponds, estuaries and wetlands often receive groundwater impaired by land-use practices. The Pamet River watershed, which has some of the densest residential development in the Town of Truro, drains to Pamet Harbor, a marine embayment between the Pamet and Chequesset lenses. Pamet Harbor is listed on the Massachusetts Estuaries Project (MEP) list for development of a Total Maximum Daily Load (TMDL) for nitrogen that the Town of Truro will need to meet. Water samples are being collected from Pamet Harbor and East Harbor by the Town of Truro for an evaluation of their trophic status and development of a Target Threshold Nitrogen Loads through the MEP from which nitrogen TMDLs will be established and submitted by the State to the US Environmental Protection Agency (EPA) for approval.

Comprehensive Planning and Growth Management Efforts

Most of the water withdrawn from the Pamet lens is transferred to Provincetown and discharged to the Pilgrim lens. As a result, comprehensive land-use planning and controls on future development are necessary in Provincetown to limit and maintain sustainable water withdrawals from the Pamet lens.

The Pamet lens is located entirely within the Town of Truro where land use has the potential to impact the quality water use by both towns. For this reason, specific comprehensive land-use and contingency planning and controls on the types of land use are necessary in Truro to protect water quality.

Local Comprehensive Plans

The local comprehensive plan (LCP) is an important municipal planning tool that identifies a municipality's long-term goals and sets forth strategies and actions to achieve those goals. It is important for this watershed management plan and the Towns' LCPs to be consistent.

Generally, LCPs delineate goals and recommend actions that encourage appropriate commercial and economic development through regulatory and planning incentives and the provision of public infrastructure and facilities in a manner that is consistent with the preservation and sustainability of cultural and natural resources. On Cape Cod, resources such as water are critical to the success of commercial and economic enterprises. In particular, the Pamet lens is the sole supply of drinking water to the Towns that also supports habitat and natural landscapes, both of which are basic to the Lower Cape's tourist-based industry.

Provincetown

The Land Use and Growth Management section of the Provincetown Local Comprehensive Plan, last updated in 2000, contains an inventory of the Town's municipal water supplies in the Pamet lens. The plan describes State-issued water-withdrawal authorizations, well locations and land-ownership for supplies located outside the CCNS, including a special-use permit (SUP) issued by the National Park Service (NPS) for interim use of CCNS wells during the peak season (June through October). The Natural Resources Section of the LCP describes obstacles to the development of water supplies in the Pamet Lens and actions to be implemented toward meeting the goal of growth and development that is *"consistent with the carrying capacity of the Town's*

natural resources." A limit on development that is linked to water availability has been implemented.

Truro

The Truro LCP was last updated in 2005. The LCP's water-resource, open-space and CCNS sections identify water-resource and watershed-protection goals. The LCP adopts recommended water-resource policies that rely upon a water-resource classification system modeled after the 2002 Regional Policy Plan (RPP) for Cape Cod. The policies provide the bases for prescribed development limits and practices. For example, the regional 5-parts per million (ppm) nitrogen loading standard is adopted as a policy for protecting drinking water.

The LCP also recommends actions and strategies for the development of future water supplies (Objective 1.) and to address land-use challenges that affect water quality. The LCP contains an inventory of federal -, municipal- and state-held open space and affirms a commitment to pursue a regional water-supply system with the Town of Provincetown, the CCNS, and possibly with the Town of Wellfleet. The North Unionfield (NUF) and C-5 sites are identified as potentially promising locations for future water supplies.

The LCP's land-use section anticipates that the Town of Truro will retain its predominantly residential character and that the town may not be able to support a full-service economy for the foreseeable future. The LCP describes land-use controls for residential areas within the CCNS, a site-plan review process for commercial properties outside the CCNS, and recommends an evaluation of the following options:

- Elimination of the special permit for industrial- and manufacturing-zoned land together with prohibitions of certain types of commercial development along the Route 6 business corridor,
- No further increases in commercially-zoned land,
- Retention of the existing minimum residential lot size while encouraging mixed-use development in village centers,
- Limitations on excessive coverage of residentially-zoned lots,
- Use of Land Bank funds to purchase a targeted amount of open-space, and
- Re-zoning of portions of the Pamet River watershed as greenbelt.

Generally, the LCP recommends:

- Development of a strategy for water supply 'allocation' should the Provincetown water system expand, and
- No encouragement of wastewater treatment facilities in the absence of public-health or water-quality concerns, and the development of health regulations.

Growth Management and Development Controls

Historically, zoning by-laws have been put in place by municipalities to direct development by type to specific geographic areas, as well as restricting certain uses. The by-laws may also include growth controls that restrict the size and density of development. Such by-laws are important regulatory tools for protecting water quality and maintaining a sustainable water demand.

Provincetown

Article 6 of Provincetown's Growth Management By-law was updated and approved in 2007. The by-law requires a growth management allocation permit for new construction, new uses, expansions, changes and alterations to existing uses. To manage growth and water use, the by-law provides for an allotment pool of wastewater design flows to which

an annual addition of up to 6,860 gallons per day (gpd) are made through 2008 and 3,190 gpd thereafter, subject to compliance with State water management permit requirements. Decreases in Title-5 design flows resulting from changes and alterations to existing uses are allocated to a surplus pool.

Truro

Nearly 90% of Truro is located with the Massachusetts Natural Heritage Estimated and Priority Habitat area. This requires that most projects be reviewed through Natural Heritage & Endangered Species Program under Massachusetts Endangered Species Act (MESA).

Growth Management

Truro's Growth Management section of the zoning by-law limits the annual number of building permits for new single-family dwellings units to no more than forty (40). This provision became effective on March 3, 2006 and expires on December 31, 2016

The zoning by-law provides for Open Space Development (OSD). The zoning by-law requires 33,750 s.f. of upland per lot (3 acres in the CCNS) with 150 feet of frontage. The OSD by-law allows a minimum lot size of 14,000 s.f., 60 feet of frontage, and a minimum of 40% open space of which no more than 5% may be developed for accessory structures or pavement. There is no incentive for more dwelling than would be allowable under the zoning by-law.

Zoning Districts

Areas of Truro outside of the CCNS are primarily zoned residential. Commercial development is limited to three Limited Business Districts and two General Business Districts (see land use-water resource overlay map):

- *Beach Point Limited Business*
- *Route 6A, North Truro Limited Business*
- *Truro Center Limited Business*
- *Route 6 General Business*
- *North Truro Center General Business*

Truro's zoning by-law identifies land uses that are permitted in zoning districts as follows:

- Automotive-related, industrial and manufacturing businesses are permitted only in the N.Truro Center and Route 6 General Business Districts. Industrial and manufacturing businesses require a special permit.
- Small engine repair, marine-related businesses and research facilities are allowed by special permit in all districts except the Truro Center Limited Business and Seashore Districts.
- Repair and trade-related businesses are permitted only in the N.Truro Center and Route 6 General Business Districts, and the Truro Center Limited Business District.
- Agriculture is permitted in all business districts except animal husbandry on parcels of less than 5 acres in the Truro Center Limited Business District. Animal husbandry on parcels of less than 5 acres requires a special permit.

The central portion of the N.Truro Limited Business District and the northern section of the Route 6 General Business District overlay Water Resource Protection Districts. Certain uses currently permitted in these areas, such as automotive-related and industrial/manufacturing activities, agriculture, and services that use or store hazardous

materials and waste, may pose significant threats to water quality without proper guidelines or restrictions.

As required by State law, agriculture is not subject to zoning by-law for parcels of 5 acres or more. The LCP recommends that consideration be given to the elimination of the special permit for industrial- and manufacturing-zoned land together with prohibitions of certain types of commercial development along the Route 6 business corridor. Alternatively, additional restrictions may be considered in Water Resources Protection Districts (LCP Objective 2. Strategy a.).

Local Wastewater Regulations

Generally, areas of Truro that rely on private wells have been deemed to be Nitrogen Sensitive Areas. This designation has been extended to all areas of Truro except Beach Point, which is served by the public water-supply system.

Any development control provided by State and local wastewater regulations on Beach Point is generally limited to septic-component setback requirements from wetlands, property boundaries, building structures, wells and the water table. Wastewater regulations applicable to Nitrogen Sensitive Areas provide a limited level of additional control on development intensity. Title 5 limits wastewater flows in these areas to 440 gpd per acre. This limit may result in groundwater nitrogen-loading concentrations that exceed the 5-ppm-N regional planning goal.

Lot Coverage

The Truro planning board is considering a progressive lot-coverage limit up to 7,000 s.f. to "*aid in the preservation and protection of the neighborhood character, the landscape and the relation of buildings to the environment*." The limit could have the incidental benefit of limiting water-quality impacts for lot sizes over 1 acre. Under the proposal being considered, the regional 5-ppm-N nitrogen-loading planning goal could be met on 6-acres with 2-story residential development.

Alternatively, a 4,000 s.f. cap on lot coverage could achieve the 5-ppm-N nitrogen-loading goal on 3-acres with 2-story residential development. The median developed lot size in the Truro portion of the CCNS is approximately 2-1/2 acres. Approximately 5% of the parcels are 6 acres or larger and may be eligible for sub-division, subject to a 3-acre minimum. Three campgrounds with access from Head of the Meadow, Highland and South Highland Roads comprise the largest of these (see land use-water resource overlay map).

In addition to or as an alternative to lot coverage requirements, the Truro planning board is considering Floor Area Ratios to control growth.

Cape Cod National Seashore

The CCNS was established in 1961 and zoning for the district was created in 1963. The Seashore District is intended for further preservation and development in accordance with Federal law. Approximately 70% of the Town is located within the CCNS. Uses within the Seashore are limited to residential and CCNS uses and the Secretary of the Interior may acquire property that fails to conform or is in any manner opposed to or inconsistent with the purposes of the CCNS.

Build-out Analyses

Projected Water Connections

Future development in the Town of Provincetown is limited by water-supply allocations under the Provincetown growth management by-law. Emphasis is placed on redevelopment and re-allocation of water surplus credits provided under the by-law (pers.communication, David Guertin). According to the 2001 Provincetown Water System Management Study (aka Water Master Plan), combined future water demand for the Towns are projected to increase by a 4,970 gpd per year in accordance with the IMA.

The Water Master Plan's thirty-year water-use projection for Truro is based on the potential connection of 120 unserviced lots along the existing water main between the South Hollow (SH) well field and the Truro/Provincetown line. The projected annual increase in Truro's water demand could exceed 1,320 gpd per year and the total projected water demand of 39,600 gpd for all then-unserviced lots because, as noted in the Water Master Plan, additional hook-ups may be requested for municipal buildings, new commercial development and condominium conversions, or due to the inability of property owners to meet minimum private-well setbacks from onsite septic systems. The projected increase in water use as an average for future residential development is reasonable because potentially higher projected water demand for larger future homes would be offset by lower actual water demand which is generally lower than the assumed Title-5 design flow rate.

Truro Water Demand Study

The Town of Truro contracted with Weston & Sampson Engineers, Inc. to evaluate the potential increase in water demand on the Provincetown water system that could result from the expansion of water main in Truro. Results reported in 2003 quantify potential future water demand for the following scenarios:

- Properties along the existing water main only (from the South Hollow wellfield),
- Properties along water main extending from potential new wells sites, and
- All Truro properties.

These analyses are compared with the baseline existing average-day and maximum-day Truro water demand of 66,700 pgd and 166,750 gpd, respectively, derived from 2000-2003 Provincetown billing records. The potential future average-day and maximum-day water demand along the water main from the South Hollow wellfield is estimated to be 24,740 gpd and 61,850 gpd, respectively (excluding projected water demand associated with the then-proposed Cape End Manor nursing home). No future water demand is projected along water main extended from the NUF site because adjacent National Seashore property is not developable. Potential future additional average-day water demand ranging from 11,500 to 17,500 gpd and maximum-day water demand ranging from 28,700 to 43,700 gpd is estimated along water mains from other potential future well sites that were considered, while a Town-wide water system would need to meet an average-day water demand between 0.3 and 0.6 million gallons per day (MGD) and a maximum-day water demand between 0.75 and 1.5 MGD.

A number of recommendations stem from the Truro water demand study. Among these recommendations is that measures be taken to ensure that new water supplies in the Town of Truro *safely* meet water demand and the need for system redundancy. In addition, it is recommended that the Town of Truro monitor groundwater quality; further evaluate water demand in areas where groundwater is found to be degraded; and develop by-laws, rules and regulations that govern connections to the water system.

Areas served by private wells

While there are currently no private water supplies in the Town of Provincetown (pers.communication, David Guertin), nearly the entire Town of Truro is supplied by private wells. Nearly 70% of Truro's total area is zoned for residential use to the exclusion of commercial, industrial and manufacturing uses. The areas zoned "residential" include the Pamet River watershed. A review of Truro's 2005 LCP revealed an error in the calculation of the number of remaining developable lots. The following analysis was contributed by the Town of Truro (pers.communication, C.Greenhalgh):

The original (1994) LCP estimated that there were 2000 potentially developable lots remaining as of 1994, assuming no future changes in minimum lot size. There have been no subsequent zoning changes - minimum lot sizes outside and inside the CCNS remain at 33,750 s.f. and 3 acres, respectively. Between 1995 and 2007, 502 building permits were issued leaving an estimated 1498 potentially developable lots within the Town of Truro.

From 1981 through 2007, 1095 building permits for single-family residences (SFR) were issued - an average of 40.55 permits per year. At this rate, the 1498 remaining developable lots would be built out by the year 2044. If the trend were based on the rate of SFR permits issued over the past 10 years (39.6 permits per year), build-out would occur in 2045. Using the past five years (29.2 permits per year), build-out would occur in 2058. Build-out may occur sooner because some lots will not be built on. Alternatively, the actual build-out year could be later because some new lots may be created.

It is not clear if the original 1994 number of 2000 "developable lots" includes land in the CCNS. Based on information provided by the CCNS to the Town of Truro, a total of 211 private lots were developed in the Truro portion of the CCNS as of June 2005. Eleven of the lots exceed 6 acres and could theoretically be subdivided into a total of 38 lots. Substantially fewer new lots could be created because of access-, frontage-, and wetlands-related constraints.

Natural Resources

Hydrology

The lens of fresh water beneath the Town of Truro is referred to as the Pamet groundwater lens. The lens is important to the Towns as the sole source of fresh drinking water to these communities and, for this reason, the management of the Pamet lens is a focus of the IMA between the Towns.

The Pamet lens is fresh water stored in the portion of the Lower Cape Cod Aquifer located between East Harbor to the north and the Pamet River to the south, marine embayment and estuarine systems into which the Pamet lens discharges. The aquifer is comprised of sediment deposited by South Channel ice lobe of the Wisconsinan ice sheet that blanketed New England approximately 15,000 years ago. Most of the pore space between sediment grains that extend down to bedrock, approximately 900 feet below sea level, are saturated with salt water. Precipitation falling on the land surface percolates through unsaturated sediment and contributes to the freshwater lens that is buoyed above the salt water due to its lower relative density.

Groundwater of the Pamet lens flows slowly toward coastal waters where it discharges. Groundwater is not immediately lost to the ocean because the sediment that stores the Pamet lens impedes groundwater flow and allows the lens of fresh water to form a mound

of groundwater that stands above sea level. Surface water features occur where the top of the mounded fresh water, the water table, intersects the land surface. Examples include streams such as the Little Pamet River and kettle ponds more common to the Chequesset lens on the south side of the Pamet River.

The amount of water stored in the Pamet lens reflects the aquifer's hydraulic properties. An aquifer's hydraulic properties generally reflect the manner in which the aquifer sediment was deposited. Unlike sediment deposits of much of the Chequesset lens and the Nauset lens to the south, which are finer-grained having traveled longer distances before being deposited, the Pamet lens is stored in relatively course-grained sediment deposited by melt-water streams relatively close to the glacier. Unlike the Nauset lens, the Pamet lens is not bound beneath by less-permeable silt and dense clay deposits that restrict the flow of groundwater. As a result, the course-grained material of the Pamet lens, while becoming finer at depth, results in less impediment to flow and a more subdued mound of fresh water relative to the Chequesset lens and Nauset lenses.

Habitat and Surface Waters

The Town of Truro is host to a variety of rare wetland wildlife habitats and priority sites for rare species and natural communities according to the Natural Heritage Endangered Species Program and the Association for the Preservation of Cape Cod Atlas. Wetland areas where flora and fauna may be dependent upon the water table for moisture are shown on this plan's land use-water resource overlay map. Wetlands that are in hydraulic communication with the water table may be vulnerable to drawdown of the water table in response to pumping.

Model simulations conducted by the US Geological Survey suggest that pumping in certain areas of the Pamet lens could reduce stream flow in the Little Pamet River (Masterson, 2004). Masterson showed that inferred tighter aquifer material at depth at the CCC-5 well site would result in less response of salt-water interface to pumping compared to the SH well field and the proposed NUF well site. It may be inferred that tighter aquifer deposits at depth would result in a broader lateral capture of water within the Little Pamet River watershed. Similarly, the Water Master Plan concludes that safe yield of the North Truro Air Force Station (NTAFS) wells could be increased up to 1.3 MGD with the addition and realignment of wells. The Water Master Plan notes that effects on surface water bodies may be the limiting factor that determines the long-term safe yield, rather than salt-water intrusion.

[Description of CCNS | PALS freshwater pond sampling effort: C.Phillips, CCNS]

Existing Infrastructure, Services and Programs

Water supplies

Public water supplies

The Pamet lens provides all water to the public water-supply system operated by the Town of Provincetown which serves all of the Town of Provincetown and portions of the CCNS and northern Truro. The system pumped approximately 240 million gallons of water from public wells in the Pamet lens in 2007, most of which is transferred and discharged to the Pilgrim lens. As a result, water is essentially mined from the Pamet lens because water transferred to the Pilgrim lens is not returned to the Pamet lens as return flow. The limited amount of return flow to the Pamet lens occurs via septic systems, irrigation etc. at properties in Truro that are connected to the water main (see land use-water resource overlay map).

Water withdrawal points are located at various locations in the Pamet lens consisting of two well fields outside the CCNS - the Knowles Crossing (KC) and the SH well fields - and the NTAFS wells within the CCNS. The Town of Provincetown is currently investigating additional water supply sites on land owned by the Town of Truro at NUF and C-5 toward creating redundancy in the water system (see land use-water resource overlay map).

The Massachusetts Department of Environmental Protection (MADEP) issued a Source Water Assessment and Protection (SWAP) report (see Appendix) for the Provincetown Water Department in 2004. The report is a planning tool that identifies land uses in Zone IIs that may comprise threats to drinking water and recommends Best Management Practices (BMPs) and other measures to protect drinking water. A copy of the report is appended to this plan.

Private water supplies

While connections to the public water supply are optional, there are currently no private water supplies in the Town of Provincetown (pers.communication, David Guertin). Conversely, nearly the entire Town of Truro is supplied by private wells – properties not connected to the public water supply. Properties in northern Truro that are adjacent to the public water main extending along Route 6 and Route 6A from the Truro Central School to the Provincetown-Truro town line (see land use-water resource overlay map) are connected to the municipal water system operated by the Town of Provincetown

In the summer of 2007, Truro's Water Resources Oversight Committee (WROC) began implementing a water-quality monitoring project. The purpose of the project is to establish baseline nitrate information for Truro's private wells. Nitrate is a good indicator of water-quality degradation that results from development. Subsequent water samples may be compared with the baseline to identify trends in water quality over time and inform decision-making that may become necessary to protect public health.

Participation in the study by Truro residents is free, confidential and voluntary. All taxpayers with private wells will have been offered well testing by the summer of 2009. Water samples from private wells are collected by WROC and analyzed by the Barnstable County Laboratory to determine the amount of nitrate in the water. Water samples from approximately one third of the private wells in Truro are planned for testing each year.

Monitoring results for samples collected in 2007 are summarized as follows:

- Residents in the Pamet River area received 90% of the initial 889 requests for water samples. The remaining requests were made randomly throughout northern Truro. Approximately half of the bottles (442) were returned with water samples for lab analysis.
- The drinking-water limit of 10 ppm-N nitrate was not exceeded for any of the water samples.
- Nitrate concentrations between 5 ppm-N and 10 ppm-N were reported for 2% of the samples.
- The average of reported nitrate concentrations is 0.92 ppm-N.

The WROC did not observe geographic clustering of results that exceed 5 ppm-N nitrate and concluded that a nitrate problem does not currently exist in private drinking-water supplies in the Pamet River area. The WROC did not draw conclusions regarding the quality of private water supplies in other parts of Truro beyond the need for additional monitoring.

Wastewater

All wastewater generated in the Town of Truro is treated and discharged to groundwater by on-site wastewater treatment systems. The Board of Health maintains a digital record of system repairs and up-grades, in addition to Innovative/ Alternative systems (see land use-water resource overlay map). The largest I/A system capable of nitrogen removal is an Advantex system with a Title-5 wastewater design flow of 6,800 gpd located in the contributing area for the KC well. Goals and objectives of the Truro LCP encourage use of individual on-site septic systems unless larger facilities (typically with design flows at or above 10,000 gpd) are necessary to protect public health, water quality and where public water supply is unavailable.

Stormwater and Spill Response

Stormwater runoff in Truro is generally managed on site or adjacent to local and regional roadways. Extensive stormwater systems are generally limited to the management of runoff from State roadways such as Routes 6 and 6A.

As a community outside an urbanized area, Truro's municipal stormwater facilities are not subject to the Federal Phase II general permit for stormwater. The State recently proposed a general permit for groundwater discharges of stormwater runoff from new and expanded parking lots with high intensity uses (314 CMR 5.00).

Where not provided through Federal and State permitting, stormwater management and spill response measures typically detailed in pollution prevention plans required by these permits may be addressed through local regulations and Standard Operating Procedures (SOP). The development of SOPs for spill prevention and response is a short-term recommendation of this plan.

In 2008, the Town of Provincetown submitted a membership application to the Massachusetts Water/Wastewater Agency Response Network (WARN) (pers.communication, David Guertin). The program allows Massachusetts water systems to receive rapid mutual aid and assistance from other systems in Massachusetts to restore services damaged by natural or man-made incidents. More information is available from the WARN website: http://portal.mawarn.org/.

Community Water-Related Education and Recycling Programs

The Town of Truro continues to participate in regional water-resource education and waste-collection programs. These programs are designed to convey the importance of land-use practices and waste management to Cape Cod communities.

Water education (WET) festivals are offered to Cape Cod Schools by AmeriCorp Cape Cod and the Cape Cod Groundwater Guardian Team, a regional organization consisting of county and local government agencies and private organizations. Truro has been an active participant in this program which has introduced its school children (grades 4 through 6) with fundamental concepts about their water resources. Public outreach and education programs that directly target adults are encouraged at the local level to address water conservation and threats to water quality such as disposal of pharmaceuticals and personal care products (PPCPs) and lawn-maintenance alternatives.

Local and regional no-charge waste-collection services encourage broad community participation and minimize the illegal dumping of waste. Most types of waste is collected daily at the Truro transfer station at no charge to residents. A hazardous-waste collection event is held annually at the Truro transfer station during the summer. The Towns of Provincetown and Wellfleet also hold hazardous-waste collection events at other times during the summer and are open to Truro residents. Information about waste recycling and collection events is available at the following www links:

http://www.capecodcommission.org/waste/RecycleChart2003.pdf
http://www.capecodcommission.org/waste/HHW2008.pdf.

CCNS Water Resource Management Plan

The 1999 Water Resources Management Plan developed for the CCNS updates the 1981 plan and details research, management and outreach priorities through 2009. The plan identifies six objectives toward meeting the goals of water-resource protection and restoration:

1. Develop an inventory of water-resource information,
2. Identify water-resource problems,
3. Delineate management actions to address identified problems,
4. Clarification of NPS legislative mandates in relation to local and regional issues,
5. Improve communication with state and regional agencies, and
6. Development of water-resources management program

Identified water-resource concerns include impacts from water withdrawals and sources of surface- and groundwater contamination associated with population growth. The plan specifies concern about the potential for water withdrawals to deplete surface water levels and stream flows, and for contamination of surface- and groundwater by septic system discharges, landfills, fuel-storage tanks and stormwater runoff. Recommended projects identified in the plan to expand the knowledge base and to respond to critical issues include:

- Resolution of jurisdictional issues and integration of efforts among various water-resource stakeholders;
- Establishment of a technical interagency committee and public-outreach tools as communication links between stakeholders;
- Development of a water-quality monitoring database;
- Continued monitoring of landfill impacts;

- Mapping and assessment of non-point pollution sources, including septic systems and fuel storage, and preparation of an emergency response plan;
- Groundwater modeling to evaluate impacts of water withdrawals and point and non-point contamination sources; and
- Meter water-use at CCNS facilities and evaluate water-conservation options.

[Status and findings of WRMP programs to be drafted by C.Phillips, CCNS]

Evaluation of Future Water-Supply Needs

An evaluation of projected peak-season water demand is appropriate for planning the Towns' future water-supply needs. Peak-season demand is the average daily water demand over the summer months. For comparison, peak-season demand may be contrasted with peak-day and peak-hour demand. Peak demand is typically accommodated without exceeding the supplies' safe yield through reliance on above-ground storage.

In 2005, the Town of Provincetown and the NPS prepared an Environmental Assessment (EA) projected a 2.3 MGD peak-day water demand to 2020, close to the peak-day demand projected by the Water Master Plan. Alternatively, use of 2000 and 2001 peak day-to-average day demand ratios results in a projected peak-day demand that is 100,000 gpd greater. Water storage of 7.6 MG is available to meet peak-day and peak-hour water demand provided peak-season deficits are addressed. Based on projected future water needs presented in the EA, contingency shut down of the SH well field in the absence of a long-term continued use of the NTAFS water supply could create projected (2020) peak-season and peak-day water deficits of 1.2 MGD and 2 MGD, respectively.

The EA anticipates that future SUPs will be required at least through 2011 during the new-source permitting process, design and construction of replacement water supplies outside the CCNS. The EA further describes the need for a comprehensive impact assessment in the form of an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) if an Environmental Impact Report (EIR) filed under the Massachusetts Environmental Policy Act (MEPA) unit of the Executive Office of Energy and Environmental Affairs (EOEEA) recommends long-term continued use of the NTAFS wells to meet municipal water demands.

Existing water supplies outside the CCNS are pumping at or near safe yields. The Water Master Plan describes assessments of new water-supply alternatives that have been evaluated through 2001, including successful efforts to mitigate unaccounted water (UAW). The Water Master Plan describes a 61.5% reduction in UAW since 1996, to approximately 15% as of 2001. Over the past few years, UAW has fluctuated around 15%.

The Water Master Plan reports that water withdrawals were reduced from a peak of 418.96 million gallons per year (MGY) in 1996 to 303.36 MGY in 2001, a rate that is comparable to early 1990s levels and met the State-permitted withdrawal limit of 311.62 MGY. Although peak season and peak day demand have generally increased over this period, average day demand steadily decreased to 240 MGY, or 43% from 1996 to 2007 (January 3, 2008 DPW report to the Provincetown Town Manager – see the following table).

Table - Summary of Water Pumpage Statistics for 2002-2007
DEP Annualized Daily Average Permit of 850,000 Gallons/Day
[total pumpage for the year divided by 365 days]

Annual data for the year:	DEP permit allows an average daily withdrawal of 850,000 GPD on an annual basis.	Number of days >1,000,000 GPD – this is the total "Safe Yield" from both the South Hollow (800,000) & Knowles Crossing (200,000) wells.		Number of days > 1,330,000 GPD – this is the total yield from the system's well fields plus the seasonal permitted use of the NTAFB wells under an Agreement with the NPS, renewable annually until 2011.	
	Average gallons per day	No. of days per year	% of year	No. of days	% of year
2002	870,000	132	36%	54	15%
2003	792,000	81	22%	63	17%
2004	831,000	98	27%	21	6%
2005	785,000	81	22%	32	9%
2006	723,000	79	22%	28	8%
2007	658,000	98	27%	0	0%

Pumpage for calendar 2007 per month per facility

Month	Knowles	South Hollow	Truro AFB #4	Truro AFB #5	Truro AFB	Total Pumpage
January	1,553,720	9,222,609	76,968	738	77,706	10,854,034
February	301,947	9,385,343	25,941	-	25,941	9,713,231
March	1,177,692	9,358,539	3,347	4,752	8,099	10,544,330
April	2,286,997	11,315,134	57,592	809	58,401	13,660,532
May	3,224,423	19,956,917	64,504	57,356	121,860	23,303,200
June	2,883,576	22,068,185	1,215,894	883,505	2,099,398	27,051,158
July	1,823,607	25,403,399	4,886,914	4,226,399	9,113,313	36,340,318
August	4,687,972	25,152,489	4,877,342	4,237,298	9,114,640	38,955,101
September	3,661,293	17,858,619	3,162,341	2,823,418	5,985,758	27,505,670
October	1,956,591	14,636,878	1,569,122	1,576,222	3,145,343	19,738,812
November	1,999,502	7,750,106	684,117	642,177	1,326,294	11,075,902
December	2,024,203	9,531,271	39,822	38,017	77,839	11,633,313
	27,581,521	181,639,489	16,663,902	14,490,690	31,154,592	**240,375,602**

Evaluation of the potential withdrawals from the Pilgrim lens resulted in a Water Master Plan recommendation against further consideration of the Pilgrim lens as a new-source alternative. A feasibility study of ocean water or deep saline groundwater desalination described in the Master Plan addresses technical considerations and costs, but does not identify desalination as a preferred alternative. The Master Plan recommends further evaluation of increased withdrawals at the NTAFS using the groundwater model developed by the USGS that would likely require a spatial reconfiguration of the NTAFS wells.

Search for Redundant Water Supply

In 2005, the Town of Provincetown requested a site examination from the State for a 1-MGD water supply at the NUF site (see land use-water resource overlay map) and seeks approval to conduct an aquifer test with pumping rates greater than 70 gallons per minute (gpm) to evaluate the site's water-yield capacity. The request is the culmination of a three-year effort during which several municipally-owned properties were evaluated as potential water-supply sites. The inter-municipal effort is laudable considering the significant capital expenditure committed by the Town of Provincetown in funding the hydrogeologic investigations and potentially the capital infrastructure necessary to develop a water supply on municipal property provided by the Town of Truro.
The aquifer test was conducted in June 2007 in accordance with the aquifer performance testing plan detailed in the request and using a maximum pumping rate of 700 gpm. The test results have not yet been released to the public.

The request outlines the regulatory environment and includes a number of supporting documents, including the water conservation plan for the existing system. The plan details the annual water audit conducted by the Provincetown Water Department and numerous conservation measures required for the approval of the new source.

The request details preliminary evaluations of several sites in the Pamet lens as potential water supplies, and more detailed investigations at the NUF site. The investigations were completed in the Spring of 2005.

Findings of the NUF investigations include:

- Aquifer thickness of approximately 275 feet,
- Withdrawal capacity of 500,000 to 700,000 gpd,
- Significant variability in lithofacies that, together with Zone I constraints, pose challenges to the siting of a supply well,
- Identification of suitable test-well locations with coarser-grained sediments that can meet Zone I constraints if appropriate land-use restrictions are put in place, and
- High water quality suitable for a water supply.

The site characterization contained in the request provides information about land use in the interim Zone II (see land use-water resource overlay map). An estimated Zone II is also shown in the request which is based on a simulated a pumping rate of 800,000 gpd using the groundwater model developed by the US Geological Survey for the Lower Cape.

Consistency with State, Federal & Regional Regulations and Policies

Water withdrawals by the Town of Provincetown are currently permitted under the State Water Management Act (WMA) permit. Withdrawals up to 950,000 gpd and 311.62 MGY are authorized by the Water Registration Statement. The withdrawal permit and authorization are up for renewal in 2008.

The 2001 Water Master Plan and the 2005 Request for Site Approval cite the need for a minimum of 800,000 gpd in additional water supplies to create adequate system redundancy required by the State. This need is based on the contingency replacement of the SH well field and continued availability of all other currently utilized water supplies, including the NTAFS wells.

An Environmental Notification Form must be filed with MEPA for withdrawals that exceed 100,000 gpd. In addition, the State will require the following before the new source is permitted:

- The requested additional withdrawal volume is within the Safe Yield of the supply,
- The water system's UAW is at or below 10% by 2017,
- Residential gallons per capita day (RGPCD) use is at or below 75 gallons (reduced in 2006 to 65 gallons and subsequently waived for Cape Cod as a seasonal community and replaced by a requirement for a Seasonal Demand Management Plan to be implemented by May 2009), and
- Updated water conservation plan.

Peak season water demand of 1.3 MGD been has been met by supplementing the permitted withdrawal with withdrawals from NTAFS wells through Provincetown's submittal of Declarations of Water Emergencies to the State. Use of the NTAFS wells must satisfy requirements of NEPA and Federal law governing the administration of the CCNS which include the requirement for an EA.

Since the Department of Interior issued a Finding of No Significant Impact based on an EA completed in 2000, the NPS has issued SUPs to Provincetown annually for withdrawals from the NTAFS wells as an interim water supply. Continued issuance of SUPs beyond the initial 5-year period is contingent upon an assessment of a full range of water-supply alternatives contained in an EA completed in 2005. Conditions of the SUPs are: 1) a demonstrated need for water supply, 2) implementation of conservation measures, and 3) diligence in the search for alternative supplies outside the CCNS. Additional water supplies will need to be pursued to satisfy this last requirement after a redundant supply is constructed and permitted.

Water Needs Forecasting and Conservation Standards

The Massachusetts Water Resources Commission (MWRC) issued the Policy for Developing Water Needs Forecast for Public Water Supplies and Communities and Methodologies for Implementation in 2007. The Policy stipulates that the MWRC will develop water needs forecasts to inform the WMA review process for additional water supplies. Forecasts are expected to be released in 2008.

The MWRC policy assumes that water suppliers will develop plans and programs to comply with Water Conservation Standards issued by Executive Office for Environmental Affairs (EOEA) in 2006. The Standards provide guidance for meeting goals identified by the 2004 Massachusetts Water Policy, including the goal of maintaining sustainable water use through water-conservation measures.

Key policy standards include steady progress toward 10% UAW and 65 RGPCD. The 65 RGPCD standard was waived for Cape Cod as a seasonal community and replaced by a requirement for a Seasonal Demand Management Plan (SDMP). Review and continued implementation of the SDMP is a long-term/on-going recommendation of this plan.

Achievement of the Water Conservation Standards will require continued implementation of a combination of other standards and recommendations that include leak detection, water-meter upgrades, a pricing structure that provides conservation incentives to homeowners and businesses, and adoption and implementation of a drought-management plan and a seasonal water-use restriction bylaw.

Institutional Arrangements

The IMA between the Towns was extended in 2004 through 2008. The IMA limits the Provincetown's ability to exercise eminent domain in the taking of additional land in Truro for the development of water supplies in exchange for a commitment from the Town of Truro not to take any action that would restrict Provincetown's ability to take water from Truro. The IMA resulted in the establishment of the PLOG, comprised of representatives from both municipalities, to steward management of the Pamet lens and to pursue a new water supply at NUF toward replacement of NTAFS and development of redundant supplies. This report is a product of the PLOG.

Recommendations

Recommendations are prioritized as short-term recommendations to be completed within eight (8) to twelve (12) months. On-going and long-term recommendations are open-ended.

Short-term Recommendations

- The Towns should develop a process for implementing this plan's recommendations.
- The Towns should jointly develop a stormwater and spill-prevention and -response plan that incorporate the following provisions:
    - Evaluate stormwater outfalls and road-salting practices in sensitive areas such as the SH well field. Stormwater collection and discharge facilities for State highways should be located and mapped, and alternative de-icing practices should be evaluated in partnership with the Massachusetts Highway Department.

      Public water-supply quality should continue to be monitored to identify any change or trend toward deteriorating water quality that may be attributed to hazardous-waste spills, stormwater runoff and road salt. Sentry monitoring wells should be installed to provide advance warning.
    - Develop and rehearse standard operating procedures (SOP) for community-based response to hazardous-materials and -waste spills along roads and highways. In addition to specific response actions, the SOP should:
        - Describe minimum responder qualification requirements.
        - Identify responders within 15 miles of the furthest Zone II boundary.

        - Provide for and describe equipment and materials storage areas (e.g. backhoe loader, sand, etc.) at multiple locations across the Pamet lens suitable for immediate response to large spills (on the order of thousands of gallons).
        - Delineate spill-response zones for which response equipment and materials are dedicated.
- The Town of Truro should identify and take steps to secure the ownership of potential well fields within the Town of Truro and assess land use necessary for appropriate Zone I and Zone II management.

Long-term | On-going Recommendations

- The Towns should update the PLOG about on-going growth management efforts in the Towns and should periodically review local plans, regulations and by-laws. This plan's recommendations should be updated as necessary to maintain consistency with local plans and regulations.
- The Town of Truro should incorporate health and fire department records related to wastewater, fuel storage, MADEP-tracked (Ch.21E) hazardous-waste disposal sites, and small-volume public and private water supplies in the Pamet lens into a comprehensive electronic database and add the information to this plan's land use-water resource overlay map.
- The Town of Truro should review public and private facilities that may be affected by MADEP's proposed general permit for groundwater discharges from land use with higher potential pollutant loads and parking lots with high intensity use in sensitive areas (314 CMR 5.00).
- The Town of Provincetown should develop an accounting of BMPs and measures promoted by SWAP that have already implemented and a feasibility assessment of those that have not yet been implemented.
- The Town of Truro should incorporate water-resource policies adopted by the Truro LCP into local health regulation:
    - 5-ppm nitrogen-loading standard for groundwater; prescribe calculation method and parameters.
    - Shared wastewater treatment in areas where necessary to protect public health and water quality.
- The Town of Truro should develop special-permit zoning guidelines for agriculture, particularly livestock, on parcels of less than 5 acres in Water Resources Protection Districts.

  Similarly, the Town of Truro should adopt local health regulations for parcels of 5 acres or greater to address water-related challenges associated with agricultural.
- The Town of Truro should continue to evaluate lot-coverage limits for small- to mid-sized lots that may also address water-quality impacts.
- The Town of Truro should continue to monitor private water supplies for nitrate. Initial monitoring-program results indicate that the quality of private water supplies is generally good. Additional regulated analytes may be added during subsequent sampling rounds - such as ammonia, volatile and semi-volatile

organics - where nitrate concentrations exceed 5 ppm-N and as part of a 'sentry' monitoring program in Zone IIs.

- The Town of Truro should implement actions recommended by the Truro LCP:
  - Continued partnership with the Massachusetts Estuaries Program and the Pond & Lake Stewardship Program to evaluate surface water quality.
  - Evaluate open space preservation options, including tax incentives and regulation that requires cluster development and increased density, where appropriate.
  - Evaluate advantages of re-zoning as greenbelts residentially zoned areas of the Pamet River watershed and areas of the Route 6 General Business District that are located in the Water Resources Protection District. The Truro LCP recommends that consideration be given to the elimination of the special permit for uses currently permitted by zoning by-law in the N.Truro Center and Route 6 General Business Districts. Alternatively or in conjunction, additional restrictions may be recommended to preclude certain uses in Water Resources Protection Districts (LCP Objective 2. Strategy a.). Model by-laws that may be useful in the development of appropriate regulations are appended to this plan.
  - Incorporate Low-Impact Development (LID) design requirements into subdivision regulations and site-plan review process. Truro's subdivision regulations allow the use of vegetation to treat stormwater runoff, but do not require LID, a comprehensive land planning and engineering design approach with the goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. Strengthened stormwater-management requirements for subdivisions are recommended by the LCP for consideration.
  - Continue participation in regional programs such as the WET and hazardous-waste collection programs sponsored by the Towns of Provincetown, Truro and Wellfleet.
- The Town of Truro should initiate new local education and outreach programs to encourage community involvement and awareness of issues relating to water quality such as water conservation, disposal of pharmaceuticals and personal care products (PPCPs), and lawn-maintenance alternatives. Programs may be modeled after successful projects such as the Falmouth Friendly Lawn Project: http://www.preservefalmouthbays-ponds.org/content5.php.
- Recommend continued cooperation between the PLOG and the CCNS to provide:
  - Updates on the status and findings of CCNS Water Resource Management Plan programs, and
  - Information about future development projects in the CCNS such as the Highland Center.
- The Town of Provincetown should continue to pursue a water supply at NUF concurrent with MADEP requirements for approval:
  - Review and continued implementation of the Seasonal Demand Management Plan,

- Continued reductions in UAW, and
- Continued implementation of water conservation measures. Existing water conservation plans should be periodically reviewed and updated as necessary to meet State requirements.

- The Town of Provincetown should continue to pursue long-term continued use of the NTAFS water supply for emergency purposes.
- The Town of Provincetown should periodically review water distribution and storage capacity to meet expanded demand.
- The Truro LCP recommends the development of a strategy for '*water supply allocation*' if the Provincetown water system expands.
  The Towns should jointly evaluate Truro's water needs in conjunction with:
  - Review the Route 6 build-out analysis conducted by Weston & Sampson, a summary of which should be added to this plan as a finding.

    The review should consider potential incentives created by expanded water-distribution capacity for economic and affordable-housing development and the need for strengthened management of growth, particularly south of the existing water main.
  - Update of the land use-water resource overlay map incorporated into this plan to include the already-extended public water main to the Truro Central School and the water main extending from NTAFS.

  Areas to which water-distribution capacity would be expanded should be evaluated following successful development and permitting of a redundant water supply for the existing water system.
- The Towns should agree (e.g. MOU) to enter into negotiations to establish an inter-municipal cost-sharing arrangement for additional water-supply infrastructure to support future water demand in the Town of Truro if the Provincetown water system expands.
- The Towns should prepare an EIR for additional water supplies at the appropriate time.
  Advantages to EIR filing:
  - Provides the opportunity for expanded public involvement/input and protection of all stakeholder interests, and
  - Provides a framework to ensure that environmental concerns are addressed,
  - Potentially provides for an expedited WMA permitting process.

  Projects that are required to complete an EIR are also required to undergo review by the Cape Cod Commission as Developments of Regional Impacts.

Bibliography

Water Resource Protection Plan for the Town of Truro, Massachusetts (1985) prepared for the Town of Truro by IEP, Inc. under a grant from the Massachusetts Executive Office of Communities and Development. 72 pp.

Cambareri, T.C. et al. 1989. Hydrogeologic Assessment of the Truro Landfill: Truro, Massachusetts. Cape Cod Planning and Economic Development Commission report for Town of Truro. 23 pp.

Cambareri, T.C. et al. 1989. Truro / Provincetown Aquifer Assessment and Groundwater Protection Plan. Cape Cod Planning and Economic Development Commission report for Towns of Truro and Provincetown. 65 pp.

Outer Cape Capacity Study (1996) prepared for the Outer Cape Capacity Study Steering Committee by the Cape Cod Commission in cooperation with Whiteman and Taintor. Overview Report: 32 pp.

Eichner, E.M. et al. 1997. Pamet River Investigation: Groundwater Assessment Study, Truro, MA | Groundwater Impacts Associated with the Removal of the Tidal Gate and Dike Structures. Cape Cod Commission. 39 pp.

Sobczak, R. and T.C. Cambareri. 1998. Water Resources of Outer Cape Cod: Final Report of the Lower Cape Water Management Task Force. 50 pp.

Truro Municipal Landfill Comprehensive Site Assessments (1998) prepared for the Town of Truro by East Cape Engineering, Inc. 21 pp.

Water Resources Management Plan (1999): Prepared by Massachusetts Water Resources Research Center, Amherst, Massachusetts in cooperation with and for the Cape Cod National Seashore. 252 pp.

Provincetown Local Comprehensive Plan (2000): Prepared by Local Comprehensive Plan Committee, Town of Provincetown.

Environmental Assessment for the Short-term Municipal Use of Water Supply Wells at the Former North Truro Air Force Station (2000) prepared by the National Park Service, the Town of Provincetown and Environmental Partners, Inc. 53 pp.

Water Master Plan (2001) prepared for the Town of Provincetown by Environmental Partners Group.

Sobczak, R. and T.C. Cambareri. 2002. Optimizing well placement in a coastal aquifer: Outer Cape Cod, Massachusetts. Journal of the American Water Resources Association. vol.38. 10 pp.

Sobczak, R.V., T.C. Cambareri and J.W. Portnoy. 2003. Physical Hydrology of Selected Vernal Pools and Kettle Hole Ponds in the Cape Cod National Seashore, Massachusetts: Ground and Surface Water Interactions. National Park Service/Cape Cod Commission. 175 pp.

Eichner, E.M. et al. 2003. Cape Cod Pond and Lake Atlas. Cape Cod Commission. Barnstable, MA.

Michaud, S. and T.C. Cambareri. 2003. Hydrogeologic Investigation of the Pilgrim, Pamet, Chequesset and Nauset Lenses - Water Table Map of the Outer Cape: May 21-23, 2002. Cape Cod Commission.

Potential Future Water Demands: Town of Truro, Massachusetts (2003). Letter report prepared for the Town of Truro by Weston & Sampson Engineers, Inc. 8 pp.

Source Water Assessment and Protection (SWAP) Report for Provincetown Water Department (2004): Massachusetts Department of Environmental Protection. 10 pp.

Masterson, J.P. 2004. Simulated interaction between freshwater and saltwater and effects of ground-water pumping and sea-level change, Lower Cape Cod aquifer system, Massachusetts: U.S. Geological Survey Scientific Investigations Report 2004-5014, 72 p.

Enhancing Wastewater Management on Cape Cod: Planning, Administrative, and Legal Tools (2004) prepared for Barnstable County by Wright-Pierce.

Massachusetts Water Policy (2004): Massachusetts Executive Office of Environmental Affairs. 34 pp.

Truro Local Comprehensive Plan (2005): Prepared by the Local Comprehensive Planning Committee, Town of Truro.

Environmental Assessment for the Emergency Short-term Municipal Use of Water Supply Wells at the N.Truro Air Force Station in Order to Secure New Source Approval of N.Union Field (2005) prepared for under a general agreement between the Town of Provincetown and the National Park Service: Cape Cod National Seashore. 64 pp.

The Request for Approval for Site Exam and Pump Test for a Public Water Supply Source over 70 GPM (2005) prepared for the Town of Provincetown by Environmental Partners Group. 29 pp.

Water Resource Management Planning: A Guide for Towns and Communities (2006): Massachusetts Department of Environmental Protection. 25 pp.

Aquifer Test Report Figures for December 2007 PLOG Meeting, prepared by Environmental Partners Group.

Growth Management By-law (approved 2007): Article 6 - Town of Provincetown Zoning By-laws.

Policy for Developing Water Needs Forecast for Public Water Supplies and Communities and Methodologies for Implementation (2007): Massachusetts Water Resources Commission. 14 pp.

Appendices

Land Use-Water Resource Overlay Map

Source Water Assessment and Protection (SWAP) Report
http://www.mass.gov/dep/water/drinking/4242000.pdf

Model Aquifer Protection Overlay District Bylaw
http://www.capecodcommission.org/bylaws/wateroverlay.html

Model Open Space Residential Development Bylaw (cluster bylaw)
http://www.capecodcommission.org/bylaws/cluster.html

Model Hazardous Waste Bylaw
http://www.capecodcommission.org/bylaws/hazards.html