DRAFT PLAN / EIS

W.W.

Water Quality Management Plan for Martha's Vineyard

July, 1977

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This report is a staff draft - July , 1977.
The Commission is in the process of reviewing
the contents and recommendations

DRAFT ENVIRONMENTAL IMPACT STATEMENT

on the

PROPOSED 208 WATER QUALITY MANAGEMENT PLAN

for

Martha's Vineyard

August 1977

Prepared by:

Martha's Vineyard Commission
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DATE: August 29, 1977

MEMO TO: All persons receiving copies of the "Water Quality Management Plan for Martha's Vineyard"

FROM: Bill Wilcox, Water Quality Program

RE: ERRORS

From a quick review of the document, I have outlined the most important mistakes in the document. Sorry for the inconvenience.

<u>Page</u>

27 bottom of page - all figures and tables prefixed with "a" are to be found in the appendices to this document.

28 ninth line in Section 3.12 - reference to Table 44 should be to Table <u>47</u>

32 line 3 near top of page - reference to Table 10 should be to Table <u>9</u>

43 year round low population in 1985 should read <u>9400</u> not 9800 in Table 3

48 bottom of page - reference to Figure 13 should be to Figure <u>a6</u>

57 under "Collective Package Wastewater Treatment" - "(See Figure 9)" should be "(<u>See Figure below</u>").

58 last line - "(Chapter 5)" should be (<u>Chapter 6</u>)

191 third paragraph, next-to-last sentence - "...diametrically opposite well #1." should read "...diametrically opposite well #4."

212 "Bioconversion" Section - annual operating cost in line 12 of this paragraph should be $<u>100,000</u>

235 Table 45 - phosphate input in Edgartown should be <u>.0225</u> not 27.6; nitrogen input should be <u>.276</u> not .240

247 top line - average winter use should be 300,000 - 347,000 gpd.

PREFACE

The following Draft Water Quality Management Plan is a product of the cooperative efforts of the Martha's Vineyard Commission, the Department of Environmental Quality Engineering (DEQE) of the Commonwealth of Massachusetts; and the United States Environmental Protection Agency (EPA), Region I, Boston. It is part of a two year, areawide water quality management planning process funded by the EPA as a result of the 1972 Federal Water Quality Act Amendments, Section 208.

This document serves as both a staff report to the Martha's Vineyard Commission and a Draft Environmental Impact Statement. It summarizes the alternative technical and management alternatives that might be used to protect the Island's water resources. It indicates the environmental, economic and social impacts of each, both positive and negative.

Staff recommendations are made in the following areas: land use, on-lot waste water disposal systems, municipal sewering programs, landfills, watercraft wastes, small industrial-commercial activities, other water pollution sources and water supply.

The purpose of the Draft Environmental Impact Statement is to provide the local officials, the Martha's Vineyard Commission and the general public with a means of evaluating and selecting among proposed actions resulting from the areawide water quality management planning process. This is mandated by the National Environmental Policy Act (NEPA) of 1969.

Section 102(2)(c) of the Act requires an Environmental Impact Statement whenever a proposed action will "significantly affect the quality of the human environment". To the extent necessary, the environmental impact statement must address:

1. The environmental impacts of the proposed alternatives,

2. Any adverse environmental effects which cannot be avoided...

3. Alternatives for proper management of waterbodies,

4. The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

5. Any irreversible or irretrievable commitments of resources which would be involved in the alternatives which have been explored.

Additional copies of this E.I.S. can be reviewed at:

Martha's Vineyard Commission Office
Old Stone Building
New York Avenue
Oak Bluffs, MA

All Island Libraries and Town Halls

Environmental Protection Agency
Region I
JFK Building
Room 2203
Boston, MA

An information meeting on the proposed alternatives, as discussed in this report will be held at:

Cornell Hall
Tisbury
Monday September 12, 1977
8:00 p.m.

Public comments on all aspects of the proposed alternatives are invited both at the information meeting, a public meeting to follow, and by mail to the Martha's Vineyard Commission, Box 1447, Oak Bluffs, MA. 02557. All comments received prior to September 30, 1977, will be incorporated and addressed in the final reports.

The final Water Quality Management Plan/EIS will be published by November 15, 1977. The final recommendations of the Martha's Vineyard Commission and a users guide which will help officials implement the recommendations will be included in the final report.

This report was prepared by William Wilcox of the Martha's Vineyard Commission and the Environmental Protection Agency.

ACKNOWLEDGEMENTS

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THE WATER QUALITY STUDY

Summary Report

For protection of the resources of

MARTHA'S VINEYARD

Beautiful beaches
Recreational water-uses
Plentiful shellfish
Vacation cottages

1.0 Summary

1.1 Introduction

The Federal Water Pollution Control Act Amendments of 1972, address a myriad of activities for controlling all types of water pollution sources and problems. Section 208 of the Act mandates area-wide management planning. Through Section 208, local areas, such as Martha's Vineyard are provided a unique opportunity to plan and manage a comprehensive program to protect their water resources. At the national level, this program is geared to cleaning up polluted waters. Its primary goal is to restore and maintain the nations water quality to produce fishable and swimmable waters. Martha's Vineyard, however, is not in the same situation: we are blessed with high quality resources. We have good quality ground water to drink. There are over 60 miles of beaches and approximately 3000 acres of shellfish area open to the general public for harvesting. The primary goal of this program was therefore to develop a program to maintain the quality of our water resources.

Prior to the initiation of the Water Quality Program, data was lacking on what impact man's activities had on the Island's water resources. A failing septic tank, an occasional contaminated well, or a harbor closed to shellfishing during the summer months were the only observable results. At this time, we have taken a large step forward in identifying the problems and outlining the alternatives available to protect our water resources. This comprises the body of the document which follows.

1.2 Program Objectives

The people of Martha's Vineyard have expressed a desire to protect their magnificent beaches and their unhurried way of life. In future years, our year-round population will increase, there will be more homes built and more tourists will visit our Island to escape from the traffic and the pressures of the mainland. The current absence of major water quality problems, coupled with these increased pressures on our water resources, emphasize the need for good planning and water quality management now. To safeguard the future of so vital a resource, the Martha's Vineyard Commission , with much public input, has developed this program to protect the Island's waters in three areas of concern.

1. the protection of the groundwater and its recharge areas,

2. the protection of coastal waters including harbors and areas of shell and fin-fish production,

3. the protection of the fragile ecology of the Island's ponds, marshes and other surface water bodies.

1.3 What is the Problem?

During the 208 program the Martha's Vineyard Commission conducted an eighteen month sampling program (over 300 samples) and gathered data to assess the present quality of our ground and surface waters. Results from the sampling program to date have generally documented the existing high quality of our ground and surface waters. (See Chapter 5). There are, however, some indications that the water resources on the Island have been impacted by certain activities. For example, there have recently been emergency closures of Brush Pond and Lagoon Pond because of contamination by sewage and oil respectively. Degradation of water quality on the Island is associated with municipal and commercial activities, on-lot disposal systems, landfills, stormwater runoff and construction activities and watercraft waste.

1.31 Municipal, Commercial and Small-Scale Industrial Activities

On Martha's Vineyard, there are very few municipal, commercial and industrial activities which can be labeled as point sources.* Point Sources of pollution are discrete indentifiable sources of contaminants. The two largest potential point sources of pollution are:

(a) The Edgartown Sewage Treatment Plant which handles between 12,000 and 120,000 gallons of waste water per day, depending on the season. The treated effluent is discharged into sand filter beds. Ground water monitoring wells were installed by the Water Quality Program to determine the impact of this discharge on the ground water. It was found that nitrate* is being introduced into the ground water at the disposal site and steps are now being considered by the Sewer Commissioners to remedy this problem. In the area sewered, ground water quality is slowly recovering while surface waters have greatly improved. The treatment plant is presently operating at the expected level of pollutant removal.

additional wells put in by sewer commission

cut these out

*terms set off by an asterisk are defined in glossary.

(b) The Martha's Vineyard Hospital treatment system handles between 17,000 and 35,000 gallons of hospital waste water per day. Wastewater is discharged through filter beds, collected and distributed to a leaching field. The treatment plant is situated at 5 to 10 feet above sea level and within 150 feet of Brush Pond. This pond was monitored to delineate any effects of the waste water discharge on the pond water quality. It was found that the treatment plant is operating at the expected level of contaminant removal. No adverse impacts on nearby Brush Pond were identified, therefore the major sewage problem has been alleviated.

1.32 <u>On-Lot Sewage Disposal Systems</u>

Except for the downtown area of Edgartown and the Martha's Vineyard Hospital, all other municipal, commercial and small-scale industrial structures utilize septic tanks* and/or cesspool* systems to dispose of their wastewater. Septic systems, if designed properly, obtain good removal of pollutants and will not degrade the Island's water resources. Many of these systems, however, have been improperly designed, installed, inspected or maintained. Besides the obvious health hazard that failing on-lot disposal systems cause due to the "breakout" of leachate or flooded basements, they may also contaminate ground and surface waters in a less visible manner. When tanks do pose problems, they are pumped and, with no proper disposal site available for the "nightsoil"*, it is usually disposed improperly at the landfills*. Contamination of private and public supplies and the ground water by septic tanks can and have occurred. The sampling of tap-water supplies have thus far turned up significant results relating to porosity* of soils, depth to ground water and density of systems. The major pollutant, for example, of concern in sandy Island soils is nitrate. This contaminant has been found in excess of recommended Public Health Service limits in three homes where siting of well and septic systems meet minimum State requirements. In other areas, such as Mattakeset, Katama Plains, Ocean Heights, Lagoon Heights and Lobsterville, nitrate levels are above expected background levels (see chapter 5).

1.33 <u>Landfills</u>

Figure 7 locates the seven landfills on the Island. Conclusive evidence shows that the percolation of rain water through landfills can generate a contaminated liquid known as leachate* which could have an adverse impact on the Island's water resources. Pollutants that enter the ground and surface waters as leachate are nitrates, phosphates* and some metals such as iron and zinc. In landfills where nightsoil is disposed, bacteria* and viruses* might also enter the Island's water resources. Four sampling wells at the Edgartown disposal site have thus far documented the chemical impacts. It was found that nitrate and ammonia levels exceed normal background levels in the vicinity of the landfill.

1.34 Watercraft Waste

During the summer months, large numbers of private boats flock to the harbors of Oak Bluffs, Vineyard Haven, Menemsha, Edgartown and Tashmoo. An estimate made from photographs notes that Martha's Vineyard has slip and mooring facilities for 1,075 recreational boats. Preliminary sampling results indicate that boating wastes can contribute to bacterial problems and most likely nitrate and other nutrient overloads. Samples were taken in Tisbury, Oak Bluffs and Menemsha harbors to investigate boating impacts.

It should be noted that studies (Long Island Sound 1975) have not revealed large public health impacts of pleasure craft discharge, but the potential remains, as do the aesthetic objections. Shellfish areas in particular are susceptible to contamination by intermittent discharges. Sound public health regulations require that, in open shellfish areas, water quality samples must meet the standards and there must be no possibility for sewage discharge.

Another problem associated with watercraft which was noted during the course of this study was the pumping of bilge water in our harbor areas.

1.35 Oil Spillage

Oil contamination is a continual concern. No one is sure what impact off-shore oil drilling on Georges Bank will have on our water resources. Spectacular spills, such as the Argo Merchant create headlines and, in some cases, havoc; but the minor almost routine spillage in handling areas in our harbors accounts for a large part of the problem.

Numerous boat yards and marinas store petroleum products immediately adjacent to our surface waters. The major sites are inspected by the United States Coast Guard on a regular basis. Smaller marinas are spot checked on an irregular basis. Contingency plans outlining actions to prevent spillage for large gas and oil storage facilities are required by the Environmental Protection Agency. Oil pollution of our harbor waters at this time is not a serious problem as demonstrated by the sampling program. Proper disposal of drain oil from gas stations also poses problems. Storage of asphalt and road oil occurs at two major sites on the Island. (see Ch. 12)

Provision of a collection? hazardous materials - paints, oils, resins

1.36 Storm Water Runoff

Storm water runoff which cleanses the streets of Vineyard Haven, Oak Bluffs, Edgartown and other built up areas on the Island introduces sediment, organic pollutants, debris and other contaminants into the harbors and other water resources on the Island. Runoff from croplands, construction sites, pastures, landfills and surface storage areas of road salt is also a potential source of contaminants. In general, these activities were not identified as major contributors to water quality problems.

1.4 Recommended Actions

After the water quality problems were identified, the most important work segment of the Water Quality Management Program became the development of a program to implement the findings of the study. In view of the fact that Martha's Vineyard has high quality water resources, our choices were prioritized as follows:

First: Utilize existing regulations to continue to protect water resources.

Second: Restructure or modify the existing framework to accomplish the goals of the program--such as to increase the County's role in solid waste disposal.

Third: Establish new laws and institutions.

The prevention of water pollution has traditionally been a multi-agency, multi-purpose program effort with the towns having the principal responsibility for installing and operating pollution control facilities and regulating land use activities; the State water pollution control agencies performing basic regulatory and enforcement duties, preparing comprehensive plans, implementing surveillance of ground and surface water resources and administering State aid; and the Federal government aiding the localities and states with treatment facility grants, additional enforcement authority and technical, financial and planning assistance.

On the Vineyard, we have an additional means of protecting our water resources: the Martha's Vineyard Commission which was established under Massachusetts General Laws. Chapter 637 provides the Commission with special land use authority to protect environmentally sensitive areas and to regulate developments of regional impact. This arrangement has led to the creation of an approach to protect water resources which evolves around local input and enhancement of local powers. The actual implementation of the Plan can be carried out under the existing framework of agencies and powers.

In view of the fact that no new agencies are recommended, our concern for improving local tools for preventing water pollution led to a recommendation for the hiring of 1) a Regional Sanitary Engineer to assist the Boards of Health in implementing an inspection and rehabilitation program to improve on-lot disposal practices and 2) a Regional Water Resources Planner to assist the towns and Commission in implementing the goals of the program, such as improving solid waste disposal practices, reviewing Developments of Regional Impact, reviewing and guiding new Critical District nominations and conducting a water quality sampling program in coordination with the Regional Engineer. With these two resource people, we feel that the towns themselves can, in most instances, implement the findings of this program.

In addition to these recommendations, additonal steps to improve our protection of water resources were developed. These actions are summarized below by topic.

On-Lot Disposal

On-lot sewage disposal systems are undoubtedly the most serious threat to the Island's ground and surface waters. Recommendations are made in Chapter 5 for the increase in water supply well-septic system separation in areas not to be served by public water and sewage facilities and an increase in requirements for the sizing of leaching areas. Further recommendations are made for establishing an inspection/rehabilitation program under the supervision of the local Boards of Health to assure the detection and correction of failing systems. Specific recommendations include;

All Towns

--In sandy soils, Board of Health require leaching fields where ground water is within 15 feet of ground surface.

--Planning Board require percolation tests and well levels on subdivisions.

--Board of Health require 200 feet setback of private wells from on-lot disposal systems.

--Board of Health require point of origin of all nightsoil pumped in the town.

--Consider using Bernhart approach to sizing lots in fragile areas (see appendix 3).

--Require increased leaching area of sewage disposal systems in soils which percolate faster than 5 minutes per inch.

Chilmark

--Utilize the Regional Sanitary Engineer to assess the on-lot sewage disposal problems in the Menemsha Village area. Carefully consider the possibility of rehabilitating septic systems rather than installing sewering.

--Conduct sampling and dye testing near identified problem streams to locate and rehabilitate sources of pollution.

~~--Consider requiring pumping well before sanitary disposal permit is granted.~~

already in effect

Edgartown

--Board of Health carefully inspect depth to ground water for future development in Clark Drive area for compliance with State Title 5 requirements.

--Utilize Regional Sanitary Engineer to conduct inspection/rehabilitation program in Sengekontacket Pond, Mattakesett Point and the interior of town areas. Carefully weigh rehabilitation of individual problem disposal systems against expansion of sewer system.

--Carefully plan future growth areas so that provision of needed services (water supply and sewerage) are within the town's capabilities.

Gay Head

--Utilize Regional Sanitary Engineer to inspect and Board of Health require rehabilitation of problem systems as needed in Lobsterville area.

--Enforce Title 5 limits on slowly percolating soils (clays).

Oak Bluffs

--Utilize services of Regional Sanitary Engineer to conduct inspection/rehabilitation program for potential on-lot waste disposal problem areas including Farm Pond area, Brush Pond area and Crystal Lake area.

--In fragile areas, strictly enforce the zoning setback for septic systems above the 10 foot contour.

Tisbury

--Utilize services of Regional Sanitary Engineer to conduct inspection/rehabilitation program for potential on-lot porblem areas including Lagoon Pond shoreline, Lake Tashmoo, interior of town.

Chilmark

--Utilize the Regional Sanitary Engineer to assess the on-lot sewage disposal problems in the Menemsha Village area. Carefully consider the possibility of rehabilitating septic systems rather than installing sewering.

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Tisbury

--Utilize services of Regional Sanitary Engineer to conduct inspection/rehabilitation program for potential on-lot porblem areas including Lagoon Pond shoreline, Lake Tashmoo, interior of town.

West Tisbury

--Utilize services of Sanitary Engineer to conduct inspection/rehabilitation process for potential on-lot disposal problem areas including Village center and Longview area.

Collective Wastewater Treatments

Currently the top priority for construction grants funds* on the Island is to develop a cost-effective means to treat the 2 to 3 million gallons of nightsoil annually produced. Detailed engineering studies are now underway to find a cost-effective way to correct the wastewater problems in downtown Tisbury, Oak Bluffs and Edgartown. The 208 program recommends that cost-effective solutions to these problems be given priority for construction grant funding. Specific recommendations include:

All Towns

--Develop an effective nightsoil treatment program.
--Carefully plan growth areas to minimize need for costly sewering of outlying areas.
--Employ treatment processes which produce useable by-products

mention Dukes Cons. District

Chilmark

--Avoid need for sewerage through rehabilitation or replacement of failing septic systems.
--Develop an appropriate nightsoil treatment capacity with Gay Head.

Edgartown

--Expand treatment plant collection system to service problem areas, in order of importance: Dunham Road, Planting Field Way, and Starbuck Neck.
--Improve nitrate removal capabilities at the treatment plant.
--Sewer Commissioners and Martha's Vineyard Commission work closely to install additional monitoring wells to determine rate and direction of flow of the treatment plant effluent.

Oak Bluffs

--Initiate sewer service for immediate problem areas on Circuit Avenue and low-lying Harbor shoreline.

Tisbury

--Establish sewer service in immediate problem areas on Main Street-Beach Road area.

Construction Grants Priorities

Currently the top priority for construction grant funding on the Island is to find the best method to treat the 2 to 3 million gallons of nightsoil generated on the Island each year. It is recommended that the on-going Anderson-Nichols study for the Environmental Protection Agency concentrate on finding a solution to this problem for Tisbury, West Tisbury and Oak Bluffs.

As described in Section 8.2 detailed engineering studies are underway to find the most cost-effective way to correct waste water disposal problems in downtown Tisbury, Oak Bluffs, and Edgartown. These are the only areas where the 208 Program feels sewering might be needed in the next 5 years. The 208 Program recommends that cost-effective solutions to these problems be given priority in receiving construction grant funding.

Land Fills

Solid waste on Martha's Vineyard is presently disposed at seven Island landfills. This study has determined that the percolation of leachate through these landfills may have an adverse impact on the Island's water resources. Many possibilities exist for improving and economizing in local solid water disposal practices. The State is currently designating areas to receive funds under the Resource Conservation and Recovery Act, 1976, to determine the best long-term solution for areawide solid waste disposal problems. It is recommended that Martha's Vineyard be designated as one study area. Other recommendations which are described in detail in Ch. 10 include:

All Towns

--Encourage home recycling efforts.
--Carefully site new landfills to minimize adverse impacts on water resources.
--Locate water supply wells away from landfills.
--Establish committee to study need for and steps to regionalize.

Chilmark

--Improve segregation and daily cover of refuse.
--Conduct a thorough site investigation to assure no landfilling activities threaten the headwaters of the Taisquam River.

Edgartown

--Improve sanitary landfill orerations at the Chappaquiddick site.
--Locate additional land for future landfilling operations.
--Carefully consider recycling efforts to minimize volume of refuse requiring burial.

Gay Head

--Provide regular cover and site improvements at the landfill
--Locate new land for future landfilling.
--Protect Black Brook headwaters from direct runoff from landfill.

Oak Bluffs

--Develop more appropriate interim nightsoil disposal practice such as infiltration lagoons.
--Provide fencing or other barriers to minimize blown refuse.
--Continue to encourage recycling efforts.

Tisbury

--Improve interim nightsoil disposal technique.
--Consider costs and benefits of relocating town well rather than landfill. If landfill is relocated, install an impermeable cover over the old landfill to eliminate leachate generation and protect supply wells.
--Begin landfilling in deep brush pit.
--Develop recycling program to limit volumes of waste requiring burial.

West Tisbury

--Require minimum setback of 400 feet for all supply wells on adjacent lots.
--Continue recycling efforts

Water Supply

Our water supply is replenished solely by rainfall. While there now appears to be an adequate volume of supply, contamination from inappropriate uses continues to threaten some portions of our aquifers. This problem requires special care in areas of private water supply and waste water disposal. Recommendations described in detail in Chapter 13 and also in the chapter dealing with on lot sewage disposal includes:

Chilmark

--Water Resources Planner continue to estimate stream flows in other stream basins to estimate available water supply.

Edgartown

--Improve zoning, acquire conservation easements or purchase land for future water supply.
--Expand service to Ocean Heights and Mattakesett as need is indicated by sampling analyses.
--Provide meter spaces for eventual future metering.
--~~Replace existing un~~-lined asbestos cement water pipe.

Gay Head

--Water Resources Planner estimate stream flows in other stream basins to estimate available water supply.

Oak Bluffs

--Protect town-owned land off County Road for future water supply--require that any landfilling operation in this area involve leachate control.
--~~Replace exising un~~-lined asbestos cement water pipe.

Tisbury

--~~Replace existing un~~-lined asbestos-cement water pipe
--Provide meter spaces on future connections eventual metering.

West Tisbury

--Water Resources Planner continue to estimate stream flows in other stream basins to estimate available water supply.
--Water Resources Planner continue to monitor pond and well levels in the town to provide data on water supply problems.

Surface Waters

The Island's surface waters are generally of very high quality. Impacts from boating wastes, on-lot sewage disposal and other waste generating uses have not yet severely impacted our coastal ponds. Bacterial contamination from sanitary boating wastes threatens shellfishing uses in and around our harbors. In addition, effluent from private sewage systems may cause luxurient pond weed growth leading to lower water quality. Recommendations to protect these waters from the impacts of pollution include:

All Towns

--Require vaults surrounding all new and replacement storage tanks for hydrocarbons (oil) situated in the ground water or in areas of potentially significant ground water resources.

Chilmark

--Continue Menemsha Pond zoning to locate overnight vessels in appropriate locations to limit adverse impacts on shellfish beds.
--Require bilge pump-out outside Harbor.
--Use onshore toilet facilities and require sealed heads in Menemsha Basin.
--Check success or failure of this program with regular bacterial testing.
--Involve fish market discharges in State NPDES program.
--Conservation Commission work closely with Planning Board to protect wetlands from development on nearby steep slopes.

Edgartown

--Determine circulation pattern in the Harbor and locate mooring areas to minimize adverse impact on shellfish beds.
--Establish zero discharge areas (for boats) in Cape Pogue Pond, Katama Bay and Sengekontacket Pond.
--Require bilge pump-outs outside Harbor

Gay Head

--Establish harbor zoning in Menemsha Pond to situate overnight boating away from shellfish areas.
--Conservation Commission work closely with Planning Board to protect wetlands from development on adjacent steep slopes.

Oak Bluffs

--Install onshore toilet facilities and require sealed heads on boats in Harbor.
--Request State to apply to EPA to designate the Lagoon a zero discharge area for boaters.

Tisbury

--Request State to apply to EPA to designate Lagoon Pond as a zero discharge area for boaters.
--Establish controlled mooring areas for overnight boaters in Lake Tashmoo & Lagoon to minimize adverse impacts on shellfish beds.

West Tisbury

--Conservation Commission and Planning Boards work closely to limit impacts of construction on steep slopes near wetlands.

Runoff

Specific recommendations to mitigate the impact of storm water runoff from built up areas, agricultural and construction sites include:

All Towns

--Planning Boards, Conservation Commissions, Dukes Conservation District and Martha's Vineyard Conservation Commission work closely to establish guidelines for construction on steep slopes and preventing agricultural runoff into surface waters.

Edgartown

--Continue regular street and settling basin cleaning.
--Board of Health assure that no disposal of kitchen wastes into storm drains by restaurants occurs.

Oak Bluffs

--Continue regular street and settling basin cleaning.
--Conduct dye tests in Campgrounds to assess any contributions of on-lot disposal systems to storm drains.

Tisbury

--Continue regular street and storm settling basin cleaning.
--Eliminate direct runoff from Spring Street into wetland at Lake Tashmoo.

Miscellaneous

--Edgartown, Gay Head, Oak Bluffs and Tisbury conduct soil surveys.

Regional

Martha's Vineyard Commission

--Develop technical assistance capabilities to assist local communities in protecting water resources.
  --provide technical data on water quality to local Boards.
  --gather and interpret water quality monitoring data.
  --purchase Bacterial Quality Test kit to expand sample analysis capability.
  --coordinate activities of other on-going studies i.e. Coastal Zone Management Studies, U.S. Geological Survey Study etc.

--Review Developments of Regional Impact to assure water resource protection.
--Establish Critical Districts as nominated or needed in order to protect water resources.
--Seek funding assistance for soil surveys and improving landfill operations.

Dukes Conservation District

--Develop and implement guidelines for sediment erosion control and fertilizer and pesticide/herbicide application.
--Seek town support and funding to establish a program for the application of a nightsoil ~~land spreading program~~ to benefit farms.
--Seek funds for pilot sewage composting project

State

Office of the Governor

--Designate Martha's Vineyard as a regional solid waste study area under the Resource Conservation and Recovery Act (1976).

Department of Environmental Quality Engineering (DEQE)

Southeastern Regional Office

--perform field visits to Island's landfills for inspection and meetings with local officials and Commission staff to draw up plans for improvement of sites.

--provide technical assistance on request ~~Aid local communities in investigating subsurface sewage disposal options.~~

Division of Water Supply

--~~provide technical assistance.~~ obtain needed funding to Perform water quality testing (bacteriological analyses) of public water supplies under existing programs and as required by the new Federal Safe

Drinking Water Act. (This would require additional funding to DEQE as the Commissioner has just recently made the decision that DEQE would have to cut back on the services because of severe cuts in the Lawrence Experimental Lab's Budget.)

Division of Water Pollution Control

--provide technical assistance: perform regular bacteriological surveys of harbors, inland ponds, and water quality chemical analyses.
--update permit files and applications: work with EPA in sending NPDES permit applications to those point sources of pollution identified in chapter 9. Send permit applications for disposal of wastes to the ground to the Edgartown Sewage Treatment Plant and Martha's Vineyard Hospital.
--update State Sanitary Code to ensure:
  --ground water quality in sandy soils is protected.
  --local communities institute inspection/maintenance programs for septic systems.

Office of the General Counsel

--provide technical assistance: Provide legal assistance to Conservation Commissions.

Coastal Zone Management (CZM)

--recommend to EPA Regional Administrator that the following waters be designated as "no discharge" areas: Cape Pogue, Sengekontacket, Lagoon Pond and Tashmoo Pond.

Federal

Environmental Protection Agency

--provide needed implementation funding for 208 program
--provide financial assistance for careful planning and construction of waste water collection and treatment systems.
--designate the waters listed above as "no discharge" zones.
--require greater documentation of need for sewering in 201 studies.
--provide technical assistance.

U.S. Department of Agriculture

--provide technical assistance.
--provide soil surveys in towns not yet surveyed.

2

Study History

2.0 Study History

Section 208 of the 1972 Amendments to the Federal Water Pollution Control Act calls for the Governor to designate areas in the state which require study to develop solutions to complex water quality problems. The Dukes County Planning and Economic Development Commission, with the support of the six Island towns, requested designation for the Island. The Island was designated under the supervision of the newly formed Martha's Vineyard Commission and work was initiated in July of 1975. The program is 27 months in length and will conclude in late September, 1977, following an Enviromental Impact review process. This document will be followed in September by a Water Users Manual designed for the general public.

✓ November →

2.1 Public Involvement

✓

The goal of maintaining our high quality water resources can best be achieved at the local level. The essential community groups which determined the effectiveness of this water quality management program include the local Boards of Selectmen, Planning Boards, Boards of Health, Conservation Commissions, shellfish wardens and harbor masters. The Martha's Vineyard Commission and State and Federal Agencies also contributed. This program sought the involvement of the general public as well as those groups listed above at key decision points throughout the two year planning process. These key points included:

- --September 1975-April 1976 - intial meetings were held with individual boards to outline problem areas and define alternative solutions.
- --June 1976: The Water Quality Planning Seminar in which future growth areas were defined.
- --October 1976: The Interim Report Presentation in which the water quality problems and alternative solutions were outlined.
- --March 1977: The Water Workshop in which participants selected most appropriate solutions to specific water quality problems.

The most directly responsible citizen group was the Water Quality Advisory Committee, which included individuals representing town Conservation Commissions, Boards of Health, Planning Boards, the League of Women Voters, the Vineyard Conservation Society, the Martha's Vineyard Commission, and other interested residents. This group has been very helpful in developing guidelines for the water quality management plan and has sponsored numerous workshops and seminars.

The Water Workshop, held near the close of the data gathering effort was very effective in outlining problem areas and solutions. Those actions which ahd a 75 percent consensus at the workshop form the nucleus of our plan and are listed below.

Prevent Pollution from Septic Waste

- assure adequate separation of septic systems and wells (200 feet)
- develop Island wide program of inspection of septic systems which are polluting surface waters
- require holding tanks on boats in harbors or ponds (fine for violators; pump out facilities and toilets on shore)
- control concentration of septic systems to prevent overtaxing the capactiy of the soil to treat waste water
- allow and encourage composting toilets
- require pumping, rehabilitation or replacement of malfunctioning systems
- require holding tanks where ground cannot handle waste and no other systems are practical
- discontinue disposal of night soil at dumps
- encourage use of composting toilets

Twice!

Protect Ground & Surface Waters

- control density of development so that water can be supplied by individual wells (and public water not required)
- keep major aquifers free from development (perhaps use ground water recharge districts)
- determine sources of pollution in streams, ponds, harbors and coastal waters
- provide penalty or fine for polluting and require that the polluting activity cease or discontinue polluting
- develop emergency program for dealing with oil spills including advanced detection
- develop comprehensive plan of action to restore and maintain shellfish areas and seek the funds to implement the plan
- prevent contamination from chemicals such as nitrates, phosphates and fertilizers
- require regular inspection of fuel facilities in harbors
- allow no water pollution to leave property boundary (under penalty of fine)

Conserve Water

- minimize use of water disposal of waste in waste treatment
- encourage use of composting toilets
- minimize runoff from homesites through plantings and erosion control techniques and minimizing impermeable surfaces

Reduce Solid Waste Loads to Prevent Contamination of Ground and Surface Waters

- encourage private composting efforts

-prohibit disposal of harmful wastes in landfills
-reuse salvageable waste
  -towns purchase woodchipper in common
  -establish town wide recycling effort in towns where trash pick up is now operating
  -provide dumpsters at landfills for collection of separated reusable trash and oil
  -encourage private enterprise to establish recycling in cooperation with town Boards of Health

Protect Against Salt Water Intrusion into Public and Private Water Supplies
-develop well siting and performance standards for coastal areas
-zone for appropriate densities in coastal areas to insure safe and adequate water supply

Participation in this water quality program has helped make people aware of what we need to do and has prompted individuals and groups to take action. Probably the most significant accomplishment to date has been the adoption of health regulations recommended by the Water Quality Program to protect the coastal waters, the coastal Great Ponds and streams and wetlands of Martha's Vineyard as part of the Martha's Vineyard Commissions Districts of Critical Planning Concern program. Also, as a result of public initiated requests during the course of this study, the water quality program has:

1. Provided the Edgartown Sewer Commission with direct technical assistance to assess nitrate levels in the ground water near the Edgartown Sewage Treatment Plant.

2. Helped Tisbury town officials with their application to the State for relocating the solic waste landfill.

3. Assisted local Boards of Health of Edgartown, Gay Head, Oak Bluffs, Tisbury and West Tisbury in developing health regulations.

4. Begun a Hach Kit colorimetric testing program of individuals' well water. To date over 75 wells have been tested in all Island towns.

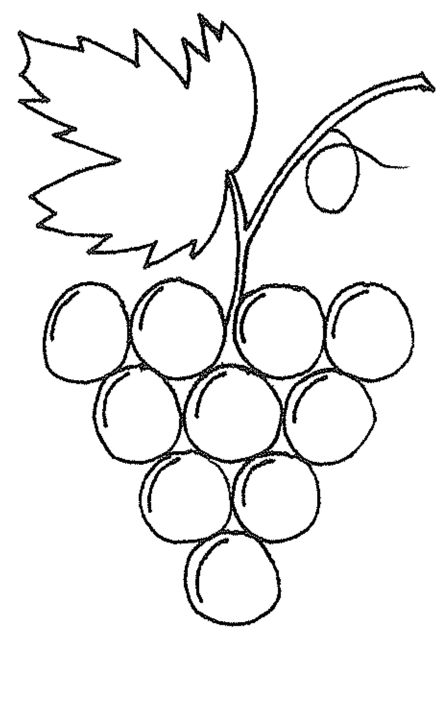
5. Contributed technical input at meetings with town Boards of Health, Planning Boards, Conservation Commissions and the All-Island Selectmen's Association.

6. Installed a) four wells at the Edgartown dump to assess solid waste runoff impact on ground water and b) two wells at the Edgartown Sewage Treatment Plant to assess nitrate leaching.

7. Participated in the A-95 Office of State Planning review process for assessing impacts on the Island of projects using federal monies. This 208 agency prepared A-95 reviews which commented on:
   a) Tighe and Bond Purifax nightsoil treatment plant;
   b) Tighe and Bond sewering proposal--this review started the process of examining the proposed service area in detail which culminated in EPA calling for an Enviromental Impact Statement;
   c) Tisbury landfill relocation;
   d) expansion of the Edgartown sewage system.

3

Natural Resources



3.0 The Island's Natural Resources

Martha's Vineyard is an island of intriguing diversity. The land area is approximately 95 square miles. The south shore baseline runs east and west for a distance of about 20 miles, the north south distance is about 9 miles. The Island's topography is extremely varied ranging from wide barrier beaches*, coastal ponds and outwash plains* to rolling morainal hills and coastal escarpments. The Island's diverse land forms were produced by the unique occurence of as many as five separate glacial advances and terminal moraines*. The Vineyard was just at the edge and junction of two major ice fronts at the final stage of the last glaciation. Its triangular outline consists of two different terminal moraines and three outwash plains, laid over clays and tills of many previous glaciations. The resulting variety of topographic forms reflects an internal diversity of soils.

3.1 Water Resources

The Water resources of the Island can be separated into surface waters and ground waters for discussion purposes.

3.11 Surface Waters

Surface waters include coastal, waters, coastal ponds, inland ponds, streams and wetlands. The Island's surface waters are vital to its economy and quality of life, providing shellfish, sportfish and the basis of the tourist economy.

-Coastal Waters

The waters surrounding the Island are the gateway to the Vineyard. They also supply large quantities of fish to support our local fishing industry. These waters are now classified "SA"* by the State Division of Water Pollution Control which means suitable for any high water quality uses such as swimming and fishing. They must be protected from the disposal of waste both from the Island and the mainland. Plans for dredge-spoil disposal and ocean outfall of Cape area sewage have in the past threatened these high-quality waters.

-Coastal Ponds

Our salt tidal ponds provide great volumes of shellfish each year and have received progressively greater interest and study recently. As the boundary between land and sea, they provide a variety of habitats and attract an abundance of wildlife. These waters are subject to contamination from waste disposal on-shore and boating.

-Inland Ponds

Of the three geomorphic provinces of Martha's Vineyard, the eastern moraine, the outwash plain and the western moraine, only the western moraine contains extensive surface water drainage. Table a1 lists surface waters which are included on Figure a 1.*

Because of their confined nature, inland ponds are subject to contamination by sewage disposal from nearby development and possibly the cumulative impact of developments further away which may contaminate ground waters flowing into the ponds. Erosion of soils after clearing land can also clog and pollute these waters.

-Streams

All major streams are found on the western half of the Island due to the presence of less porous soils and more varied topography. Preliminary measurements indicate that the Tiasquam and Mill Brook discharge 1.14 and 2.05 million gallons per day respectively of the rainfall received. Figure a2 plots rainfall quantities and flow observed at Warren Pond on the Tiasquam River and Alberts Pond on Mill Brook. The characteristics of the basins studied are tabulated in table a2.

The Islands internal drainage network provides recharge to the ground water supply of the outwash plain. For example, many of the steep slopes of the morainal uplands terminate in the coarse sands and gravels of the outwash plain where runoff is largely recharged. Wells located between Germantown Road and the State Forest are often found to be artesian. It is believed that this results from the recharge of water to the outwash plain aquifer from the highlands of the morainal areas. The origination at a higher elevation provides the impetus to drive the water up in the wells in this area. For this reason, it is important to protect these contributing slopes from growth incompatible with protecting potential water supplies.

The ground water flow resulting in observed stream flows on the western moraine is roughly equal to the annual water recharge. Approximately one-quarter of this total then becomes available for consumption. Additional surveys of all streams in the western moraine need to be conducted to obtain a better idea of available water resources in this area. Studies are suggested for Paint Mill Brook, Roaring Brook, Fulling Mill Brook, Mill Brook in

*all figures and tables labelled "a" are to be found in the appendices to this document

Chilmark, Black Brook and Blackwater Brook.

Surface waters on the Island are generally not potable without some form of pre-treatment. They are typically high in iron and discolored by tannin*. The need for public supplies in West Tisbury or Chilmark may ultimately lead to the use of the surface waters in the area.

A study by the United States Department of Agriculture (1975) inventoried potential and existing upstream reservoir sites in the Cape and Islands region. In all Vineyard sites surveyed there are private legal rights which must be acquired before constructing a reservoir. These sites are identified in table 56 and located in figures 32 and 37.

-Wetlands

Wetlands not only support abundant wildlife but also reduce the impact of storm swollen streams. The wetlands which are most significant in preventing flooding are those which are part of a drainage network, for example, those along the Tiasquam River (see figure a1). These wetlands offer flood retention capacity and also filter out nutrient overloads from development along stream margins. Both those wetlands which are part of a drainage network and isolated wetlands are important because they absorb water during wet periods and slowly release this moisture during dry periods to replensih our water supplies. Wetlands can be adversely affected by filling, dredging and erosion from nearby construction. They are presently protected by local Conservation Commissions under chapter 130 and 131 of the State Laws.

3.12 Island Ground Water

Martha's Vineyard's water supply is replenished entirely by rainfall. Estimated recharge is 16 inches out of 45.8 inches per year (see figure 1 and 2). A conservative estimate to allow for drought periods would assume only 12 inches of recharge each year. This still amounts to 20 billion gallons of water per year available for supply. Estimates of recharge for different parts of the Island are listed in Table 44.

The Island's aquifers (see figure a3) can be summarized as follows:

1) Eastern and southern outwash* and ice contact* sands (see figure a4). Vertical soil sequences in this area are primarily silty sands and gravels as indicated in the borings. (Soil profile locations are indicated on figure a4).

2) Shallow surficial slopewash sands in the western moraine (see figure a4). The vertical

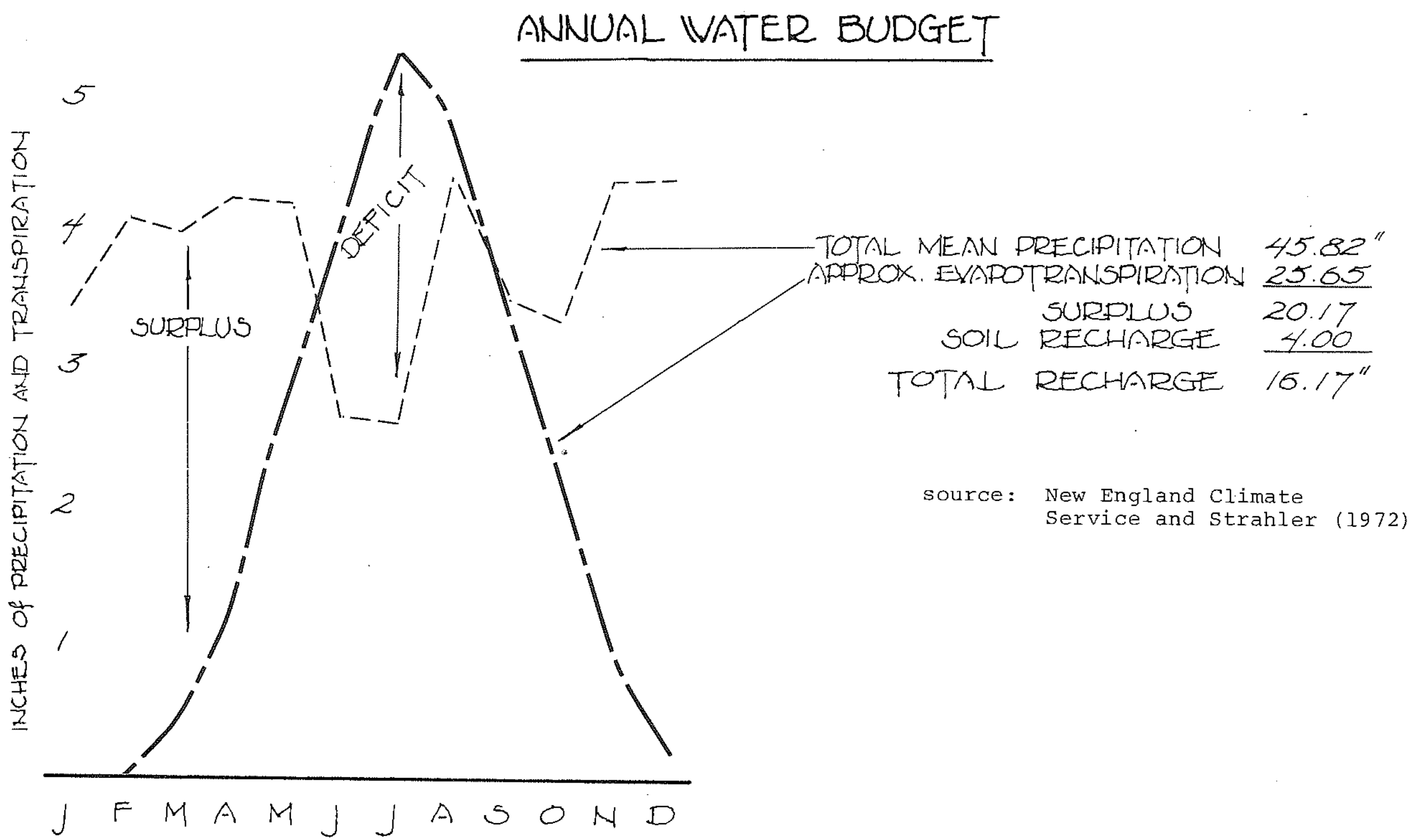
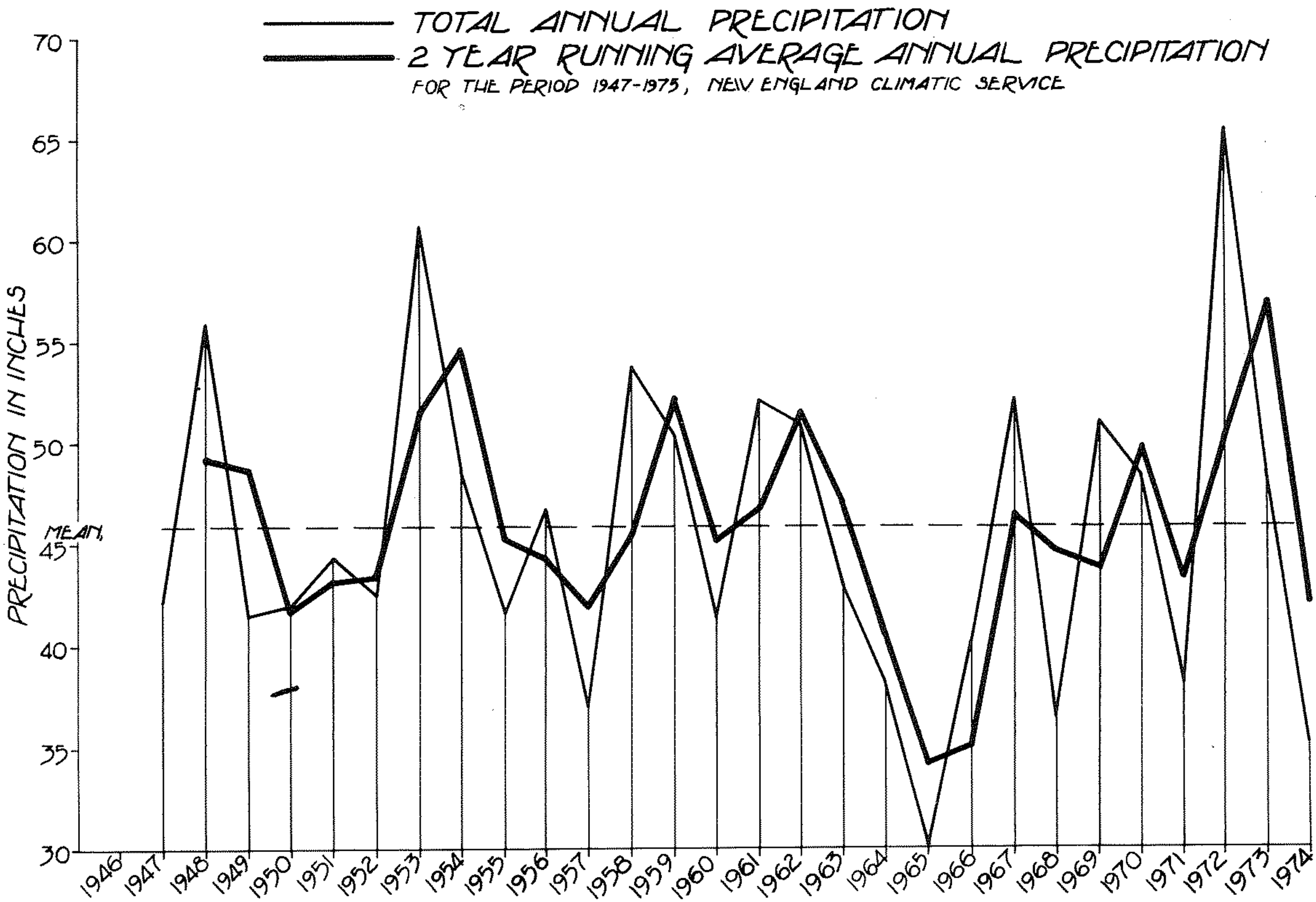

ANNUAL WATER BUDGET
INCHES of PRECIPITATION AND TRANSPIRATION
5
4
3
2
1
SURPLUS
DEFICIT
J F M A M J J A S O N D
TOTAL MEAN PRECIPITATION 45.82"
APPROX. EVAPOTRANSPIRATION 25.65
SURPLUS 20.17
SOIL RECHARGE 4.00
TOTAL RECHARGE 16.17"
source: New England Climate Service and Strahler (1972)

Figure 1

FIGURE 2


TOTAL ANNUAL PRECIPITATION
2 YEAR RUNNING AVERAGE ANNUAL PRECIPITATION
FOR THE PERIOD 1947-1975, NEW ENGLAND CLIMATIC SERVICE
PRECIPITATION IN INCHES
MEAN, 45
70
65
60
55
50
40
35
30
1946
1947
1948
1949
1950
1951
1952
1953
1954
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1974

sequences in this area is very variable as the surface sands are discontinous and clay is frequently present at the surface. The borings graphically displays these soil sequences.

3) Confined sand and gravel layers isolated within thick clay layers in the western moraine (see figure a4). Typical soils profiles are illustrated in the borings.

The deposits of prime importance to the Island's future water supply are the eastern and southern outwash plains. The United States Geological Survey has initiated a data gathering effort to establish the nature and thickness of these deposits. A Massachusetts Institute of Technology research team has proposed to interpret this data by developing a computer model of the Vineyard's ground water. Initial findings indicate that the aquifer beneath the State Forest is far thinner than was originally believed (some 100 feet deep - see the borings). The recharge rate in the area is also quite large - on the order of 3 feet per year. This probably results in the high discharge rate observed in our coastal ponds where fresh springs are very common. Both of these programs are important in establishing a sound ground water management program for the future. The entire eastern and southern outwash plains are to be considered as an aquifer recharge zone*. At this time, there are no known impermeable zones which would preclude the recharge of infiltration of rainwater into the ground water. here.

In the western slopewash sands area, the depth to ground water is quite shallow. The ground water is probably perched on impermeable layers of clays. There may be access to a deeper aquifer in this area. In the western moraine, the ground water is prone to contamination from on-lot sewage disposal due to its presence in confined aquifers.

The confined sand and gravel aquifers are highly variable in depth . It is quite possible to drill a well in one location and hit nothing but clay and within 200 to 300 feet drill into 50 feet of good water-bearing sand. For subdivisions in this area, proof of available water should be required.

Island ground water is low in dissolved solids as indicated by a chloride content normally below 25 mg/L (milligrams per liter). Well supplies along coastal areas often do show more dissolved solids. Such increases are in part the result of natural mixing of freshwater with the underlying salt water. Some well supplies near the coast are brackish or salty. It is suspected that these wells are either drilled too deep or are located in areas where recharge is inadequate to maintain an adequate source of freshwater supply. Nutrient levels in our ground watersare naturally low-nitrate, phosphate and ammonia levels are normally near zero (see table 10). Our ground waters are usually slightly acid and high in iron.

3.2 Soils

Soils play a significant role in determining the success or failure of on-lot sewage disposal systems, landfills and home sites. Certain soils are so densely compacted with clay materials that leaching field liquids cannot percolate through them. The soil quickly clogs with solids and the liquid waste will pond up near the surface and create health hazards. Other soils are so porous that the liquid waste percolates through to nearby ground waters so rapidly that treatment by soil bacteria and vegetation and filtration of organic solids does not occur. Both soil types limit the intensity of land use dependent on leaching fields for wastewater disposal. Hardpan near the surface can impose a barrier to the infiltration of septic waste liquid which may run along this impervious surface to the nearest surface water and contaminate it.

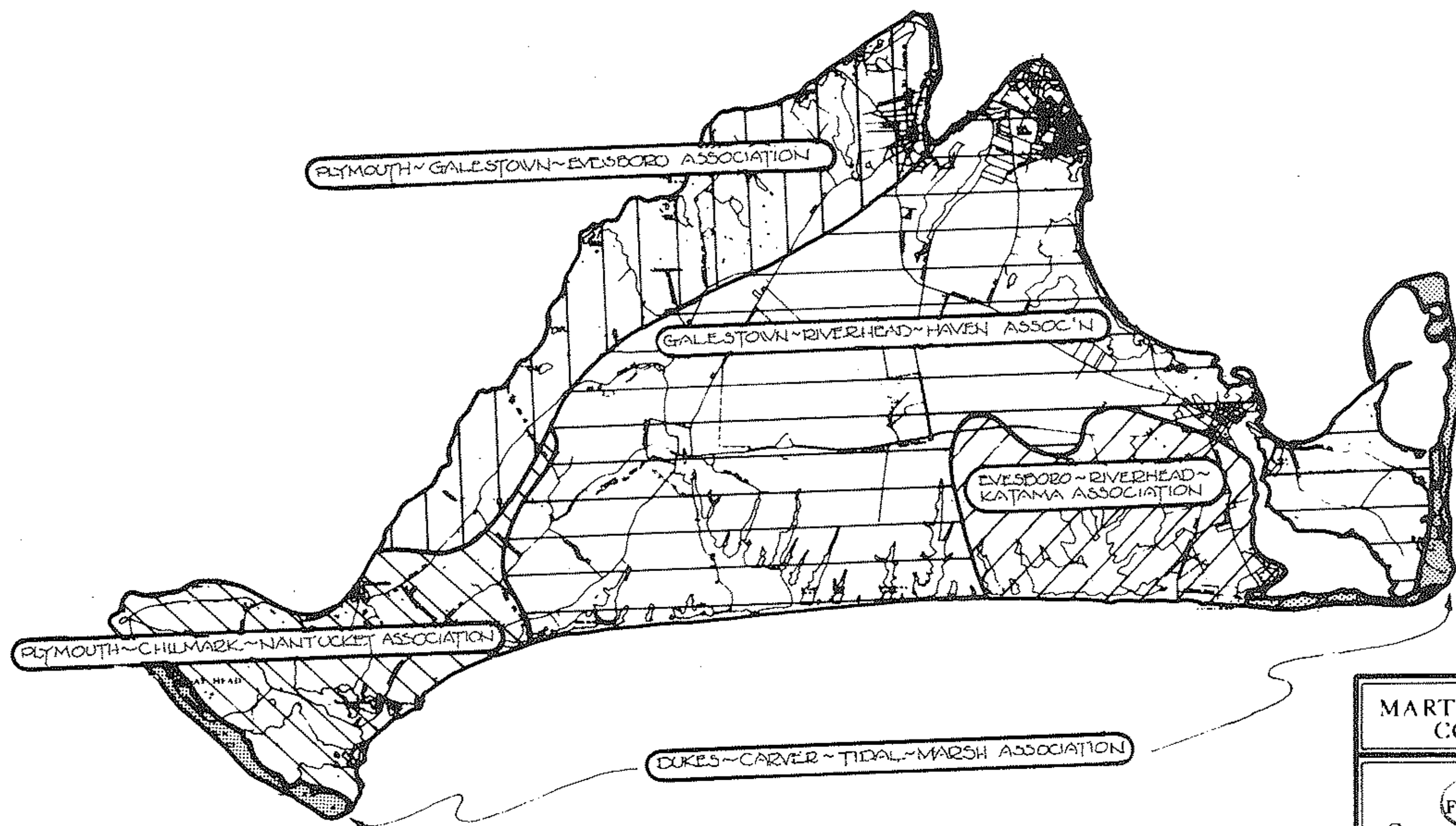
All of these factors should be pre-determined before allowing a particular land use on Martha's Vineyard. This is especially important in the western portion of the Island where great variability in soils is common. Percolation tests provide some information regarding the potential for the success of on-lot disposal systems. Further recommendations for the use of percolation tests in determining land uses and restrictions are suggested in Chapter 7.

The Island's soils associations and their descriptions are as follows (see figure 3):

1) Plymouth-Chilmark-Nantucket Association--These soils occur on gently sloping to moderately steep slopes on the moraines. The Association consists of stony, sandy and loamy soils.

   Chilmark and Nantucket soils have severe limitations for on-site sewage disposal because of slow permeability. Plymouth soils on the other hand can absorb large amounts of sewage effluent but they are so rapidly permeable that ground water supplies can be contaminated.

2) Evesboro-Riverhead-Katama Association--These sandy and loamy soils are found on nearly level to moderately steep outwash plains or coastal plains. The plains occupied by this Association are bounded by the southern



MARTHAS VINEYARD COMMISSION

FIGURE 3
General Soil Map
source: u.s. dept. of agriculture

scale:
FEET 8000 16,000 24,000
MILES 2 4

beaches.

Droughtiness severely limits the use of Evesboro soils for farming. Riverhead and Katama soils have few limitations for this use and farming is of growing importance in the areas where this Association is located. All three of the major soils in this Association have few limitations for residential development. They also have the capability to absorb large quantities of sewage effluent from on-site disposal systems. Because of their rapid permeability, however, ground water supplies may become contaminated.

3) Galestown-Riverhead-Haven Association--This Association of sandy and loamy soils occurs on outwash plains, nearly level to moderately steep, which occupy only about 3% of the Island.

Droughtiness severely limits the use of Galestown soils for farming. Riverhead and Haven soils have slight limitations for farming. The major soils in this Association have few limitations for residential development. Galestown soils have severe limitations for on-site sewage disposal because of slow to very slow permeability in the lower part of the subsoil. Riverhead and Haven soils are capable of absorbing large quantities of sewage effluent, but they are so rapidly permeable that ground water supplies may become polluted. All of the major soils in the Association have few limitations for recreational development.

Many areas of Riverhead and Haven soils could be developed for residential use or farming.

4) Plymouth-Galestown-Evesboro Association--These sandy soils occur on nearly level to moderately steep moraines and outwash plains.

This Association occupies about 2% of the area.

Droughtiness severely limits the use of the major soils in this Association for farming. They have few limitations, other than slope, for residential development. Galestown soils have severe limitations for on-site sewage disposal because of slow to very slow permeability in the lower part of the subsoil.

Plymouth and Evesboro soils can absorb large quantities of sewage effluent but ground water supplies may become polluted. All of the major soils of the Association have few limitations for recreational development.

3.3 Shellfish and Finfish

One of the most important natural resources of the Island is its shellfish. The shellfishing industry provides one of the key off-season industries essential to the local economy. Four species of bivalves are gathered: 1) the bay scallop, 2) the quahog, 3) the soft-shell clam and 4) the oyster. The bay scallop is the most economically valuable, comprising 70% of the total annual value. The scallop season extends from October through March.

All shellfish are intolerant of polluted water and can present serious health hazards when contaminated. Numerous studies have concluded that, with some cultivation, the enclosed, sheltered ponds could produce far more shellfish than are presently harvested. Although many plans have been suggested for increasing yields, the only form of cultivation currently employed is the regular breaching of ponds to prevent the water freshening to an extent that the clam and scallop populations could not survive.

Productive fishing waters will need protection from contamination by on-shore development, disposal of dredge spoils and oil spills. Representative shellfish yields in Island waters are listed in Table 2. Figure 4 lists productive fishing waters.

Ganyalaux or Red Tide contamination has occurred in nearby waters in recent years. In the past analyses of shellfsh samples harvested by the Shellfish Wardens, prepared by the State Lobster Hatchery and analyzed by the Lawrence Lab were used to insure safety. The Lobster Hatchery will not be able to prepare these samples in the future. It is recommended that the State provide regular surveillance of local shellfish to protect the consumer and maintain the confidence of seasonal visitors.

The following are recommendations from the Martha's Vineyard Shellfish Group to protect and enhance Island shellfisheries (Karney, 1977):

1) Provide for regular and frequent water quality testing to ensure shellfish qulaity and monitor condition of the ponds--coliform testing; nutrient testing (nitrates, phosphates); Red Tide testing: pollutants, heavy metals, oils.

2) Prevent flow of sewage, septic drainage, chemical pesticides and fertilizers into the ponds:
   --inspection of septic systems--dye studies;
   --correction of defective systems-- possibly a subsidy or matching fund made available,

TABLE 2

SHELLFISH YIELDS IN EDGARTOWN WATERS, 1976

			Value Est.
Commercial			
Edgartown Great Pond	Clams	1,683 bu.	$37,699
Katama	Littlemecks	3,210 bu.	78,645
	Cherrystones	1,110 bu.	1,320
Edgartown Harbor	Quahogs	350 bu.	3,500
Cape Pogue	Scallops	7,800 bu.	
Sengekontacket	Scallops	875	
Family Permits			
Mostly Katama, Some Sengekontacket	Clams	886 bu.	$19,842
	Quahogs	1,345 bu.	32,960
Cape Pogue	Scallops	566 bu.	11,322
Edgartown Great Pond	Oysters	80 bu.	1,199

SHELLFISH YIELDS IN CHILMARK WATERS, 1976

Commercial			
Nashaquitsa Pond	Quahogs Large	529 bu.	4,162
	Quahogs Medium	353 bu.	4,236
	Littlenecks	375 bu.	12,362
Tisbury Great Pond	Clams	390 bu.	8,190
	Oysters	100 bu.	1,200
Family Permits			
Nashaquitsa Pond	Quahogs Large	30 bu.	
	Quahogs Medium	25 bu.	
	Littlenecks	40 bu.	
Menemsha Pond	Scallops	25 bu.	
Tisbury Great Pond	Oysters	50 bu.	
	Clams	20 bu.	

SHELLFISH YIELDS IN OAK BLUFFS WATERS, 1976

Commercial	
Quahogs	
Sengekontacket	136 bu.
Oak Bluffs Harbor	765 bu.
Lagoon	10 bu.
Scallops	
Sengekontacket	694 bu.
Lagoon	1,589 bu.
Family Permits	
Quahogs	
Sengekontacket	254 bu.
Lagoon	34 bu.
Oak Bluffs Harbor	12 bu.
Clams	
Sengekontacket	38 bu.
Lagoon	33 bu.
Oak Bluffs Harbor	2 bu.
Scallops	
Sengekontacket	10 bu.
Lagoon	80 bu.
Oysters	
Farm Pond	36 bu.

Oak Bluffs total value: $83,663

FIGURE 4

FIN- & SHELLFISH on MARTHA'S VINEYARD

as improvements will benefit the "water common", a community resource;
--discourage use of pesticides and fertilizers on shore properties and along creeks feeding the ponds through public education and regulations;
--adopt sealed-head regulations for boats entering harbors and ponds and provide on-shore facilities for waste disposal.

3) Discourage flow of damaging sediments into the ponds and provide for their removal:
--identify and correct areas of bank erosion through re-vegetation;
--protect and stabilize dune areas to prevent sand from blowing into ponds--limit traffic (pedestrian and vehicular) over the dunes through designation of public access areas planned to have least detrimental effects;
--construct and maintain catch basins on storm sewers;
--streamline the procedure (less hearings!) for permits for maintenance dredging of channels periodically requiring removal of tide-deposited sediments.

4) Manage the breaching of brackish ponds to maintain optimum salinities and ensure the spawning runs of anadramous fishes such as herring.

5) Reduce the amount of litter entering ponds and interfering with fishing through a ban of one-way, no-deposit containers.

3.4 Vegetation

The density and type of vegetation growing on recharge areas affects the amount of precipitation that can be captured. Vegetation also affects transpiration: large stands of trees will transpire more water than unvegetated lands. Estimates of land use performed by MacConnell can be effective in predicting the evapo-transpiration from different types of soil and vegetative cover (see Figure 7).

Exposure to the prevailing southwesterly winds and salt spray limits vegetation on Martha's Vineyard. Large trees are generally found away from the coastline with progressively small, scrubby trees and hardwood woodland located on the western moraine. Oak is the dominant species here.

Scrubby or shorter species are generally a transitional stage between abandoned fields and woodland. Where exposed to prevailing southwesterlies, however, this vegetation may become stable. Much of the south shore contains such stunted trees.

Low heathlands are found mainly along the shoreline. Heaths are fragile and can be readily destroyed unless great care is takend to prevent misuse. Typical plants of the heathland community include beach heath, lichen and bearberry. Further inland, bayberry, low bush blueberry, wild cranberry, heather, beach rose are dominant. Wasque Point, Gay Head and the south shore are heathland areas.

Dune vegetation is of great importance in stabilizing and protecting the beaches and, by building dunes, eliminating coastal flooding. Human activities such as dune buggies and pathways through the dunes must be controlled to prevent blow-outs which can significantly weaken the dunes. This kind of blowout was probably a major factor leading to the recent Katama Bay barrier breach.

Wetlands are one of the most biologically productive vegetated areas and provide habitat for many species of marine animals. Wetlands absorb nutrients which might otherwise degrade coastal waters and provide a buffer to erosive waves. They also trap up to 2,000 tons of silt per acre per year. Inland wetlands, in absorbing floodwaters from rain-swollen streams, provide vital habitat for wildlife.

Agricultural and open lands have been decreasing in the past 20 years (MacConnell, 1971). Heathlands were reduced by nearly 32% during the same period. Only 1% is attributed to house and road construction. The major change resulted from new growth of tree species.

Forestland on Martha's Vineyard gained 219 acres over this period by natural succession of abandoned fields and pasture.

3.5 Wildlife

The tremendous variety of wildlife found on the Island is a significant natural resource. Future development on the Island should not occur at the expense of wildlife habitats.

The following are the most important wildlife areas on the Island which must be protected from the irreversible impacts of development (Figure a-5).

Squibnocket--a complete ecosystem with fresh and salt waters nearby--pond, marsh, beach scrub and tree groves. Inhabited by Canada geese, mute swans, black duck, heron, spotted sandpipers and piping plovers.

Cranberry Lands--an unusual dune, beach, swamp area surrounded on three sides by salt water. Several small ponds are isolated in the interior. Inhabited by herring gulls, black-backed gulls, sparrows, heron, snowy egrets and short-eared owls.

Sengekontacket or Anthiers Pond--rich abundance of nutrients and tidal flow cause large concentrations of various species of waterfowl. It usually has open water even in severe winters. Shellfish, striped bass, eels, ducks, geese, pheasant, quail, deer and rabbit all inhabit the Pond and it shores.

Katama Plains--the beach, extensive open fields and scrub, small ponds and Katama Bay provide an abundance of habitat. Terns, gulls, swans, geese ducks and many land birds inhabit the area. Scallops, clams and quahogs can be had in the Bay.

Wasque and Cape Pogue--the habitat varies from moors to beach and dunes, scrub thickets and cedar groves, fresh, brackish and salt ponds. These areas provide nesting for many unusual species of birds including oyster catchers and short-eared owls. Tremendous herring gull and tern rookeries and large populations of pheasant, deer, raccoons, muskrats and other are in the area. Shellfish are abundant in the tidal waters of Cape Pogue and Poucha Pond.

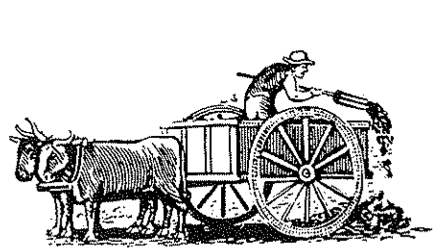
Chilmark Pond and Black Point Pond--habitat here is very similar to that mentioned for Katama Plains and the inhabitants are also similar.

Edgartown and Tisbury Great Ponds--deep protected coves and wetlands and brackish to salt pond offer a large variety of habitat for may birds and animals.

Martha's Vineyard's South Shore--includes numerous fresh, brackish and salt ponds which are valuable wildlife and shorebird habitat.

4

Human History, Population and Land-Use



4.0 The Island's Human History, Population and Land Use

One of the most important elements in the creation of a water quality management plan for Martha's Vineyard is the analysis of past, present and future population and land use. These considerations are vital to assure that the plan is consistent with the nature of the community and its' needs.

4.1 History

There are several theories available to account for the Island's name. According to one, Leif Ericson discovered the Island and the name was derived from "Vinland the Good". Others say, however, that Bartholomew Gosnold, an English navigator, discovered Martha's Vineyard in 1602. First settlements were made in 1646. During the 19th Century, Martha's Vineyard was famous as a whaling port. The towns of Tisbury and Edgartown have many of the large white whaling captains homes each facing the sea, not the road. After petroleum was discovered in the 1850's the whaling industry declined. Since then, the chief Island industry has been summer tourist trade and associated second home building. There is some fishing and some lobstering, but the beaches and the boating draw most of the income. The Vineyard has six separate townships each supporting its own social history as well as its own individual aesthetic character. From west to east, these include: Gay Head, Chilmark, West Tisbury, Tisbury, Oak Bluffs, and Edgartown.

4.12 Population

The major demands which are put on our resources come from population growth which requires water for drinking and disposal of waste. One of the most important determinants of water, population, varies tremendously with the seasons and so too does the water quality and quantity. Unfortunately, the greatest demand for water supply comes at that time of the year when the least amount of water is available for consumption. The winter period of low demand for water allows soils to recover and ground water supplies to recharge. In the future, increasing conversion of seasonal homes to year-round use may lead to water-related problems.

4.21 Present Population

An analysis of Steamship Authority (SSA), other private ferry, and air traffic statistics has lead to the conclusion that the peak summer day population for 1975 was 55,000 to 60,000 and the winter minimum was 7,900. The summer figures include an estimated 15 to 25 percent day-trippers which are not part of the overnight population. Figure 5 indicates the seasonal variations in population based on this study. Each curve represents the net population when the item indicated is added on. The curve reaches a peak in August of some 47,000 people including the year-round population. A study of the statistics available from the Steamship Authority however indicated this to be low. The figures available sometimes did not reflect weekend peaks in travellers. They also do not include private boats and planes. Corrections were made which resulted in the 55,000 to 60,000 peak estimate. A simple check of space available for peak population can be used to substantiate these estimates.

It is estimated that there are presently 7,500 dwelling units on the Island of which roughly 40 percent or 3,000 are year-round and 60 percent or 4,500 are seasonal. If we assume 6 people per seasonal house and 4.5 people per year-round house during this peak day, we have a total of 37,800 people. Hotels can accomodate 4,500 people and boats moored in our harbors 2,500 people. Campers may add another 1,500 people for a total of 46,300 people when the year-round residents are included. Ten thousand day-trippers from the Steamship Authority, airlines and other boat lines would account for 56,300 people. The two estimates agree closely on 50-60,000.

4.22 Population Projections

Projections of future year-round and summer overnight populations are included below. Given the large uncertainties in the driving forces and limiting factors in the Island's population, two distinct projections were made.

Table 3 Population Projections

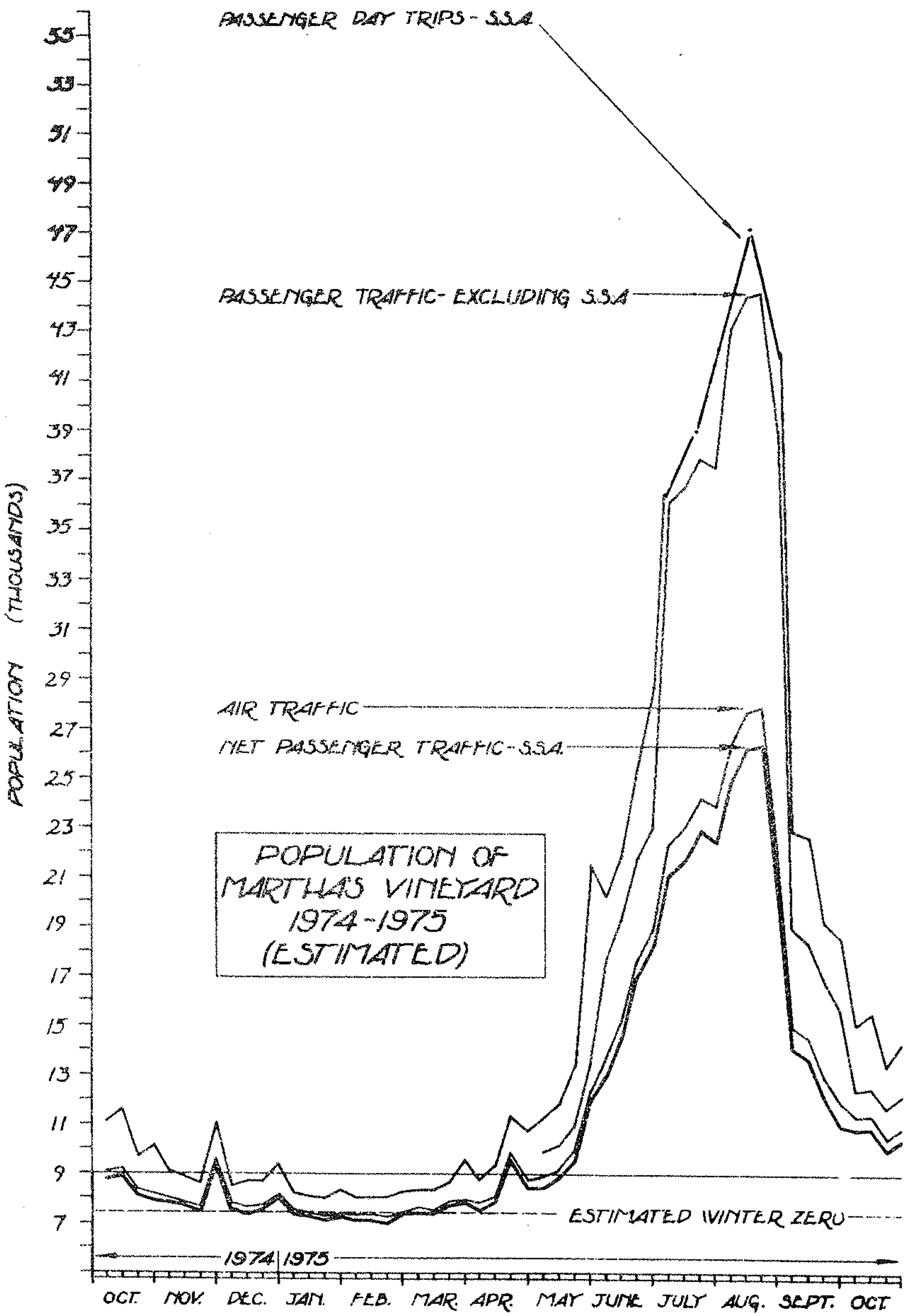
	1975	1980	1985	1990	1995	2000
year-round						
low	7,900	9,000	9,800	9,400	9,400	9,400
high	7,900	9,600	10,900	11,800	12,400	12,800
summer	45,000	50,400	60,400	63,000	65,000	70,000

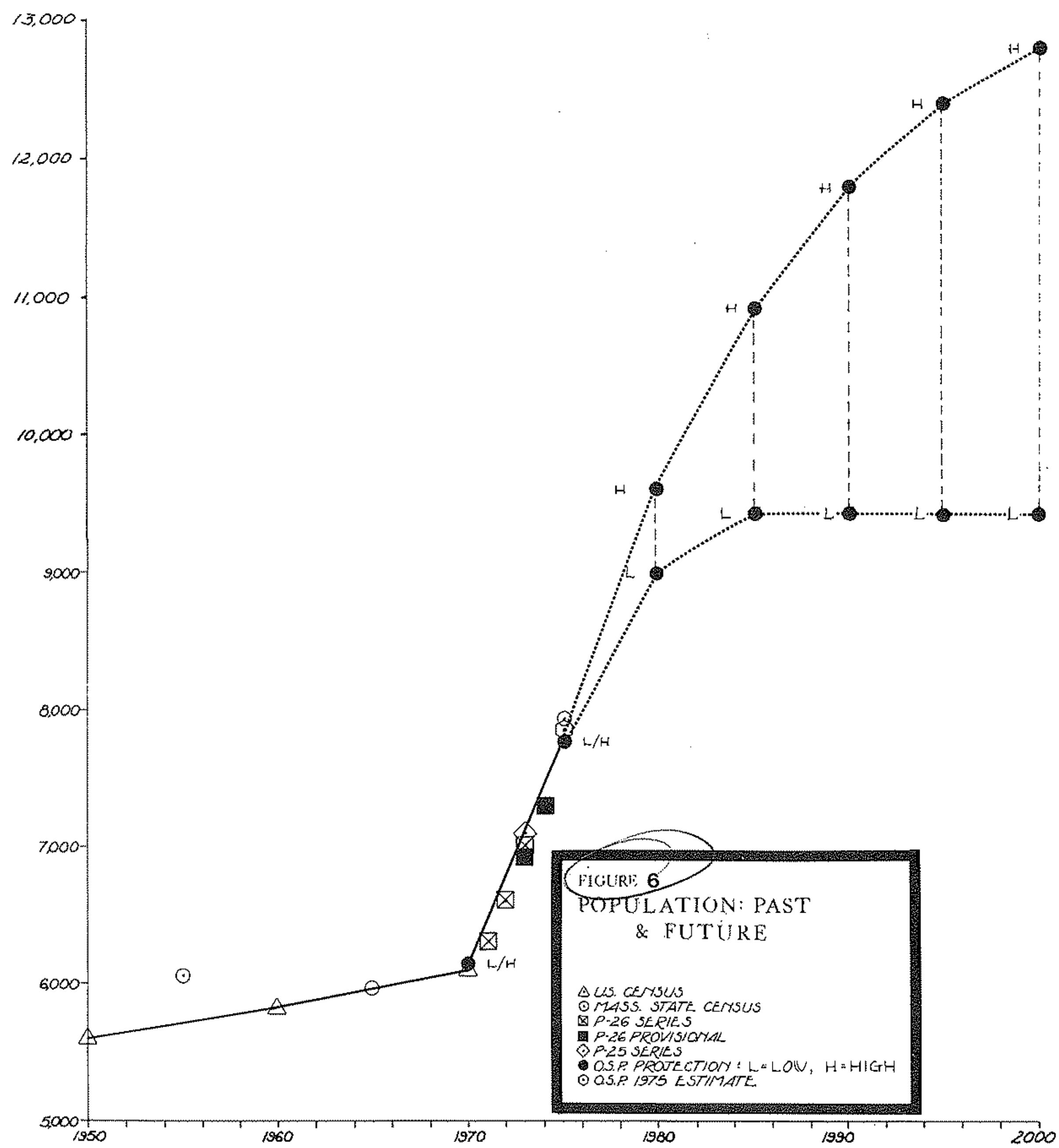
The 25 year growth in year round population is projected at 1500 under the low growth scenario and 4,900 under the high growth scenario. Growth in both year round and seasonal population depends on whether the Island continues to be attractive for recreation/second home/retirement and whether competing localities might become more attractive or convenient. The most volatile factor is the proportion of the feeder population - eastern Massachusetts and the New York City area - which wishes to recreate or retire here. Since these factors can not be accurately assessed at this time, these projections are considered approximate. Figure 6 clearly demonstrates a decided increase in rate of year-round growth. The overnight seasonal figures in Table 3 are based on a maximum projected growth in housing. See figure 9 for high & low housing projections.

Growth in population has serious water quality implications. Each person added to our population requires 45 to 75 gallons of water per day. This is mainly used for human waste disposal or combined with the waste in our disposal systems. It is par-

Figure 5

POPULATION OF MARTHA'S VINEYARD 1974-1975
(ESTIMATED)




13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
1950
1960
1970
1980
1990
2000
L/H
H
L
FIGURE 6
POPULATION: PAST & FUTURE
△ U.S. CENSUS
⊙ MASS. STATE CENSUS
⊠ P-26 SERIES
■ P-26 PROVISIONAL
◇ P-25 SERIES
● O.S.P. PROJECTION: L=LOW, H=HIGH
⊙ O.S.P. 1975 ESTIMATE

tially treated and released to percolate in to the ground water or piped to a sewage treatment plant as in Edgartown only.

The 1,500 additional year-round people projected for 1995 would release an additonal 140,000 pounds of waste into the environment each year. If there were 6,000 total new houses with an estimated 5 persons per household during the summer, there could be 750,000 total pounds of waste to deal with. This waste would be disposed with a total of 122 to 203 million gallons of water which must be supplied from our aquifers. In addition the added seasonal visitors associated with the 6000 new dwellings could produce some 7000 tons of solid waste which must be landfilled each year. Obviously there is a limit to the waste which can be absorbed by our land and waters. As we approach that limit, more and more contamination problems will occur. It is one aim of this program to define these problems and outline a program to mitigate them.

4.3 Economy

Of the total Martha's Vineyard economy, over 95% of the area's base economy, as indicated by total receipts, is related, either directly or indirectly, to the resort industry, vacation services and sales or second-home construction and attendant services. The resort industry, and thus the bulk of Martha's Vineyard's economy, is dependent on two major factors: the state of the nation's economy and the attractiveness of Martha's Vineyard as a resort community.

While the economy of the Island each year is becoming more tourist-based (Massachusetts Division of Employment Security, 1977, Table 4) in spite of a 20 million dollar per year input, tourism, when combined with off-Island purchases, may cause a net economic loss to the Island through establishing unfavorable trade arrangements with other areas. Instead of Islanders providing goods and services for each other, the Island provides tourist services for outsiders and then uses that income for purchasing goods and services from the outside.

During the 1976 tourist season, for example, about 1,100 to 1,200 jobs were held by non-residents earning 5.5 million dollars, most of which left the Island when the non-residents went home (Massachusetts Division of Employment Security, 1977). Unemployment for residents averages 8.4% year-round (1976). How much the Island has to spend on tourist infrastructure--roads, sewers, landfills and police; who benefits and who pays for services and what the social impacts of a tourist based economy are must be much better understood before large capital improvement programs are embarked upon.

For example, between 1950 and 1970 the Islands population grew by 8%. The MacConnell aerial survey indicated a growth in land uses by a constant 3 to 4% each year. In the period 1971-1976, the Islands

Table 4

Average Annual Number of Jobs by Industry
Dukes County, Massachusetts Labor Area—1970 & 1976

	TOURIST SEASON			YEAR ROUND			ANNUAL AVERAGE		
	1970	1976	Per Cent Change	1970	1976	Per Cent Change	1970	1976	Per Cent Change
Total	3,907	5,401	+38.2	2,446	3,508	+43.4	2,933	4,139	+41.1
Agriculture, Forestry, Fisheries	212	215	+1.4	104	131	+26.0	140	159	+13.6
Construction	636	592	-6.9	491	462	-5.9	539	505	-6.3
Manufacturing	260	378	+45.4	174	256	+47.1	203	297	+46.3
Transportation, Communications, Public Utilities	193	224	+16.1	119	150	+26.1	144	175	+21.5
Wholesale and Retail Trade	1,023	1,669	+63.1	542	891	+64.4	702	1,150	+63.8
Finance, Insurance, Real Estate	173	403	+132.9	132	307	+132.6	146	339	+132.2
Service	1,225	1,729	+41.1	735	1,112	+51.3	898	1,318	+46.8
Public Administration	185	191	+3.2	149	199	+33.6	161	196	+21.7

Nonagricultural Employment Dukes County Labor Area Annual Averages 1970-1976

INDUSTRY	1970	1971	1972	1973	1974	1975	1976
Total	2,240	2,510	2,660	2,820	2,940	3,120	3,270
Contract Construction	340	380	400	400	430	370	340
Manufacturing	50	60	70	80	90	80	80
Transportation, Communications, Public Utilities	120	130	180	110	120	150	150
Wholesale and Retail Trade	700	830	840	980	960	1,060	1,150
Finance, Insurance, Real Estate	110	120	140	210	260	270	270
Service	550	600	610	640	670	750	810
Government	350	370	400	390	390	410	430
Miscellaneous	20	20	20	20	20	30	40

Annual Average Job Openings Dukes County Labor Area 1976-1979

OCCUPATION	TOURIST SEASON	YEAR ROUND	TOTAL
All	165	332	497
Professional, Technical	6	53	59
Managers, Administrators	19	33	52
Clerical	11	59	70
Sales	23	48	71
Craftsmen, Foremen	11	26	37
Operatives	16	32	48
Service	75	58	133
Laborers	4	23	27

Note: This table indicates the net annual increase of jobs expected in each category over the next three years

Table 5

Regional Employment Allocations: 1975-1995

RPA: Martha's Vineyard 12

SIC	Category	1975	1977	1980	1985	1990	1995
	Manufacturing, Total	47	48	49	53	57	65
	Nonmanufacturing, Total	3087	3118	3473	3755	3947	3943
01-09	Agric., Forest, Fish	23	22	20	17	14	14
15-17	Contract Construction	330	340	497	560	515	514
40-49	Transportation, Util.	125	126	132	136	142	142
50-59	Wholesale, Retail	1088	1098	1182	1258	1347	1343
60-69	Finance, Insurance,etc.	280	284	298	317	333	333
70-89 10-14	Services (& Mining)	518	519	603	698	805	806
91-93	Government	723	729	741	769	791	791
	Other Nonagriculture	209	202	196	181	164	164
	RPA Employment, Total	3343	3368	3718	3989	4168	4172

year-round population increased by 31.4% (Massachusetts Division of Employment Security, 1977). Numerous demands for services associated with rapid growth can outpace a communities ability to keep pace leading to water quality and quantity impacts. The factors which play a part in determining future growth are complex. To be more precise than to say the Island will become increasingly attractive in the future is impossible. Each of the factors listed below will affect future growth:

--major, new land use controls
--congestion in the down town centers
--offshore oil development
--gasoline shortages
--red-tide and/or PCB scare in our fisheries
--reasonably priced seasonal housing for the seasonal service force

Table 5 outlines projected employment for the Island (Massachusetts Office of State Planning). These projections suggest an increase in construction of 56%, wholesale and retail business increase of 24% and services increase of 56% .

4.4 Land Uses

An important element in the creation of a future water quality management plan for Martha's Vineyard is the analysis of past, present, and potential land use in the area--land use particularly as it affects water quality. Martha's Vineyard is a large coastal island situated approximately three miles off Cape Cod at its nearest point and contains roughly 95 square miles. Over the past twenty years, but especially over the last five to ten years, the Island has experienced tremendous growth both in year-round and seasonal population and in homes and businesses.

Changes in land use over the period 1951-1971 are available (William MacConnell, et.al, University of Massachusetts). This data compiled by aerial photograhic interpretation, indicates the following changes:

--average increase in residential acreage of 80 acres/year;
--average increase in commercial acreage of 5.3 acres/year;
--average decrease in agricultural acreage of 120 acres/year;
--average decrease in natural uses by 70 acres/year.

Tables 6&7 tabulate these changes in land use categories over the 20 year period and Figure 13 graphically illustrates these trends. This data very

TABLE 6

EXISTING LAND USE BY COMMUNITY IN ACRES

COMMUNITY	TRANSPORTATION	BEACHES	Forest	OPEN Agricultural & Open Space	Wetland	RESIDENTIAL High	RESIDENTIAL Low	COMMERCIAL-INDUSTRIAL	MINING & WASTE DISPOSAL
						DENSITY			
Chilmark	0	79	8,635	1,676	1,435	---	466	3	10
Edgartown	42	419	11,871	3,098	2,730	561	257	42	34
Gay Head	0	70	3,051	114	641	---	176	0	4
Oak Bluffs	30	38	3,046	640	805	391	263	75	56
Tisbury	11	49	3,188	389	622	421	116	52	11
West Tisbury	92	173	13,556	1,815	1,000	151	114	4	15
TOTALS	175	828	43,347	7,732	7,233	1,524	1,392	176	130
Percentages	.2	1.3	69.3	12.4	11.6	2.4	2.2	.3	.2

TOTAL ACRES--62,537

TABLE 7

CHANGE IN LAND USE (in acres) 1951-1971

COMMUNITY	FOREST	AGRICULTURAL & OPEN LAND	WETLAND	RESIDENTIAL	COMMERCIAL-INDUSTRUAL
Chilmark	-181	-996	+655	+430	+3
Edgartown	-115	-1,459	+526	+549	+23
Gay Head	+523	-774	+1	+176	0
Oak Bluffs	-6	-365	+55	+137	+55
Tisbury	-76	-148	+42	+107	+7
West Tisbury	-28	-457	+116	+224	+4
TOTALS	+117	-4,199	+1,395	+1,623	+92

not quite

clearly demonstrates the growth in residential/commercial uses at the expense of natural and farming lands and the growth in forests at the expense of open lands.

Figure a6 indicates geographically where these growth changes occurred. To this data (gathered in 1970), field surveys in 1975 added approximately 800 acres of low density residential land which is included on the map. These changes in land use illustrate the trend toward spreading residential centers and the gradual infilling of the area between town centers. The growth areas delineated in this manner, in combination with the existing subdivision map point out where potential future growth might occur.

4.41 Present Land Use

The Island can be divided into two general areas, each with distinctive land use patterns, called locally "down-Island" (Tisbury, Oak Bluffs, and Edgartown) and "up-Island" (West Tisbury, Chilmark and Gay Head). For the most part, the down-Island towns contain the majority of the population and related commercial and light industrial land uses. As this area is also the major entry to the Island, it has the greatest land use activity--both residential and commercial.

The village centers of West Tisbury, Gay Head, and Chilmark are much smaller than their down-Island counterparts. They contain only a few commercial uses in additon to the residential buildings. The down-Island towns draw most of the commercial activity for the Island as a whole and essentially function as the "urban" part of the Island. This has become increasingly more true in recent years. The down-Island concentration of developed land uses is reflected in the zoning patterns of the towns: generally more small-lot zoning and commercial zones exist in the down-Island towns. It is in the down-Island towns that the most intensive use of the land and the greatest resulting impacts on water quality have occured. The intensity of use of this area is reflected in figure a7 which illustrates housing density based on the United States Geological Survey topographic map, dated 1972.

Figure 7 is a generalized land use map based on the MacConnell remote sensing survey of 1971. This map also illustrates the concentration of intense use in the three down-Island towns.

4.42 Future Land Use

In the past, much of the growth on the Island has occurred between the towns and on their outskirts. This is reflected in the changes in land use between


WEST CHOP
EAST CHOP
CRYSTAL LAKE
LAKE TASHMOO
VINEYARD HAVEN HARBOR
Vineyard Haven
LAGOON POND
Oak Bluffs
OAK BLUFFS HARBOR
OCEAN PARK
O.B. BEACH
FARM POND
OAK BLUFFS
SENGEKONTACKET POND
STATE BEACH
HIGH SCHOOL
Vineyard Haven Rd
MARTHA'S VINEYARD AIRPORT
Edgartown West Tisbury Rd
EDGARTOWN
Edgartown
EDGARTOWN HARBOR
CHAPPAQUIDDICK ISLAND
CAPE POGE BAY
KATAMA BAY
POUCHA POND
WASQUE POINT
KATAMA BEACH
EDGARTOWN GREAT POND
SCRUBBY NECK
OYSTER POND
LEGEND
HIGH DENSITY RESIDENTIAL
LOW DENSITY RESIDENTIAL
URBAN INDUSTRIAL
CONSERVATION
WASTE DISPOSAL
WATER SUPPLY
OPEN FIELDS
WOODLANDS
MARTHA'S VINEYARD
LAND USE MAP
THE MARTHA'S VINEYARD COMMISSION
PROJECT:
DATE:
SCALE:
FEET 3000 6000 10000
KILOMETERS 1 2 3
MILES 1 2
ACRES
25
100
500
640 / 1 SQ MILE

FIGURE 7

1951 and 1971 (see figure a6). Field surveys in 1975 added approximately 800 acres of low density residential land which is also included on the map. Building permits issued between 1972 and 1976, also reveal clues as to where the Island is experiencing growth (figure a8). By assuming that future growth will continue in the same pattern as in the past, we can estimate locations and amounts of growth and predict areas requiring services.

locations are approx.

In developing future land use projections based on historical trends, the available data was put to the following uses: building permit, electrical inspections and Assessors' records were used to develop a high and low magnitude of future growth. The location map of building permit data was used to break up the total projected growth for each town into different growth neighborhoods by taking a simple percentage of the projected growth. This percentage was estimated by the ratio of the number of building permits issued in a given neighborhood to the total building permits for the town in the 1970-1975 period. Within the growth neighborhoods, future growth was located within existing subdivisions (figure 8) and around the growth centers indicated in figure a6. Acreage consumption was then estimated by existing zoning requirements.

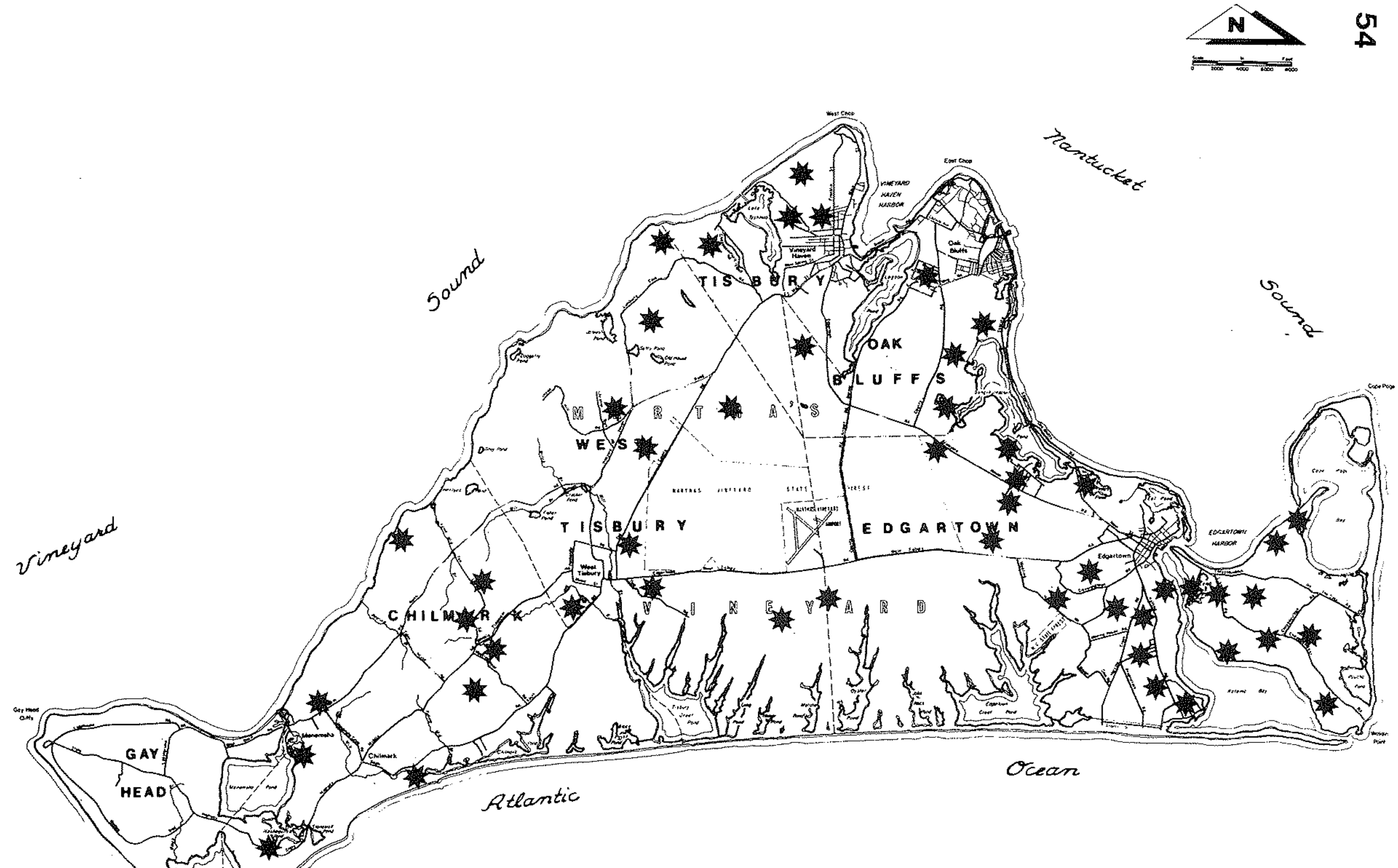
Growth projections of dwellings and acreage are included for both high and low projected growth rates in Figure a9 . Growth projections for the entire Island are presented in figure 9. Total dwellings which could potentially be constructed on the Island far exceed the projected high growth possibility (see table a-3).

Future Growth - Low Prediction

The low historical growth rate projects a total of 65 new dwellings per year. This growth rate approximates that experienced in the 1960's. (see table 8). In this scenario, it is also assumed that people would continue to use water resources as in the past. Water conservation, waste recycling and appropriate siting of waste disposal units are assumed to continue in a manner which is not cognizant of the limitations of the environment. In this case, the slower pace of development could improve water resource-related impacts in two ways;

1. There would be less wastes to be processed;
2. There would be added time to develop new waste water disposal methods.

Also the need for public facilities for water supply and waste water disposal would be reduced substantially both in volume and in area served, resulting in savings to the towns. Sewer service



Existing Subdivided Areas
each star denotes an area
recently subdivided: details at mvc office

Figure 8

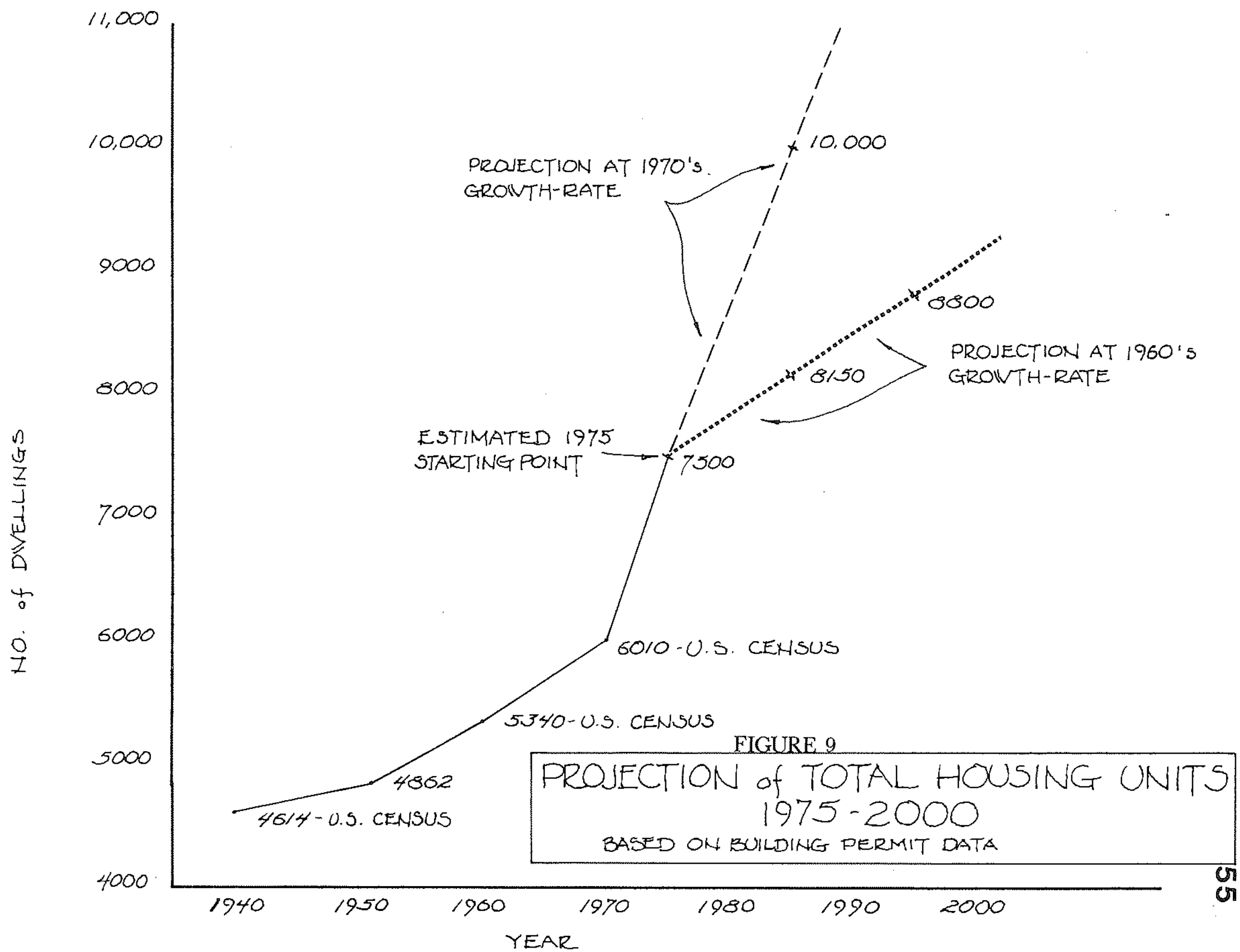


FIGURE 9

PROJECTION of TOTAL HOUSING UNITS
1975-2000
BASED ON BUILDING PERMIT DATA

needs would be expected to be limited to the downtown portions of the major towns. Water supply would also be limited to the immediate vicinity of existing service over the 20 year planning period.

Table 8

Estimated Average Construction Rates

Town	Number of Dwellings Constructed/Year 1960's	1970's
Chilmark	13	25
Edgartown	11	75
Gay Head	1	6
Oak Bluffs	16	48
Tisbury	14	58
West Tisbury	10	39
	65	251

Figures are derived from Town building permit records, assessors records of dwellings, Massachusetts Department of Commerce and electrical inspection data. They are considered approximate.

Future Growth--High Prediction

The high historical projection predicts a total of 251 new dwellings per year on the Island as a whole. This growth rate approximates that experienced during the early 1970's. (see Table 8). In this scenario it is assumed that people would continue to use water resources as in the past. The more rapid pace of development, if disposal systems are not appropriately sited will cause adverse impacts in proportion to the greater number of visitors. The demand for sewer and water services would also be proportionately greater in this secenario. Demands for these services would probably occur in outlying areas such as Ocean Heights, Lagoon Heights and Mattakesett Pt.

Growth centers on Martha's Vineyard which may require services include the following (as described in Chapter 8):

Edgartown--Ocean Heights
Mattakesett
Herring Creek
Clevelandtown
Oak Bluffs--Waterview (water supply only)
Lagoon Heights
Tisbury--Village
West Tisbury--Germantown

Other areas where significant growth is expected but for which no future water-related service demands are projected are listed below. In these areas, it is anticipated that preventative and rehabilitative action should be sufficient to preclude any adverse water impacts (see Figure 20).

Chilmark--North Shore
Middle Road--East
West Tisbury--Lamberts Cove
Outwash
Chappaquiddick--areas 1 and 2

4.5 Limiting Impacts of Future Growth

In the 1960's the Metcalf & Eddy plan was developed which was essentially an environmentally oriented plan. Their solution to the Island's need for room to grow was to confine it to a single growth center and to sewer and supply it with water. The approach was to maintain as much open space as possible for groundwater recharge and wastewater treatment as well as wildlife and aesthetic enhancement. However, the central recommendation of the Metcalf and Eddy plan appears to have been found unacceptable by the people of the Island. Planning for a new town has not been implemented in any fashion. Instead, growth has been absorbed through the gradual spread of the existing town centers: in Edgartown, in the Katama Plains and Ocean Heights; in Oak Bluffs, to the west into Lagoon Heights; and in Tisbury, to the south into Lagoon Heights and west toward Lake Tashmoo.

Several options are available through which the towns might guide growth in a manner designed to minimize water quality impacts. These alternatives are spelled out in more detail in Chapters 6 and 7.

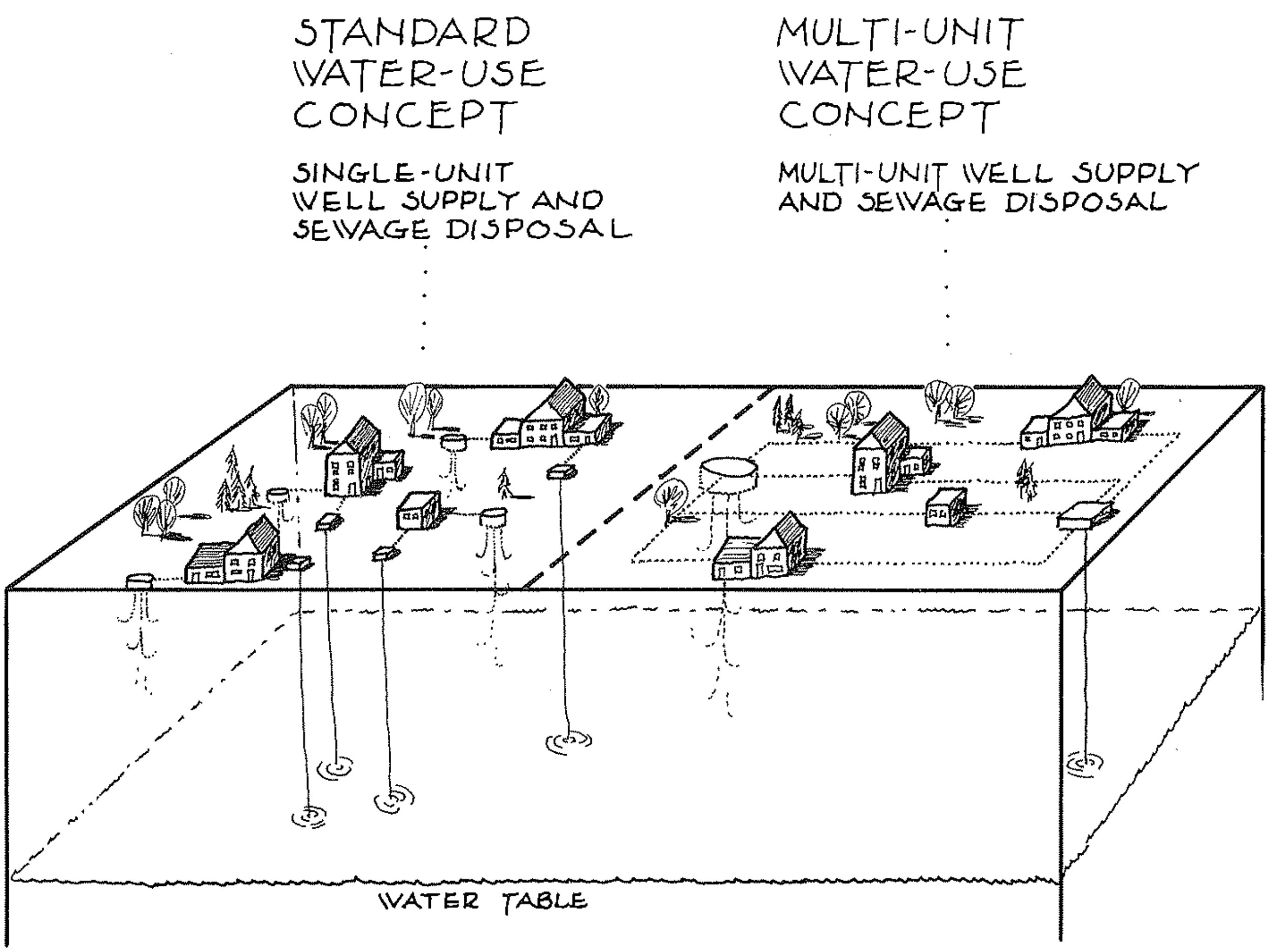
- Collective package wastewater treatment - in which a few to several hundred homes may be hooked into an advanced treatment system. By isolating the source of potential pollution (individual septic systems or treatment plants) from the water supply, the risk of well contamination is reduced ~~(see Figure 9)~~. see figure below

- Large collection systems - may also be required in high density areas to protect the ground and surface waters from adverse growth impacts. Careful planning is needed to assure future areas needing sewer service can be hooked in at a reasonable cost and that the expected flow from the area to be served can be handled by the plant. At present, large areas in Edgartown, Oak Bluffs and Tisbury are so zoned that sewer service could be mandatory should build-out occur. The cost of this eventuality is prohibitive in terms of capital cost and annual operation and maintenance.

-Another option to assuring environmentally compatible growth is one involving the use of such planning tools as health and zoning regulations, conservation restrictions and transfer of development rights. The areas which should be considered for protection include the following:

- -coastal areas;
- -pond and stream margins;
- -wetlands;
- -aquifer recharge zones;
- -potential water supply areas;
- -steep slopes;
- -areas of poor soil;
- -areas of good agricultural soil.

Mechanisms to accomplish these goals are available and, in many cases in force through the Wetlands Protection Act, Martha's Vineyard Commission Coastal District, zoning permitted density limitations and subdivision control regulations (Chapter ~~5~~ 6).



5

Water Quality

5.0 Water Quality

The quality of the Vineyard's water resources is dependent on both natural processes and man's activities. The quality of our ground waters depends on its environment (whether in an intensely used or open area), its movements and the ultimate source. Samples from the Edgartown Water Company's exploration wells at Beetle Pond and Lily Pond give us fairly accurate estimates of ground water quality in a relatively open area. These ground waters contain no ammonia and 0 to 1 part per 10 million of nitrate. Protected supply wells in Tisbury and Oak Bluffs show similar low levels of these pollutants (see Table 9). In the following discussion, pollution is defined as man-induced degradation of the natural water quality of our water resources. On the Island, pollution can derive from unwise land-use development, improperly operating on-lot sewage disposal systems, municipal, commercial and small scale industrial activities, landfills, watercraft wastes and construction activities.

Prior to the initiation of this program, data were lacking on the impact of man's activities on Island water resources. A failing septic system, as occasional contaminated well or a harbor closed to shellfishing during the summer have been the only observable impacts.

To help determine the quality of our water resources and to establish a base line to distinguish trends in quality, the Martha's Vineyard Commission and the Massachusetts Division of Water Pollution Control jointly conducted an intensive water quality survey.

Sampling was performed during the following periods: August 13 and 14, 1975; November 17 - 19, 1975; February 17, 1976; April 5-7, 1976; April 21, 1976; July 26-28, 1976, August 16-18, 1976; and December 13 and 14, 1976. Surface water quality samples were collected from saltwater and freshwater ponds, harbors, bays, tidal streams, and inland freshwater streams and rivers. Groundwater samples were collected from 52 public and privately owned water supplies. Wastewater discharge sampling was conducted at the Edgartown Wastewater Treatment Plant in Edgartown and the Martha's Vineyard Hospital Wastewater Treatment Plantin Oak Bluffs. In addition, sampling was conducted at four experimental groundwater monitoring wells located adjacent to the Edgartown dump and one at the Treatment Plant. All surface water quality and ground water samples were "grabs"* while most of the wastewater discharge monitoring samples were "composites".*

Chemical and bacteriological samples were anal-

TABLE 9 WATER QUALITY ANALYSIS FOR TOWN WATER (1975)

City or town	Source (1975)	Turbidity	Color	pH	Alkalinity	Hardness	Calcium	Magnesium	Sodium	Potassium	Iron	Manganese	Silica	Sulfate	Chloride	Ammonia N	Nitrate N	Copper	Spec. Cond (Micromhos/cm.)	No. of Samples
					Milligrams per Liter															
Oak Bluffs																				
	5 G.P. Wells & Infiltration Gallery	1	2	6.4	8	9.3	2.4	0.8	7.7	0.7	.22	.00	5.5	5	11	.00	0.3	.00	64	3
	G.P. Wells, 5 Wells	5	17	6.4	8	8.3	2.0	0.8	7.7	0.7	1.2	.04	7.1	3	11	.00	0.1	.03	60	3
	Station #2, Farm Neck Rd.	0	3	6.3	5	7.7	1.1	1.2	10	0.7	.03	.00	4.4	0	14	.00	0.3	.04	67	3
	Tap in Water Dept. Office	0	2	6.3	7	9.3	1.9	1.3	10	0.7	.45	.02	5.9	0	13	.00	.02	.07	73	3
Edgartown																				
	Dug & Tubular Wells, Wintucket	1	3	6.9	7	7	1.1	1.1	10	0.5	.05	.01	3.1	4	15	.00	0.0	.00	67	3
	G.P. Well #2, W. Shurtleff Gas	1	2	6.0	9	25	4.9	3.0	19	2.5	.05	.09	7.4	13	27	.33	3.5	.11	157	3
	Mashachet G.P. Well, Tap in P.S.	1	3	6.7	13	8	1.1	1.1	12	0.8	.00	.00	7.1	0	21	.01	0.1	.00	72	3
	Tap on System	1	2	7.0	16	8	1.2	1.3	14	0.7	.09	.01	7.2	0	14	.02	0.3	.03	87	3
Tisbury																				
	G.P. Well #1, Edgartown Rd.	1	3	6.6	13	7.0	1.5	0.8	8.0	0.5	.01	.01	8.6	2	11	.00	0.0	.03	60	1
	G.P. Well #2, W. Spring St.	1	3	6.6	10	7	1.5	0.7	7.5	0.5	.10	.03	9.0	1	11	.00	0.0	.03	52	2
	Tashmoo Spring	1	3	6.3	10	10	2.0	1.3	10	0.6	.02	.00	7.4	4	15	.00	0.1	.02	74	2
	Tap in Town	1	4	6.4	11	7.0	1.5	0.8	8.0	0.6	.02	.02	10	2	11	.00	0.0	.12	55	2

yzed at the Lawrence Experiment Station of the Masschusetts Division of Environmental Health. All analyses were performed according to the procedures set forth in the American Public Health Association's Standard Methods for the Examination of Water and Wastewater (13th Edition, New York, 1971). Most samples were analyzed within twenty-four hours after collection.

The sampling program to date has generally documented the high quality of our waters. However, there are clear indications that the water resources in some areas on the Island have been impacted. The standards against which our sampling results were weighed are summarized in Table 10.

5.1 Surface Water Study

The harbor and saline pond investigations were designed to assess the water quality problems associated with boat use, onshore development and storm runoff. Our coastal waters are currently classified "SA" by the Division of Water Pollution Control which means suitable for swimming and fishing. In general, the sampling program documented this classification. During high use periods, however, certain of our waters do not meet these standards. It is in the interest of our tourist and shellfish industries that we continue to maintain our high quality surface waters.

Oak Bluffs and Tisbury Harbors, Sengekontacket and Menemsha Ponds were sampled. Sampling stations are located in Figure 10. All of these waters and the adjoining coastal groundwaters undergo an intense high use period during the summer months which introduces a slug of contaminants into them. The contaminants are dissipated by tidal flushing, growth in pond weeds such as eel grass, algae and codium and production of phytoplankton. In our salt waters, phosphate nutrient for growth of phytoplankton is supplied by sea water, while nitrate is supplied by fresh water runoff from the land. On-lot sewage disposal releases nitrogen compounds which in combination with available phosphates can lead to aquatic weed problems. Most of our coastal ponds are not well flushed by tides or fresh water influx. Because of this, pollutants introduced from the land may be completely incorporated in weed production causing extreme vegetative growth and sediment accumulation.

The effects of nutrient enrichment of surface waters are subtle and slow acting. Our coastal ponds are in a general state of natural eutrophication which may become severe as in the case of Sengekontacket Pond where thick eel grass growth threatens shellfish yields. That additional nutri-

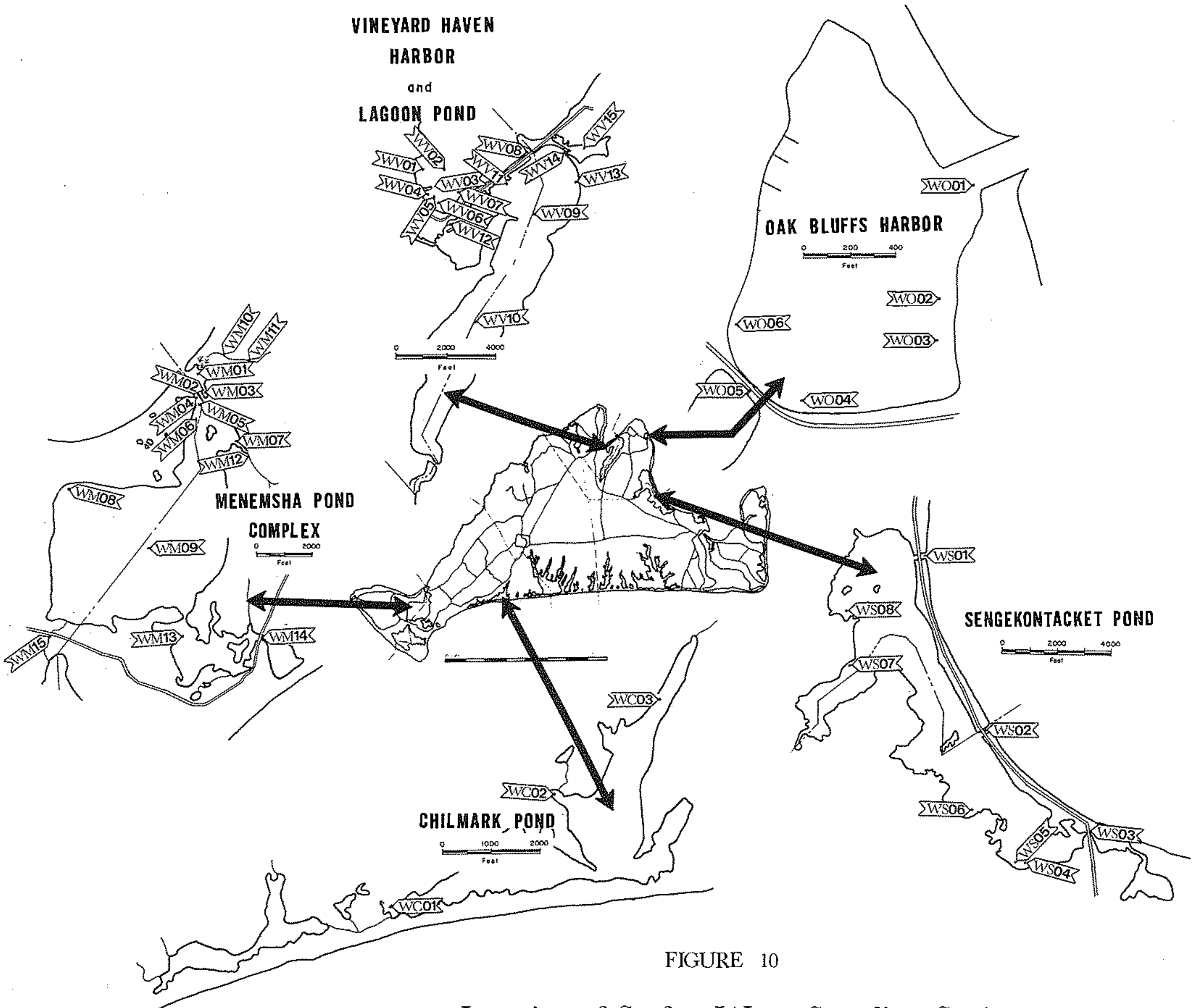


FIGURE 10

Location of Surface-Water Sampling Stations

TABLE 10
WATER QUALITY STANDARDS

Parameters	For "SA" Surface Waters	For Drinking Water
Total Coliform.	[1]Median MPN no greater. . . 70/100 ml and no more than 10% of the cases exceed 230	1/100 ml[2]
Fecal Coliform.	[1]Median MPN no greater. . . than 14/100 ml; no more than 10% of cases exceed 43/100 ml	1/100 ml[2]
pH (acidity).	6.8-8.5.	--
Do (Dissolved oxygen).	No less than 6.0 ppm.	--
Ammonia (NH_4).	.5ppm (for fresh water)[3]. .	.5 ppm[4]
Arsenic (As).	1.0 ppm[3].	.05 ppm[4]
Barium (Ba).	5.0 ppm (fresh)[3]	1.0 ppm[2]
Boron (B).	--	1.0 ppm[5]
Cadimium (Cd).	.01 ppm (fresh)[3].	.01 ppm[2]
Chromium (Cr)	.05 ppm (fresh & salt)[3]. .	.05 ppm[2]
Copper (Cu).	.02 ppm (fresh & salt)[3]. .	1.0 ppm[5]
Cyanide (Cn).	--	.01 ppm[6]
Detergents (MBAS). . .	2 ppm (fresh & salt)[3]. . .	.5 ppm[6]
Fluoride (F)	1.5 ppm (fresh & salt)[3]. .	1.8 ppm[2]
Iron (Fe).	--	.3 ppm[6]
Lead (Pb).	.1 ppm (fresh & salt)[3]. .	.05 ppm[2]
Manganese (Mn). . . .	-- . . .	.1 ppm[5]
Mercury (Hg).	.01 ppm (fresh & salt)[3]. .	.002 ppm[6]
Nitrate nitrogen (NO_3)	90 ppm	10.0 ppm[2]
Phenols	1.0 ppm (fresh)[3]	.001 ppm[6]
Selenium (Se)	--	.01 ppm[2]

Table 10 cont. WATER QUALITY STANDARDS

Silver (Ag)	.01 ppm (fresh & salt) . .	.05 ppm[2]
Sodium (Na)	--	20 ppm[5]
Sulfate (SO_4)	--	250 ppm[5]
Sulfide	.5 ppm (fresh & salt)[3] . .	--
Suspended Solids (SS)	--	--
Total Dissolved Solids(TDS)	--	500 ppm[5]
Turbidity	--	1 Turbidity unit[2] as monthly average
Uranyl (UO_2).	--	5.0 ppm[5]
Zinc (Zn)	.1 ppm (fresh)[3]	5.0 ppm[5]
ORGANIC CHEMICALS		
Endrin.		.0002 ppm[2]
Lindane		.004 ppm[2]
Methoxychlor.		.1 ppm[2]
Toxaphene		.005 ppm[2]
2,4-D		.1 ppm[2]
2,4-5-TP (silvex)		.01 ppm[2]
RADIOACTIVITY		
Gross Alpha		15 pc/1*

* pico-curies/liter

1. New England Interstate Water Pollution Control
2. Environmental Protection Agency
3. California State Water Quality Control Board (1963)
4. World Health Organization
5. Salvato Environmental Engineering Manual (1972)
6. U.S. Public Health Service

ents will increase the rate of eutrophication or pond aging, is an accepted fact. Neither the ammonia, nitrate nor phosphate levels recorded in our surveys of tidally flushed coastal ponds are believed to offer significant indications of pollution. Ammonia levels show a seasonal fluctuation which relates to plant decomposition and the leaching of organic nutrients from the sediments. Nitrate levels were mostly below the limit of detection. Local release of pollutants from failing cesspools can only be detected by a more detailed sampling program (greater frequency and number of stations). In lieu of this program, it is suggested that the steps recommended in the on-lot wastewater disposal section be followed to protect our surface waters.

In the Harbors, boating impacts on water quality have been documented. Bacterial impacts have, at times, been severe. Nutrient impacts have not as yet reached a level of concern. At Churches Pier for example, the samples taken reveal the interactions of several cycles in, as yet, unknown proportions. These cycles are 1) the natural growth/decay cycle of vegetation, 2) the boating peak discharge period, 3) the on-shore development peak use period. These results (in Table 11) are explained in the following fashion: during August, boating contaminants are introduced directly into the harbor waters and show up as an ammonia peak. At the same time, a slug of contaminants in the high density part of town is introduced to the groundwater. These contaminants reach the Harbor in the fall and add to the ammonia peak seen in December. Natural vegetation and phytoplankton in bloom during the spring and summer, absorb nutrients for growth creating an ammonia low in July. Starting in August and continuing through till December, the release of ammonia to the waters from plants creates an ammonia peak. This ammonia cycle is common to all our surface waters and the levels of ammonia detected are not seen as indicating an existing problem.

Table 11 Sampling Results

Churches Pier Sampling*

Date	Ammonia-nitrogen Concentration in ppm
4/ 5/76	.12
7/26/76	.08
8/17/76	.16
12/13/76	.21

Table 11 cont.

Vineyard Haven Harbor Sampling

Date	01	03	05	06
8/13/75	-	.06	.05	.04
11/18/75	.18	.16	.25	.20
4/ 5/76	.06	.08	.08	.08
8/16/76	.05	.06	.08	.08
12/13/76	.15	.18	-	.36

Sengekontacket Pond Sampling

Date	05	08
8/14/75	.08	.05
11/18/75	.23	.26
4/ 5/76	.20	.12
7/26/76	.11	.05
8/16/76	.05	.07

*Note: These ammonia peaks may result from natural release of nutrients. The relative portions resulting from natural and human inputs have not been completely defined.

Very little is now known as to the increase in rate of pond or harbor eutrophication and filling-in which can be stimulated by the introduction of nutrients. For this reason, setbacks and vegetative buffers are important to minimize adverse impacts of on-shore development of our surface waters.

Bacterial contamination of surface waters results from several potential sources: on-shore development, boating discharges, storm water runoff or even warm blooded animals such as ducks and geese. Up to the present time, bacterial contamination has occasionally been severe. The bacteria are used as indicators of a potentially more harmful organism, the virus. Sampling of Island shellfish producing waters by the Department of Environmental Quality Engineering is available several times a year. A greater frequency of testing would add considerable information and greater protection to the public health.

The most severe and consistent instances of bacterial pollution occur in the Harbor areas. Vessels of all types, commercial and recreational, passing through the waters of Vineyard Sound and in and out of the Harbors are contributors of wastes to our waters. The boating wastes are in some cases untreated or inadequately treated. Major anchorages and estimates of boats are included in Table 43. It is difficult to say how much of the pollution observed in these harbors relates to boating wastes and how much relates to increased activity on shore.

Sewage effluent from surrounding homes increases algal blooms in Crystal Lake each summer.

In Edgartown Harbor, prior to the installation of a sewer system, there was evidence of a great deal of bacterial pollution during the summer months. During this time of year, not only were there at least 100 overnight vessels, but the hotels and restaurants located right on the shoreline were also full. Studies have determined that bacterial contamination is not likely from properly sited sewage disposal systems unless there is direct access via a pipe or tunnel in the soil. After the sewering was completed, samples taken in this Harbor revealed the following bacterial counts.

Table 12

EDGARTOWN HARBOR BACTERIAL ANALYSIS

Commercial Dock		Yacht Club		Ferry		Lighthouse	
Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal
1300	1300	1300	790	170	110	79	49
330	79	110	4	240	130	330	170
79	33	46	7.8	49	33	22	4.5
490	230	110	13	17	13	4.5	4.8
490	79	93	6.8	230	130	79	14

Samples taken more recently in late August (Aug. 31, 1976) revealed no major indication of contamination. Samples taken in Oak Bluffs Harbor have shown periodic, extremely high bacterial counts which are tabulated below.

Table 13

OAK BLUFFS HARBOR BACTERIAL ANALYSIS

	8/27/76	8/29/74	8/30/74	4/76	8/17/76	8/31/76
Mobil Wharf	*490/330	790/790	3500/3500	-	-	93/43
Wesley House	-	540/70	5400/3500	3.6/ 3.6	10/10	240/15
Our Market	34/34	350/46	350/79	3.6/3.6	60/15	-

*Total Bacteria/100 ml/Fecal Bacteria/100 ml.

While these figures are not conclusive (contributions from cesspools may be an important factor in Oak Bluffs), the samples in Edgartown do point to some source other than on-shore pollution.

Samples taken on a more regular basin in Menemsha Basin by the Wampanoag Fishery Project have also revealed very high fecal coliform counts. These are tabulated below.

Table 14

REPRESENTATIVE FECAL COLIFORM MONITORING--MENEMSHA BASIN
(Wampanoag Fisheries Project)

Date/Station		Sept. 1	Sept. 7	Sept. 13	Sept. 20	Sept. 27
Vineyard Sound						
Bell Buoys	S	1	1	1	0	0
	B	-	-	-	-	-
Menemsha Basin						
Entrance	S	31	22	4	5	27
	B	18	12	5	1	0
North Dock	S	160	41	1	9	TNTC
	B	58	46	5	-	40
Poole's Dock	S	173	90	40	70	40
	B	33	102	40	19	30
Texaco Dock	S	24	45	3	0	14
	B	13	55	6	14	15
Dutcher's Cr.		58	72	40,20	26,134	36,65,38
Hancock Dock		77	2	6	26	21
Coast Guard		180	4	2	5	-
West Dock	S	9	18	11	0	20
	B	21	17	22	7	8

Waste discharged from boats is generally clumped materials with particles of considerable mass and mixed liquids. This material requires time for decomposition of organic material and the destruction of the micro-organisms included within. Numerous studies have shown that sewage micro-organisms have a shorter lifetime in salt than in fresh water. The exact die-off period is also related to temperature, increasing slightly with decreasing temperature. However, no exact information is available on the expected lifetime.

Several studies conducted in Long Island have concluded that the quality of wastes discharged at any one time into a specific anchorage area was not sufficient to exert a significant oxygen demand on the water. Substantial increase in bacterial concentrations were however observed. (U.S. EPA People & the Sound, 1975). Boating wastes can pose a hazard to the health and well-being of persons utilizing the same water for bathing and shellfishing if improperly treated. Suggestions for improving our control over boating waste impacts are included in Chapter 11.

5.2 Groundwater

To assess the impact of mans' activities on our groundwater resources sampling stations from private wells were located in various parts of the Island. The stations were sited in areas of various densities of disposal systems, depth to groundwater and soil types. These stations were located to determine the relationships between housing density, soil types and groundwater quality. Figure 11 locates the sampling stations. Table 10 identifies the water quality

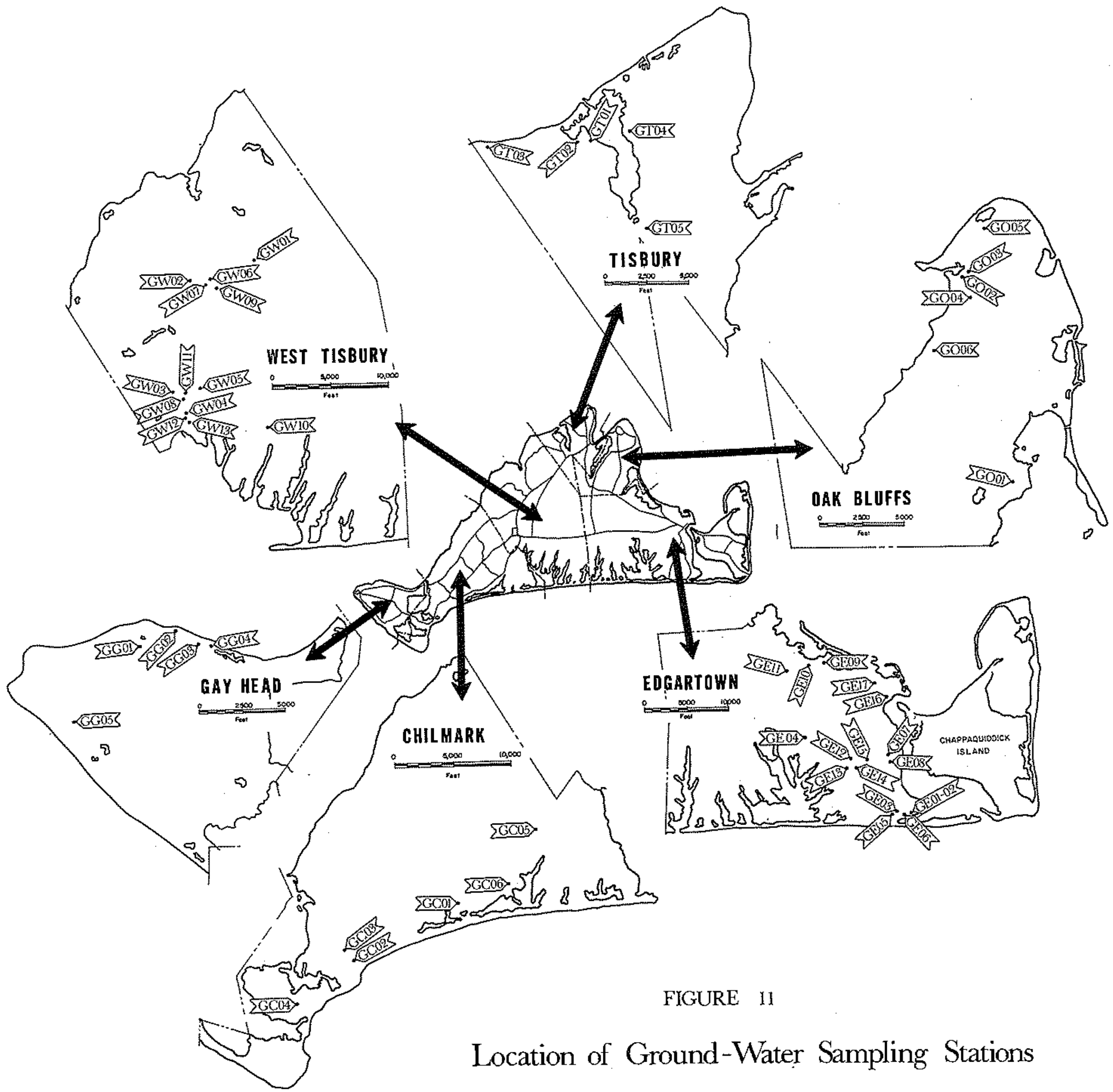


FIGURE 11

Location of Ground-Water Sampling Stations standards used to make comparisons.

In reviewing the data as far as nitrate levels go, the following quote from Salvato (1972) should be kept in mind: "Allowing for these important controlling factors, the following ranges in concentration may be used as a guide: Low - less than .1 ppm; Moderate - .1 to 1.0 ppm; High - greater than 1.0 ppm."

The sampling program has demonstrated the link between potential degradation of groundwater supplies and coarse soils, shallow water tables and/or high densities. We can clearly point to the outwash plain in Edgartown and indicate some deterioration of the ground water at Mattakesett Point where overall densities are reasonably low--about 1.4 acres/dwelling. Here, the overriding factor is apparently the coarse soils and shallow water table.

Nitrate problems evident in the Katama Plains, Mattakesett, Ocean Heights and Lagoon Heights are not evident in Chilmark or other areas with more clayey soils. In the interior of the Katama Plains, the implications of water quality problems are also clear, the ½ acre zoning in that area will not allow on-lot wastewater disposal and water supply on an individual basis.

Housing density affects groundwater supply. For example 1/8 to 1/4 acre will produce gross groundwater contamination in the outwash plains from nitrate and ammonia as is indicated by analyses of groundwater in downtown Edgartown, Oak Bluffs, and Tisbury. One-half acre might produce nitrate levels often exceeding drinking water standards and for lots up to 1½ acres nitrate contamination is possible due to the very sandy soils and water table levels at less than 20 to 30 feet. Table a4 includes data derived from the wells discussed below.

Well # GE05 is situated on Mattakesett Point in the sandy, coarse soils of the outwash plain. The water table is situated at approximately 5 to 10 feet. The well services a large number of seasonal dwelling units. Nitrate levels in the well fluctuate from a low of 2.5 parts per million in the summer to a high of 7.1 parts per million in late winter to early spring. These nitrate levels indicate contamination of the well by on-lot waste disposal effluent. Ammonia levels are only slightly elevated because most of the nitrogen present has been oxidized to nitrate. Chlorides are typical of coastal wells but increase in the peak use summer period. The lag between the appearance of nitrogen-nitrate and the peak summer use period is due to:

1) time lag for nutrients to travel from the source to the well; or

2) reduced pumping of "clean" water during the winter season; or

3) less recharge of clean rainwater during the winter which causes an increase in concentration of nitrate.

The ammonia cycle is the reverse of the nitrate cycle; it reaches a peak of 0.2 ppm in the summer peak use period. The well here is 25 feet deep and the nearest leaching area is 150 feet away, clearly meeting minimum Title 5 requirements.

All other wells sampled in this area showed elevated nitrate and in some cases ammonia levels. The total density of dwelling units on Mattakesett Point is 75 (each condominium counted as 3 units) on 107 acres (density of 1.4 acres/dwelling). In order for the soils to handle the waste generated by residences in these soils and high water table levels, larger lots are required.

Wells #GE07, 08, 12, 13, 14 and 15 are sited in interior Katama. Soils are coarse and sandy. The water table is 15 to 20 feet below grade. Well 08 was sampled most frequently. Nitrate-nitrogen levels in the late winter and spring months were found to exceed normal background levels and in one sample Public Health Service drinking water standards. The well depth at this location is estimated at 25 feet and the distance between well and leaching field is 100 feet. Well 07 situated to the north showed lower nitrate levels. This well was deeper than the 08 well.

Directly to the west, off Herring Creek Road, a cluster of 4 wells was analyzed--12 through 15. In this cluster, well 12 revealed a similar cycle of increased nitrate levels in late winter-spring falling off to more acceptable levels in the summer. Chloride levels follow the fluctuating nitrate pattern.

Well #14 indicates an existing near-surface contaminated zone in the water table. A sample analyzed by spectrophotometer revealed a nitrate level of 16 ppm on April 13, 1976 and 18ppm on April 29. This was from a shallow well of 25 feet. The well was driven to a depth of 55 feet and on May 11 a second analysis revealed 1ppm of nitrate at that depth. While the nitrate level was safe at 55 feet, there still was evidence of nitrate contamination.

GE16 was a sample analyzed from a well (approximately 15 to 20 feet deep) used for lawn watering in downtown Edgartown. This area has been served by a sanitary sewer system since 1973. There is still evidence of extreme ammonia and nitrate contamination. This may be the result of areas to the west which are not yet served but with moderately high housing density (1/8 to 1/4 acre density). It may also result from continued leaching of old, on-lot wastewater disposal units in the area.

Well GE17 located on Pine Street, is approximately 20 feet in depth with the waste disposal system 75 to 90 feet away. Extreme nitrate and ammonia levels were found. This was probably due to the proximity of the well to the waste disposal and the high water table.

Water table levels in this area are quite near surface (5 to 10 feet). For any future development in this area percolation tests must be carefully performed to assure proper sizing of the system. Leaching field systems only should be allowed. Zoning permits density in the area of 5,000 square feet. However, actual density is approximately 20,000 square feet.

In the Ocean Heights area, wells 09, 10 and 11 were sampled. Well 09 is located in the cluster development of 10-20,000 square foot lots. Considerable fluctuation in Methylene Blue Active Substances (MBAS)*, total solids and specific conductance* were observed in the two samplings made. The nitrate-nitrogen level in the second sampling exceeded Public Health Service Standards. The well depth is estimated at 20 to 25 feet and the leachfield-well separation is 100 to 125 feet.

Well GE10 is located at an elevation of approximately 30 feet and the well depth is expected at 35 to 40 feet. The density of dwellings in the immediate vicinity is approximately 1 acre. Nitrate levels above background were found but no severe problem is indicated. GE11 is situated above 50 foot elevation. The well depth is estimated at 50 to 55 feet. At this location there is little chance for contamination from up-gradient because there are so few dwellings so located. Nitrate-nitrogen levels are significantly lower in this section.

Wells sampled in Gay Head were mainly confined to the seasonal dwellings located along Lobsterville Beach. Old sand dunes covered with scrub vegetation are the only soil available to treat wastewater from on-lot disposal systems. All wells in this area are fairly shallow, mostly less than 25 feet. Densities are fairly low. Wells GG02, 03 and 04 all revealed indications of ammonia-nitrogen contamination, increasing toward the end of the summer season and into the fall. Total phosphorus levels were also greater than normal background levels. Iron levels also tend to be very high in these dwellings ranging up to 16ppm in well GG02. This is natural iron either released from nearby bogs or leached from accumulations in siderite nodules. Well GG01 situated at an elevation of 70 to 80 feet revealed high phosphorus content. This may result from contamination from the waste water disposal system or from the siting of the well in a phosphatic deposit (such as greensand common to the Gay

Head area). Careful planning and sizing of lots in the Lobsterville dune area is required in the future to limit contamination problems. Well-septic separation of 200 to 250 feet is recommended.

Wells sampled in Oak Bluffs along the northern Lagoon Pond shore also revealed nitrate contamination. The soils in this area are medium to coarse sands with silt. Well depths are generally less than 25 feet in the area of G002, 003 and 004. Nitrate levels in G004 illustrate the same pattern as revealed in other wells--reaching a peak in late winter--early spring and declining in the summer and fall. Two other wells, 002 and 003, located along Brush Pond shore also indicate nitrate contamination, well 003 illustrating the same pattern as 004. A pit dug in front of G003 revealed surface water table levels of 2.6 ppm nitrate and .02 ppm ammonia, well above background levels.

A growth of Ulva Lactuca (sea lettuce, light green) was observed at the new Oak Bluffs bathing beach near the Sea View. This algae commonly indicates nitrogen pollution. A pit dug into the water table at the beach revealed extensive pollution:

ammonia-nitrogen	0.21 ppm
nitrate-nitrogen	6.0 ppm
total phosphorus	0.03 ppm

This level of contamination indicates the impact of high density, seasonal dwellings on the ground water near the bathing beach. Groundwater samples taken in Tisbury along Lake Tashmoo revealed no significant level of contaminants.

In West Tisbury, two wells sampled on Music Street revealed no major problems (GW03 and GW08). In well GW03, the MBAS were high on November 17, 1976 but were zero on April 6, 1976. GW03 indicated a nitrate content of 1.8 ppm. The overall density in this area is less than 1 dwelling unit/acre. Repeated samplings of GW04 near the center of town revealed no significant contamination. An analysis at the laundromat (GW11) indicated total phosphorus levels higher than background. Further analyses on a more regular basis are recommended to determine the extent of the pollution plume, if one exists, of the laundromat as sudsing problems in some wells in the area have been reported.

In Chilmark, well GC01, located on the coarse sands of the outwash plain indicates nitrate levels in excess of expected background levels. Ammonia levels reached a peak in July and August in this well but both parameters declined to zero in December.

It is possible that the valley channels contaminants from on-lot disposal from development on Abel's Hill toward GC01. Further well sampling in the area is recommended.

The Community Center (GC02), also indicated increasing nitrate levels in July and August. This building receives peak use in the summer months increasing wastewater flows substantially. Chloride, total alkalinity, iron and specific conductance levels suggest a trend opposite to the nitrate curve peaking in late fall and declining into the summer months. No theory is available to account for this phenomenon.

The analyses at the Chilmark School indicate no nitrate beyond background.

Experimental ground water monitoring wells were installed in the vicinity of the Edgartown landfill and the Treatment Plant. These wells were installed to a depth of 5 feet into the water table to allow sampling of the most contaminated portion of the water table. Difficulty has occurred in clearing the mud from these wells due to their limited ability to be pumped. The results from the wells are included in Table a5.

Little conclusive interpretation of the results from the landfill wells can be drawn until better sampling techniques become available. The extreme variations of total solids observed in the analyses probably result from variations in water level in the well. Nutrient levels in these wells are expected to be representative of the ground water. Iron, zinc and manganese levels are influenced by casing materials and are <u>not</u> considered valid.

At the treatment plant well, the mud problem is far less severe. Nitrate levels have been found to vary considerably thus far from 29 parts per million to 5.5 ppm. The nitrate is a byproduct resulting from the oxidation of ammonia released in the effluent of the plant. The Sewer Commissioners have expressed interest in installing additional wells further away from the plant to reveal the magnitude of the problem. The following nitrate levels have been recorded.

Table 15 Edgartown Treatment Plant - Experimental Well Results

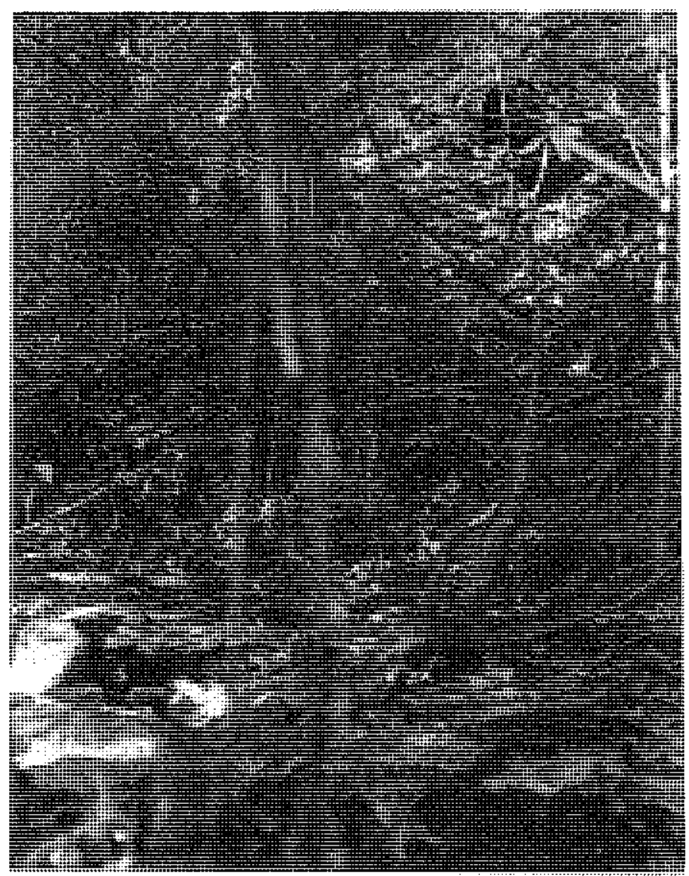
Date	Nitrate	Phosphate	Ammonia
8/10/76 (Hach Kit)	11.2	.18	2+
8/11/76 (State Analysis)	29.0	.11	.5
11/15/76 (Hach Kit)	10.8	.14	1.3
6/1/77 (Coffin & Richardson)	5.5	-	.16

5.3 Storm Water Runoff

Rainfall flushing our paved streets can be a significant cause of pollution during short periods of time. On the whole, however, this source of pollution is not of the magnitude of boating wastes or on-shore development. The major contaminants introduced are bacteria, nutrients, and suspended solids (organic and inorganic).

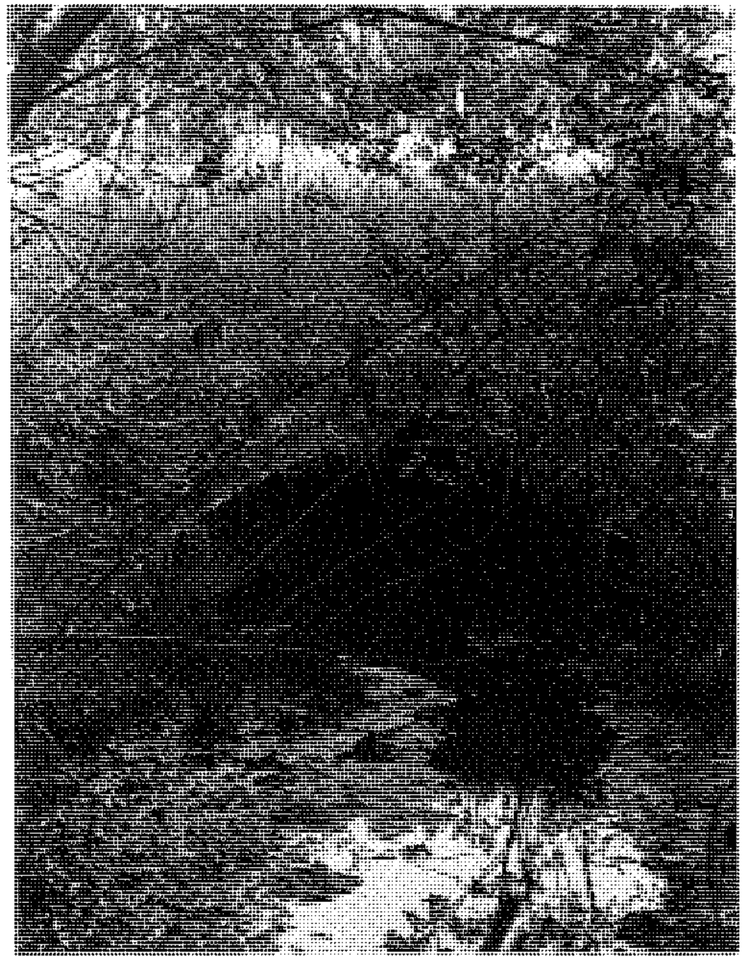
Samples taken from the Oak Bluffs Harbor storm drains indicated concentrated suspended sediments and nutrients measured as phosphate and nitrate. Samples were not taken directly from the drains but from the Harbor water where the storm water surged in. These samples were analyzed for turbidity (Formazin Turbidity Units over 100 units) and nitrate (5-10 parts per million). Additional testing is recommended to more closely estimate the quantity of fine materials introduced to our harbors by storm water runoff. Storm drain outlets are indicated on Figures 25, 26 and 27.

In addition to the harbors, storm drains flowing directly into surface waters with no settling basins were identified at Lily Pond, Lake Tashmoo and Lagoon Pond.



Storm-drain (arrow) resulting in filling of a wetland near Lake Tashmoo.

Storm-drain releasing road sediments directly into Lily Pond.



5.4 Inland Ponds and Streams

Seths Pond--sampled once during the peak summer use period and once in the winter. The sampling site was on the north shore 50 yards from the road. Contamination from on-lot disposal systems is evidenced. Ammonia, nitrate and detergents (MBAS) were higher than normal for a fresh water pond. Dye testing of disposal systems in the area followed by rehabilitation is recommended. No evidence of bacterial contamination from swimmers was found.

Mill Brook, Chilmark--the upper reaches of this stream indicated a high ammonia content (0.80 ppm). MBAS and phosphorus were both high at station 104. Further sampling and dye testing to determine the source is recommended.

Paint Mill Brook--Station 108 revealed a high ammonia level (0.5 ppm on December 14, 1976). Further field checking in the area is recommended.

Smith Brook--very high total (380 and 400 counts/100 ml) and fecal (100 counts/100ml) indicate possible contamination of this stream. Dye testing is recommended at the Cranberry Acres campsite immediately upstream from this station.

Dodger Hole: a typical ground-water pond.

5.5 Other Sampling Programs

The U.S. Geologic Survey has recently initiated a study of the Islands water resources. As part of this study, several well sites will be analyzed for standard parameters (nutrients, hardness & pH) metals (lead, iron, zinc, chromium, copper, mercury and arsenic) and for insecticides and herbicides. These results are not as yet available.

Under the Environmental Impact Statement now in progress, a number of wells were installed in Tisbury and Oak Bluffs to determine ground water quality. These wells were sampled twice each month and analyzed for nutrients and bacteria. At this time, the data are still being interpreted but no major signs of contamination were detected. This may result from the fact that each well was driven into the water table some 10-15 feet and may therefore not detect the more significant pollution near the top of the water table.

5.6 Summary

In general, we have documented the high quality of our ground and surface waters. In certain situations, however, our ground and surface waters have been adversely impacted by our uses of them. These instances include marinas such as Oak Bluffs and Menemsha Harbors, where boat wastes lead to bacterial contamination. Areas where fuel oil or gasoline is stored near the shoreline have produced some evidence of hydrocarbon pollution. Where high density housing (½ acre or less), porous soils or shallow water tables occur, our ground waters have been adversely affected to the point where, in some areas, nitrate levels exceed recommended Public Health Service Standards. In the vicinity of our landfills and treatment plants some degradation of the ground water quality has also been documented.

There is a definite need to continue to accumulate data in problem situations identified by this survey. Greater detail in terms of frequency of sampling and concentration of sampling stations is needed to improve the reliability of the data. As data are accumulated, better understanding of the nature of our water quality problems and their significance, as well as their implications for planning, can follow. This sampling program should not be viewed as an end but rather as the initiation of a continuing data collection effort.

5.7 Recommended Future Monitoring Program

There are several areas where continued monitoring of ground and surface waters is highly recommended. These areas can be briefly outlined as follows:

1. Continue monitoring private wells which have indicated problems; make recommendations on extension of public water, new well, etc...

2. Initiate monitoring of wells in vicinity of others which showed signs of pollution to assess the magnitude of the problem.

3. Continue monitoring program established by Anderson-Nichols Company in numerous ground water wells in town centers of Tisbury and Oak Bluffs to more accurately estimate the fluctuations of nutrient levels through the summer season.

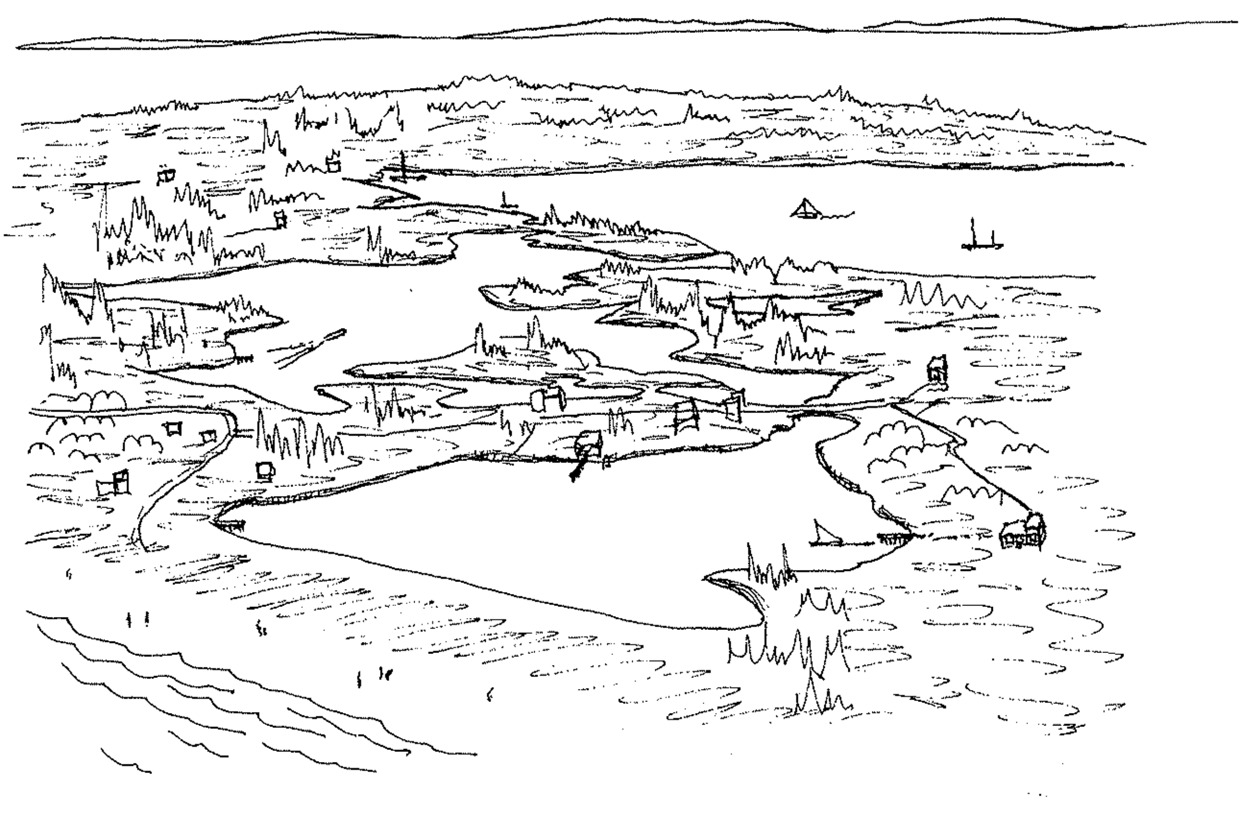
4. Continue monitoring wells at Edgartown Landfill and treatment plant; additional information is found in Chapters 7 and 14.

5. Conduct more detailed field checking in vicinity of demonstrated surface water contamination, consisting of:
   a. further sampling in a spatial array so as to detect the source
   b. assist boards of health in conducting dye tests of potential sources.

6. Install ground water infiltration collectors in Sengekontacket and other shallow bottomed coastal ponds. These collectors will consist of 4" to 6" diameter pipe driven into the bottom sediments. Water remaining in the pipe is bailed down. After a period of time analyses are conducted on water which has infiltrated to assess its quality. Simultaneously, samples will be taken from surrounding surface waters to demonstrate the dilution of the infiltrating pollutants. Potentially a series of these collectors could be installed extending away from the shoreline. The waters in those collectors installed furthest from shore should represent the contribution of wastewater sources furthest inland. The purpose of this project is to assess the quantity (estimated from the rate of infiltration) and quality of wastewaters contributed to a coastal pond with onshore development.

6

Protection of Water-Related Lands



6.0 Protection of Water-Related Lands

A major goal of the Water quality Planning Program is to examine the potentials for guiding growth and development in a manner designed to minimize detrimental water quality impacts.

Growth patterns affect water quality in several ways. Rapid high density residential growth can lead to failing septic systems and deteriorating ground and surface waters. Dispersed growth areas can lead to tremendous expense to supply sewer or water services and, if unserviced, can lead to contaminated water resources. In addition, wastewater treatment facilities and interceptors themselves can induce growth.

Many land uses can result in water quality problems. There are direct land use impacts on water quality, such as the leachate from a landfill or storm water runoff; there are impacts such as industrial growth which result in water quality problems; and there are indirect impacts such as the case where increased residential growth results in increased water demand. This in turn can result in excessive water withdrawal from ground water supplies causing salt water intrusion.

In the interest of maintaining some desirable growth which is projected in Chapter 4 while not degrading or destroying the spur to our economy which is the environment, we must take steps to minimize the impacts where possible and make carefully thoughtout trade-offs where necessary. A strategy so designed must consider how and where we should grow.

In meeting these decisions, the land use/water quality issues outlined below will play a major role in deciding the impact of the growth and the need for services.

6.1 Land Use/Water Quality Issues

6.11 Location of Land Use

In planning future land use alternatives and in deciding on the best strategy to reach the objective of maintaining high quality water resources, the benefits and detriments of convenience of location must be weighed against the limitations of the environment. The key limits on land use are soils, depth to ground water, topography and proximity to surface waters.

For example, if moderate to high density development is allowed in areas with coarse sandy soil and ground water near the land surface, it is highly likely that the introduction of nitrates and/or bacteria from on-lot disposal systems would rapidly preclude the use of the ground water as a source of supply. The Mattakessett area as well as the Lagoon Heights area are posing problems at this time for this reason. In both areas, coarse sandy soils combine with shallow water tables and moderate densities of disposal systems to create problems. Both areas should be carefully monitored in the future to assure that nitrate contamination will not become a health hazard.

6.12 Type of Land Use--Density of Development

In addition to limiting the location of land uses based on critical areas in which development is not compatible with maintaining our water resources, considerable attention must be given to the siting of particular types of land use. In the interest of cost effectiveness in terms of delivering water and sewer services, it is important that the most intense land uses which need these services be so situated that a minimum of piping and pump stations are required. The location of intense land uses must allow convenient hook up to required services when and if the need arises.

For example, should a dense pattern of housing be allowed in an area which is beyond the reach of both sewering and water these dwellings are forced to supply on-lot services. If the soils allow rapid infiltration of septic effluent, a situation may arise where the water becomes contaminated to the point where all of the owners are required to go deeper for water. Furthermore, if this particular development is situated near the shoreline, the additional depth of fresh water may not be available due to the presence of underlying salt water. Contaminated ground water will slowly move toward surface waters and pollute them also. This kind of situation can and will result if more thought is not given to the type and location of land uses. The ground water sampling program is indicating beginning problems in Mattakesett in Edgartown,Lagoon Heights in Oak Bluffs, and Lobsterville in Gay Head. Future problem areas could develop in Ocean Heights, Lagoon Pond Shores, Town Cove area in West Tisbury and Chilmark Pond shore areas.

6.13 Timing of Development

Of similar importance is the pace of development which occurs. Should the rate of building of residences be allowed to outstrip the capabilities of the towns to supply services, various problems along the lines mentioned above can result. This kind of problem could arise from insufficient monies being available to expand the service area of a water company or from the inability of the aquifer to supply the required demand. In either case, the outcome can be serious. The owner is forced to supply his own water, contaminated or not, or the well may be pumped at a rate beyond its safe yield which can result in salt intrusion contaminating the supply as a whole. While these problems are not of immediate concern, they must be incorporated into long term planning. In the case where the extension of a sewer line can be expected to lead to a new level of demand for other municipal services, the expansion of the treatment system should be phased with the expansion of other municipal service capabilities. Areas should only be hooked in where the town can supply the full range of services to that area. These services include: fire and police protection, solid waste disposal, public recreational facilities, traffic control, parking, jobs, municipal budget, energy supplies, and road maintenance.

6.2 Administration of Land Use

At this time, Martha's Vineyard has a "loose" management framework for dealing with water quality/land use issues. Local zoning and Board of Health and subdivision regulations make up the backbone of this effort. On the regional level, the Martha's Vineyard Commission has two unique land use regulatory functions. This chapter will elaborate and describe this framework as well as several other alternatives to allow the towns and the Martha's Vineyard Commission to choose the most effective alternative.

Tables 16, a8 and 17 are a summary of the primary local land use determinants and controls operating on Martha's Vineyard. Several of the regulations, such as the wetlands regulation and Board of Health regulations, stem directly from State legislation, while others, such as the zoning by-law and ordinances and subdivision control regulations stem from State enabling legislation. The following discussion presents a brief summary of the local land use controls and their implementation.

6.2. Zoning

The principle of any zoning ordinance is to structure land use controls that respond to and encourage a pattern of development that reflects the sort of future a community feels is appropriate for itself. The present zoning on Martha's Vineyard is a traditional type of approach based on regulations

MARTHA'S VINEYARD TOWN ZONING BY-LAWS

TABLE 16

GENERAL PROVISIONS

SPATIAL REQUIREMENTS

TOWNS AND DISTRICTS	Minimum lot sizes (acres) ⅛	¼	½	⅝	1	1¼	1½	2	3	[illegible]	Set back minimum	Height maximum	Frontage minimum	Lot depth minimum	Corner clearance	Cover maximum	Septic setback
CHILMARK-ALL DISTRICTS										①		●					
AGRICULTURAL-RESIDENTIAL I									●								
" " II-A									●								
" " II-B									●								
" " III								●									
" " IV							●										
" " V								●									
" " VI									●								
EDGARTOWN-ALL DISTRICTS												●			●		
R-5 RESIDENTIAL	●									●	●		●	●			
R-20 RESIDENTIAL			●							●	●		●				
R-60 RESIDENTIAL							●			●	●		●				
R-120 RESIDENTIAL									●	●	●						
RA-120 RESIDENTIAL/AGRICULTURAL									●	●	●						
B-I BUSINESS																	
B-II BUSINESS											●						
GAY HEAD-ALL DISTRICTS										●	●	●				③	●
RURAL - RESIDENTIAL								●									
MARINE COMMERCIAL								●									
OAK BLUFFS-ALL DISTRICTS										②		●			●		
R-1 RESIDENTIAL		●									●	●	●			③	
R-2 RESIDENTIAL			●								●	●	●			③	
R-3 RESIDENTIAL							●				●	●	●			③	
BUSINESS											●						
TISBURY-ALL DISTRICTS												●					
RESIDENTIAL-10		●								●	●		●	●			
RESIDENTIAL-20			●							●	●		●	●			
RESIDENTIAL-25				●						●	●		●	●			
RESIDENTIAL-30						●				●	●		●	●			
BUSINESS-1																	
BUSINESS-2											●						
INDUSTRIAL											●						
WEST TISBURY-ALL DISTRICTS										①	●	●	●				
AGRICULTURAL-RESIDENTIAL							●										
BUSINESS					●												
INDUSTRIAL			●														

PERMITTED USES

TOWNS AND DISTRICTS	1 Family dwelling	2 Family dwelling	Specified institutional	Specified recreational	Agriculture & produce sales	Fishing & fish processing	Accessory uses	Specified commercial	Industrial
CHILMARK-ALL DISTRICTS	●		●	●	●	●	④		
AGRICULTURAL-RESIDENTIAL I									
" " II-A									
" " II-B									
" " III									
" " IV									
" " V									
" " VI									
EDGARTOWN-ALL DISTRICTS									
R-5 RESIDENTIAL	●	●	●	●	●		④		
R-20 RESIDENTIAL	●	●	●	●	●		④		
R-60 RESIDENTIAL	●		●	●	●		④		
R-120 RESIDENTIAL	●		●	●	●		④		
RA-120 RESIDENTIAL/AGRICULTURAL	●		●	●	●		④		
B-I BUSINESS									
B-II BUSINESS			●	●				●	
GAY HEAD-ALL DISTRICTS									
RURAL - RESIDENTIAL	●		●		●	●	④		
MARINE COMMERCIAL			●		●	●	④	●	
OAK BLUFFS-ALL DISTRICTS	●		●	●					
R-1 RESIDENTIAL									
R-2 RESIDENTIAL									
R-3 RESIDENTIAL									
BUSINESS								●	
TISBURY-ALL DISTRICTS									
RESIDENTIAL-10	●		●	●			④		
RESIDENTIAL-20	●		●	●			④		
RESIDENTIAL-25	●		●	●			④		
RESIDENTIAL-30	●		●	●			④		
BUSINESS-1	●		●	●			④	●	
BUSINESS-2	●		●	●			④	●	
INDUSTRIAL								●	●
WEST TISBURY-ALL DISTRICTS									
AGRICULTURAL-RESIDENTIAL									
BUSINESS									
INDUSTRIAL									

USES REQUIRING BOARD OF APPEALS SPECIAL PERMITS

TOWNS AND DISTRICTS	1 Family dwelling	2 Family dwelling	3 Family dwelling	Multi-family dwelling	Cluster development	Mobile home park	Specified institutional	Specified recreational	Agriculture & produce sales	Specified accessories	Specified commercial	Professional offices	Industrial	Mineral extraction	Temporary mobile structures	Specified conversions	All others not prohibited	All commercial	All industrial
CHILMARK-ALL DISTRICTS		④					●	●			●	④		●		●			
AGRICULTURAL-RESIDENTIAL I																			
" " II-A																			
" " II-B																			
" " III																			
" " IV																			
" " V																			
" " VI																			
EDGARTOWN-ALL DISTRICTS																			
R-5 RESIDENTIAL			④		●			●			●	④				●			
R-20 RESIDENTIAL		④			●			●		●	●	●		●		●			
R-60 RESIDENTIAL		④			●		●	●						●		●			
R-120 RESIDENTIAL					●		●	●						●					
RA-120 RESIDENTIAL/AGRICULTURAL					●		●	●						●					
B-I BUSINESS																			
B-II BUSINESS											●		●						
GAY HEAD-ALL DISTRICTS														●					
RURAL - RESIDENTIAL					●												④		●
MARINE COMMERCIAL																		●	
OAK BLUFFS-ALL DISTRICTS		●					●			●	●				●	●			
R-1 RESIDENTIAL																			
R-2 RESIDENTIAL																			
R-3 RESIDENTIAL																			
BUSINESS																			
TISBURY-ALL DISTRICTS											●				●				
RESIDENTIAL-10		④			●		●	●	●	●		●		●		●			
RESIDENTIAL-20		④			●		●	●	●	●		●		●		●			
RESIDENTIAL-25		④			●		●	●	●	●		●		●		●			
RESIDENTIAL-30		④			●		●	●	●	●		●		●		●			
BUSINESS-1								●											
BUSINESS-2								●											
INDUSTRIAL	●	●				●													
WEST TISBURY-ALL DISTRICTS		④			●			●			●			④		●			
AGRICULTURAL-RESIDENTIAL																			
BUSINESS																			
INDUSTRIAL																			

USES APPROVED BY SELECTMEN, PARKING, RESTRICTED USES, PROHIBITED USES

TOWNS AND DISTRICTS	Uses approved by selectmen: All	Uses approved by selectmen: Multi-family dwelling	Parking required with development	Restricted uses: Trailers & mobile homes	Restricted uses: Unregistered cars	Restricted uses: Signs	Restricted uses: Mineral extraction	Prohibited uses: All not specifically permitted	Prohibited uses: Hazards	Prohibited uses: Specified recreational	Prohibited uses: Specified commercial	Non-conforming use regulations
CHILMARK-ALL DISTRICTS								●				●
AGRICULTURAL-RESIDENTIAL I												
" " II-A												
" " II-B												
" " III												
" " IV												
" " V												
" " VI												
EDGARTOWN-ALL DISTRICTS				●	●	●		●				●
R-5 RESIDENTIAL			●									
R-20 RESIDENTIAL			●									
R-60 RESIDENTIAL			●									
R-120 RESIDENTIAL												
RA-120 RESIDENTIAL/AGRICULTURAL												
B-I BUSINESS	●		●									
B-II BUSINESS			●							●	●	
GAY HEAD-ALL DISTRICTS				●		●			●			●
RURAL - RESIDENTIAL			④									
MARINE COMMERCIAL												
OAK BLUFFS-ALL DISTRICTS				●	●	●		●				●
R-1 RESIDENTIAL		④	●									
R-2 RESIDENTIAL		④	●									
R-3 RESIDENTIAL		④	●									
BUSINESS												
TISBURY-ALL DISTRICTS				●		●		●				●
RESIDENTIAL-10			●		●		●					
RESIDENTIAL-20			●		●		●					
RESIDENTIAL-25			●		●		●					
RESIDENTIAL-30			●		●		●					
BUSINESS-1												
BUSINESS-2												
INDUSTRIAL												
WEST TISBURY-ALL DISTRICTS								●				●
AGRICULTURAL-RESIDENTIAL				●								
BUSINESS			●			●	●					
INDUSTRIAL												

ADMINISTRATION

TOWNS AND DISTRICTS	Building & land-use change permits: Required for all uses	Approval: Board of selectmen	Approval: Building inspector	Application requirements: Determined by Bd of Selectmen	Application requirements: Specified	Site plan review: For 10 or more parking spaces	Site plan review: By planning board	Violator penalty: $30 fine	Violator penalty: $20 fine	Board of appeals establishment: Appointment by board of selectmen	Board of appeals establishment: Appointment as provided by state law	Special permit procedures: Application requirements determined by Bd of Appeals	Special permit procedures: Specified	Evaluation criteria	Public hearing
CHILMARK-ALL DISTRICTS	⑤	●		●				●		●					
AGRICULTURAL-RESIDENTIAL I															
" " II-A															
" " II-B															
" " III															
" " IV															
" " V															
" " VI															
EDGARTOWN-ALL DISTRICTS	⑤	●		●				●			●				
R-5 RESIDENTIAL															
R-20 RESIDENTIAL															
R-60 RESIDENTIAL															
R-120 RESIDENTIAL															
RA-120 RESIDENTIAL/AGRICULTURAL															
B-I BUSINESS															
B-II BUSINESS															
GAY HEAD-ALL DISTRICTS	⑤	●						●		●				●	
RURAL - RESIDENTIAL															
MARINE COMMERCIAL															
OAK BLUFFS-ALL DISTRICTS	⑤		●		●				●	●				●	●
R-1 RESIDENTIAL															
R-2 RESIDENTIAL															
R-3 RESIDENTIAL															
BUSINESS															
TISBURY-ALL DISTRICTS	⑤	●		●				●		●		●		●	
RESIDENTIAL-10															
RESIDENTIAL-20															
RESIDENTIAL-25															
RESIDENTIAL-30															
BUSINESS-1															
BUSINESS-2															
INDUSTRIAL															
WEST TISBURY-ALL DISTRICTS	⑤	●		●				●		●		●	●		●
AGRICULTURAL-RESIDENTIAL															
BUSINESS															
INDUSTRIAL															

SPECIAL PROVISIONS

TOWNS AND DISTRICTS	Cluster development option	Open space community option	Large development review requirements	Conservation requirements	Wetlands requirements	Coastal regulations	Subdivision development rate regulations
CHILMARK-ALL DISTRICTS							
AGRICULTURAL-RESIDENTIAL I							
" " II-A							
" " II-B							
" " III							
" " IV							
" " V							
" " VI							
EDGARTOWN-ALL DISTRICTS					●		
R-5 RESIDENTIAL	●						
R-20 RESIDENTIAL	●						
R-60 RESIDENTIAL	●						
R-120 RESIDENTIAL	●						
RA-120 RESIDENTIAL/AGRICULTURAL	●						
B-I BUSINESS							
B-II BUSINESS							
GAY HEAD-ALL DISTRICTS			●	●			
RURAL - RESIDENTIAL	●						
MARINE COMMERCIAL							
OAK BLUFFS-ALL DISTRICTS		●					
R-1 RESIDENTIAL						●	
R-2 RESIDENTIAL						●	
R-3 RESIDENTIAL						●	
BUSINESS							
TISBURY-ALL DISTRICTS							●
RESIDENTIAL-10	●						
RESIDENTIAL-20	●						
RESIDENTIAL-25	●						
RESIDENTIAL-30	●						
BUSINESS-1							
BUSINESS-2							
INDUSTRIAL							
WEST TISBURY-ALL DISTRICTS	●						
AGRICULTURAL-RESIDENTIAL							
BUSINESS							
INDUSTRIAL							

① [illegible] OR BY SPECIAL PERMIT
② SUBDIVISION PLANS
③ IMPERVIOUS LOT COVERAGE LIMITED FROM PROPERTY LINES
④ LIMITS ON TYPES OF USES
⑤ ZONING BY-LAW IMPOSES BUILDING PERMIT

TABLE 17

BOARD of HEALTH REGULATIONS

PROVISIONS / TOWN	Surface Water Supplies	Surface Water Courses	Water Table	Mean High Water	Obs. Test Hole	Wells	Property Line	Dwelling	Edge of Fill 1:10	33% Slope	Subsurface Analysis	Capacity	Abutting Septic System	Abutting Wells	Perc. Test Required	Cesspools Allowed	Privy Allowed	Communal System Allowed	Min. Leaching Area	Well Flow	Plan Required	Approvals: Perc Test Inspector	Approvals: Well by Zoning Inspector	Approvals: Entire System Before Cover	Approvals: Board of Health Permit
CHILMARK												(1000)													
Septic Tank		80	5'			150	30							150	●			NO			●	●		●	●
Leach Field			5'			150	30							150	●	NO		NO			●	●		●	●
Building Sewer			5'			150	30							150	●			NO			●	●		●	●
Privy																	NO								
Wells													150							2 GPM	●				
EDGARTOWN																									
Septic Tank	100	25	4			50	10	5				1000 gal.			MAY BE	NO					●			●	●
Leach Field	100	25	4		6	100	10	20	25	50	6								.5 SQ.FT./G		●			●	●
Building Sewer	100																				●			●	●
Privy																									
Wells																					●				
GAY HEAD												(1000)													
Septic Tank						150	20																		
Leach Field				6		150	20									NO									
Building Sewer							20																		
Privy																									
Wells																									
OAK BLUFFS	TOWN USES STATE SANITARY CODE MINIMUMS																								
Septic Tank	100	25				50	10	5				1000 gal.			●						●			●	●
Leach Field	100	25	4		4	100	10	20			4				●	●			.5 SQ.FT./G		●			●	●
Building Sewer	100					10									●						●			●	●
Privy	100	25				100	30	30									●								
Wells																					●				
TISBURY																									
Septic Tank		25					10	20				1000 gal.													●
Leach Field		25					10	20								●									●
Building Sewer		25					10	20									●								●
Privy							20	20																	●
Wells																									
WEST TISBURY																									
Septic Tank	100	25				50	10	25				1000 gal.			●						●			●	●
Leach Field	200	100	5'		10	200	30	75	25	50	10				●						●	●		●	●
Building Sewer	100														●						●			●	●
Privy	100	100				100	50	75	50	50							●				●				●
Wells							10														●		●		

and to some extent the projections of existing land use patterns. This type of approach does not necessarily take into account the environmental limitations of the land. Figure 12 is a map of the existing zoning on the Island. Recommended minimum lot sizes to allow placement of leaching areas are included in Table 18.

Local zoning provisions that currently protect water related lands include:

Tisbury

Coastal District--Development regulations of the Martha's Vineyard Commission (see section 6.26 of this chapter) have been incorporated into the Town Zoning By-Laws. These cover fragile coastal areas, major ponds and streams. Regulations specify the location of buildings, wells, and waste disposal systems in these areas.

Flood Hazard District--A HUD insurance program incorporated in the Zoning By-Laws administered by Selectmen and Planning Board.

Cluster Developments--Designed for the preservation of open space. There is, however, a disincentive for clustering in Tisbury due to the 25% increase in land area requirement.

Rate of Development--In subdivisions of over 7 lots, building permits are issued at a rate no greater than 1/7 per year. This provision offers incentives for density reduction by relaxed rate of development (by Special Permit).

West Tisbury

Coastal District--Same as under Tisbury above.

Special Places Districts--These zones protect water bodies larger than 4 acres, including those protected in Coastal District. Placement of on-site sanitary disposal systems within 100 feet of ponds is prohibited.

Cluster Zoning--Administered by Board of Appeals, the regulation stipulates that open space shall constitute 50% of the site but provides no density incentives*.

Site Plan Requirements for Special Permits from Board of Appeals--A survey of water bodies, streams, slopes and wetlands required showing drainage, soils analysis, vertical soil profiles, etc.

TABLE 18

RECOMMENDED MINIMUM RESIDENTIAL LOT SIZES
FOR ONE-FAMILY DETACHED DWELLINGS

Soil Characteristics	Private on-lot sewage disposal system (septic tank and leaching field) and private on-lot water system	Public water system; private on-lot sewage disposal system	Public water system; public sewerage system
Rapid permeability (percolation rate faster than 10 minutes/inch); ground water below 4.5 ft.	60,000	20,000	15,000
Moderately rapid permeability (percolation rate between 10 minutes/inch and 30 minutes/inch); ground water below 4.5 ft.	80,000	35,000	25,000
Slow permeability (percolation rate slower than 30 minutes/inch); ground water at or near surface	not suitable	not suitable	not suitable

NOTE: The final size for individual lots should be determined by soils and ground water investigations on each particular lot.

(Metcalf & Eddy, 1972)

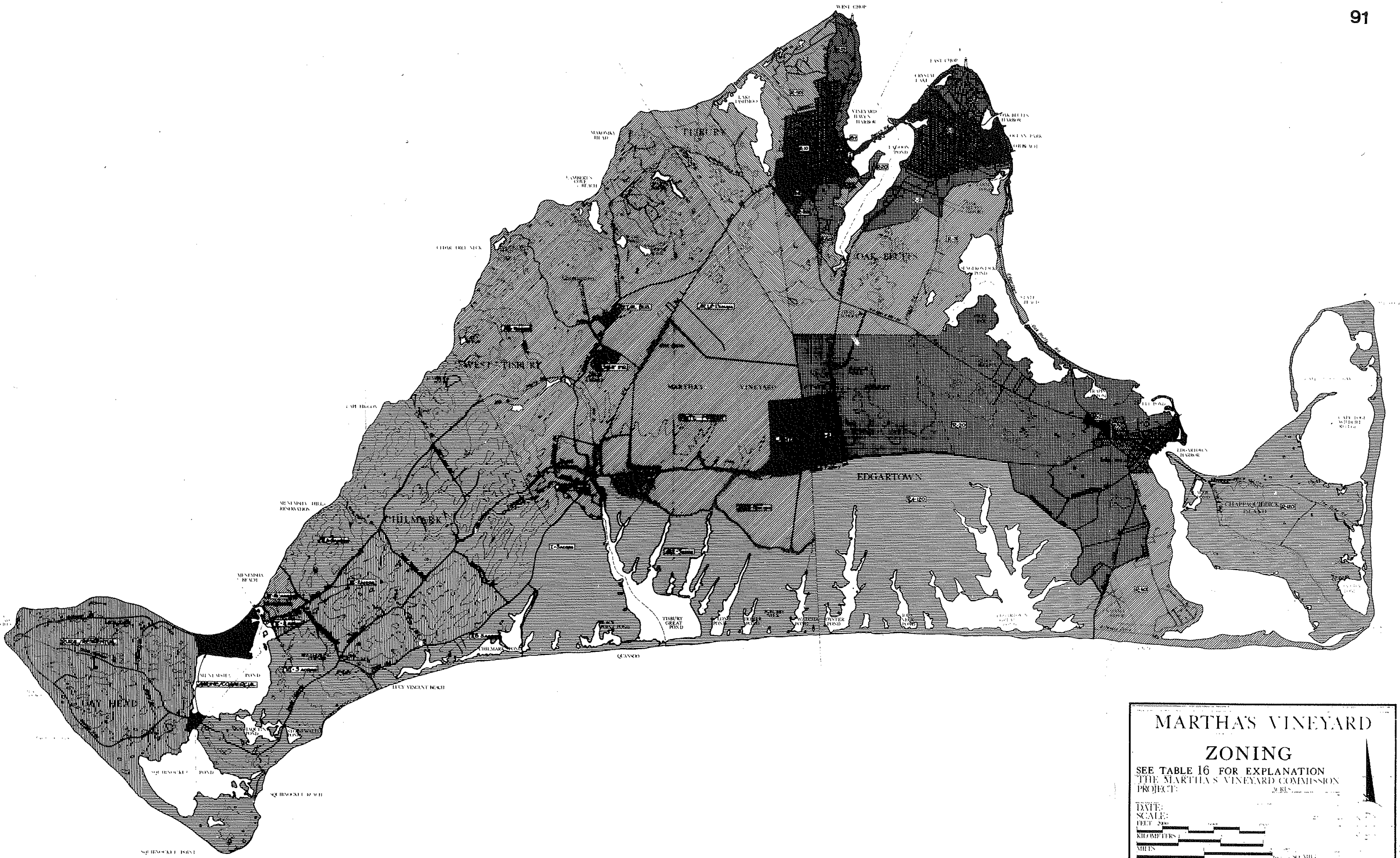

WEST CHOP
EAST CHOP
TISBURY
VINEYARD HAVEN HARBOR
OAK BLUFFS
WEST TISBURY
MARTHA'S VINEYARD
EDGARTOWN
EDGARTOWN HARBOR
CHILMARK
GAY HEAD
CHAPPAQUIDDICK ISLAND
TISBURY GREAT POND
OYSTER POND
QUANSOO
LUCY VINCENT BEACH
MENEMSHA POND
SQUIBNOCKET POND
SQUIBNOCKET BEACH
SQUIBNOCKET POINT
MARTHA'S VINEYARD
ZONING
SEE TABLE 16 FOR EXPLANATION
THE MARTHA'S VINEYARD COMMISSION
PROJECT:
DATE:
SCALE:
FEET
KILOMETERS
MILES

FIGURE 12

Gay Head

Coastal District (MVC)--Same as Tisbury.

Performance Criteria for Development--Includes erosion control, protection of surface and ground water, prevention of salt intrusion, protection of marine habitats.

Special Overlay Regulations--For the protection of coastal waters, ponds, streams, etc..., including regulations for construction along with a requirement for a "site plan review".

Density Regulations--Regulations for location of wells and sanitary disposal systems.

Conservation Regulations--Regulations affecting conservation areas, excavation, water areas and clearings.

Compact Siting--A form of cluster development administered by the Planning Board by special permit, it offers no density incentives.

Oak Bluffs

Coastal District (MVC)--Same as Tisbury.

Open Space Community--A form of cluster development administered by Board of Selectmen by special permit, which does provide density increase incentives.

Coastal Regulations--Requirements that no habitable structure, foundation, waste disposal system or well be placed below an elevation of 10 feet above sea level. Leach field drain tiles shall not be less than 50 feet inland from the 10 foot elevation contour.

Special Places District (MVC)--Includes protection of Duarte Pond (within 100 feet).

Edgartown

Cluster Developments--Includes provision 12.2C: "Tracts not having access to publicly available water and/or sewerage must provide on-lot systems that will insure adequate protection to the water table's purity." The regulations do provide a density incentive (1.1 multiple).

Beach Area and Wetlands Regulations--"For the reasonable protection and conservation of certain irreplaceable natural resources including: streams, tidal rivers, marshes, swamps, ponds and beach areas."

Coastal District (MVC)--Same as Tisbury.

Chilmark

Flexible Siting--A form of cluster development with no density incentive.

Rate of Development--Construction on subdivisions greater than 3 lots limited to not more than 1/10 per year. There is no provision for relaxing this rate as an incentive for reducing density.

Coastal District (MVC)--Same as Tisbury.

Special Places District (MVC)--Protects Harlocks Pond (within 100 feet).

6.21 Subdivision Regulations

Subdivision regulations are rules of an administrative agency--the planning board--which relate to the subdividing or parcelling of the land and to the development process. They are, therefore, unlike zoning by-laws because they do not control uses of the land. In Massachusetts subdivision control regulations are enabled by State legislation, Chapter 41. Subdivision plans must be submitted to the Planning Board and to the Board of Health for approval. The provisions of the subdivision regulations can affect water quality in that they can stipulate storm drainage, erosion control, water and sewer installations, and site restoration requirements.

The subdivision control regulations on Martha's Vineyard vary from town to town. Table a8 is a matrix which compares the six towns' subdivision rules and regulations relating to runoff and erosion control.

6.23 Board of Health Regulations

The local Boards of Health administer several provisions of the State Sanitary Code which relate to on-site sewage disposal and to the assigning of refuse disposal facilities. The State Sanitary Code provides minimum standards which must be met by septic systems. It is the perogative of the local boards to increase the requirements of the Code as needed to accomodate peculiarities of the areas' soils and water resources. This function is perhaps the most important water resources protection practice now carried out by towns. The provisions of the local sanitary codes vary from town to town on the Island (see table 17). More details are found in chapter 7.

State Environmental Code--Title 5

This statute has been "...promulgated to provide minimum standards for the protection of public health and the environment when circumstances require the use of individual systems for the disposal of sanitary sewage in areas where municipal sewer systems are not accessible..... Specific, identifiable local conditions may require more stringent regulation to protect these interests."

Requirements particularly appropriate for the Island are:

1) deep observation holes--at least 2 per lot to determine character of soil and depth to ground water;

2) percolation test to determine suitability of soil to handle waste and to determine size of leaching area;

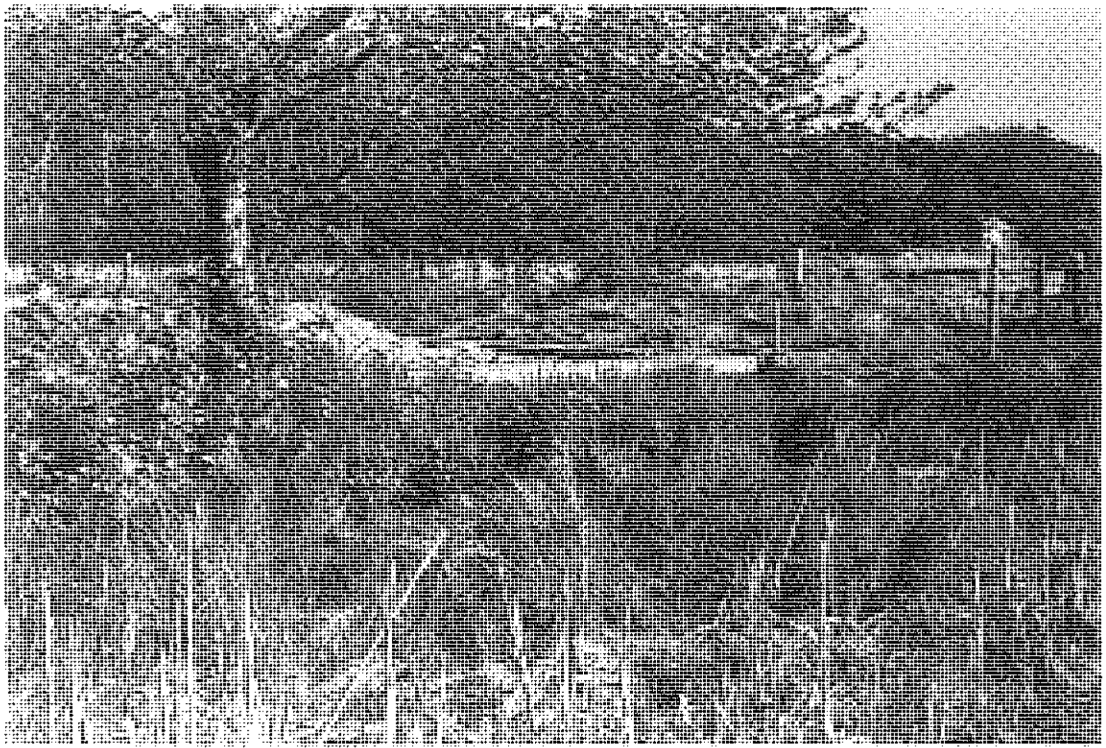
6.24 Conservation Commission Regulations

The Conservation Commissions, under the provisions of the Massachusetts Wetland Protection Act, have the authority to regulate developments on water related lands if, after public hearings, they determine that such development would be of significant impact to public or private water supply, to the ground water, to prevention of pollution or to the protection of fisheries (Chapter 131, Section 40, Massachusetts General Laws). While the Act does not stipulate the outright denial of a proposed development, it does allow the placement of Orders of Conditions.

The two major problems that Conservation Commissions face in enforcing the provisions of the Act are the lack of public awareness and the inability to control cumulative impacts. Also, the Commissions have great difficulty in dealing with property owners determined to carry through with an undesirable project. Lack of State-level support can be a difficulty. A problem with cumulative impacts is that any given individual's action may be insignificant to the Conservation Commission and it approves the development. However, the total of this action and others may eventually significantly impact the waterways or wetlands.

6.25 The Coastal Wetland Restrictions Act--Chapter 130, Section 105

This program identifies and maps significant local wetlands and restricts their future use. Restrictions are placed on the types of alterations that may be made to the land including dredging, filling, removing or polluting wetlands.



Conservation Commissions have jurisdiction over developments in wetlands, under law, although proper referrals are not always made, as in an addition to an existing structure (above), and landfilling activities in a wet area (right).

what towns are done?

Effectiveness depends on adequate monitoring and enforcement. A violation of the Wetland Restrictions Act is to be reported to the Conservation Commission.

Restrictions may tend to reduce the market value of a landowner's property. Chapter 59, Section 11, MGL, provides that restricted wetlands be assessed separately by the local assessors.

6.26 Regional Regulations--Chapter 637

Chapter 637 created the Martha's Vineyard Land and Water Commission, a 21-member public body with 2 major roles: to designate Districts of Critical Planning Concern and to specify conditions and modifications necessary for the control of Developments of Regional Impact. Implementation of these regulations is left to the towns (see section 6.21).

Districts of Critical Planning Concern (DCPC)

The MVC has the power and authority to nominate, designate and to specify guidelines for development in DCPC's. To date, the MVC has designated 7 DCPC's 2 of which specifically deal with protection of the ground and surface waters of the Island. (see figure 13). These are:

Coastal District--To prevent flood damage, maintain water quality, assure adequate water supply, prevent pollution, promote wildlife habitats, assure the maintenance of cultural and historic sites and values, preserve and enhance the character of views, prevent damage to structures, land and water as a result of erosion, promote economic development of fisheries and related industries and maintain and enhance the overall economy of the Island.

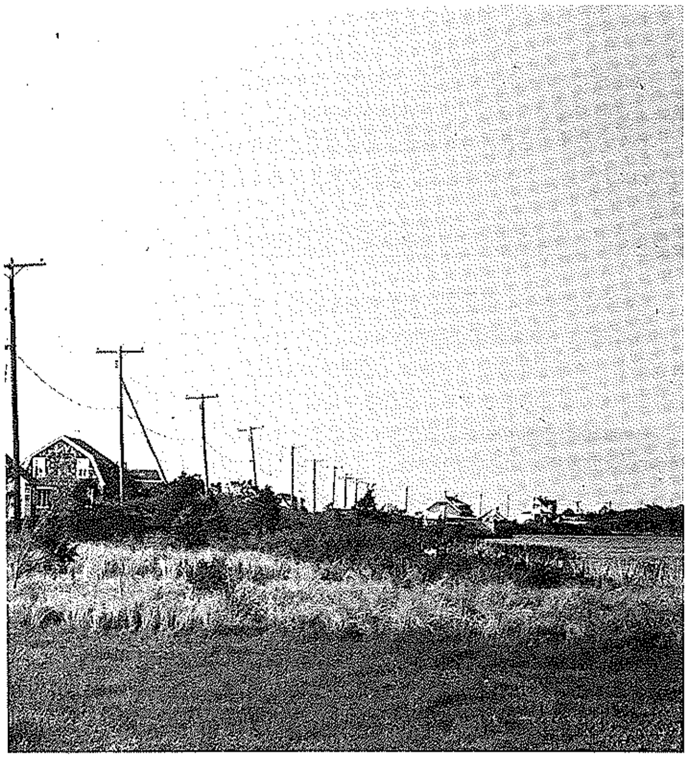
The protected areas include:

--the coastline
--Great Ponds (urban centers exempted)
--streams and wetlands draining into Great Ponds.

The Guidelines include:

1) setbacks from water bodies for building, waste disposal systems and wells;
2) area-specific health guidelines beyond the State minimum regulations.

Enforcement--Four of the six towns adopted regulations which conform to the MVC guidelines for the District by a 2/3 Town Meeting vote. Edgartown and Oak Bluffs tabled the guidelines proposed to their Town Meetings by the local Planning Boards. The MVC therefore adopted regulations forthe townsbased on those proposed by the local Boards.



The Martha's Vineyard Commission "Coastal District" is intended in part to control the proximity of sewage disposal systems to coastal waters, as at Crystal Lake in Oak Bluffs (above), and at Nashaquitsa Pond in Chilmark.

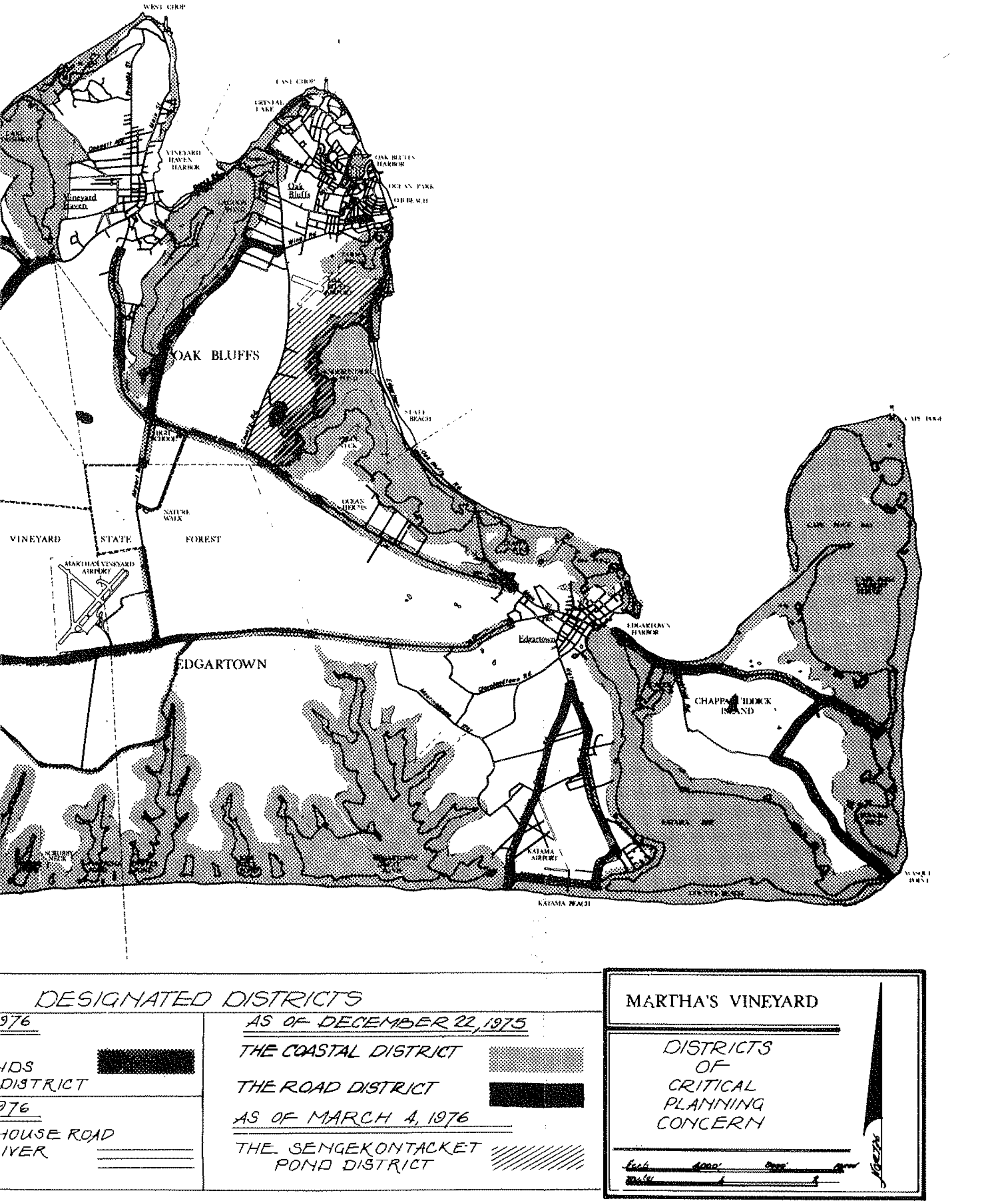

WEST CHOP
EAST CHOP
OAK BLUFFS
VINEYARD
STATE
FOREST
EDGARTOWN
CHAPPAQUIDDICK ISLAND
KATAMA AIRPORT
KATAMA BEACH
DESIGNATED DISTRICTS
976
IDS
DISTRICT
976
HOUSE ROAD
IVER
AS OF DECEMBER 22, 1975
THE COASTAL DISTRICT
THE ROAD DISTRICT
AS OF MARCH 4, 1976
THE SENGEKONTACKET POND DISTRICT
MARTHA'S VINEYARD
DISTRICTS OF CRITICAL PLANNING CONCERN

FIGURE 13

Coastal District Regulations

Four of the Island towns have adopted special regulations for the protection of the Coastal District. The Commission has adopted regulations for their Edgartown and Oak Bluffs until the towns develop own proposed regulations. The regulations conform to the MVC recommendations for these areas. They are more limiting in their requirements than those of the State Environmental Code.

Those regulations control the placement and installation of wells and sanitary disposal systems including:

1) 200 foot separation between well and salt water body;
2) 200 foot separation between well and sanitary disposal facility;
3) perc tests required prior to subdivision of land;
4) 5 foot separation of disposal field and water table in areas of slower than 5 minutes/inch perc rate and 7 foot separation for faster than 5 minutes/inch;
5) 200 foot setback of sanitary disposal facility from salt or fresh water body;
6) 300 foot separation between sanitary disposal facilities;
7) 600 foot setback from public supply wells for sanitary disposal facilities.

Special Places District--Inland Ponds and Hilltops

Inland Ponds--To prevent pollution and sedimentation problems resulting from grading and filling or septic leaching into the pond waters.

Hilltops--To prevent runoff problems of erosion and sedimentation precipitated by development.

Guidelines include setbacks for buildings, waste disposal systems and wells from the designated Special Places.

Enforcement--All towns except Tisbury have designated Special Places. West Tisbury, Chilmark and Gay Head have adopted regulations in conformance with the guidelines. In Edgartown and Oak Bluffs the regulations were imposed by the MVC as with the Coastal Districts.

Developments of Regional Impact (DRI)

The MVC has the power and responsibility to develop criteria for determining which land developments are of sufficient regional importance to constitute "Developments of Regional Impact". The

Commission develops standards for reviewing DRI's and may approve DRI's with or without conditions. Generally these standards involve a finding that the development's "probable benefits" will exceed the "probable detriments" to the region. A local board may not grant a permit until the project is approved by the Commission.

Criteria for review of large-scale developments include consideration of the following:

1) transportation (vehicle access, preservation of old by-ways, creation of new non-vehicular paths, provisions for transit connections, public access to water bodies and special places);

2) growth rate;

3) water resources;

4) erosion and sedimentation control;

5) moderate-income lots or dwellings;

6) preservation of open space for purposes including ground water recharge;

7) mixed-use development.

6.3 Recommended Amendments to Local Zoning By-Laws

We have examined the towns' zoning by-laws for possible improvements in protecting water resources. A number of changes are needed to further protect the Island's water resources. The following are specific amendments recommended by this 208 study.

6.31 West Tisbury

--VII.B.2. Administration-- Board of Appeals
(6) Require a statement of potential adverse impacts on the ground and surface water adds on proposal and adjacent sites, to be reviewed by the Water Quality Planner prior to the hearing.

--V. Cluster Zoning
Insert in line 2: "to protect aquifers and aquifer recharge areas between West Tisbury...".

(A) 3.
Insert in line 2 between "Health" and "must certify": ", Regional Sanitary Engineer and Water Quality Planer".

(C) 4.
Insert after "features": "The cluster will be evaluated based on protection of the resources including but not limited to the following: agriculture, aquifers, horticulture, silviculture,

vistas, recreation, historical preservation."

--Appendix A, 8. Water Resources

C.
Line 2 insert "aquifers" between "wetlands" and "and".

D.
Proposed means of disposal of the waste and environmental assessment to be reviewed by the Regional Sanitary Engineer.

F.
Estimates of solid waste generated for a 1, 5 and 10 year period.

6.32 Gay Head

--IV.D. Aquifer Protection
Development shall be sited away from designated aquifers and critical recharge areas where possible. Any development in such areas where there are porous sandy soils shall utilize leaching fields.

--V.A. Compact Siting, 3.
Insert in line 2 between "space," and "utilizing": "preserving existing and potentially productive agricultural land, protecting aquifers,".

6.33 Tisbury

--8.1.2.
On line 7 delete ", and excluding 25% of remaining buildable land area".

--8.1.7.
At the fifth indenture add: "preserving land for the purposes of agriculture, horticulture, silviculture, aquifer protection."

6.34 Oak Bluffs

--12-1
Under Objectives, insert in line 4 between "conservation" and "and": ", aquifer protection".

--12-2
Replace "Board of Selectmen" in line 1 with "Planning Board". Also replace same in lines 5 and 7.

--12-3

a) In line 3-4 add: ...review by "Planning Board, Board of Health and Conservation Commission" prior to.....

b) In line 2 change "Board of Selectmen" to "Planning Board".

c) Add to line 10: "the plan shall also be reviewed by the Sanitary Engineer and Water Quality Planner prior to application."

d) Line 2: ...plans, "the Planning Board shall transmit one copy each to the Board of Selectmen, Board of Health and the Conservation Commission. The Board of Health and the Conservation Commission shall submit reports to the Planning Board within 45 days of the application date, the Planning Board shall make no decisions until receipt of all such reports, or until 45 days have lapsed since date of application without such reports."

e) Line 2: change "Board of Selectmen" to "Planning Board". Add in line 5: between "conservation" and "or", ", aquifer protection".

--(12-4)-(12-5)
Change all references to Selectmen from said Board to Planning Board.

6.35 Edgartown

--11.6.7
No pollution of the "ground and surface" water...

8.
Insert in line 2 between "features" and "and" the words "protect aquifers".

--13.1. Beach Areas and Wetland Regulations
2.g.
The beach areas and wetland regulations are included within the Coastal District.

6.36 Chilmark

--III Use Regulations

(A) 2. Accessory Uses
b.9
Such use must not cause any pollution of the "ground or surface" water, certified by the Board of Health; or cause any pollution of the air.

(A) 2. Non-Accessory
e.5
The proposed sanitary disposal facilities shall be reviewed by the Regional Sanitary Engineer.

6.4 Additional Zoning Tools Appropriate for the Protection of Water Supply and Quality

6.41 Aquifer Protection--Regulations should include delineation of known aquifers and their recharge areas and provide use regulations (setbacks, performance criteria for wastewater disposal systems and density limits). Edgartown and West Tisbury should designate the State Forest an Aquifer Protection District with Commonwealth approval.

6.42 Natural Resource or Conservancy Zone--Similar to the Aquifer Protection District, these zones would include agricultural lands, forests, ancient ways, etc. Owners may have to be compensated for reduction of property market value due to this "down zoning".

6.43 Harbor Zoning--Regulations for the protection of shellfish beds including:

1) a harbor use plan
   --transportation lanes
   --private and public mooring spots,
   --shellfish protection areas,
   --commercial fishing docks;

2) use regulations;

3) sanitary regulations;

4) a schedule of fines for violators--this zoning is recommended for all harbors, particularly Edgartown, which has considerable room for versatile arrangements.

6.44 Transfer of Development Rights between non-contiguous parcels under the same ownership--The town may wish to prevent development altogether on a particular site because of its special resource or conservation value. If the landowner also owns property in another area of town, he could be allowed to transfer his development rights to that site under the cluster by-law. Both parcels, though non-contiguous, would be considered as part of the same development area.

The cluster plan might leave site A entirely open or permit a few building sites because of its important resource or conservation value. The density at site B would then be increased over that prescribed in the zoning district to compensate for the decrease in density at site A. The density increase would be calculated on a "point system" as outlined below.

6.45 Density Incentives--Towns with cluster zoning or "open space communities" should provide incentives to encourage preservation of agricultural land, aquifers, vistas, historic sites, etc. One option is a point system of the following form:

1) Establish the allowable density; let 1 be the allowable density within a given district (i.e., 1 unit per 60,000 square feet).

2) Assign Amenity Points in the following categories:

Category	Criteria	Points
Aquifer Protection	for 1st 10 acres preserved	10 points
	for each acre thereafter	1 point each
Preservation of Agricultural Land	for 1st 10 acres preserved	10 points
	for each acre thereafter	1 point each
Scenic Easement	for each view with public access	25 points
Dedicated Public Trail	for each trail connecting with other existing or proposed access routes	10 points each 25 maximum

3) For every 25 Amenity Points, the developer may receive an 0.1 density multiplier as an incentive for providing these public amenities.

4) The maximum permissible multiplier may be 0.4 (or whatever the town shall choose).

Example

A landowner has 75 acres in a 60,000 square foot district. Subtracting land prohibited from development by local and State regulation or conservation restriction:

75 - 15 acres not buildabe = 60 acres applicable land area

60 acres/1 1/2 minimum lot size = 40 lots.

Under the cluster incentive the developer provides 2 public trails (20 points) and 45 acres of preserved aquifer and agricultural land (45 points) for a total of 65 points. Sixty-five points gives a .25 density multiplier so that the original 40 times the 1.25 multiplier gives 50 lots--a 10 lot incentive. Some variation of this concept is recommended for use by all towns on the Island.

6.5 Changes in Subdivision Control

The State is now in the process of amending the Subdivision Control Act. The following summary of regulations affecting water supply and quality include changes that are likely to be made by House Bill 3067.

6.51 Applicability

"Subdivision" shall mean the division or redivision of a tract of land into 2 or more lots (whether or not such land is situated on a public way).

Subdivisions of fewer than 6 lots may be exempted by the Planning Board from the provisions of Subdivision Control.

"Developments of Regional Impact" shall mean subdivisions of more than 5 lots within 500 feet of one of the following:

--wetlands of 50 acres or more,
--Great Ponds,
--water bodies for which minimum water quality standards have been set by the Massachusetts Division of Water Pollution Control,
--forests or recreation areas owned or leased by the State or County,
--scenic preserves,
--historic monuments
--fish and wildlife refuges,
--municipal boundary.

6.52 Subdivision Plans

Definitive Plan Specifications include:

--proposed water, sewer and drainage systems;
--topography in no greater than 5 foot intervals with graph drainage analysis;
--indication of high water mark;
--proposed and existing vegetative cover;
--location of ground water and results of perc tests;
--proposed grading of lots and ways;
--environmental assessment form and proposed erosion control efforts.

Review procedures by Planning Board (Pl. Bd), Conservation Commission (C. C.) and Board of Health (Bd. of H.):

1) Preapplication review called by the Pl. Bd. and jointly held with C. C. and Bd. of H.

2) Public hearing for Definitive Plan held jointly by Pl. Bd., C. C. and Bd. of H.:
--Bd. of H. shall report which, if any, lots shown on plan cannot be used for building sites without injury to the public health or danger of flooding prior to decision;
--C. C. shall, where applicable, issue an

order under Chapter 131, Section 40 prior to decision.

Conditions:

1) The Pl. Bd. may impose conditions on a subdivision plan including:
   --phased construction (not to exceed 5 years);
   --improvements to sewer, water or drainage services outside boundary of plan;
   --dedication of land for park and recreational area.

2) The Pl. Bd. may also require performance guarantors (bond, deposit or covenant) to insure that ways and services are provided to serve any lot before a structure is built on land conveyed to another owner.

6.53 Subdivision Control Options

1) Requirements of Sedimentation-Erosion Control Plan

   a) methods of Control:

   --to minimize soil exposure--staging of grading and revegetation;
   --control runoff

channel	(interception (diversion (safe disposal of runoff
volume	(special grading (staged construction (preservation of natural vegetation

   --surface protections--mulch cover;
   --good site planning
   --restoration

   b) Administration:

   --administered by Pl. Bd. and requiring a site visit as part of preapplication review;
   --review of plan by Water Quality Planner within 21 days prior to submittal of definitive plan.

2) Requirement of Installation of Water Quality Monitoring Wells

   a) Applicability:

   --for areas of less than 3 acre zoning;
   --for subdivisions of more than 10 lots

b) Basis:

--from Title 5, State Sanitary Code.

In outwash plains--3 monitoring wells for 10 or more lots.

In eastern moraine--3 for first 10 lots and 1 for each additional 10 acres

In western moraine--3 wells for 5 lots and 2 wells for each additional 5 lots.

6.6 Additional Regulation Options

Land Division--For all subdivisions the developer should be required to demonstrate to the satisfaction of the local Board of Health and the Planning Board that the soil is capable of handling on-lot sanitary disposal systems. Alternative techniques to accomplish this include percolation tests and deep observation holes (see Subdivision Control Options, Section 6.53).

Pump-Out Monitoring--The Boards of Health of 2 of the Island towns are currently keeping a record of all of the septic pump-outs within the towns to determine the rates of septic system failures and the areas in which they occur in order to conclude remedial actions.

Regional Health Council--The Island towns may realize benefits by establishing a regional council made up of members of all the local Health Boards, the purpose of which includes:

--forum for exchanging information and dealing with intertown problems (e.g., the Great Ponds);
--study possible regional solutions to such problems as solid waste disposal, sewerage, water supply and nightsoil disposal;
--act as supervising agency for Regional Sanitary Engineer;
--study feasibility of regional sanitary disposal district for considering land application of septic waste, make and implement recommendations;
--administration of regional recycling program.

Solid Waste Disposal Management--Includes establishing recycling by-law and banning plastic bags from landfills to minimize land consumption and permit biodegrading of waste materials.

Boards of Health and Planning Boards work together with Regional Sanitary Engineer and Water Resources Planner to bring zoning area requirements into conformity with carrying capacity of the soils and ground waters in the instances where the area requirements are too small.

6.7 Incentives

6.71 Zoning

Cluster Developments--All of the Island towns have cluster provisions. None of the towns offer any incentive for clustering; in fact, Tisbury has a disincentive by decreasing the applicant's land area by 25% over and above reductions for other restrictions such as Wetlands restrictions. All towns should consider the use of incentives such as those suggested in the section on zoning tools in which a point system is utilized to reward the development which offers amenities such as preservation of open space and protection of aquifers.

Transferable Development Rights--Where an owner may transfer the rights to develop between parcels in order to preserve historic places, agricultural lands, windfall gains or losses: the owner forfeits right on one parcel and picks up on another. There is a balance. This should only be used in conjunction with the cluster concept so that open space is assured on both parcels.

6.72 Use Value Assessment

There are 3 programs in Massachusetts which entitle the landowner to a reduced property tax assessment on his land in exchange for restrictions placed on the land's use: Chapter 61A, "Preferential Assessment of Agricultural and Horticultural Lands"; Chapter 61 or 61A, "Taxation of Forest Lands and Products"' and Chapter 184, which provides for "Conservation Restrictions".

Chapter 61A: Preferential Assessment of Agricultural Lands

This law allows local assessors to assess farmland according to its use value rather than its potential development or market value (established by zoning). Any landowner whose property will be used for agricultural or hortiucltural use may apply if:

- --the land is a minimum of 5 acres in area (not including the house lot);
- --gross sales of agricultural and horticultural products total at least $500 per year, except where the land is more than 5 acres in which case the $500 must be increased at the rate of $5 per acre;

--the land is actively devoted to agriculture or horticulture for 2 years prior to application (however, if it is clear that the landowner intends to produce the required income as determined by the "Guidelines for Crop Development Time Periods" issued by the State, the application may be approved by the assessors);

--adjoining open land not now used for agriculture may also qualify, but the acreage cannot exceed that being actively farmed.

The landowner applies by filing an application form (available from the local assessors' office) by October 1 of the year preceding the desired year of entry to the program. The assessors are required to act on the application within a fixed number of days and if the assessors deny the application, the landowner has a right to appeal the decision to the State Department of Corporations and Taxation.

The program specifies certain penalties that shall apply if the land is converted to non-agricutural use: a conveyance tax or a rollback tax.

Land which is assessed under the program cannot be sold for, or converted to, residential, commercial or industrial use without notifying the Town Selectmen of the intended sale or conversion. In the case of a sale, the town has a 60 day first refusal option to meet a bonafide offer to purchase the land. In the case of an intended conversion not involving a sale, the town is provided an option to purchase the land at the fair market value.

Chapter 61: Taxation of Forest Lands and Products

A landowner may qualify for the program if:

--the land is a minimum of 10 contiguous acres;

--it is primarily used for the production of forest products;

--the land is valued at a "mean per acre value" of not more than $400 per acre, based on its forest use (The precise meaning of this requirement has not been clarified by the Department of Corporations and Taxation; how it should be interpreted is therefore at the discretion of the local assessors.).

The applicant landowner must file a work plan for the next 5 years showing priorities of work to be accomplished. The land is then assessed at $10 per acre.

In conjunction with the harvest of forest products from the land, the landowner must pay an 8% stumpage tax on all the forest products harvested (except for $100 worth of products allowed for personal use). As with Chapter 61A, there are penalties for withdrawing land from the program--landowners must pay the tax money saved through the program, plus 8% annual interest. The penalty, however, cannot exceed $200 per acre.

Chapter 184: Conservation Restrictions

A conservation restriction, also called a conservation or scenic easement, is an agreement between a landowner and a town, city, state or private charity, where the owner contracts to keep his land in a primarily undeveloped use permanently or for an agreed upon period of time. It must be approved by the Town Selectmen. Approval is also required from the State Secretary of Environmental Affairs.

It may prohibit all development, permit certain uses (for example, farming and forestry) and/or provide for public access. Because the land has legal restrictions placed on its use, its potential market value should be less than for developable land. Massachusetts law (Chapter 49, Section 11) requires assessors to reassess land subject to a permanent conservation restriction, but gives no specific guidance in determining the change of value.

A landowner may also obtain a federal income tax deduction for a gift of a permanent conservation restriction amounting to the difference between the market value of the land before and after the restriction is imposed. Upon the owner's death, the estate taxes on the land's value will be reduced thus enabling the land to stay in the family rather than be sold to pay the tax.

6.8 Land Acquisition

Methods of Acquisition

There are 4 primary means by which a public agency can acquire full fee title to critical lands. One, of course, is outright purchase from private owners. Another is through donations or gifts made by the owners. A third mechanism is taking possession by eminent domain. (Both purchase and eminent domain can be used to obtain tax delinquent properties whose owners may be either known or unknown.) Fourthly, titles already held by the public can be traded with private owners for more critical lands.

Advantages and Disadvantages

As indicated above, the greatest overall advantage to public acquisition is that it allows the responsible agencies (as representatives of the people) to determine the specific uses (or non-use) to which particular properties are devoted. If the lands are left as conservation or open space areas, or if adequate pollution controls are applied to their use, part of the water quality protection problem will be solved. Many other public needs can be met at the same time, if the acquisition programs are properly planned.

There are, however, some disadvantages to this approach. No matter which means of acquisition is employed, unless the land is allowed to follow natural patterns of ecological growth and succession there will be some cost attached to its development and use. Except in cases where land is leased to a private interest for development under specific conditions, public expenditures would be needed to pay for planning, design, construction, operation, maintenance and supervision functions. The actual amounts would depend primarily on the nature of the development program, and appropriate funding sources would have to be found.

Another significant disadvantage is the loss of potential property tax revenue that accompanies the transfer of land to the public domain. This annual cost persists as long as the land is held. There are, however, several conditions that could limit it in appropriate instances. One is the case of tax delinquent properties which have not been providing revenue anyway (although they could do so in the future, if sold to private parties at public auction). Another is the savings in public services and facilities that can result if lands are withheld from intensive development through public ownership. Thirdly, income can be obtained through property leases and/or user fees.

6.81 Purchase

The purchase of land for public purposes may involve the highest expense per acre of any acquisition method, except in tax delinquency cases. This is particularly possible on Martha's Vineyard, where land costs have been rising rapidly in recent years. However, the approach does have distinct advantages. Its primary advantage is that it can give the public the greatest amount of flexibility in acquiring the kind of land it desires. From a legal point of view, it can also be the most direct way of getting full title; but title clearance can require costly, complicated procedures.

While outright purchase may impose the highest cost on the public, this can be somewhat alleviated by the savings and income possibilities mentioned above. However, in many cases it is still necessary to obtain additional funds from other sources. Bonds and direct appropriations from tax revenues to be used for land acquisition, development and use can be supplemented in several ways. One technique that has great potential for helping towns on the Island is that of forming a town conservation fund, which allows private donations to be combined with public monies for specified purposes. This has recently been initiated in Oak Bluffs. If it is given enthusiastic support and used wisely, it can contribute very effectively to water quality protection in Oak Bluffs and the other towns on Martha's Vineyard.

Another source is the Massachusetts Executive Office of Environmental Affairs "Self-Help" program. This program provides matching grants to municipalities with their open land acquisitions. It also applies to the planning and design of public conservation and recreation projects. In addition, the Federal government's Bureau of Outdoor Recreation provides grants for similar purposes through the State's administration.

6.82 Donations

If owners give their land to the public, the large investment of a purchase is obviously avoided. However, the rate of acquisition by this means is likely to be very slow, since the initiative must come from individuals. Similarly, the public agency is usually put in a reactive posture with respect to the selection of desirable properties. This means that it does not actively pursue the lands it wants, but only rejects offers of those it does not want. Furthermore, such gifts may come with conditions attached to the titles that are contrary to the public purposes.

One version of this that is frequently used by local governments throughout the United States to achieve various objectives is the requirement for subdividers to dedicate some of their land to the public in order to receive final approval of their plans. However, in Massachusetts this practice is specifically prohibited by the Subdivision Control Enabling Act.

6.83 Eminent Domain

The power of eminent domain can be used by some public entities to acquire property for public purposes, including the protection of water supplies. More strict legal requirements must be met if condemnation is used. For example, a municipal eminent domain proceeding requires a 2/3 vote by a Town Meeting before action can be taken by the Selectmen, who have sole power to do so. Administration of the property then is delegated by the Selectmen at their discretion.

Even under eminent domain, compensation must be paid to the owner. But this may often be less than a negotiated purchase price, since a court ultimately rules on any question of fairness that is raised regarding the determination of free market value. The main benefits are that eminent domain ensures clear title and allows complete choice of the precise areas desired, without restriction to existing property lines or private owners' unreasonable demands.

6.84 Land Trading

In order to trade for particular properties critical to water quality protection, the public must have already acquired others by one of the 3 processes discussed above. Agreeable owners must then be found. This means that the properties offered must be at least as valuable for the individuals' purposes as the ones they are asked to give up, and negotiations will probably take some time. By the same token, however, trading does provide a way to achieve greater fulfillment of public purposes through land banking.

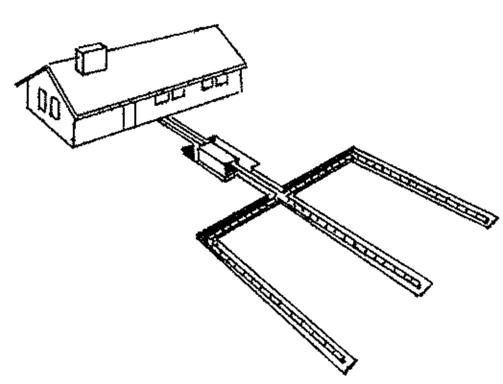
6.9 Recommended Water Related Land Use Program

The water related land use plan described in this Chapter, revolves around the existing agencies and their powers. We have an established process for review and consideration of various land-use proposals. In addition, we have a unique regional agency for the review of developments which are potentially regional in their impact. The Martha's Vineyard Commission also has an established process for the nomination, consideration and establishment of regulations for critical areas which are beyond the capability and scope of local powers. The Commission powers may extend beyond the General Laws when the General Laws are inadequate to protect the Island's water resources.

Certain changes in our present approaches to guiding growth can further minimize their environmental impacts. Fuller use of the optional requirements allowed by Title 5, zoning and subdivision control regulations will lead to further protection of our water resources. Recommendations for improving our on-lot sewage disposal, solid waste and sewage treatment techniques are made in the respective chapters which follow.

7

On-Lot Sewage Disposal



7.0 On-Lot Sewage Disposal

Except for the downtown area of Edgartown and the Martha's Vineyard Hospital, Martha's Vineyard residents rely primarily upon 7000 septic and cesspool systems for treating wastewater. As a result of our sampling program, it was determined that on-lot disposal problems are the most important nonpoint pollution problem arising on the Island.

7.1 Existing Regulations For On-Lot Disposal Systems

7.11 What the State Allows

In Massachusetts, the regulation of on-site sewage disposal is outlined in the State Sanitary Code. This code establishes minimum regulations for the location and construction of septic tanks and similar systems which discharge into the ground and regulates piped discharge of sanitary sewage into the waters of the Commonwealth. It is clearly indicated that it is the responsibility of local Boards of Health to increase these regulations as is necessary to protect their water resources. The aim of the State Sanitary Code is to assure the function of sewage disposal systems. It does not establish performance regulations designed to preclude contamination of ground and surface waters. This activity is left to the local level. The Code does specify minimum distances for sewage systems from wells, water supply lines, water courses and the groundwater.

7.12 Local Boards of Health

In Massachusetts, the regulation of on-site waste disposal is the responsibility of the local boards of health. The code described above may be made more stringent by these local boards. The regulations of each town are spelled out in Table 17. Both Edgartown and Oak Bluffs use the state minimum standards except in the Coastal Districts; the other towns have enacted more stringent regulations.

7.2 What is the Problem?

If a septic system is properly designed, installed and maintained, it can offer long-term protection to our water resources. However, these conditions have not always been met.

The septic system is a two-part treatment and disposal system in the ground, composed of a septic tank and a leaching area. The sewage flows by gravity first into the septic tank where solid particles are settled out and then on to the leaching system where the liquid is allowed to soak into the ground. The leaching system generally consists of either a network of perforated pipes laid in gravel-filled trenches or a perforated concrete chamber placed in a gravel-lined pit. In the soil below the leaching system, small particles carried along by the wastewater (including disease causing organisms) are filtered out. Bacteria that live in the soil remove some of the dissolved pollutants and some other pollutants, such as phosphates and metals become electrically bonded to clay particles in the spoil. The other pollutants percolate into the ground water.

In order to evaluate the contamination potential of on-site sewage disposal for a specific situation, several environmental factors should be established. These factors include:

1. Depth to Groundwater Table
   In the soil, a zone of aeration exists which is of vital importance for organic contaminant removal. The greater the distance to groundwater (hence the thicker the aerated zone through which the sewage must percolate), the more effective the treatment. If the depth to groundwater is less than four feet during the wettest part of the year, the site is unacceptable. Particle size is also important in determining the degree of aeration and retention time of sewage in the soil as described below.

2. Effective Particle Size of the Soil
   Silts and clays (less than .74 millimeters diameter) have a significantly greater potential to treat wastewater than sands due to their increased surface area and higher cation exchange potential*. In very clayey soils, however, sewage systems may not leach properly.

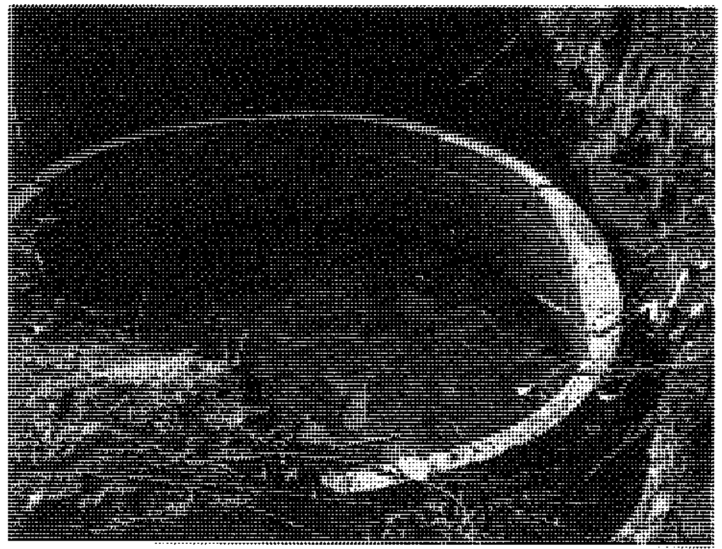
3. Permeability of the Soil (Percolation Rate)
   Soil permeability is a measure of the rate at which water will migrate through the soil. Percolation rates can be either too fast or too slow. If the soil percolates slower than 30 minutes per inch, it is unacceptable. Also, if it percolates faster than 5 minutes per inch some remedial action is necessary to limit ground water contamination.

4. Water Table Gradient
   Both the direction and the rate of flow of the ground water are important in determining potential contamination of wells and nearby surface waters. Whether the ground water is flowing toward or away from a significant water use must be determined.

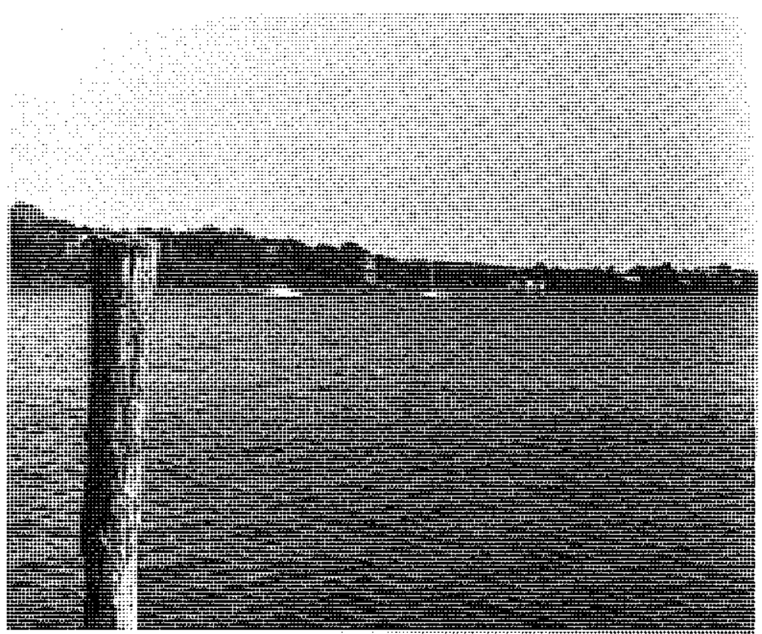
5. Horizontal Distance to a Definable Water Use
   The farther pollutants travel from the

SOURCES

On-lot waste disposal releases liquids which percolate down into our ground-waters which are our only source of water supply.



Inadequate set-back from surface water of on-lot sewage disposal facilities



source, the lower the possibility of contamination due to increasing dilution and treatment.

7.21 Soils With High Perc Rates

Septic systems have traditionally been designed to prevent the return of wastewater to the surface. Failure of a system is still judged by a visible lack of drainage. However, it is now recognized that dissolved organic compounds, plant nutrients, salts, bacterial, viral and other particulates can be introduced into ground water in sufficient quantity to cause contamination. The pollution will prevent safe drinking without treatment, may threaten the harvesting of shellfish, even limit recreational use of surface waters fed by contaminated ground water. How much of these harmful materials will be introduced into the ground water depends upon the treatment system, the patterns of water used, the wastes which have been introduced and the capacity of the soil to use, alter or retain the contaminants. This capacity is related to the particle size, fertility of the soil and the depth of the zone of aeration or the time that the water is in contact with aerated and adsorbant soil particles. The highly permeable soils which have little difficulty in draining away wastewater also allow contaminants such as the nutrient ions, phosphate and ammonium to pass through unfiltered. When highly permeable conditions are found associated with a high water table, contaminants may reach the groundwater. In several areas of Martha's Vineyard incompletely oxidized contaminants such as ammonium ion are found in association with soils composed of dune sands and gravel, Carver loamy sands overlying coarse sand and gravel, particularly where the surface elevations are less than 20 to 30 feet. The evidence collected from the analysis of private well water is sparse, and in some cases the possibility of contamination due to the proximity of well and wastewater disposal must be considered.

The observed conditions in high perc soils indicate that with present wastewater treatment techniques, contaminants of private waste disposal find their way into the on-site water supply (Bennett, 1975). These problems will increase with increasing population density, unless wastes are treated differently and prevented from reaching ground water. Water supply problems could be avoided by the establishment of distribution systems that would provide water from uncontaminated areas.

7.22 The Coastal District

The State Sanitary Code is designed to protect public health but is not specifically designed to

SOLUTIONS

Adequate set-back from surface water

protect against nutrient leaching. In Edgartown, for example, a residence near Mercier Way had nitrate levels which exceeded Safe Drinking Water Standards and for which the depth to water was estimated at 20 to 25 feet and the distance to the on-lot disposal system was 100 feet. This clearly meets the State minimum regulations but does not take into account additional limitations of the land. In some areas we must begin with the State Code as a minimum and develop more appropriate setbacks.

The Island's shoreline is particularly sensitive to nutrient pollution due to 1) the porous nature of the soil, 2) ground water depth is shallow encouraging soil-water saturation, 3) septic units are frequently located close to the water's edge allowing only a short distance of soil adsorption of potential contaminants and 4) the recreational attractiveness of our Island often causes temporary overcrowding of homes leading to overloaded septic systems. Once these overloaded conditions develop, both nitrogen and phosphorus compounds can move significnat horizonatal distances, eventually discharging into surface waters, encouraging microscopic algae blooms and dense pond weed growth (Kerfoot, 1976).

The Martha's Vineyard Commission, working closely with local communities, has designated the Coastal District as a District of Critical Planning Concern. The Coastal District includes the land, streams, and wetlands, which lie below the ten foot elevation above mean sea level, or within five hundred feet of mean high water or a coastal water body exceeding ten acres in size, or the ocean, and all land within one hundred feet of streams and wetlands draining into coastal great ponds. These coastal areas are potentially susceptible to contamination from unsewered dwellings.

In order to protect our coastal resources, the 208 Program has implemented the requirement that a single family home be allowed in this area provided that:

tabulate need for 1½ ac. to dilute NO3 to acceptable levels

> In order to control the quantity of sanitary disposal system leachate released into the ground in a district there shall be not less than a three-hundred (300) foot separation between adjoining on-site sanitary disposal facilities measured from the center of the leaching area or pit. Regulations may permit, in particular cases, lesser separation by variance which may be granted after public hearing; provided that there shall be a minimum separation of two-hundred (200) feet and the applicant must prove that there will be no pollution to ground or surface water, domestic water supply or fisheries. In no case, shall the lowest part of the disposal or leaching facility

be less than five (5) feet above maximum ground water elevation.

There is not less than two-hundred (200) foot separation between any on-site sanitary disposal facilities and domestic water supply wells.

Wells and on-site sanitary disposal facilities shall be not less than two-hundred (200) feet from any portion of a surface water body.

All domestic water supply wells will require a permit from the town board of health before installation to assure compliance with all health regulations.

All on-site sanitary disposal facilities shall be located not less than six-hundred (600) feet from wells used for public water supply.

use "leaching" "trenches" not "fields"

At the present time four out of the six towns have developed regulations that comply with these guidelines. The Martha's Vineyard Commission has developed regulations to meet these requirements for the other two towns.

7.3 Alternatives to Manage On-Lot Sewage Disposal

There is a need to assure the protection of groundwater supplies from improperly designed, located and maintained disposal systems. If septic tanks are properly sited and cared for, and, if densities of disposal systems are appropriate, it is entirely possible to continue withdrawing water and disposing of sewage on the same lot in the foreseeable future. Many options are available for accomplishing this goal including:

1. Homeowner Education
2. Stringent Local Health Codes
3. Maintenance Program
4. Sewering (Discussed in Chapter 8)

7.31 Homeowner Education

Perhaps the most important tools for preventing the failure of home disposal systems is the education of the homeowner. To help protect a septic system from premature failure, the homeowner should follow these simple recommendations:

1. Pump the septic tank regularly. Until your community has an annual septic tank inspection program, have your tank pumped about every four years. Do not wait until the symptoms of failure show up. An annual inspection is suggested.

2. Minimize water use in the home. Excess water will decrease the effectiveness of the septic tank and lead to flooding of the leaching area. As a general rule, do not empty basement sumps or other sources of clear water into the septic system. Use water saving pumping fixtures where possible (faucet aerators, low-flow showers, low-flow toilets, etc.) and run dishwashers and washing machines with full loads only. Fix leaky faucets and toilets promptly.

3. Although small amounts of the following materials may be acceptable, whenever possible don't dispose of these substances in the septic system (recycle them or put them in the trash):

   Coarse Organic Matter

   Vegetable trimmings, ground garbage, sanitary napkins and coffee grounds will clog the septic tank with sludge and require frequent septic tank pumping.

   Fats and Grease

   Cooking oil, automotive oil, bacon grease, etc., will overflow the baffles of the septic tank and clog the leaching area causing the system to back up.

   Chemicals

   Pesticides, disinfectants, acids, medicines, paint, paint thinner, etc., will kill the bacteria which decompose organic matter in the septic tank thereby causing increased sludge accumulation. As a result, more frequent pumpouts will be required to keep the system operating properly.

4. Insist on proper location and construction of any new leaching area. Improper location and construction will usually result in problems and failure of the system.

5. Keep heavy vehicles off the leaching area, their weight could lead to crushed pipes and expensive repairs.

6. Don't plant deep-rooted trees or bushes over the leaching area, their roots may clog pipes.

7.32 Stringent Local Health Codes

As pointed out in Section 7.11 the State Sanitary

Code provides the minimum standards for installing septic systems. The 208 Program recommends that the local health codes insure proper design and installation.

Proper Design: Because of the porous soil on Martha's Vineyard, the 208 Program recommends that:

1. local Boards of Health require leaching fields in areas below 20 feet elevation where the percolation rate is less than 10 minutes per inch. This will increase the volume of soil through which the wastewater must travel thereby increasing the level of treatment.

2. local Boards of Health increase leaching area requirements for soils which percolate at less than 5 minutes per inch; .4 gallons per square foot is suggested.

Proper Installation: One of the major causes of septic system failure is improper installation. It is imperative that local communities thoroughly inspect the installation of septic systems to ensure that state and local health codes are adhered to. For example: in the absorption area, the excavation is the most important aspect. Large machines, bulldozers or front-end loaders should not be permitted to excavate. The use of a back hoe is preferred. Bulldozers and front-end loaders tend to smear the bottom of the leaching area, which will reduce the percolation of the water through the soil. Often times, ruts and gouges are left by these machines creating ponding areas and uneven settlement of gray water on the bottom of these beds. If this occurs, measures should be taken to hand rake these problem areas.

The State Enviromental Code (Title 5) requires that stone used in leaching areas be free from fines, silt and dust. These contaminants tend to work down to the bottom of the leaching area creating an impervious layer. A very easy test to determine whether or not the stone meets standards is to take a bottle, fill it with water and place the stone inside the bottle. The silts, fines, iron and dust will cause the water to turn cloudy and hazy and it is unacceptable.

Many problems arise from backfilling, usually because of the materials used in backfilling (large stumps, boulders, masonry and other construction material) which alters the alignment of the leaching pipes, disrupts the level of distribution in the distribution box or adds other unsuitable material in the leaching field. Precautions should be taken in preventing this material to be deposited over a leaching field. If, during the inspection, stumps, logs, large rocks, etc., are noted, the contractor should be required to purchase clean material and backfill with it. Distinctive mounding over a septic system should be incorporated to allow for settlement from rain and normal compaction of soils. If levelling off the field only is required, settlement will occur leaving ponding areas directly over the leaching field.

It is recommended that the towns develop an effective inspection program for all parts of on-lot sewage disposal systems to guarantee proper functioning of the system and to limit the aggravation of failing disposal systems for homeowners and local officials. The Regional Sanitary Engineer could develop such a program with the assistance of the Building Inspectors. (See maintenance Program below).

Appropriate Setbacks: The following setbacks are recommended. Water quality results sited in Chapter 5 indicate the minimum setbacks are not appropriate in all situations. Literature review indicates that more appropriate setbacks are those listed below. Figure 14 illustrates the distance of travel of nitrate from its source in sandy soils. Appendix 5 includes recommendations on establishing minimum lot sizes and setbacks.

	In Areas Not To Be Sewered or Served w/ Public Water	In Areas To Be Sewered & Served w/Water
1. Well to septic area	200 feet	100 feet
2. Leach area to surface water	200 feet	100 feet
3. Well to salt water	200 feet	100 feet
4. Bottom of leach area to water table	5 feet	5 feet

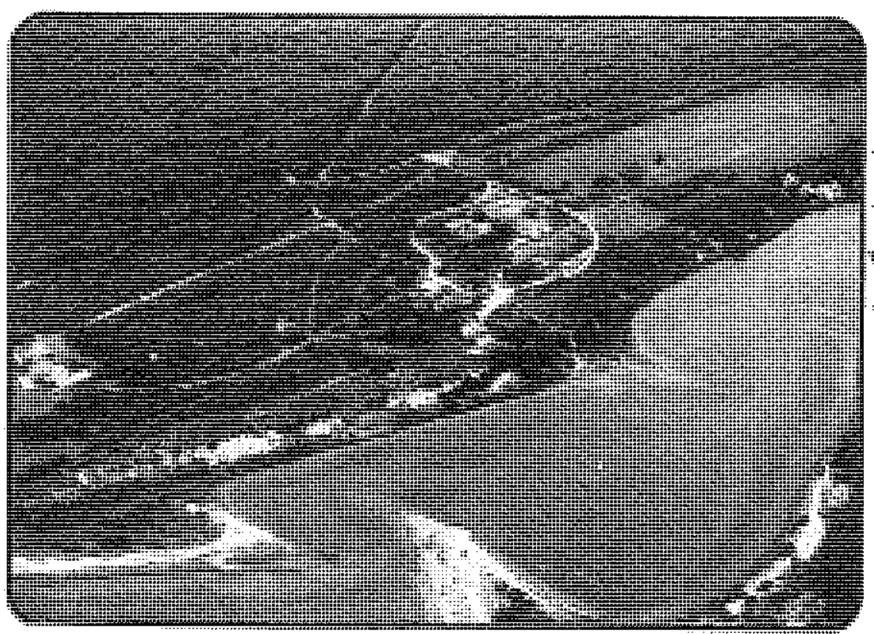
Well to leaching field distances could be decreased for deeper wells. Distance between leach area and surface waters could be decreased for higher elevations.

7.33 Maintenance Program

A septic system is not a device which can be put in the ground and forgotten. In order to ensure that they operate properly, a regular maintenance program is an absolute necessity. Proper maintenance will extend the life of the system and will improve the treatment of sewage thereby saving the homeowner money and limiting environmental pollution. Pumping of septic systems on the Island on a regular basis (once ever 3 to 4 years) is recommended.

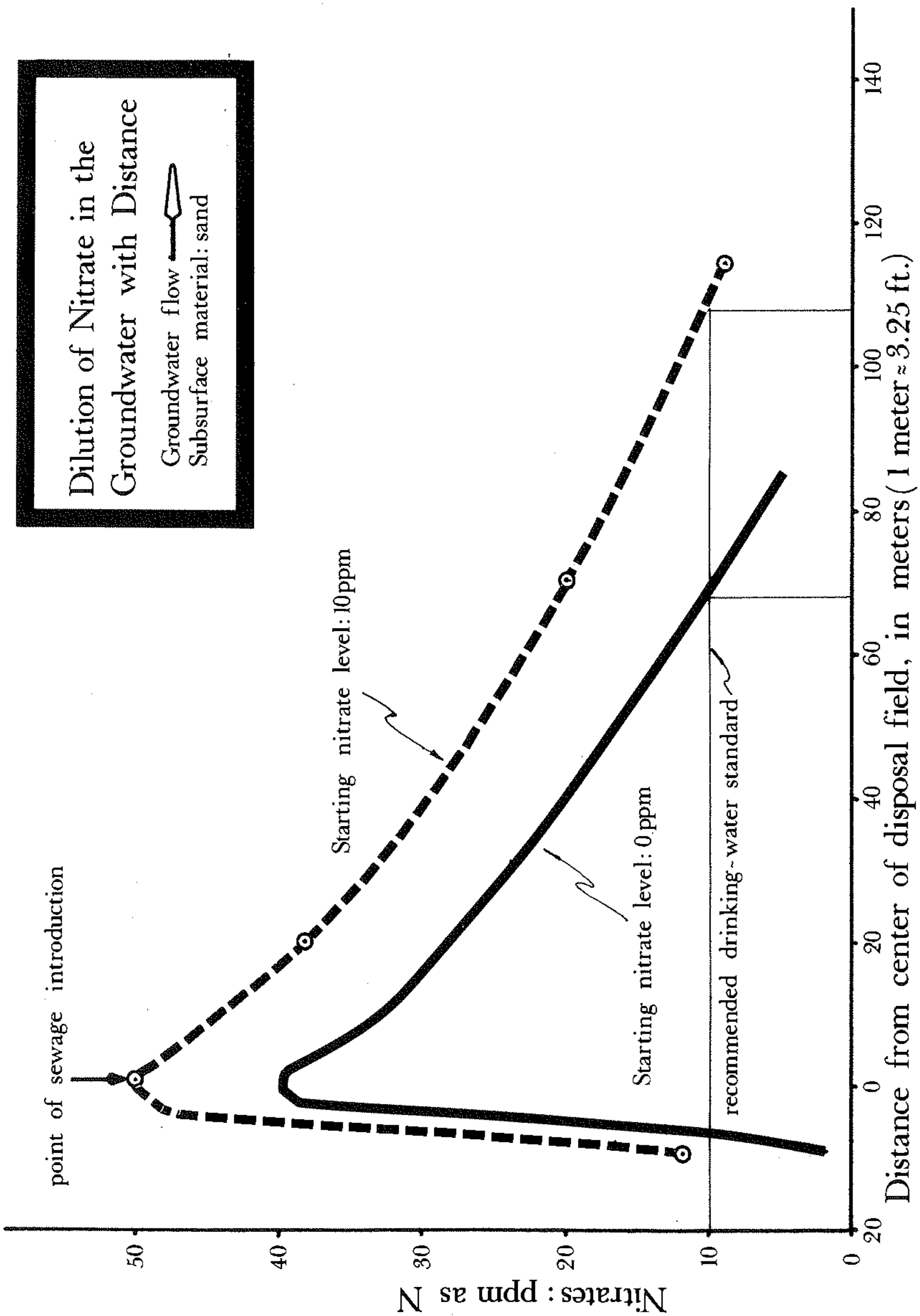
LAND-USE INTENSITIES DIRECTLY AFFECT WATER QUALITY

High-density development can contaminate ground and surface water and may require costly sewering.



In areas with coarse soil and near-surface ground-water, lower densities will help protect our water supplies and coastal ponds.

Figure 14



Source: Walker, et al., J. Environ. Qual., 2:4, 1973

In the immediate future, it is strongly recommended that individual homeowners take the initiative and begin caring for their sewage disposal systems. For the near future, we recommend that the State ~~Sanitary~~ Code be revised and expanded to encourage local Boards of Health to set up a maintenance program and to require regular pumpouts.

The Program could be initiated by a questionnaire sent out with the tax assessments on residential dwellings in the town. The questionnaire would simply ask how long it had been since the wastewater disposal system had been pumped, 1 to 5 or more years. The questionnaire would be returned with the tax payment. A rotating file system could be established for mandatory pump-outs the next year, those systems which had not been pumped for 5 or more years required to be serviced the first year, those those not pumped for 4 years the second year, etc. With subsequent billings, pump-out notices would be issued. The notice would have to be signed by the septage hauler and returned to the Town Hall within 90 days for filing with the owner's card.

This type of program will not only benefit the quality of our resources but will also increase the lifetime of on-lot sewage disposal systems. This in turn will save homeowners costly repairs and installations. A prerequisite to establishing this kind of program is an adequate disposal/treatment system for the nightsoil (see Section 7.36).

When to pump your septic tank: By periodically pumping your septic tank, you will prevent sludge and grease from entering the soil in your leaching field and clogging it. This in turn will lead to better and longer operation of your system. To decide when a pumpout is required, you must measure the thickness of the scum (at the surface) and the sludge (at the bottom). Measuring techniques are indicated in Figure 15. If the bottom of the scum mat is within 3 inches of the submerged outlet, the tank should be pumped. In addition, if the sludge depth is equal to or more than one third of the liquid depth, the tank should also be pumped.

This approach will lead to improved operation of your system, but it will not lead to the detection and correction of broken or poorly located systems. To accomplish this important task, an inspection and rehabilitation program conducted by the Boards of Health is recommended in the sections which follow.

7.34 Rehabilitative Actions

In the areas where improperly located on-lot sewage disposal units have caused ground or surface

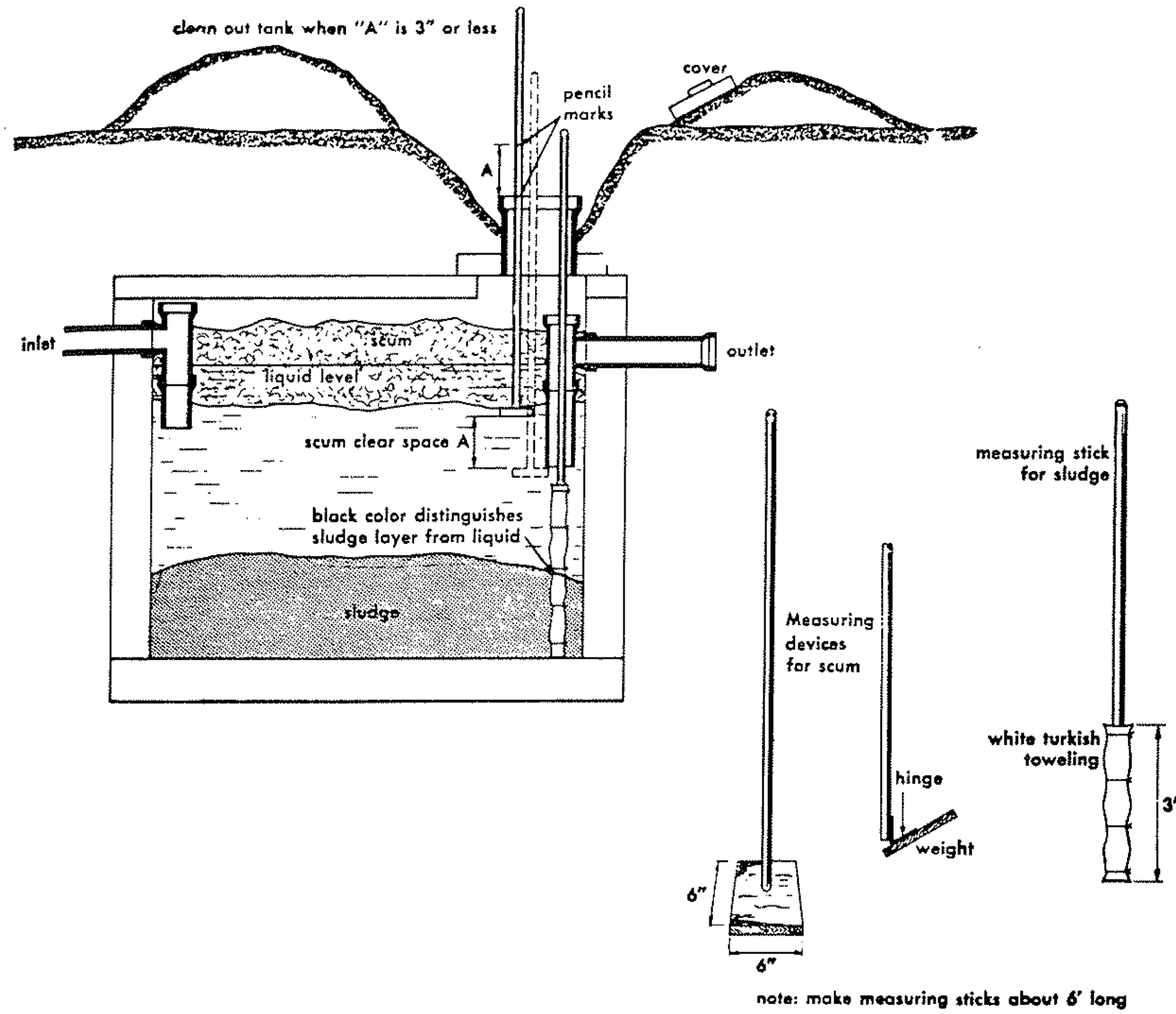


FIGURE 15

PROCEDURE FOR CHECKING FOR THICKNESS

OF LAYER OF SCUM AND DEPTH OF SLUDGE

water contamination, a rehabilitative program is necessary to remedy the problems. The areas where problems exist or are suspected are outlined in Figures 16, 17, 18 and 19. These areas are consolidated into Nightsoil Districts in Figure 20. In these areas, inspection of all on-lot sewage systems should be performed by the Regional Sanitary Engineer.

The most vital aspects of this program include:

1. Water supply quality monitoring - the failure of disposal systems in an area may first show up as pollution of supply wells in the area;

2. Nightsoil pump-out documentation - septic systems may fail by backing up repeatedly. If point of origin records are kept of pump-outs, the need for remedial action can be quickly ascertained and problem areas readily defined.

3. Inspection of existing disposal units in fragile areas - older systems were often improperly installed, and unless these problems are uncovered and rehabilitated, continued water quality contamination will occur (see Table 19).

4. Rehabilitative action - after the steps above are followed, for those systems which have been identified as failing and polluting ground or surface waters, corrective actions may be required. Rehabilitation of household waste water systems may involve replacement-correcting broken pipes, cleaning drainfields, installation of new leaching fields, etc. (see Table 19).

code requires local Bd's to license pumpers & to indicate where it goes

In the case where small lots preclude new leaching areas or where the density of units calls for more advanced treatment systems, sewering, aerobic waste-water disposal units (when approved), composting toilets and other flow reducing measures may be required.

Tight tanks may have to be installed in areas where zero discharge is required due to high water table or proximity of small lots to a fragile surface water body.

Step 1 as described can be carried out by the Water Resources Planner. Several Boards of Health are now keeping track of pumpouts within their towns. It is recommended that Step 2 be conducted by these Boards. Steps 3 and 4 can best be accomplished by the Regional Sanitary Engineer as recommended in the section which follows.

ON-LOT SEWAGE DISPOSAL SYSTEMS: SOME PROBLEMS & SOLUTIONS TABLE 19

SYMPTOMS	ACTIONS	DIAGNOSES	SOLUTIONS
I. Foul odor at septic tank or in drain-field	Try to pinpoint source	A. Drainfield overloading	1. Water conservation 2. Add leaching area 3. Replace drainfield
		B. Poor soil	1. Expand leaching area 2. Use dry toilet 3. Conserve water
		C. High water-table	1. Keep roof runoff away from drainfield 2. Conserve water 3. Install holding tank or dry toilet
		D. Roots in drainfield	Roto-rooter
		E. Septic tank leaks	Check for broken walls or inlet-outlet pipe
		F. Broken waste-line going to tank	1. Replace line 2. Check venting pipe on toilet for clog
II. Erosion or daylighting of septic liquid	Use Rhodamine-B dye; check daily at suspicious points	A. If dye is found, dye is contributing	1. Install fill 2. Install new drainfield
		B. If no dye, look for springs, broken water mains, etc.	Relocate drainfield
III. Poor flush or drain	Snake toilet or use draino	A. If no improvement	1. Check outlet from septic tank for clog 2. Check liquid levels in septic tank pump if necessary 3. Water conservation
IV. Suspected or proven contamination of well	Sample well or install ground water monitoring well to 10 feet below watertable	If any of these exceed indicated limits, system is probably failing: fecal coliform 0ppm chloride 25ppm nitrate/nitrogen 5ppm BOD 5ppm	1. Increase leaching area for cesspools, add a leaching field 2. Drive well deeper 3. Re-locate well or disposal system

fig 16

EXISTING & POTENTIAL PROBLEM AREAS

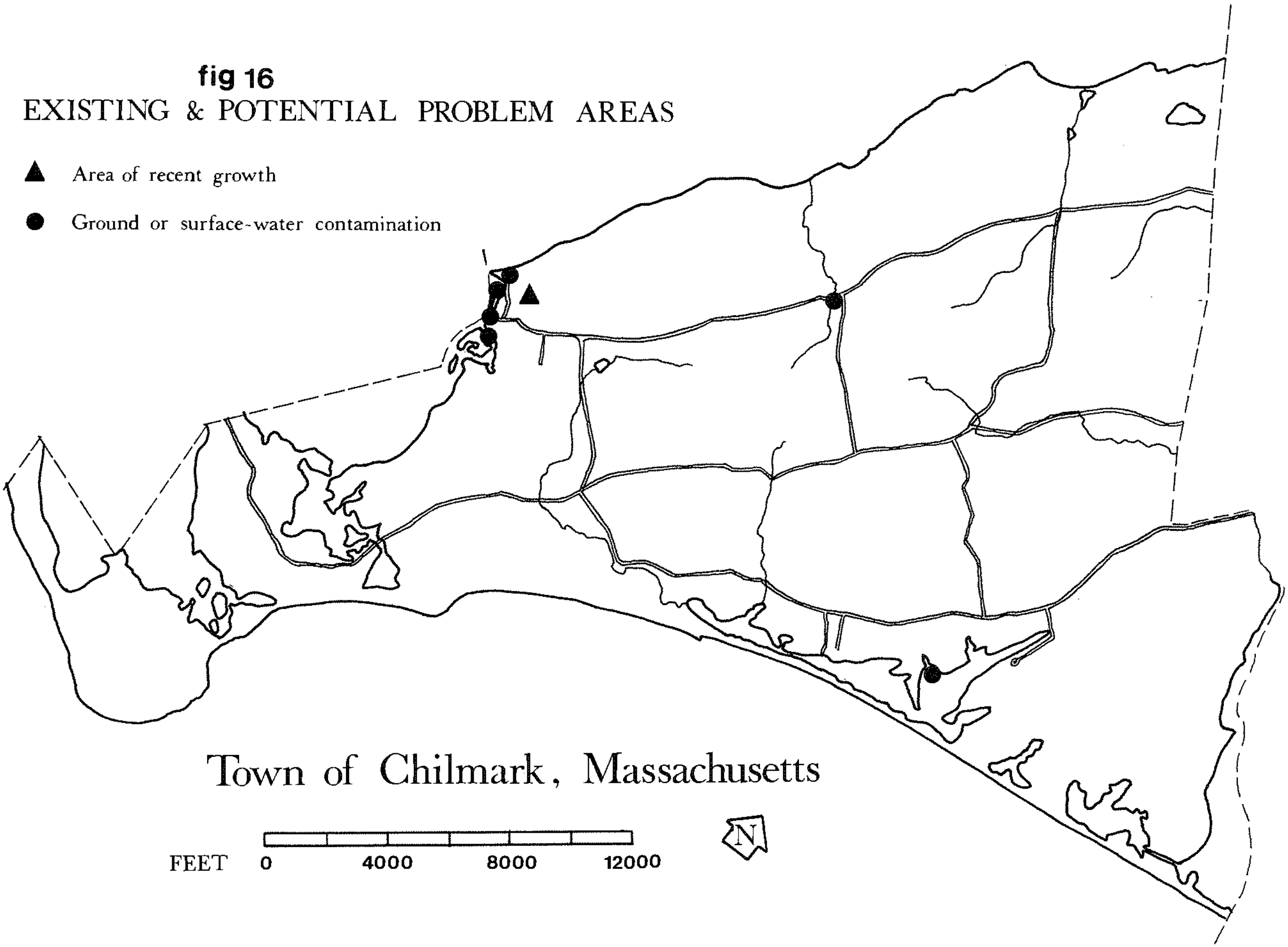
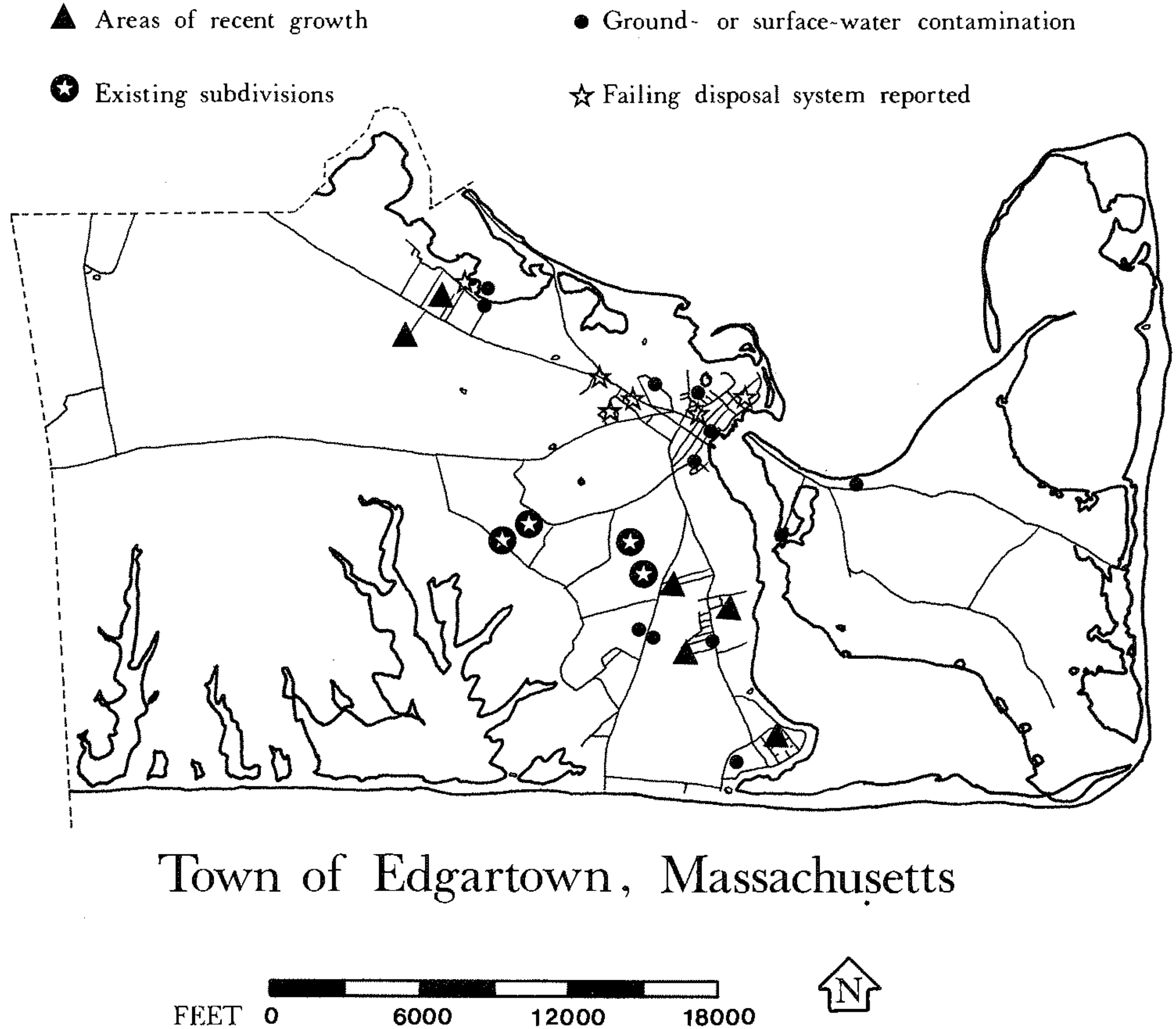


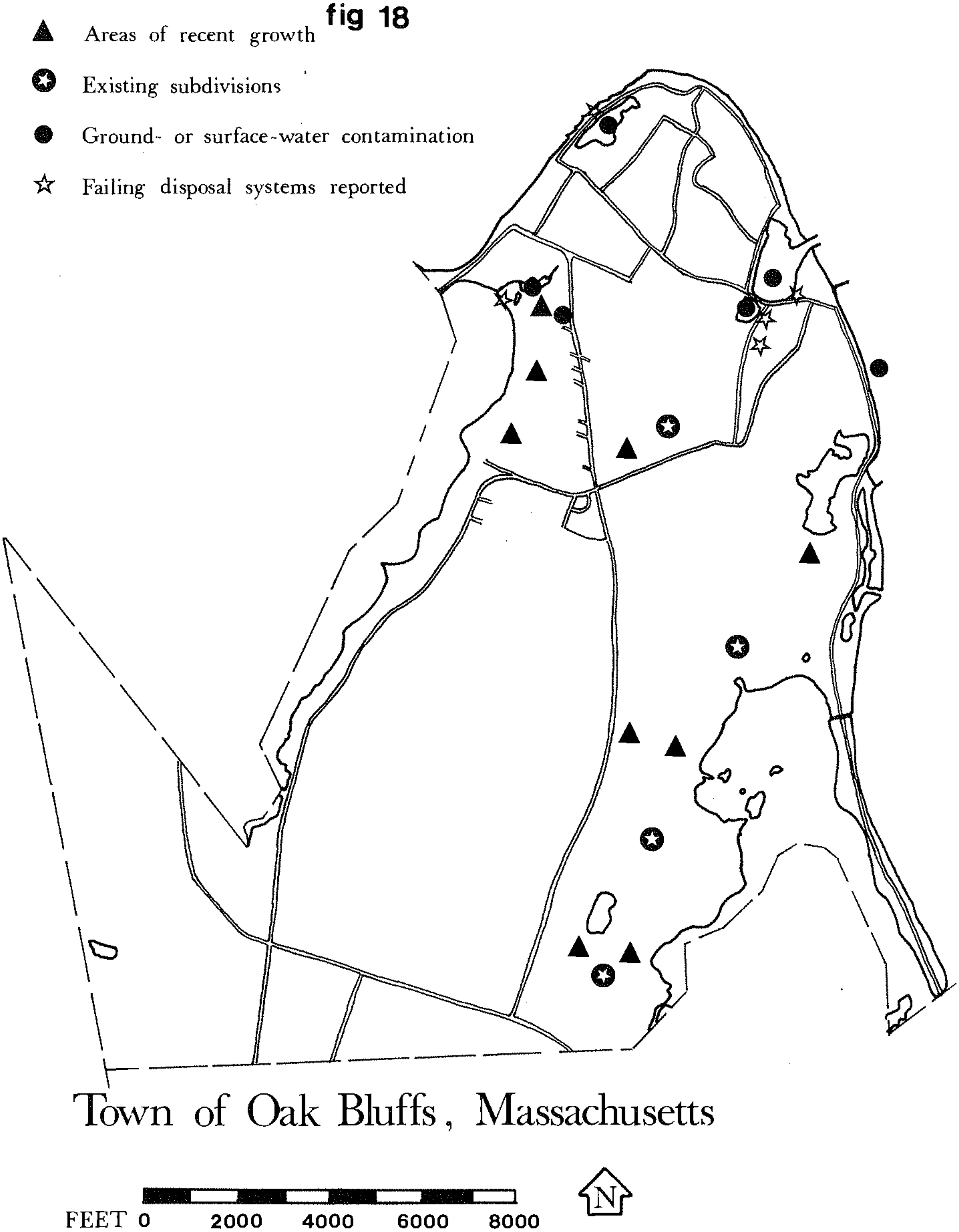
fig 17

EXISTING & POTENTIAL PROBLEM AREAS



EXISTING & POTENTIAL PROBLEM AREAS

fig 18



EXISTING & POTENTIAL PROBLEM AREAS

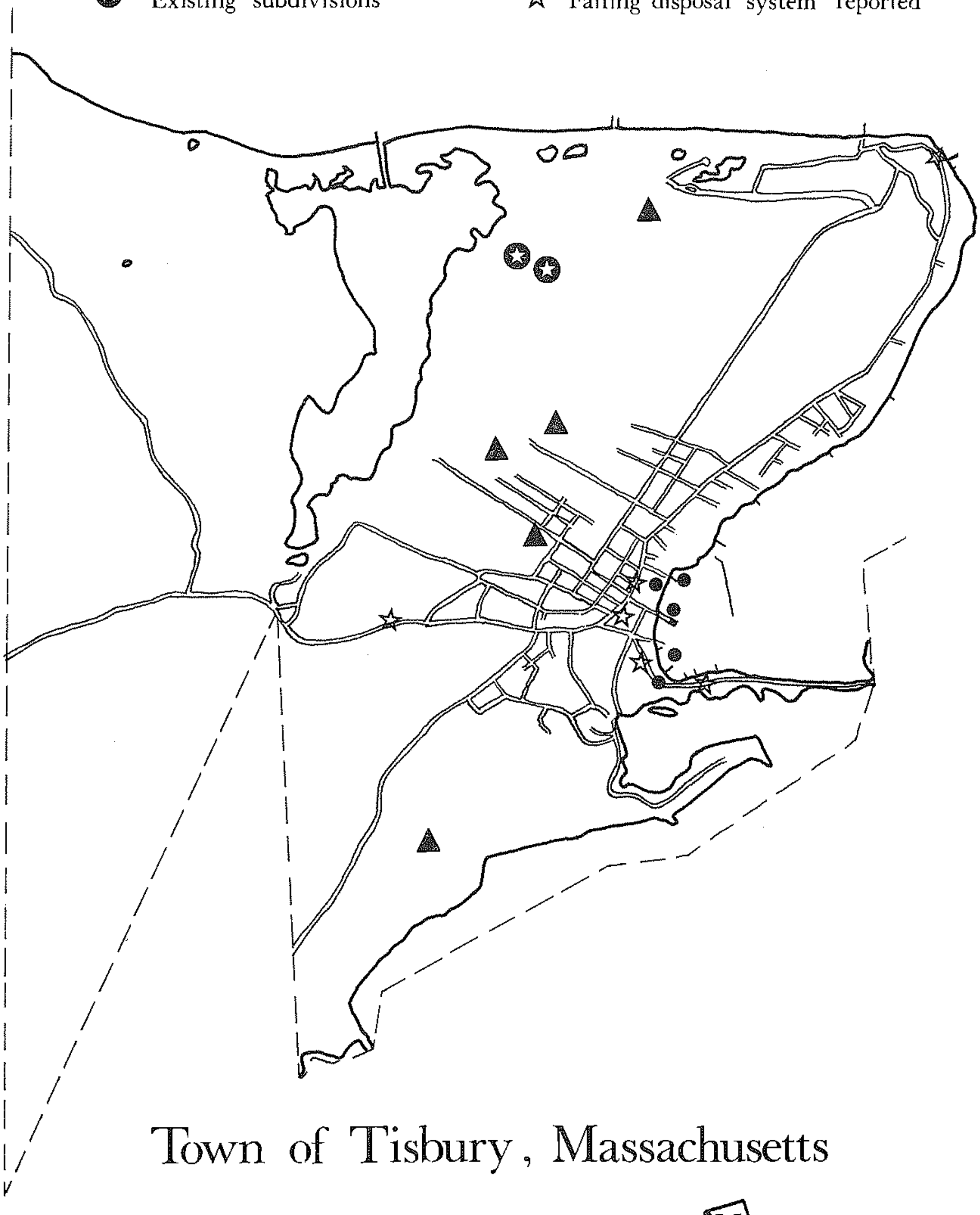
fig 19

▲ Areas of recent growth

● Ground or surface-water contamination

✪ Existing subdivisions

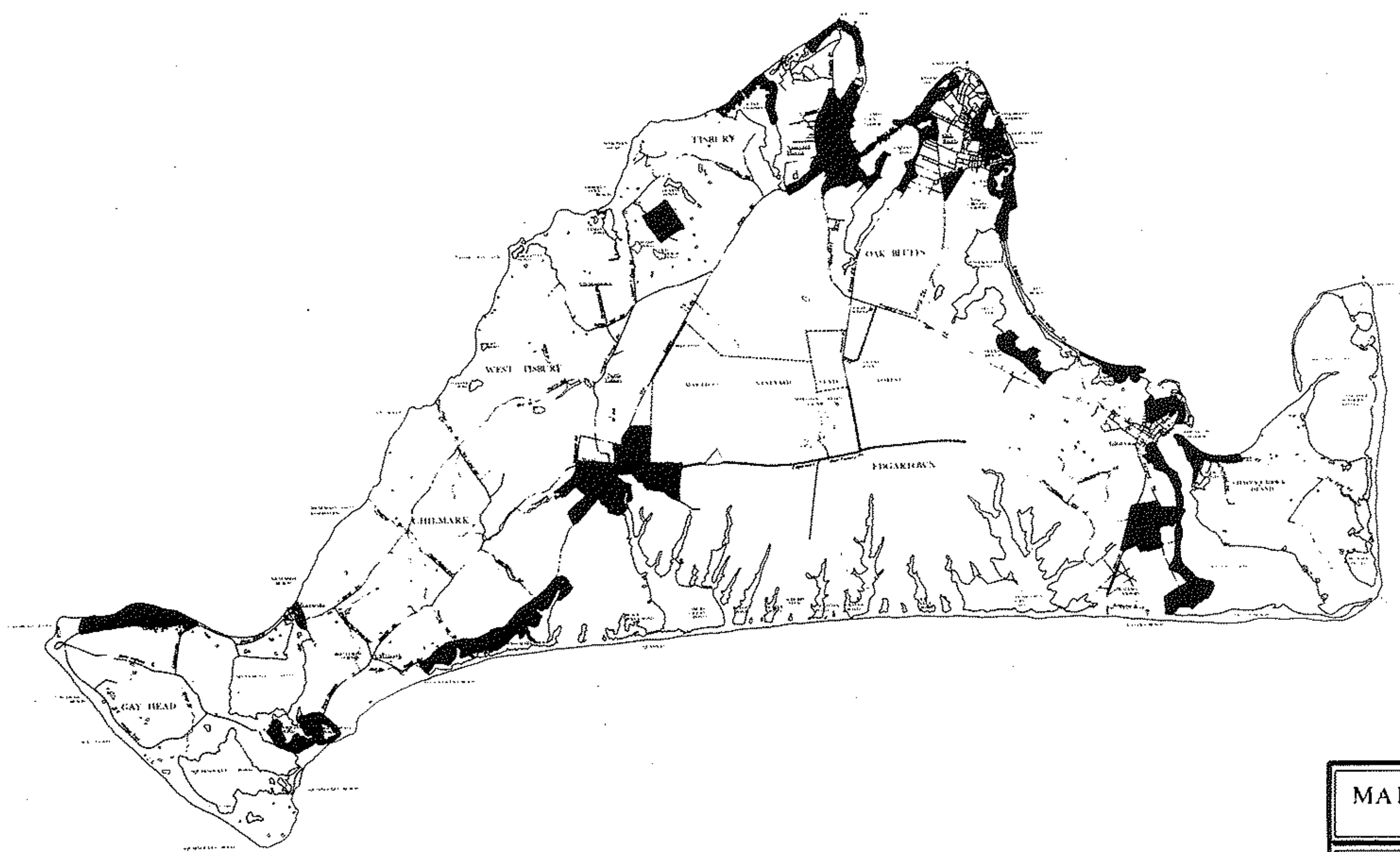
☆ Failing disposal system reported



Town of Tisbury, Massachusetts

FEET 0 2000 4000 6000 8000

N



Nightsoil Districts are areas where on-lot sewage systems are probably failing and an inspection/rehabilitation program is recommended.

MARTHAS VINEYARD COMMISSION

FIGURE 20
Night Soil Districts

7.35 Recommendation for a Regional Sanitary Engineer

At the present time the local boards of health are responsible for ensuring the proper design, installation and operation of septic systems. The duties of these local boards are becoming ever more demanding and complex. For example, where once the state reviewed and approved on-lot sewage systems handling over 2000 gallons per day, now the local boards must review and approve systems up to 15,000 gallons per day. New types of systems such as composting toilets are also now allowed. The duties of the Boards of Health could be made more effective and less demanding by the availability of a qualified sanitary engineer. The engineer would be called on to assist the Boards of Health with sanitary waste disposal problems, to attend their meetings and to instruct sanitary inspectors in such techniques as conducting percolation tests and inspecting new disposal systems prior to burial.

Another major duty of the engineer would be to conduct on-site inspections of disposal systems on behalf of the Boards of Health. These inspections might be required in areas where wastewater disposal problems are suspected or where new and innovative disposal systems are installed. This process would assure the detection and rehabilitation of potential sources of pollution before contamination occurs.

7.36 Septage Treatment Alternatives

In order to implement a maintenance program and ensure theproper operation of septic systems, Martha's Vineyard must find a way to treat its nightsoil. The Water Quality Program has recommended the establishment of Nightsoil Districts in fragile areas in each town. In these areas, regular inspection, pump-out and rehabilitation as needed will assure the proper operation of on-lot sewage disposal systems. This approach is very cost-effective because only failing systems are remedied and costly sewerage collection systems are not required. Maintenance and inspection programs will generate greater volumes of nightsoil, however.

The nightsoil districts outlined in Figure 20 are based on: identified problem areas based on contaminated wells or reported pumpouts, poor soils, high water tables, nearby fragile waters and density of dwellings. These areas are not intended to limit the scope of the inspection program but to focus immediate action on the problem areas. The nightsoil generated from these areas can be handled in a number of ways outlined in Table 20 and below. The impacts of alternative treatment methods are described in Table 21.

per what?

Table 20 Septage Treatment Options

Practice	Advantages	Potential Problems	Cost
1) Landfill no leachate control	simple, equipment already available	creates possible odor, insect, rodent and operation problems. Drains contaminated liquid to groundwater.	$ 2,000
leachate control	prevents groundwater contamination	added costs and operation	100,000
2) Composting	returns a desired product, increases landfill site life	requires area, equipment and operation, monitoring and control	150,000
3) Land Spreading	simple, returns a desired product;may increase fertility	requires area, probably some equipment, site preparation,control and monitoring	30,000
4) Lagooning	simple, most equipment already available	possible odor,insect and operation problems, contaminated liquid to groundwater, solids return to landfill	795,000
5) Addition to Waste Treatment Plant	control of treatment conditions at central facility	possible reduction of plant reliability, requires considerable equipment and operating expense; potential groundwater contamination and solids disposal problems	15,900
6) Special Treatment Plant	"	most of (5) above, greatest expense	4,000,000

Additional considerations of each of these alternatives are contained in the discussion

Summary of Capital and Maintenance Costs for Land Application of Septage

	Large Facility 7mg./year	Medium Facility 2.4mg./year	Small Facility .65mg./year
Capital Cost	$422,000-563,000	$260,000-317,000	$ 78,000-103,000
Annual operating cost	$56,000	$35,000	$14,000
Total Annual Cost (includes amortized cost)	$106,000-122,000	$ 66,000- 72,000	$ 23,000- 26,000

Capital costs should be increased to reflect local land costs of $5,000/acre.
These costs include- fencing, garage facilites, lagoon earthworks and liner, piping, access road, application truck, monitoring well and engineering costs amortized over design life of 20 years @ 20%.

From: Central Mass Regional Planning Commission (1977) Subsurface Disposal of Sewage in Central Mass.

TABLE 21

IMPACTS OF VARIOUS ALTERNATIVES

Method	Primary	Secondary
Composting (recommended) with shredded solid wastes, forced aeration (Beltsville method)	Accommodates perhaps 3,000 gal./day; dedication of about 3 acres. Cost: vic. $150,000 Operation: vic. $40,000	Generation of useful product; possibility of odor if poorly attended; implies public participation in waste sorting; labor intensive.
Further evaluation recommended: although this method would accommodate only a portion of the presently generated septage, it would reduce the consumption of the landfill and reduce the possibility of ground water contamination by the present landfill practice.		
Composting (recommended) with shredded solid wastes and additional materials, sawdust, wood chips, etc.	Costs: Beltsville method-- $100,000's + land. Eweson method-- $1-2,000,000. (Facilities have capacity to accept additional wastes)	"Industrial" activity, increased traffic and possibly noise; possible odor if poorly managed; additional effort to deal with product.
Further evaluation recommended: land area, labor and equipment are required for the windrow methods, adequate aeration and prevention of saturation are necessary to prevent ground water and odor problems. Otherwise the method is flexible, may require more solids than are readily available. The Eweson method may require training of personnel, may not be as capable of accommodating fluctuations in loading and is much more capital and energy intensive.		
Land Spreading (recommended)	Accommodates 35-75,000 gal. septage/acre/year; would require dedication of 20-40 acres to meet needs; results in increased plant growth; least likely to affect ground water of all methods which result in recharge.	Generates mulch hay or vegetation or increased fertility of woodlands; may with prolonged use cause limited fertility due to accumulation of toxic or inhibitory substances in the soil; public health aspects need consideration.
Further evaluation recommended: the method's simplicity and apparent benefits could, if substantiated, stimulate a demand for septage and ultimately result in the increased performance and service life of septic systems.		

Forgot lime stabilization of dewatering

1. Sanitary Landfill - The existing practice of dumping nightsoil in town landfills violates health standards. Septage is rated at over twice the potential hazard of treatment plant sludges. However, septage disposal in landfills is allowed in some areas. New Jersey allows 10 gallons/cubic yard solid waste as absorption limit. If leachate collection and treatment facilities exist, the safe loading rate may be increased. De-watered septage is much more compatible with landfill operation. Current practices of somewhat random disposal in open pits will, in all probability, lead to overloading the soil with waste water and increase the likelihood of ground water pollution.

   Trenching operations are very similar to landfills and in some cases the two could be combined. In trench disposal of septage, the septage is discharged into a dug trench, alternating soil and septage. A trench 6 feet wide, 100 feet long would contain slightly less than 2,500 gallons at a recommended depth of 6 inches. To absorb this pool would require about 2 feet of solid wastes (about 45 cubic yards) which should be covered daily by 6 inches of clean fill (11 cubic yards). In deep holes this layering could continue and be capped by an impermeable layer of soil about 3 feet deep. The solid wastes required would be the estimated daily total from about 2,500 people. for the whole trench

2. Composting - The annual septage generation on Martha's Vineyard is about 100 gallons (850 pounds) per person. If this were mixed with the solid wastes generated, about 750 pounds (assuming waste patterns similar to the rest of the nation), the moisture content would be about 55% which is in the appropriate range for composting processes. Alternatively, the septage could be mixed with sawdust or waste wood and brush chips in the ratio of 5 to 10 cubic yards of solids per 1,000 gallons of septage. The use of chips and a screening operation, recycling the larger particles after composting would reduce the consumption of the chips to about 2 cubic yards per 1,000 gallons.

   Composting is attractive since a usable product results. The demand for landfill area would also be decreased. The economic incentive however, must take into consideration the benefits of waste disposal and protection of ground water in addition to the usefulness of the product. The septage compost by itself could not justify the effort as it is probable that only 2,000 to 3,000 cubic yards of material would be produced annually (Laws, 1977).

3. Land Spreading - The application of septage to land utilizes the capacity of the soil and plant systems to utilize the nutrients in septage for growth, reduce or eliminate pathogens by aerobic soil microbial processes and accomodate the water by evapotranspiration and percolation. Application rates are based upon the percolation rate of the soils. The plants are harvested to remove most of the applied nutrients. Root structure and the generation of humus absorb most of the remaining materials with very little of the contaminating materials reaching ground water. However, there has been insufficient study of this method to ascertain the long-term effects either on the soil by accumulation of undesirable substances or on the transmission of human pathogens and parasites. Most studies indicate that the method is safe with the present application rate on crops not used for direct human consumption.

4. Lagoons, Ponds and Open Pits - Additional septage treatment methods are:

   a. direct discharge to an unsealed pit, which allows the more liquid fraction to sink into the ground and the solids to form a layer which is either buried or removed and buried elsewhere (at present this is the most common form of disposal on Martha's Vineyard);

   b. discharge to a sealed pit from which the liquid layer is permitted to overflow either to an infiltration/percolation pond or to a treatment facility, and then to the ground, the solids again being removed for disposal elsewhere;

   c. discharge to a sand bed from which the underflow is collected for treatment before further infiltration (the solids are removed as in [a]).

5. Sewage Treatment Plants - At the present time, this method of treatment is generally recommended nationwide. Treatment plants do have some difficulty processing septage because the balancing of physical and biological factors necessary to meet strict effluent quality requirements is easily disrupted by variations

in concentration and character of the input streams. Dilution and aeration of the septage before introduction to the incoming sewage may reduce variations in concentration in the system. Other alternatives are:

a. to store the septage and slowly introduce it in regulated quantities;

b. to treat the septage as a waste sludge, mixing it with the treated sludges;

c. to dewater it, combining the liquid fraction with the dewatered treatment sludge;

At the present time the treatment plant at Edgartown is accepting limited septage, holding it and slowly introducing it with the sewage stream. Perhaps as much as 10% of the flow is obtained by truck. Much of this material during the high flow period is believed to be essentially raw sewage from holding tanks. The Edgartown treatment plant could be expanded to accept all the residential septage from the Island with the addition of 3 sealed lagoons about 1/2 acre each with an average depth of about 6 feet. After filling, the septage in a lagoon would be allowed to settle for a month or more, the surface liquid transferred to the sewage treatment plant, the sludges dewatered and removed and the lagoon prepared to receive more septage. This sludge is currently used by gardeners. It is projected that 100 tons of sludge (50% moisture) would be generated annually from about 2.3 million gallons of septage. If the sludge were used as a soil builder, spread at a 1/8 inch depth about 10 acres would be benefitted. Pretreating the septage with lime might reduce the number of lagoons needed to reduce odors and insects, improve the quality of the sludge as a soil builder and reduce the possibility of disease transmission (at the cost of additional facilities, operation and materials).

An alternative is available calling for the construction of a pretreatment system for the nightsoil which is then bled into the incoming wastewater flow. This entails an expansion of the existing 7,000 gallon holding and pretreatment tank. In Hyannis, this approach is used to treat nightsoil (0.26 mgd) added to 1.1 mgd of raw sewage. A system of this sort could be developed for the Edgartown treatment plant and could easily handle total flows from the Island (an average flow of 0.03 mgd in summer).

If a facility is constructed which will handle nightsoil from Oak Bluffs, Tisbury and West Tisbury it is recommended that either Chilmark and Gay Head be included or arrangements be made for the Edgartown treatment plant to handle their nightsoil. The expected flows from the 1,000 homes in the area are very low (roughly 300,000 gallons per year are expected as a maximum).

6. Septage Treatment Plant - Construction of a special facility which would stabilize and discharge the materials contained in septage would be quite expensive. With Island-wide peak flows likely to be in the vicinity of 30,000 gallons per day, the expected capital costs would be close to 2 million dollars with annual operation and maintenance costs of about 100 thousand dollars. The difference in costs between sewage treatment and septage treatment is a reflection of the thousand-fold greater concentration of contaminants in septage. Thus there are definite economic advantages to consolidation of facilities.

On Martha's Vineyard the usual economics of scale are inoperative. Due to the seasonal population, the equipemnt and facilities must be able to accept the summer peaks and yet be able to operate effectively and economically in the winter when the requirements are only 1/5 as great. A treatment plant will be largely underutilized during the off-season months. There is similarly no economic advantage to having a number of smaller treatment units. The possible savings to pumpers in transportation costs would be very small considering that a regional facility would rarely require hauls of more than 15 miles (Laws, 1977).

Types of systems available:

Chemical Coagulation - Septage placed in storage tanks where it is equalized than pumped to the treatment facility. Flash mixer adds ferric chloride and lime. Solids are than separated and dewatered. Effluent is chlorinated and pumped to recharge beds. Final effluent not of a quality for in-ground disposal.

Purifax - Uses chemical oxidation by chlorination. Chlorine gas applied at 30 to 40 psi. Wastewater discharged to a lagoon to allow dissipation of high

Some adverse impacts

chlorine residuals. Reduction in acidity of effluent also required.

Aerated Lagoons - Septage screened and passed through 3 large settling lagoons to an aeration lagoon where it is aerated and passed to a final settling lagoon. Final effluent is disinfected and discharged to the ground. Settling lagoons tend to clog with solids.

Rotating Biological Discs - Septage is screened, chemically conditioned and allowed to settle. It is then introduced into a system which encourages biological growth on rotating discs which regularly pass through the liquid. Organics are biologically oxidized.

7.37 Summary

On-lot sewage disposal systems are undoubtedly the most serious threat to the Island's ground and surface waters. In Table 22, on-lot wastewater disposal alternatives are evaluated in terms of environmental, economic, social and political criteria. These considerations led to the conclusion that we should initiate remedial action in two areas: the siting and installation of septic systems and the inspection and rehabilitation of existing systems which are failing. Recommendations are made in this chapter for the increase in well-septic system separation in areas not to be served by public water or sewage and the improvement of the sizing of leaching areas. Further recommendations are made for establishing an inspection/rehabilitation program under the supervision of the local Boards of Health to assure the detection and correction of failing systems. In areas where the density is such that these actions are unsuccessful, sewering, as described in the next chapter, may be needed. With these tools we may continue to protect and improve our water resources.

KEY

- * Very Positive
- \+ Positive
- 0 No Impact
- \- Negative
- = Very Negative
- G Good
- F Fair
- P Poor

TABLE 22
ON-LOT DISPOSAL

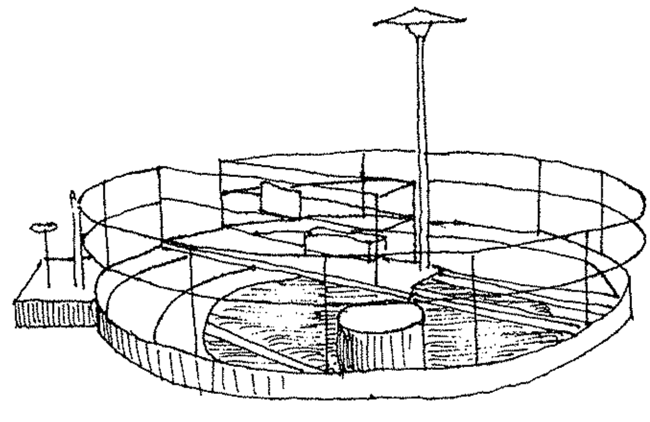
IMPACTS / ACTIONS	Do Nothing	Improve Controls	Improve Health Code	Adjust Lot Sizes	Require Maintenance	Exclude Leach Pits From Porous Soils/High Water Tables	State Inspection Program	Subdivision Control: Require Information	Increase Septic Tank Size	Plan Future Sewer & No Sewer Areas	STATE ACTIONS	Continue to Improve Title 5	Develop Viral Detection Technology	FEDERAL ACTIONS	EPA Support Small-Scale Solutions	EDUCATION	Improve Water Conservation	Encourage Dry Toilets	STRUCTURAL SOLUTION	Advanced Individual Treatment	Package Treatment	Sewering
1. WATER QUALITY GOALS																						
A. Fullfills Clean Water Act	-		+	+	+	+	+	+	+	+		+	0		+		+	+		+	+	+
B. Summary Rating	P		G	G	G	G	G	G	G	G		G	0		G		G	G		G	G	G
2. ENVIRONMENTAL EFFECTS																						
A. Hydrology																						
1. Water Quality	-		*	*	*	*	+	+	+	+		+	0		+		+	*		+	+	+
2. Water Quantity	0		0	+	0	0	0	+	0	+		0	0		+		+	+		0	0	-
3. Water Problems	-		+	+	+	+	*	+	+	0		0	+		*		+	*		*	*	*
4. Water Uses	-		+	+	+	+	+	0	+	+		+	+		+		+	+		+	+	+
5. Flood Hazards	0		0	0	0	0	0	0	0	0		0	0		0		0	0		0	0	0
B. Biology																						
1. Rare Species	-		+	+	+	+	+	0	0	0		+	0		0		0	0		0	0	0
2. Aquatic Habitat	-		+	+	+	+	+	0	0	+		+	0		+		0	+		+	+	+
3. Aquatic Population	-		+	+	+	+	+	0	0	0		+	0		0		0	0		+	+	+
4. Benthic Community	-		+	+	+	+	+	0	0	0		+	0		0		0	0		+	+	+
C. Air Quality	0		0	0	0	0	0	0	0	0		0	0		0		0	0		0	-	-
D. Land																						
1. Change in Use	0		-	-	0	0	0	0	0	*[6]		-	0		+[6]		0	0		+	+	*
2. Planning & Controls	-		+	+	+	+	+	+	+	+		+	+		+		0	0		+	+	+
3. Growth	+		-	-	0	0	0	0	0	+		0	0		+		0	0		0	+	*
4. Soil Erosion	0		0	0	0	0	0	+	0	0		0	0		0		0	0		0	0	0
5. Sensitive Areas	-		+	+	+	*	*	+	+	*		+	0		+		+	+		+	+	+
E. Wastewater Management Resources																						
1. Energy	0		+[2]	+[2]	+[2]	0	-[4]	0	+[2]	-[7]		+	0		-		+	+		-	-	=
2. Chemicals	0		+[2]	+[2]	+[2]	0	0	0	+[2]	-[7]		+	0		-		0	+		-	-	=
3. Land Commitment	0		+[2]	+[2]	+[2]	0	+[2]	+[2]	+[2]	-[7]		+	0		-		0	+		+	-	-
F. Summary Rating	P		FG	FG	G	G	G	G	G	FG		G	G		FG		G	G		FG	F	FP
3. ECONOMICAL COSTS																						
A. Cost																						
1. First Cost	+		-	-	-	-	-	-	-	0		-	0		-		+	-		-	-	=
2. Annual Cost	+		+	+	-	0	+	0	0	0		+	0		-		+	+		-	-	=
3. External Cost	-		*	*	*	+	*	+	+[5]	+		+	0		+		+	*		-	-	-
B. Value of Goods & Services																						
1. Recreation	-		+	+	0	0	+	0	0	0		+	0		+		0	0		+	+	+
2. Water Supply	-		+	+	+	+	+	+	+	+		+	+		+		*	+		+	+	+
3. Fishing & Shellfishing	-		+	+[3]	+[3]	+[3]	+[3]	0	0	0		+	+		+		0	+		+	+	+
C. Jobs	0		+[1]	+[1]	+	0	+	+	0	0		0	0		+		0	0		+	+	+
D. Economic Base & Stability	-		0[1]	0[1]	0	0	+	0	0	0		0	0		+		0	0		+	+	+
E. Summary Rating	P		FG	FG	FG	G	G	G	G	G		G	G		FG		G	FG		F	F	F
4. SOCIAL EFFECTS																						
A. Dislocation of People or Services	0		-	-	0	0	0	0	0	*		-	0		+		-[9]	-[9]		0	+	+
B. Public Health	-		*	+	+	+	+	+	+	+		+	*		+		+	+		+	+	+
C. Aesthetics	-		+	+	+	+	+	+	0	+		+	0		+		+	0		+	-	-
D. Educational & Cultural	0		0	0	0	0	0	+	0	+		0	+		0		+	+		0	0	-
E. Summary Rating	P		FG	FG	G	G	G	G	G	G		F	G		G		G	FG		G	F	F
5. IMPLEMENTATION																						
A. Legal Authority	+		+	+	+	+	+	+	+	+		+	0		[8]		0	0		[8]	[8]	[10]
B. Financial Capacity	+		+	+	+	+	-	+	+	+		+	+		-		0	0		-	-	=
C. Practicability	+		+	+	+	+	+	+	+	+		+	+		+		0	0		-	-	-
D. Public Accountability	-		+	+	+	+	*	+	+	+		+	*		+		+	+		-	-	-
6. PUBLIC ACCEPTABILITY	-		+	-	+	+	+	+	+	+		+	+		+		+	-		-	-	-

NOTES:

1. The impact of added controls on overall growth is uncertain.
2. Will decrease likelihood of sewering.
3. Uncertain
4. Requires nightsoil treatment.
5. Increased life of system.
6. May stimulate growth.
7. Will require treatment facilities.
8. Requires state approval of the small-scale approach.
9. Requires change in habits.
10. Requires state & federal approval & local ordinance.

8

Municipal Sewering Systems



8.0 Municipal Sewering Programs

As part of its 208 program, the Martha's Vineyard Commission was required to identify the anticipated municipal collection and treatment works to be constructed over a twenty year period and to establish construction grants priorities over a five year period. This is an extremely complex task. Edgartown has the only municipal sewer system on the Island. At the present time, Edgartown is working with its town consultants in an effort to expand its sewer service area. The Towns of Tisbury, West Tisbury, and Oak Bluffs have also retained a consultant in order to evaluate their sewering needs and recommend a solution.

In the past, sewering was considered a cure to all wastewater problems. However, evidence is accumulating rapidly that many of the wastewater treatment facilities funded, or planned for funding, are too expensive for the local population. A recent EPA survey indicates that "the costs are particularly burdensome on populations of communities under 10,000 that require new wastewater collection systems." This survey also indicated:

1. construction of large centralized sewer systems often result in greater induced, unplanned and environmentally adverse development than the construction of decentralized systems;

2. the costs of construction of centralized collection and treatmentsystems have increased at a much more rapid rate than installation of traditional on-lot disposal units such as septic systems;

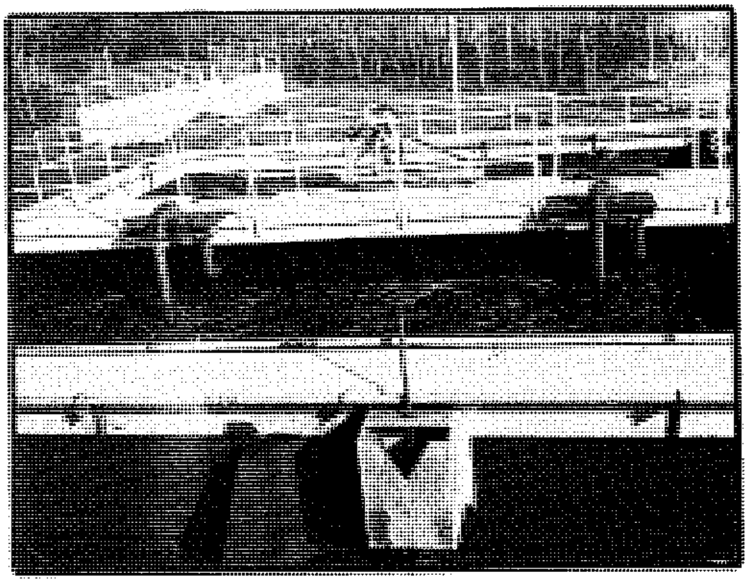
3. costs of centralized collection and treatment systems, especially in some small communities are beyond the financial means of many local residents.

Under Section 201 of the Federal Water Pollution Control Act Amendments, funds are provided for the construction of municipal sewage treatment facilities. Funding is usually available for wastewater treatment plants, interceptors and pump stations in the following proportions: 75% Federal, 15% State, and 10% local. For projects submitted through September, 1977, the Division of Water Pollution Control has extended this cost sharing to cover the collection system.

Recently adopted EPA policy regarding funding for sewage collection systems requires that the proposal be proven in the facility plan to be necessary and cost effective. Alternatives must be thor-

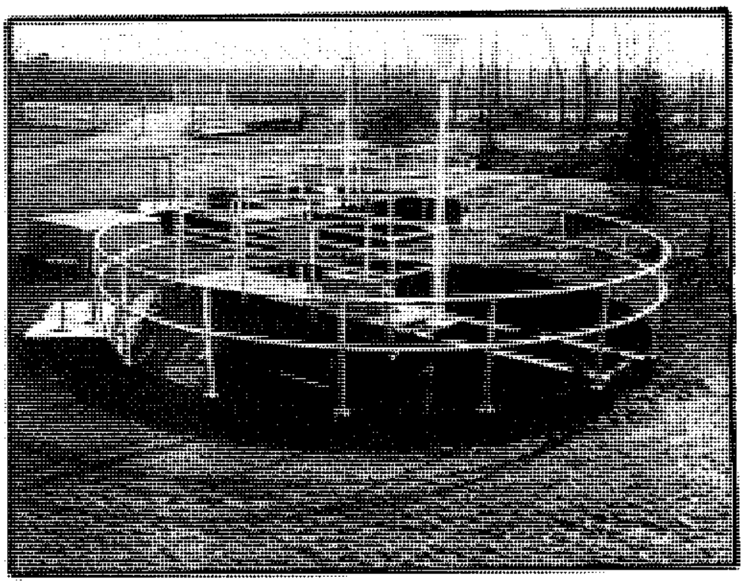
SOLUTIONS

Technological waste·disposal:



Edgartown sewage treatment plant

Aerator



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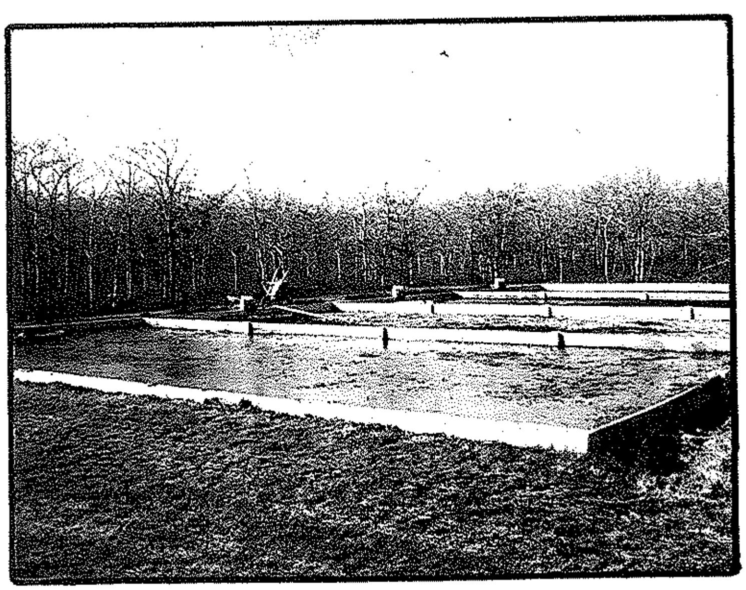


Sludge drying beds

oughly evaluated and documentation of the public health threat arising from the existing disposal systems must be presented. These policies are further elaborated in Section 8.42.

8.1 Existing Municipal Sewer Service

At this time only Edgartown is served by a sewage system. Sanitary sewers in the town of Edgartown primarily serve the downtown area, including the major hotels, restaurants and commercial establishments located along the waterfront.

Presently approximately 200 hookups exist. Users pay a fee of $16.00 per drain (sink, toilets, washing machine, etc.) or roughly $200 per year for an average home. The system is designed to handle a total of 500,000 gpd. Summer flows amounted to 90 to 100,000 gpd in 1975 and 150,000 gpd in 1974. Average winter flow is 12,000 gpd. During winter months, low flows result in partially anaerobic wastewater reaching the plant which presents treatment difficulties and results in an odor problem. Retention time in the pipes often amounts to over 24 hours. Consideration is being given to injecting peroxide into the pipe system to eliminate the odor problem; expansion of the sewer system should also improve the flow and plant operation.

The treatment process is activated sludge with extended aeration available. This is a biological treatment technique in which a mixture of wastewater and biological sludge (micro-organisms from the treatment of a previous batch of sewage) are agitated and aerated. Septage is also handled in variable amounts ranging up to a maximum of 20,000 gpd. The holdingtank for septage is 7,000 gallons and offers pre-treatment in the form of aeration and chlorination. Periodically, amounts of septage in excess of the holding capacity arrive and must then be added directly to the system with no pretreatment causing adverse effects on the treatment process. On the whole, analyses of the effluent indicated very good BOD removal of 90-95 percent. (State Analysis) Consideration is now being given to more complete removal of nitrogen and phosphorus compounds.

Should have elaborated somewhat

Any rec's?

8.2 On-Going Sewering Studies

Municipal facility planning (201 Planning) is designed to provide orderly development and submission of application for Federal and State Funding of waste treatment plants and portions of the sewering. Under the Water Pollution Control Act Amendments of 1972, more than $500 million in federal and state funding is available to Massachusetts 351 cities and towns on a matching basis for facilities construction. At a minimum, all municipal facility plans include:

a. a cost-effective analysis comparing biological, physical-chemical, and land disposal processes--to select the most efficient treatment for the needs of the municipal area;

b. an evaluation of alternatives for advanced sewer systems, including an analysis of possible interceptor connections to other municipal systems;

c. an evaluation of alternative sites and service areas;

d. a brief environmental assessment (impact statement) of the effects of the recommended treatment works on air, land, water and other resources;

e. a complete analysis of cost of all elements in the system.

8.21 Tighe and Bond Report

The Tighe and Bond study, initiated in 1974, focused on the needs of Oak Bluffs, Tisbury and West Tisbury. The study was initiated primarily over the need for a safe means of disposing of 40,000 gallons of nightsoil per day (1975 average summer day). Both sewerage and nightsoil treatment alternatives were considered and regional facilities were recommended.

The study proposed two nightsoil treatment techniques. The Purifax system employed chlorine under pressure to treat the waste. Concern over the environmental impacts of chlorination led to the rejection of this alternative. The more costly but more environmentally sound rotating biological disc system was also considered. A second volume of the study recommended sewage service for the area of Tisbury and Oak Bluffs shown in Figures 23 and 24. The sewage system proposal was supported at a Tisbury town meeting while Oak Bluffs and West Tisbury were primarily interested in nightsoil treatment. The concern of the Environmental Protection Agency over the sewering of a previously unserviced town led to a decision for an Environmental Impact Statement as described in Section 8.23.

8.22 Coffin and Richardson Report

The Coffin and Richardson Study, initiated in 1966, focused on the needs of the town of Edgartown.

The presence of numerous commercial establishments in low-lying waterfront areas had led to poor harbor water quality and failing on-lot sewage disposal systems. The study recommended sewer service in two phases. Phase one was designed to serve the densely developed residential and commercial sections of town. In 1973, sewer service was provided to this area extending from North Summer Street to the Harbor as shown in Figure 22. Phase two, as recommended, would service the remaining developed areas as outlined in Figure 22. On June 16, 1977, town meeting vote authorized the application for immediate sewage system expansion to the three critical areas outlined in Figure 22. The Sewer Commissioners were also directed to seek funding to complete the Phase two area originally proposed by Coffin & Richardson.

8.23 EPA Environmental Impact Study

In September, 1976, EPA initiated a process to more thoroughly review the sewage system, proposals for Tisbury and Oak Bluffs. Water quality sampling wells were installed in the downtown areas to assess the impacts of existing disposal systems and to define the area of need. Additional wells were installed at the proposed Tisbury treatment site to assess the impacts of sewage treatment effluent disposal in that area. Additional sites have been examined for treatment plant locations in both Tisbury and Oak Bluffs. The study has generally concluded that smaller initial sewage service areas are most needed and cost-effective. These areas are outlined in Figures 23 and 24. No conclusion has as yet been reached on the most appropriate treatment site. A draft report will be issued in August, 1977.

8.24 Other Reports

In 1967, Metcalf and Eddy studied the Menemsha Village area for possible need for a sewer system. In the area surveyed, 70 residential units and a number of boats in the Basin were found to contribute to poor surface water quality. The study recommended sewer service with a septic tank system to handle the winter's waste and an extended aeration-activated sludge system to handle the summer's waste (average 40,000 gallons per day). The town has decided to use a non-structural solution to the problem by excluding toilets from the fishing shacks along the Basin.

8.3 Water Quality Program Relationship with On-Going Sewering Study

Basically the Water Quality Programs requirements described in Section 8.0 overlap with the on-going sewering studies described in Section 8.2. In order to avoid duplication of effort, the Water Quality Program has been working closely and coordinating our activities with the on-going sewering studies. The on-going sewering studies are responsible for determining treatment plantsites, size, type of process, method of effluent and sludge disposal, interceptor sewer routing and other steps necessary for constructing the project.

The Water Quality Program will review and evaluate the on-going sewering studies and include them where appropriate, identify alternatives, identify potential sewer service areasand anticipated municipal collection and treatment works to be contructed over a twenty year period and recommend construction grants priorities over a five year period.

8.4 Wastewater Disposal Alternatives

Whereever future growth occurs, wastewater disposal needs must also be met. Depending on the soils, depth to ground water, proximity to fragile surface waters and ultimate housing density, various means to dispose of wastewater are feasible. With larger lot sizes or better treatment systems, individual disposal units can be safely used. Composting toilets are now available and other improved technology might be permitted by the State Environmental Code. Until that time we are faced with a choice of either providing lot sizes sufficient for individual supply and wastewater disposal or planning on the eventual need for public services.

composting is allowed!

The high growth scenario described in Chapter 4 will require certain services such as water supply and, in some areas, sewering. The need for these services can be predicted from past changes in intensity of use, projected growth and the nature of the soils and ground and surface watersin the area of concern. Several alternative approaches to lessen the impact of projected demand for service include:

1. Preventative Action - (zoning and health requirements);

2. Rehabilitative Action - (repair or replacement of failing on-lot disposal systems; installation of aerobic treatment tanks (as they are allowed), composting toilets, etc.) This alternative was discussed in a previous chapter.

3. Package Treatment Plant

4. Town-wide Treatment Plant

8.41 Preventive Action

In order to ensure that the treatment method or methods which a community employs will adequately serve the future, careful consideration must be given to the location and type of future development in the community. With present zoning, public water supply and possibly sewer service might be needed in widely dispersed parts of the three down Island towns. Such is the present case in Edgartown where both Ocean Heights and Mattakesett are being considered for water service.

Various land use management techniques should be considered by these three communities to prevent the helter-skelter demand for municipal sewering and water supply. Chapter 6 spells out the various land use regulations the community might utilize to ensure orderly growth. Chapter 7 spells out a program to ensure the proper operation of on-lot disposal systems.

8.42 Rehabilitative Action

In the areas where conventional disposal units have caused ground or surface water contamination, rehabilitative actions are required. The areas where problems exist or are expected to develop due to soils and ground water conditions are outlined in Figures 16, 17, 18, and 19. The inspection program is outlined in the Implementation section of this report and the areas where this program should be conducted are defined as Nightsoil Districts in Figure 20. EPA is requiring that all facilities applications for funding collection systems must demonstrate in areas of population density of less than 10 persons per acre that alternatives are clearly less cost-effective than sewering. The alternatives which must be considered include:

- improved operation and maintenance of existing septic tanks;
- new septic tanks;
- holding tanks and "honey wagons";
- upgrading existing septic systems by using aerated mounds, alternate leaching fields, etc.;
- other systems to serve individual or clusters of households.

This program supports this concept and has recommended the initiation of an inspection and rehabilitation program. The most vital aspects of this program include:

1. Rehabilitation - rehabilitation of household wastewater systems may involve replacement-correcting broken pipes, cleaning drainfields,

installation of new leaching fields, etc.

2. Water supply quality monitoring - failure of disposal systems in an area may first show up as pollution of supply wells in the area.

3. Nightsoil pump-out documentation - septic systems may fail by backing up repeatedly. If point of origin records are kept the need for remedial action can be quickly ascertained and problem areas readily defined.

4. Inspection of existing disposal units in fragile areas - older systems were often improperly installed, and unless these problems are uncovered and rehabilitated, continued water quality contamination will occur.

In the case where small lots preclude new leaching areas or where the density of units calls for more advanced treatment systems, aerobic wastewater disposal units (when approved), composting toilets and other flow reducing measures may be required.

Tight tanks may have to be installed in areas where zero discharge is required due to high water table or proximity of small lots to a fragile surface water body.

These systems are currently discouraged by the State Department of Environmental Quality Engineering. This 208 Program recommends that these systems be approved in the future to handle isolated water quality problem areas where connection to an existing townwide sewer system is prohibitively expensive. The Environmental Protection Agency is now supporting the concept of small solutions to treatment problems in small areas.

8.43 Package Treatment Plants

These self-contained systems can treat sewage from several to several hundred homes. Many of the systems available are similar in operation to larger, more conventional treatment plants. They require regular maintenance checks and a qualified operator to assure proper operation. If several such systems were in operation, a single operator might be shared. Alternatively, the operator of a larger existing treatment plant could be called on for periodic operational inspections.

There are presently available aerated tank units able to accomodate a wide range of wastewater flows. While the units designed to receive the wastewater from one unit cost about $2,500, units designed for about four units cost about $1,000 per unit, and for equivalent treatment about $600 per unit for 25 units. For extended aeration Package Treatment Plant (PTP) equipment with additional capabilities of mechanical sludge separation and effluent chlorination, the costs are about $1650/unit for a 25 unit facility $750 for a 65 unit facility and $440 for a 135 unit plant. A physical-chemical PTP with even higher quality effluent, costs about $1130 per unit for the 135 unit plant and $940 for a 270 unit plant. These figures are outlined in Table 23.

To these figures must be added the costs of the collection sewers, effluent water disposal, sludge disposal were needed, maintenance and materials, and as there may be implied or available alternatives in water supplies, their costs should be included in the assessments. Sewer pipe costs have been estimated to be about $8 per lineal foot; leaching field installations are estimated to range from $1.40 down to $1.10 per square foot; for large units spray irrigation systems are estimated at 17 units per acre with installation costs of about $350 per acre and $300 for supply pipes (Enviro/Earth Ltd., 1977). Operation and maintenance costs vary from a percent or two of the capital costs for the simple systems, septic tanks and sprinklers to about 15% for the mid-range tertiary treatment plants and then down to about 10% for the larger plants discussed. An additional difficulty in assessing the various treatment methods is that the plants have traditionally been designed to reduce the total suspended solids and the oxygen demands of the effluent. The characteristics of nutrient removal have been explored for the more complex physical-chemical tertiary treatments, but very little data is available on the effluents of the simpler systems. Data of this kind will have to be obtained in order that the environmental impacts can be assessed for the various treatment techniques. Based on the information above and a life or amortization of 20 years and an interest structure which equals the capital cost, table 24 indicates the relative cost of the various treatment and residential unit densities.

8.44 Sewering

Another solution to a problem area is to provide sewering. Cost estimates are included in Table 25 for the various alternative sewering proposals advanced by on-going sewering studies (areas to be served are outlined in Figures 21-24).

Future costs will increase. The 1985 estimates for sewering are based on an estimate of future price increases. Economic indicators during the early 1970's

Table 23 PACKAGE TREATMENT COSTS BY SIZE

units served by wastewater treatment facility	flow gallons per day	Dollars per year per unit: leach field (l.)	spray field (s.)	infiltration pond (p.)**
single	450	73	nr*	nr
25	10,000	52	47	nr
65	25,000	48	25	5
135	50,000	48	23	3
270	10,000	48	22	2

over 20 years?

*not recommended

*There have been proposals for the disposal of effluents after treatment by single unit systems. These might be used for aeration tank systems, although to do so would seem hazardous from health and operational points of view. They would seem more appropriate for systems which have separated the toilet wastes.

**Only the simplest of impoundments is considered here, and used only with treatments with higher quality chlorinated effluent.

Table 24 1/4 Acre Lot Package Treatment Costs

Units Served	Septic Tank	Aerated Tank	Units Spaced 100 Feet Apart (about 1/4 acre lot) Sewer Pipe at $40/unit/year: Extended Aeration PTP	Physical Chemical PTP
single	272	1.447(1) (s.395)*		
25	c.152	1.202 s.197	1.262 s.257	
65			1.243 s.220 p.200	
135			1.178 s.155 p.135	1.313 s.290 p.270
270				s.255 p.235

*"Backyard spray system @ $20/yr."

Table 24 1 Acre Lot Package Treatment Costs

Units Served	Septic Tank	Aerated Tank	Extended Aeration PTP	Physical Chemical PTP
			Units Spaced 200 Feet Apart (about 1 acre lots) in areas averaging 1 unit/acre	
single	272	1.447 (s.395)*		
25	192	1.343 s.237	1.302 s.297	
65			1.283 s.260 p.240	
135			1.218 s.195 p.175	1.313 s.290 p.270
270				s.295 p.275

Table 24 1½ Acre Lot Package Treatment Costs

Units Served	Septic Tank	Aerated Tank	Extended Aeration PTP	Physical Chemical PTP
			Units Spaced 245 Feet Apart (60,000 square foot lots) Sewer Pipe @ $98/yr.	
single	272	1.447 (s.395)*		
25	210	1.260 s.255	1.320 s.315	
65			1.301 s.278 p.258	
135			1.236 s.213 p.195	1.331 s.301 p.288
290				s.313 p.293

site sources

Table 25 Costs for Alternative Future Sewer Service

Proposal	Town	Capital Cost	Annual Cost
Tighe & Bond (1975)	Oak Bluffs Tisbury	$ 5.5 million	$86,000
Metcalf & Eddy (1972)	Edgartown	$ 7.7 million	-
	Oak Bluffs (& new community)	$13.1 million	
	Tisbury	$ 8.9 million	
Environmental Impact Statement	Tisbury	$ 1.8 million	$55,000
	Oak Bluffs	$ 1.4 million	$50,000

Table 26 Capital Cost Basis for Sewerage Facilities M & E

Element	1972 Unit Cost (1)	MVC 1985 Unit Cost est.
Collection system	$5,030/acre	$11,600
Interceptors	$76 - 107/ft. (2)	$175 - 246 foot
Pumping station	(3)	
Force mains	$43 - 49/ft. (4)	$99 - 113 foot
Sewage treatment plant	(5)	

Engineering News Rept.

1. Includes cost updated to ENR 1800 except pipework where an equivalent ENR 1450 is used and the added cost for Island work, engineering, contingencies, legal and administrative fees.
2. Unit price is dependent upon pipe size and assumes an average pipe invert depth of 8 feet, with a soil condition described as loose, sandy, and gravelly soil requiring fully sheeted trench.
3. Cost of each facility varies dependent upon the capacity and the total dynamic head required.
4. Unit price is dependent upon pipe size.
5. Cost of each facility varies dependent upon the type of treatment, the size of the facility, and the means of disposing of the effluent.

Table 27 Monitoring Well Results - Edgartown Koch Kit

Site	Nitrate ppm	Ammonia (NH_3)	Phosphate (PO_4)
Dunham Road at South Water - shallow	.7	.68	.07
" " " " " - deep	1.2	.58	.04
South Water Street across from Dunham Roa	1.6	.71	.14
Starbuck Point	.4	.31	.06
Sheriffs Pond Lane	3.7	.15	.18

averaged roughly 5% increase per year; in the later 1970's they have averaged 15-20% per year. For the purposes of the projection, a 10% per year increase is forecasted - a 130% increase over Metcalf & Eddy's 1972 estimate. Metcalf & Eddy's original estimates were based on ENR 1800 for all construction except sewer and pipe work. For these ENR 1450 was used. A 25% factor was added to compensate for increased Island costs and another 35% added for engineering and contingencies (see Table 26).

8.5 Existing Problem Areas

Existing problem areas for wastewater disposal are plotted for each town on Figures 16 through 19. These areas are consolidated into proposed Nightsoil Districts where some rehabilitative actions would be taken in Figure 20.

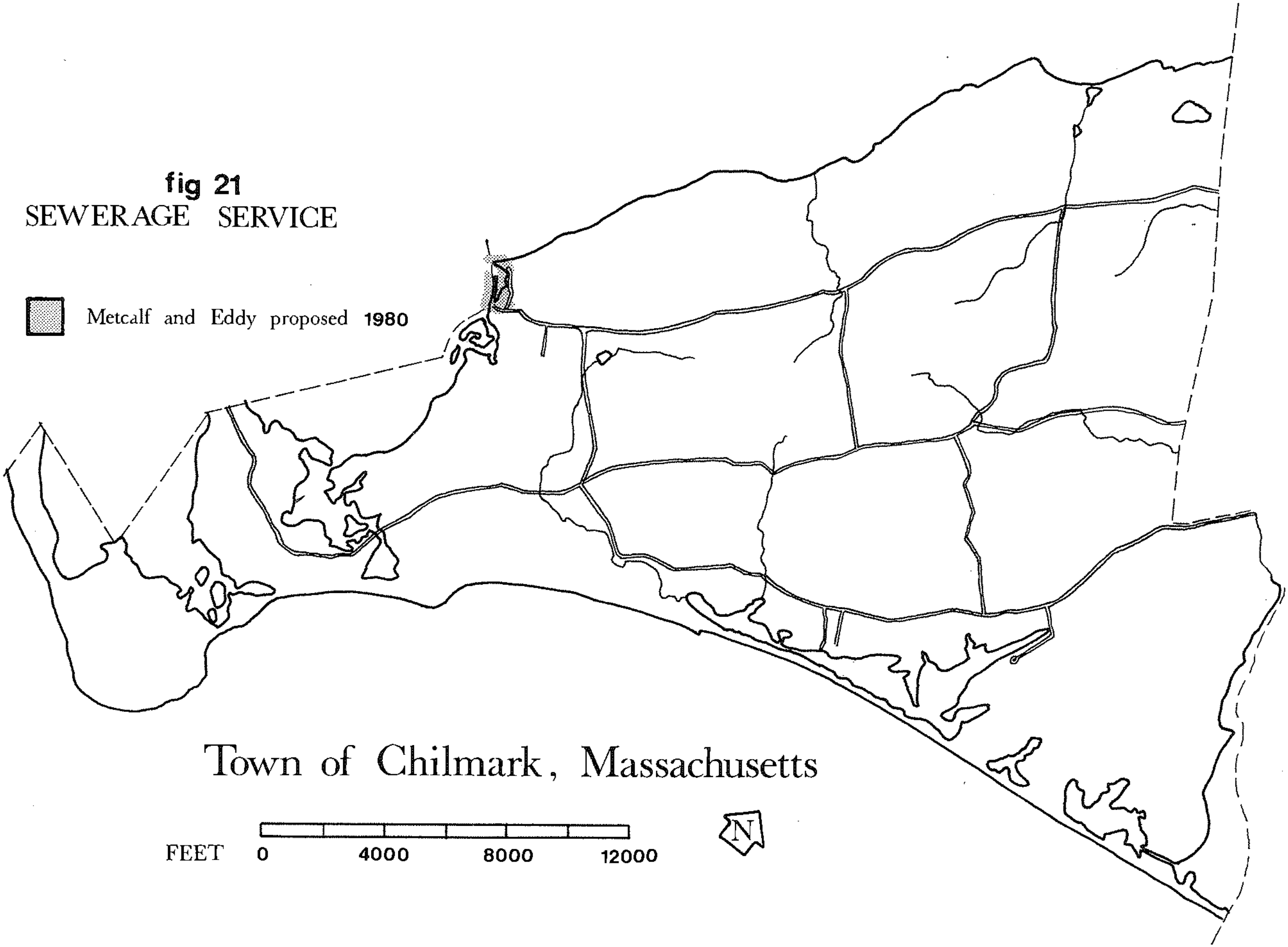
8.51 Chilmark - Menemsha Area

In the Menemsha Basin area, a large number of mostly seasonal dwellings exist on the slopes of a hill extending down to the Harbor. A large number of fishing shacks which were improperly discharging effluent into the Harbor waters have been ordered to cease discharging. As a result of this action, water quality has improved somewhat although boating discharges still cause occasional high bacterial counts. Samples taken from a small stream draining north through the village showed an increase in total phosphorus which indicates that some further investigation and possible rehabilitative action should be initiated in this area. downstream

A 1967 engineering study (Metcalf & Eddy) recommended a collection system and treatment plant for the village area. The winter populations' waste was to be handled by a septic tank system and the summer loading with an extended aeration-activated sludge facility, both discharging effluent through a leaching field on Town-owned land about 800 feet east of Basin Road. The system was designed for 39,700 gallons per day at a cost of $262,000 or about $350,000 today.

Renewed interest in the possibility is likely with the establishment of an improved shellfishery in Menemsha Pond. As a first step, it is recommended that a rehabilitative program be established using the services of the Regional Sanitary Engineer. Expanding leaching field areas, regular pumping and replacement of failing systems will limit contamination of Menemsha Pond and Harbor from on-shore development. Steps have already been taken with the elimination of the use of flush toilets in the fishing shacks along the Harbor. It is suggested that early efforts be concentrated in the area of the small pond and drainage system near the Coast Guard Station and near the small stream draining north through the village.

fig 21
SEWERAGE SERVICE



8.52 Edgartown: Present Problem Areas - Potential Nightsoil Districts - Sewer Service Area

In Edgartown, four potential nightsoil districts are defined. The district along Anthiers Pond would include areas below the ten-foot contour. The purpose of this district would be to protect valuable shellfish waters. Improved septic tank systems should be required for those houses situated immediately along the shoreline including mounding, dry toilets and closed septic tanks as soon as they are permitted by the State Environmental Code. The Ocean Heights area has numerous undeveloped small lots which could potentially result in dense housing on fairly porous soils along the fragile pond. Nitrate contamination in the ground water has been documented in one well in the area. Further, more intensive sampling is required. Assurance of properly functioning septic systems in this area is vital. In some cases, expansion of leaching field areas might provide better filtration and bacterial action to remove pollutants.

This district includes the shoreline and lowlands bordering Eel Pond. The area is mainly large-lot seasonal dwellings. Periodic inspection and possible rehabilitation and/or expansion of leaching field areas are recommended.

The northern portion of this District along Katama Bay consists mainly of large-lot seasonal dwellings at higher elevations, while the southern portion (Mattakesett Point) includes a considerable number of one-acre year-round and seasonal lots. Sampling indicates a potential problem from on-lot sewerage systems (indicated by nitrate levels over 5ppm). Much of this southern area is below the 10 foot contour. Ground water is very near the surface and the coarse sandy outwash plain soils are very porous. Inspection and requiring tight tanks for proven health threats, enlarged leaching field area or other rehabilitation may be required.

The interior Katama area is a recently developed area where inspection of existing septic systems and a regular sampling program should be initiated. Most system failures in this area occur by releasing nutrients to the ground water (due to the sandy soils) rather than by backing up. The existing and potential problem areas are outlined in Figure 17.

In the interior of town (away from the Harbor), frequent pumping of certain disposal systems has lead to the conclusion that some rehabilitative actions should be taken. Water Quality Monitoring wells installed at Starbucks Neck (north shore), Dunham Road (South Harbor area) and near Sheriffs Pond (central interior area) have revealed elevated ammonia levels (see Table 27). Water analyses of a well near the Post Office has shown extremely high ammonia and nitrate levels in an area already sewered. It is believed that the source of this contamination is the vicinity of Plantingfield Way and Pease Point Way. A proposal has been approved by town meeting to provide sewer service to these three areas (see Figure 22).

Other areas where potential on-lot sewage disposal problems may arise include Clark Drive and Clevelandtown Road. The area near Clark Drive has a high water table which presents disposal problems. The analysis of water quality of one well in this area has shown very high ammonia levels. In the Clevelandtown Road area hardpan soils have also been detected in the vicinity of Beetle Swamp. These soils are some 25 to 30 feet thick. The same soils are also found in the Sweetened Water Farm area. These soils could be overloaded with effluent from septic systems at half-acre densities.

A special town meeting held on June 17, 1977 voted to appropriate money to sewer these areas in the interior of town. The service area is the ultimate recommendation by Coffin and Richardson (see Figure 22). Immediate action is to be taken in the three priority areas identified and future action on the remainder of town is to be taken only if matching Federal and State grants are available. There is some documentation available to support the need for remedial action in some parts of the interior of town. Additional efforts at data gathering to better define these problem areas and possible others should be undertaken. Several of the proposed lines, we feel, are of questionable need. These include:

Clevelandtown Road, Mullen Way, South and Middle Streets: Some 35 acres of undivided land abut this road. Lot sizes are generally on the order of 1 acre, and ample room is available to correct failing systems. Some small lots exist on Mullen Way which may need remedial action.

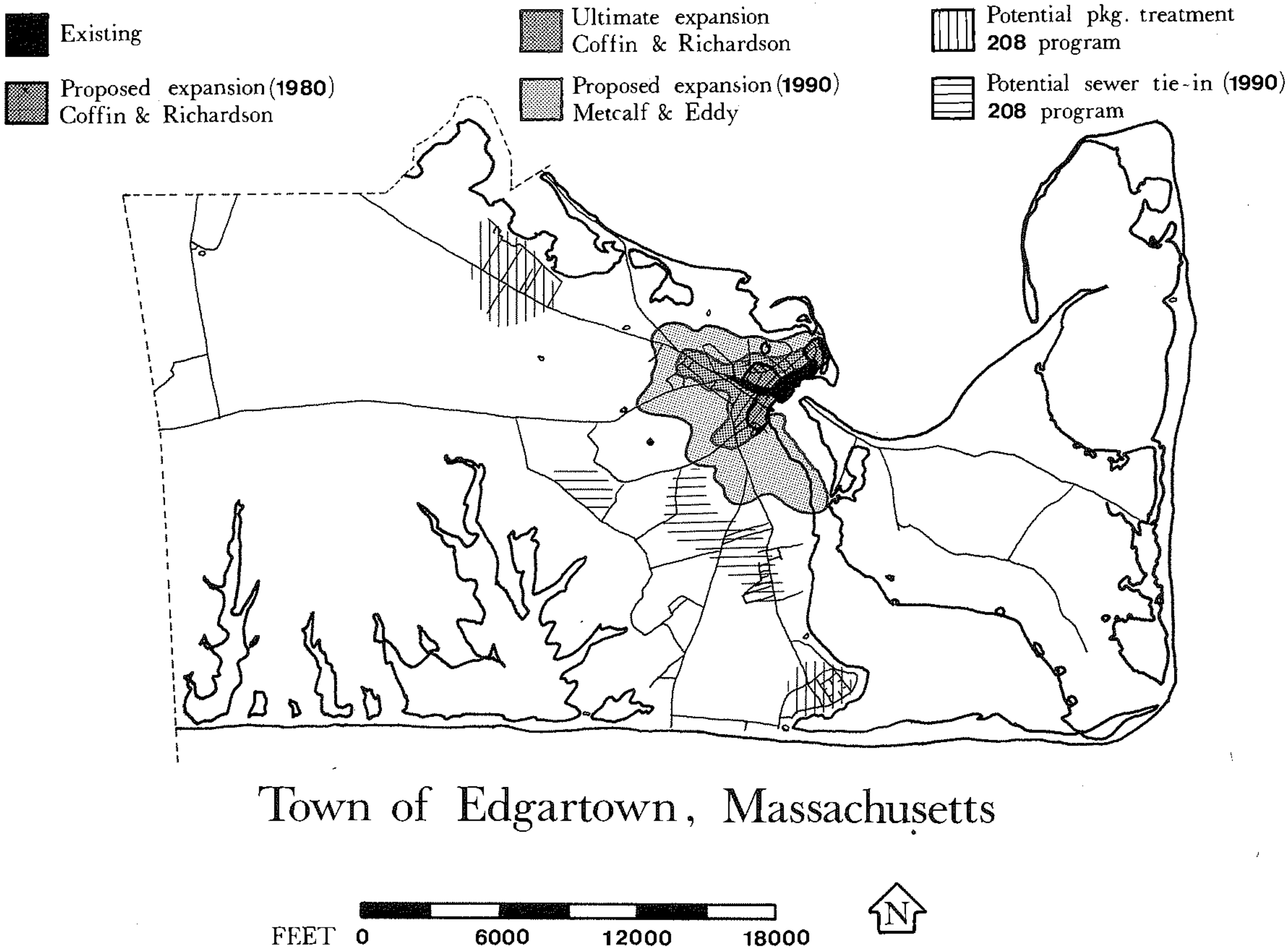
Katama Road: Some 27 acres of undivided land abut this road. Lot sizes are also on the order of 1 acre or larger.

Cooke Street: (from Pease Point Way to West Tisbury Road) Some of the smaller lots on this road could be handled by the pipe installed on Tilton Way. The cemetery abuts the road along a large part of its extent.

Large portions of the proposed service area for the interior of Edgartown will be reviewed by the Division of Water Pollution Control with EPA's new policies on funding collection systems in mind. These require proof of need as well as a thorough examination of the cost-effectiveness of the proposal in the facility plan.

fig 22

SEWERAGE SERVICE



Town of Edgartown, Massachusetts

8.53 Oak Bluffs

In this town, the major problem area is the Harbor and Circuit Avenue including the Camp grounds. Here, disposal systems (mostly cesspools) lie in or within 5-10 feet of the water table. The soils are porous sands allowing rapid infiltration of incompletely treated sewage into the ground water. Several ground water monitoring wells installed by Anderson-Nichols company in this area have not revealed any significant contamination at a depth of 10 feet into the water table. These results may be explained in several ways:

1. there is no significant contamination occuring;
2. the well penetrates through the contaminated zone;
3. contamination levels peak in late summer and are near normal during the winter months when sampling occurred.
4. an examination of historical maps of the town reveals considerable growth in a marsh area replacing open water in the south part of Sunset Lake. It may be that a large volume of nutrient low into that lake is occurring. Since no sampling wells were located along the eastern shore of the lake, the worst cases of contamination may have been missed.

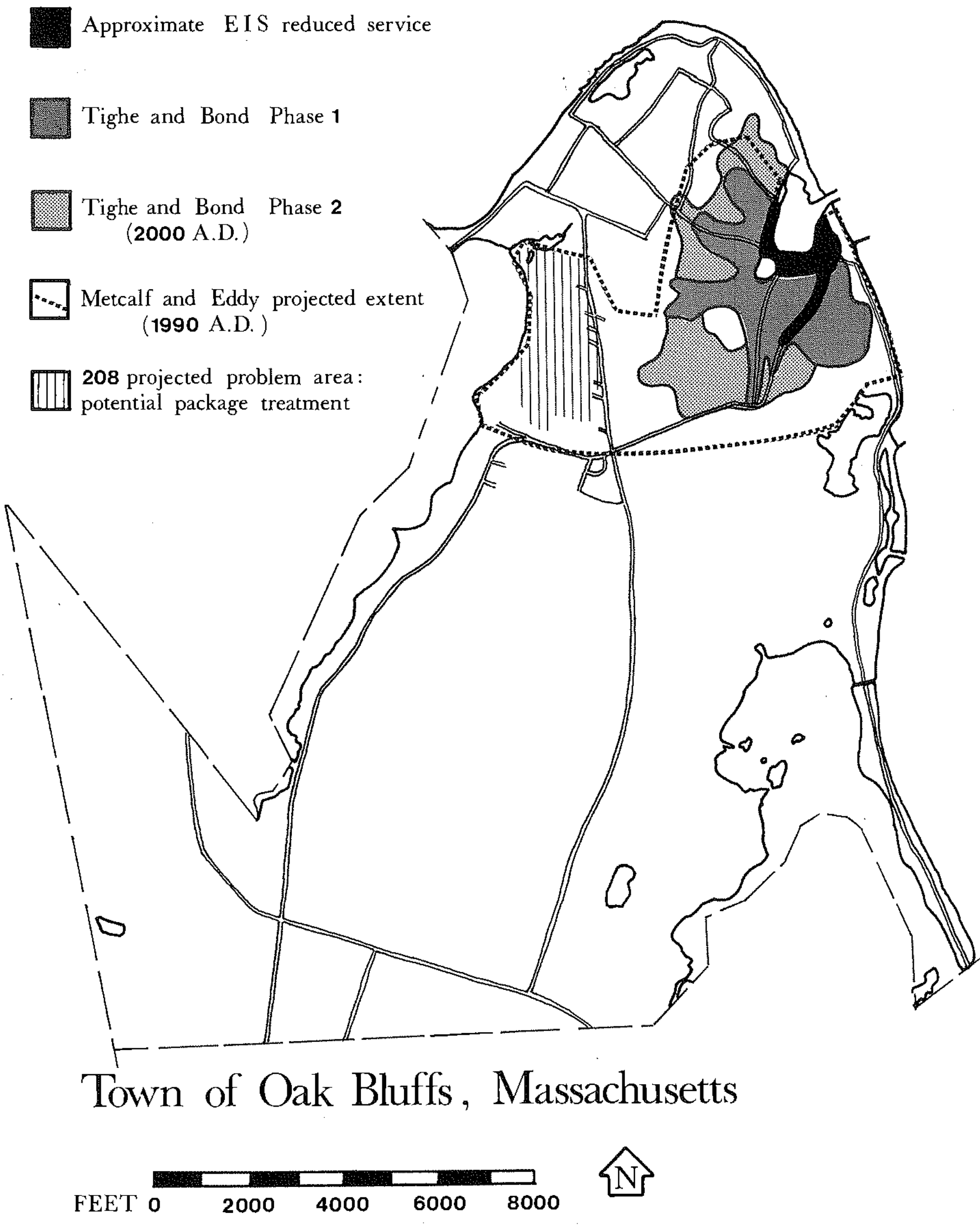
Of these alternatives, number 2 or 4 is favored. A test pit installed in Oak Bluffs bathing beach revealed more significant contamination. This program recommends sewer service to the Circuit Avenue and Harbor margin trouble areas. Other areas where sewage disposal problems occur include:

Area 1: This area includes 10,000 and 20,000 square foot lots bordering the Lagoon Pond, Brush Pond and Crystal Lake areas. The area is mostly below 15 foot elevation and includes a productive shellfish area, a tidal salt pond and fresh lake, both of which have had water quality problems in the recent past. Brush Pond has been closed to shellfishing due to bacterial contamination in the past. With the installation of a treatment system at the Hospital a large part of the problem in Brush Pond has been alleviated. A survey of the water quality of that pond made in the summer of 1976 revealed no problems. Nearly equal portions of the houses in this area are year-round and seasonal. Several wells in the northern more densely developed Lagoon Heights area have revealed excessive nitrate levels (most of the area, ~~however~~, is served by town water). As the density increases in Lagoon Heights some form of remedial action may become necessary.

no ref. to fig. 20 where?

a little heavy

SEWERAGE SERVICE
fig 23



Town of Oak Bluffs, Massachusetts

The Lagoon is a valuable shellfish resource which must be protected from the influx of nutrients from shoreline development which create luxuriant plant growth at the expense of shellfish productivity.

In the Crystal Lake area, low-lying disposal systems and sandy soils combine to produce nutrient overloads in the lake. In late summer each year, blue-green algae blooms occur in this pond as a direct result of sewage effluent from seasonal dwellings.

Area 2: This area is situated up-gradient from the Wing Road town supply well. This well is drawing water from a depth of 42 feet. Conceivably, excessive pollution from nearby development could affect this well. Some actions in the future are suggested to prevent malfunctioning septic systems in the rapidly developing 1/2-acre zoned region from affecting the town supply which is a fairly shallow well.

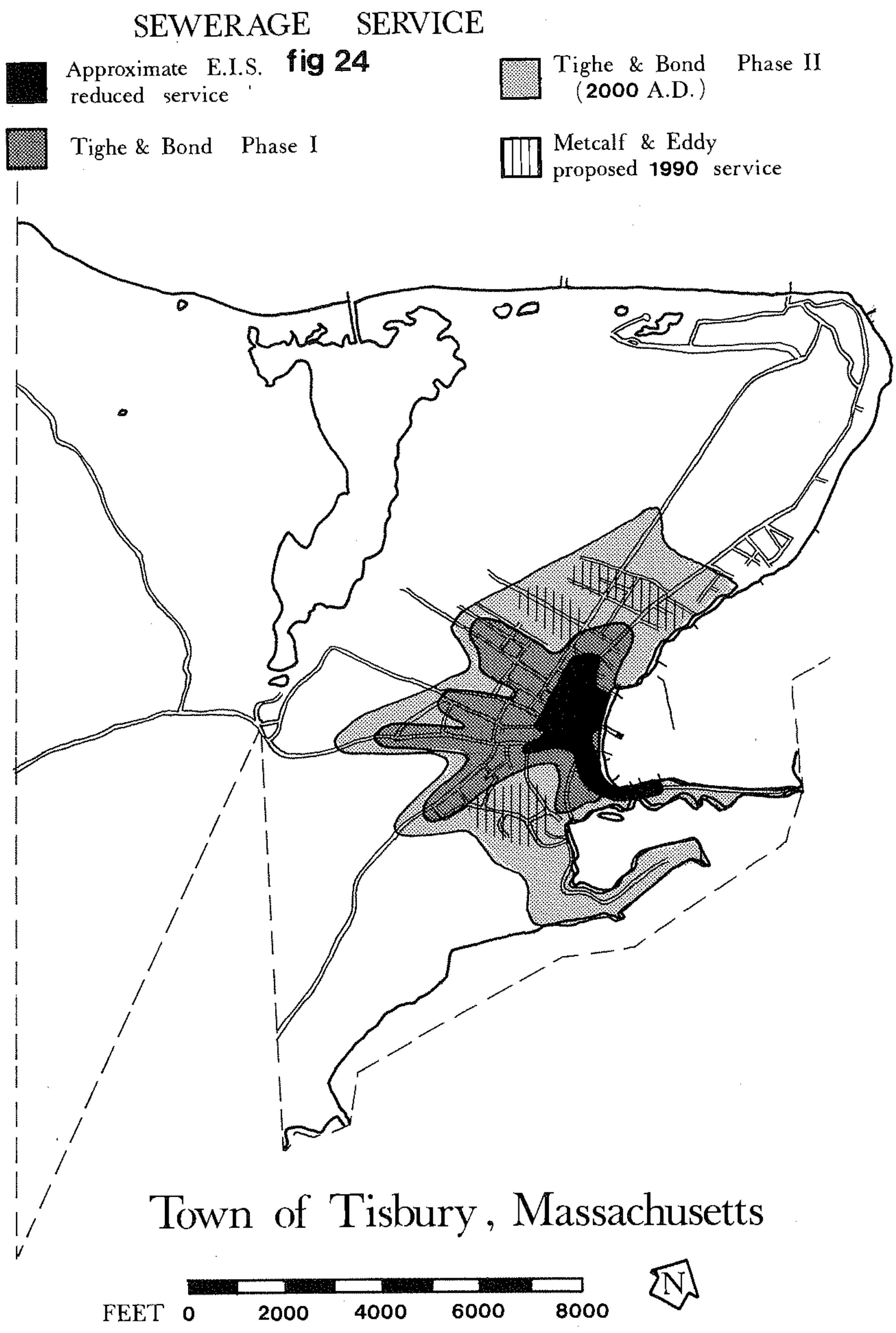
Area 3: This district includes the margin of Farm Pond, Harts Harbor and Hamlin Pond. The houses here are mostly seasonal and an inspection to insure no malfunctiong systems should occur.

8.54 Tisbury

At this time there is no sewer service provided in this area. Several parts of the town are either showing disposal problems or may in the near future. The areas are mapped as Nightsoil Districts on Figure 20. This study recommends that some remedial actions be considered in the following areas:

Area 1: This portion includes sandy barrier beaches across the mouth of Lake Tashmoo and the eastern shore of that Lake. The very sandy, porous nature of barrier beaches and the relative proximity of ground and surface waters makes this a potential problem area. Nearby residences are seasonal, offering some chance for the soil to regenerate after summer use. A large number of houses are situated on the eastern shore of the Lake; many are year-round dwellings. The Water Quality Sampling Program is taking ground and surface water samples from this area. In both areas, inspection of on-lot disposal systems to assure adequate treatment of sewage waste is recommended. The Lake itself is a shellfish and tourist resource and deserves adequate protection.

Area 2: The West Chop shoreline consists mainly of seasonal residences situated below the 20


SEWERAGE SERVICE
fig 24
Approximate E.I.S. reduced service
Tighe & Bond Phase I
Tighe & Bond Phase II (2000 A.D.)
Metcalf & Eddy proposed 1990 service
Town of Tisbury, Massachusetts
FEET 0 2000 4000 6000 8000
N

foot contour. This area is considered less fragile than Area 1, but septic systems should be inspected occasionally.

Area 3: The moderately dense portions of town near Mud Creek and bordering the Lagoon are not recommended for immediate sewering (Tighe & Bond, 1975). In this area, it is recommended that the following program be implemented to forestall the need for sewer service:

1. inspection of on-lot disposal systems to assure operation;

2. pumping of those which are not properly operating;

3. rehabilitation of improperly operating systems - such as replacing the tile field or adding leaching field area.

Area 4: This area includes the densely developed portion of downtown Tisbury and the lowlying commercial area along Beach Road. A well in the vicinity of the Steamship Authority Wharf revealed 13 parts per million nitrate-nitrogen (Anderson-Nichols Company, personal communication). Another boring put down near the Dukes County Garage by this program revealed similar nitrogen pollution.

In the lowlying areas many disposal systems are sited in barrier beach sands with only 2-5 feet to ground water. Proper operation of septic systems in this situation is very difficult. Adverse impacts on the well circulated harbor are difficult to discern because the result is only a gradual increase in bottom weed growth. Sewer service in this area is the recommended solution.

8.55 West Tisbury

The most fragile water resource in West Tisbury aside from the outwash plain aquifer, is the drainage system of the Tiasquam and Mill Brooks. The subsurface materials in the area where the streams flow through the village center are porous outwash sands. The area is zoned for 1 1/2 acre lots which should provide adequate area for safe on-lot sewage disposal. It is possible however, that older systems in the area were installed improperly and are sources of contamination. The area outlined on the Nightsoil District (Figure 20) should be included in an inspection and rehabilitative action program. The perimeter of this area is based primarily on the boundaries of the 1 1/2 acre agricultural/residential district. Final boundaries however, should be based on on-site inspection. Areas needing inspection include pond, stream and wetland margins and those areas where the ground water is within 10 feet of the ground surface.

The area in the Lamberts Cove region known as Longview has also had reported problems arising from impermeable soils. An inspection program is also recommended in this area to suggest rehabilitative action. In the morainal areas of this town and Chilmark it is vital that sizing and siting of disposal systems be based on an adequate investigation of soil strata and percolation rate.

8.56 Gay Head

In the Lobsterville area, ammonia contamination has been detected in the sampling program in those seasonal dwellings situated in the dune areas. Inspection and a requirement for rehabilitation of improperly designed or functioning systems is recommended to protect public health in this area.

8.6 Potential Problem Areas With Unplanned Growth

In other areas, the need for eventual remedial action can be foreseen based on soils, past growth history, zoning and depth to ground water. The rate of conversion of seasonal to year-round dwellings in an area is also an important factor in determining sewer needs. Those areas situated along ponds will probably experience the need for sewer service before their inland counterparts. This is due primarily to the presence of surface waters to reflect the impacts of nutrient overloads. In each of these areas, public water supply will be required before sewer service. Table 28 summarizes these areas and includes approximate costs and alternative actions.

	Estimated Need
Oak Bluffs	
Village Interior	1990
Lagoon Heights	1990-2000
Tisbury	
Village Interior	1990
Lagoon Heights R-20 Zone	1995-2000
Edgartown	
Village Interior	1990
Clevelandtown	1990-2000
Ocean Heights	1990-2000
Mattakesett Point	1995
Herring Creek	1995

Other areas where there is a potential for sewage disposal problems include Menemsha Basin and West Tisbury center. Inspection, rehabilitation and pump-out requirements will continue to protect the Menemsha shoreline. On-shore toilet facilities and sealed heads on boats in the Menemsha Basin area are needed. Should seasonsal dwellings become year-round dwellings a more structural solution will be needed. Table 28 summarizes the problem areas, approximate costs for providing sewer service and alternative actions available.

8.7 Recommended Construction Grants Priorities for Next 5 Years

In Table 29, collective wastewater disposal techniques are evaluated in terms of environmental, economic, social and political-institutional c teria. The 208 Program recommends only a very limited municipal sewering program over the next five years.

Currently the top priority for construction grant funding on the Island is to find the best method to treat the 2 to 3 million gallons of nightsoil generated on the Island each year. The current practice of disposing this waste in our landfills is illegal and unsanitary. It is recommended that the on-going Anderson-Nichols study for the Environmental Protection Agency concentrate on finding a solution to this problem.

On the Island, final sewage effluent disposal must be in-ground. The Ocean Islands Sanctuary Bill precludes ocean outfall. Since our sole source of water supply is our ground water, extreme care must be taken to obtain the highest possible effluent quality and the least chance of significant ground water contamination. The 208 planning process, if so directed, can lead to appropriate system design.

As described in Section 8.2 detailed engineering studies are underway to find the most cost-effective way to correct wastewater disposal problems in downtown Tisbury, Oak Bluffs, and Edgartown. These are the only areas where the 208 Program feels sewering might be needed in the next 5 years. The problem areas in each town are defined in Figures 16, 17, 18, and 19. The 208 Program recommends that cost-effective solutions to these problems be given priority in receiving construction grant funding.

a little vague as to boundaries

For the rest of the Island, the 208 Program recommends that careful planning of town growth be used. Various land use management techniques, which are described in Chapter 6, should be instituted by the Island communities to prevent the helter-skelter demand for municipal sewering. This program recommends that the master planning process being funded from July 1, 1977, to June 30, 1978 by HUD to the Martha's Vineyard Commission work closely with the implementation program outlined in Chapter 14. One goal of this process should

TABLE 28

POTENTIAL PROBLEM AREAS AND COST ESTIMATES FOR SEWER SERVICE

Area	Reason	Dwellings	High Growth (dwellings/ year)	Wasteflow (date)	Cost for Sewer Service Collection system	Rehabilitation	Alternative Action Suggested
Menemsha Basin		70	1	40,000gpd (1975)	$350,000	40-50 systems @ $2500-$5000	Inspection rehabilitation program
Ocean Heights	1/2 acre density and sandy soil nearby poorly circulated waters	28 on 550 acres	18	144,000gpd (1985)	$7.5 million	80 acres below 20' center - $2 million package treatment plant $300,000 plus connection costs	use zoning, health reg's to preclude need except for a confined area if this fails consider package plant
Mettakesett Point	very porous soils; near surface water tables; nearby surface waters	75 on 107 acres	11	96,000gpd (1990)	$10 million	package treatment plant $400,000 plus connection costs	use zoning, health reg's and system replacement to postpone need; use monitoring system to detect need; when need arises package plant with Herring Creek
Herring Creek	1/2 acre density and porours sandy soils	50 on 100 acres	13	124,000gpd (1995)	$7.6 million	unknown number of systems @ $2000 each	use zoning, health reg's and new on lot system to avoid need; if this fails consider package plant with Mattakesett
Clevelandtown	1/2 acre density proximity to treatment plant; poor soils	64 on 864 acres	8	89,600gpd (1995)	$4.7 million	unknown number of systems @ $2000 each	use zoning, health reg's and replacement systems to avoid need
Edgartown Village Interior	in areas with failing systems and no room for replacement	178 on 90 acres	very few	72,000gpd (1995)	$2.1 million	unknown number of systems @ $2000 each	where possible expand leaching area, rehabilitate failing disposal systems
Clark Drive - Pine Street	high water table; poor soils	77 on 40 acres	2	50,000gpd (2000)	$1.7 million	unknown number of systems @ $2000 each	rehabilitate esisting systems
Pinehurst Road	1/2 acre density	53 on 27 acres	1	30,000gpd (2000)	$1.2 million	unknown number of systems @ $2000 each	rehabilitate failing systems
Oak Bluffs downtown	high density intense use; nearby surface waters	145	very few	93,000gpd (1977)	-	-	none
Area South of Ocean Park	high density	330 on 108 acres	very few	132,000gpd (1995)	$.7 million	unknown number of systems @ $2000 each	conduct inspection program where possible install new systems or rehabilitate failing systems
Lagoon Heights - Brush Pond Area	high density sandy soils; nearby surface waters	100 on 80 acres	19	115,000gpd (1995)	$3.2 million	package treatment cost of $600,000 for 50-60 dwellings $100,000	inspection/rehabilitation; use zoning, health reg's to avoid need for services
Tisbury downtown area (from Williams Street to the Harbor)	high density; intense use						none
Interior of Town	high density	302 on 72 acres	3	145,000gpd (1995)	$4.6 million		conduct inspection program; where possible install new disposal systems or rehabilitate failing systems
Lagoon Heights R-20 Zone	R-20 Density; sandy soils; nearby surface waters	30 on 72 acres	2	28,000gpd (1995)	$4 million	rehabilitate 5-19 units below the 10 foot contour @ $2500 to $5000 per unit; package treatment for 70 units	conduct inspection program where possible install new disposal systems or rehabilitate failing systems

NOTE: Cost estimates for sewer service include collection system and force main only. Pump station costs are quite variable. The costs are based on projected future increases of 10 per cent per year. These service areas are not recommendations but possibilities should no remedial actions be taken to improve on-lot disposal systems and a high rate of growth occur. Areas isolated from surface waters will probably not be sewered quickly due to a lack of ponds to reflect contamination problems.

be to define detailed growth areas to minimize the need for widespread structural solutions such as extensive public sewerage. The 208 Program also recommends that a program as described in Chapter 7 be initiated to ensure the proper design, installation, operation and maintenance of on-lot disposal systems.

KEY

- * Very Positive
- \+ Positive
- 0 No Impact
- \- Negative
- = Very Negative

- G Good
- F Fair
- P Poor

TABLE 29
COLLECTIVE WASTEWATER TREATMENT

ACTIONS / IMPACTS

Actions: NIGHTSOIL TREATMENT

IMPACTS	Expand Edgartown Plant	Land Spreading	Composting	Lagooning	Treatment Plant	Do Nothing
1. WATER QUALITY GOALS						
A. Fullfills Clean Water Act	+	*[1]	*[1]	+	+	=
B. Summary Rating	G	G	G	G	G	P
2. ENVIRONMENTAL EFFECTS						
A. Hydrology						
1. Water Quality	+[2]	+	*	+	+	=
2. Water Quantity	0	0	0	0	0	0
3. Water Problems	+	+	+	+	+	=
4. Water Uses	+	+	+	+	+	–
5. Flood Hazards	0	0	0	0	0	0
B. Biology						
1. Rare Species	0	0	0	0	0	0
2. Aquatic Habitat	+	+	+	+	+	–
3. Aquatic Population	0	0	0	0	0	0
4. Benthic Community	0	0	0	0	0	0
C. Air Quality	–	–	0	–	0	–
D. Land						
1. Change in Use	0	–[3]	–[3]	0	–[3]	0
2. Planning & Controls	+[4]	+[4]	+[4]	+[4]	+[4]	–
3. Growth	0	0	0	0	0	0
4. Soil Erosion	0	+	+	0	0	0
5. Sensitive Areas	0	0	0	0	0	0
E. Wastewater Management Resources						
1. Energy	–	+	+	+	=	+
2. Chemicals	–	*	*	–	=	+
3. Land Commitment	–	=	–	–	–	0
F. Summary Rating	F	FG	G	FG	FP	FP
3. ECONOMICAL COSTS						
A. Cost						
1. First Cost	–	–	–	–	=	+
2. Annual Cost	–	–	–	–	=	+
3. External Cost	+	*	*	+	+	–
B. Value of Goods & Services						
1. Recreation	0	0	0	0	0	0
2. Water Supply	–	+	+	–	–	=
3. Fishing & Shellfishing	0	0	0	0	0	0
C. Jobs	+	+	+	+	+	0
D. Economic Base & Stability	0	+	+	0	0	0
E. Summary Rating	FP	F	F	F	P	FP
4. SOCIAL EFFECTS						
A. Dislocation of People or Services	0	0	0	0	0	0
B. Public Health	+	+	+	+	+	–
C. Aesthetics	0	–	–	–	–	–
D. Educational & Cultural	0	0	0	0	0	0
E. Summary Rating	G	F	F	F	F	P
5. IMPLEMENTATION						
A. Legal Authority	–[5]	–[6]	–[6]	–[6]	–[6]	–[7]
B. Financial Capacity	+	+[8]	+[8]	–	=	0
C. Practicability	+	+	+	–	–	–
D. Public Accountability	+	+	+	+	+	=
6. PUBLIC ACCEPTABILITY	+	*	*	+	–	=

Actions: SEWERING – Tisbury/Oak Bluffs

IMPACTS	Regional	Individual	Small Service Area	Proposed Service Area: Tighe & Bond	Proposed Service Area: Metcalf & Eddy	Inspection-Maintenance Program	Do Nothing
1. WATER QUALITY GOALS							
A. Fullfills Clean Water Act	+	+	+	+	+	+	–
B. Summary Rating	G	G	G	G	G	G	P
2. ENVIRONMENTAL EFFECTS							
A. Hydrology							
1. Water Quality	+	+	+	+	+	+	=
2. Water Quantity	–[9]	–[9]	+	–[9]	–[9]	+	0
3. Water Problems	+	+	+	+	+	+	=
4. Water Uses	+	+	+	+	+	+	–
5. Flood Hazards	0	0	0	0	0	0	0
B. Biology							
1. Rare Species	+	+	+	+	+	+	–
2. Aquatic Habitat	+	+	+	+	+	+	=
3. Aquatic Population	+	+	+	+	+	+	–
4. Benthic Community	+	+	+	+	+	+	–
C. Air Quality	–	–	–	–	–	0	–
D. Land							
1. Change in Use	+	+	0	+	*	0	0
2. Planning & Controls	+	+	+	+	+	+	0
3. Growth	+	+	0	+	*	0	0
4. Soil Erosion	0	0	0	0	0	0	0
5. Sensitive Areas	+	+	+	+	+	+	–
E. Wastewater Management Resources							
1. Energy	–	=	–	=	=	+	+
2. Chemicals	–	=	–	=	=	+	+
3. Land Commitment	–	=	–	–	–	0	0
F. Summary Rating	F	F	FG	F	F	G	P
3. ECONOMICAL COSTS							
A. Cost							
1. First Cost	=	=	–	=	=	*	*
2. Annual Cost	=	=	–	=	=	+	+
3. External Cost	–[10]	–[10]	+	–[10]	–[10]	+	=
B. Value of Goods & Services							
1. Recreation	+	+	+	+	+	+	–
2. Water Supply	–[9]	–[9]	+	–[9]	–[9]	+	–
3. Fishing & Shellfishing	+	+	+	+	+	+	–
C. Jobs	+	+	+	+	+	+	0
D. Economic Base & Stability	+	+	+	+	+	+	–
E. Summary Rating	FP	FP	FG	FP	FP	G	P
4. SOCIAL EFFECTS							
A. Dislocation of People or Services	+	+	+	+	+	+	–
B. Public Health	*	*	*	*	*	*	=
C. Aesthetics	+	+	+	+	+	*	–
D. Educational & Cultural	–[11]	–[11]	+	–[11]	–[11]	+	–
E. Summary Rating	F	F	G	F	F	G	P
5. IMPLEMENTATION							
A. Legal Authority	–[5,6]	–[6]	–[6]	–[6]	–[6]	–[12]	0
B. Financial Capacity	–	=	–	=	=	+	+
C. Practicability	*	+	*	+	+	*	=
D. Public Accountability	+	+	+	+	+	+	=
6. PUBLIC ACCEPTABILITY	–	+	*	+	+	+	–

Actions: SEWERING – Edgartown and Chilmark

IMPACTS	Edgartown: Small Expansion Area	Edgartown: Coffin & Richardson	Edgartown: Metcalf & Eddy	Edgartown: Inspection Program	Edgartown: Do Nothing	Chilmark: Metcalf & Eddy	Chilmark: Inspection Program	Chilmark: Do Nothing
1. WATER QUALITY GOALS								
A. Fullfills Clean Water Act	+	+	+	+	–	+	+	–
B. Summary Rating	G	G	G	G	P	G	G	P
2. ENVIRONMENTAL EFFECTS								
A. Hydrology								
1. Water Quality	+	+	+	+	=	+	+	–
2. Water Quantity	0	0	0	0	0	0	0	0
3. Water Problems	+	–[13]	–[13]	+	=	+	+	–
4. Water Uses	+	+	+	+	–	+	+	–
5. Flood Hazards	0	0	0	0	0	0	0	0
B. Biology								
1. Rare Species	+	+	+	+	–	+	+	–
2. Aquatic Habitat	+	+	+	+	–	+	+	–
3. Aquatic Population	+	+	+	+	–	+	+	–
4. Benthic Community	+	+	+	+	–	+	+	–
C. Air Quality	+	+	+	+	–	0	0	0
D. Land								
1. Change in Use	0	+	+	0	0	0	0	0
2. Planning & Controls	0	0	0	+[14]	0	+	+	0
3. Growth	0	+	*	0	0	+	0	0
4. Soil Erosion	0	0	0	0	0	0	0	0
5. Sensitive Areas	+	+	+	+	–	+	+	–
E. Wastewater Management Resources								
1. Energy	–	–	–	+	0	–	+	0
2. Chemicals	–	–	–	+	0	–	+	0
3. Land Commitment	0	0	0	0	0	–	0	0
F. Summary Rating								
3. ECONOMICAL COSTS								
A. Cost								
1. First Cost	–	=	=	+	0	=	+	0
2. Annual Cost	0	–	–	+	0	–	+	0
3. External Cost	+	=	=	*	=	–	*	=
B. Value of Goods & Services								
1. Recreation	+	+	+	+	–	+	+	–
2. Water Supply	0	0	0	0	–	0	0	–
3. Fishing & Shellfishing	+	+	+	+	–	+	+	–
C. Jobs	+	+	+	+	0	+	+	0
D. Economic Base & Stability	+	+	+	+	–	+	+	–
E. Summary Rating	G	F	F	G	P	F	G	P
4. SOCIAL EFFECTS								
A. Dislocation of People or Services	+	+	+	+	–	+	+	–
B. Public Health	+	+	+	+	–	+	+	–
C. Aesthetics	+	+	+	+	–	+	+	–
D. Educational & Cultural	+	–[11]	–[11]	+	–	+	+	–
E. Summary Rating	G	FG	FG	G	P	G	G	P
5. IMPLEMENTATION								
A. Legal Authority	–[6]	–[6]	–[6]	–[12]	0	–	–[12]	0
B. Financial Capacity	–	=	=	+	0	=	+	0
C. Practicability	+	–	–	+	=	–	+	=
D. Public Accountability	+	–	–	+	–	–	+	–
6. PUBLIC ACCEPTABILITY	+	[5]	–	+	–	–	+	–

Actions: ALTERNATIVES

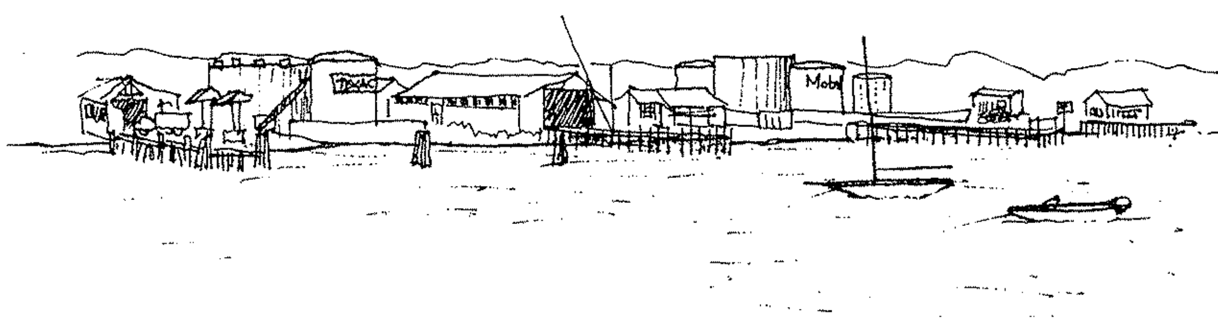
IMPACTS	Improve Health Code	Plan Service Areas	Maintenance Program	Continue as in Past	Outlying Sewer Service	Package Treatment	Do Nothing
1. WATER QUALITY GOALS							
A. Fullfills Clean Water Act	+	+	+	+	+	+	–
B. Summary Rating	G	G	G	F	G	G	P
2. ENVIRONMENTAL EFFECTS							
A. Hydrology							
1. Water Quality	*	+	*	–	+	+	–
2. Water Quantity	0	+	0	0	–[9]	0	0
3. Water Problems	*	+	+	–	+	+	–
4. Water Uses	+	+	+	0	+	+	–
5. Flood Hazards	0	0	0	0	0	0	0
B. Biology							
1. Rare Species	+	0	+	0	+	+	–
2. Aquatic Habitat	+	0	+	–	+	+	–
3. Aquatic Population	+	0	+	0	+	+	–
4. Benthic Community	+	0	+	0	+	+	–
C. Air Quality	0	0	0	0	0	0	0
D. Land							
1. Change in Use	–	+	0	0	+	+	0
2. Planning & Controls	+	+	+	0	+	+	0
3. Growth	–	+	0	0	*	+	0
4. Soil Erosion	0	0	0	0	0	0	0
5. Sensitive Areas	+	+	+	0	+	+	–
E. Wastewater Management Resources							
1. Energy	+	–	+	0	=	=	+
2. Chemicals	+	–	+	0	=	=	+
3. Land Commitment	+	–	+	0	–	–	+
F. Summary Rating	G	FG	G	P	FP	FP	P
3. ECONOMICAL COSTS							
A. Cost							
1. First Cost	–	0	–	0	=	=	0
2. Annual Cost	0	0	–	0	–	–	0
3. External Cost	*	*	*	–	–	–	–
B. Value of Goods & Services							
1. Recreation	+	0	+	0	+	+	–
2. Water Supply	+	+	+	0	–	0	0
3. Fishing & Shellfishing	+	+	+	0	+	+	–
C. Jobs	+[14]	0	+	0	+	+	0
D. Economic Base & Stability	+[14]	+	+	0	+	+	–
E. Summary Rating	FG	G	F	F	FP	FP	P
4. SOCIAL EFFECTS							
A. Dislocation of People or Services	–	+	0	0	+	+	0
B. Public Health	*	+	*	0	+	+	–
C. Aesthetics	+	+	+	0	–	–	–
D. Educational & Cultural	+	+	+	0	–	–	–
E. Summary Rating	FG	G	G		F	F	P
5. IMPLEMENTATION							
A. Legal Authority	+	+	+	+	–[6]	–[6]	0
B. Financial Capacity	+	0	+	0	=	–	0
C. Practicability	+	*	*	–	=	–	=
D. Public Accountability	+	+	+	0	–	–	–
6. PUBLIC ACCEPTABILITY	+	+	+	–	–	–	–

NOTES:

1. Accomplishes two goals: recycles and treats waste water.
2. Some potential operational problems.
3. Requires land area for treatment
4. Treatment capability allows better regulation of problem areas.
5. Requires intertown agreement.
6. Requires state approval.
7. Does not comply with sanitary landfill requirements.
8. Does however require land.
9. Potential adverse land.
10. Increased demand for other services.
11. Potential for increased growth leading to a change in way of life.
12. Requires added Board of Health responsibility.
13. Potential for increased contamination at disposal site.
14. Uncertain.

9

Industrial and Commercial Activities



9.0 Industrial and Commercial Activities

Another requirement of the Water Quality Program is to identify small-scale industrial activities on the Island and recommend measures to ensure that these activities do not adversely affect our water resources. There are relatively few commercial-industrial enterprises on the Island which should participate in the State and Federal NPDES (National Pollution Discharge Elimination System) permits program. During this study, the 208 Program looked at oil storage and dispensing activities on the Island, the Martha's Vineyard Hospital and Edgartown treatment plants and other existing and potential industrial and commercial point sources.

9.1 Oil Spillage

Oil contamination is a continuing concern. Spectacular spills, such as the Argo Merchant breakup, create headlines and, in some cases, havoc; but the minor, almost routine, spillage in the handling areas, including fueling areas, accounts for the majority of the oil discharged to water courses. Storage of toxic chemicals and petroleum products is undesirable on our aquifer recharge areas. The possibility of contamination by gasoline and other hydrocarbons presents a threat to the integrity of our ground water system. Once in a aquifer, these substances are transmitted with little alteration of their chemical composition. Gasoline has been known to move many thousands of feet through the soil to contaminate well supplies. Special provisions to minimize leakage need to be made, along with some type of monitoring system which could detect leaks before a major spill occurs (Pope, 1972).

Oil and grease analyses in Mid-August, 1975 at the Mobil Oil pier and off the Texaco company storage tanks in the Tisbury Harbor revealed .25 and .53 parts per million respectively. In August, 1976, .48 ppm was measured at the Mobil wharf. In November, when home heating oil demand increases, oil and grease levels increase to 2.2 ppm at the Black Dog Wharf, .9 ppm at Owens Park wharf and .8 ppm at the Lagoon Bridge. Marine larval stages are susceptible to concentrations of soluble hydrocarbons as low as .1 ppm (U.S. EPA, 1976). Sublethal effects (referring to interruptions of cellular and physiological processes) can result from petroleum products at concentrations as low as .01 ppm. Accumulation of oil or carcinogenic aromatics in edible aquatic species is also of concern.

9.11 Oil Storage Areas

Numerous boat yards and marinas store petroleum products immediately adjacent to our surface waters. These areas are identified below. Those enterprises situated on the outwash plain also constitute a potential threat to our ground water resources. The subsurface materials in these areas are coarse sands and gravels which offer little resistance to the percolation of non-viscous petroleum products. These enterprises are also identified below. An asphalt preparation plant operated by Grant Brothers in Edgartown produces approximately 20,500 tons per year. A similar plant is now located at Goodale Construction off State Road in Oak Bluffs, operated by Companella Corporation.

9.12 Existing Programs to Prevent Oil Spillage

No spills were detected from oil storage areas during the course of the 208 Program. This has been the result of efforts of the establishments listed below and on-going local, State and Federal programs. The U.S. Coast Guard has primary responsibility for oil pollution control in coastal waters. The Coast Guard presently conducts inspections of shoreline oil and gasoline storage and dispensing facilities. Packer and Campbell companies receive thorough yearly inspection by professional personnel from Boston. The marinas receive spot checks conducted by local personnel to ensure that all fittings and hoses are adequate, that drip pans are in place and numerous other checks. The Massachusetts Clean Water Act gives the Division of Water Pollution Control regulatory authority to prevent oil discharges and spills. The Division oil pollution control program requires Spill Prevention Control and Countermeasure plans (SPCC) at terminals and tanker areas. A permit from the Division is required to engage in the business of collecting waste oil or to dispose of waste oil in any waters of the Commonwealth including ground water. Gas stations, marinas and retail sellers of auto lubricating oil are required to install waste oil retention facilities. The Division also licenses terminals for the loading or discharge of petroleum products to ensure that they have available suitable equipment to remove chemical or petroleum spills. Vessels entering Massachusetts waters to discharge or receive oil must post bonds to cover clean up costs, damages to material and recreational resources and uncollectible fines for violation of other water pollution laws should an oil spill occur. Vessel operators are required to notify the Division as soon as they have knowledge of a spill, whereupon the Division supervises the clean up effort.

9.13 Recommendations to Prevent Oil Spills

Alternatives for dealing with oil spills put emphasis on prevention. As demonstrated by the Argo Merchant spill, existing clean up programs are incapable of effective action. New clean up operations must be developed. The most important thing learned from this spill is that Federal, State and local response to oil spills is not yet coordinated enough to respond quickly and efficiently to spills. If the oil had moved toward shore instead of out to sea, Vineyard beaches would have suffered a severe impact before clean up operations were initiated. Suggestions to improve our response to major oil spills include organization to coordinate multi-level activities and detection and early warning systems to allow preparation to clean up a spill before it reaches shore.

SPCC Plans--EPA Regulations for Oil Pollution Prevention

Spill Prevention Control and Countermeasure plans (SPCC) pertain to undergound storage facilities of 42,000 gallons or more of oil and above ground storage facilities in excess of 1320 gallons. Any violations to this program are punishable by a civil penalty of up to $5000 per day. At this time Campbells and Packers are involved in this program. These plans must clearly delineate procedures, techniques and responsibilities of Federal, State and local agencies. Cooperation and coordination commitments must be clearly spelled out.

Businessess selling gasoline and situated near the coastline typically store between 5 and 10,000 gallons of gas usually in 2000 gallon tanks. It is recommended that any future installation or replacement of storage tanks below ground be required to place the tank in a sealed vault or a non-corroding tank to further minimize the risks of gas spillage. The storage tank should be coated with a corrosion reducing material. Gasoline is a very non-viscuous fluid which would travel with the ground water to nearby surface waters. It is more miscible with water than is oil allowing it to mix more completely and more severely impact aquatic species. The following businesses are located on the coastline and, it is suspected, that in all cases the tanks are in or very near the ground water.

Shoreline Storage Facilities

Edgartown--Norton's Boatyard, Harbor (Marina)

Oak Bluffs--Ben David Motors
Vineyard Auto-Body Shop
Church's Pier (Marina)

Vineyard Haven--Dukes County Service, Beach Road
Corner Service Station, Beach Road
Packer Co., Inc., Texaco, Beach Road
J. Cambell Oil Co., Inc. Mobil, Beach Road

Coastwise Wharf Co. (Marina)
Machine & Marine (Marina)
Martha's Vineyard Shipyard (Marina)

Menemsha--Menemsha Texaco (Marina)

In addition, large fuel oil or gasoline storage facilities located inland may adversely impact water quality through spillage of non-viscuous hydrocarbons. It is recommended that permits issued for future installation of fuel related storage or dispensing facilities in the outwash plain area or, in areas of importance for ground water resources, be required to develop a form of SPCC plan. This plan should include at a minimum:

- --the quantity of fuel stored and the number of tanks involved
- --measures proposed to preclude spills
  - --corrosion resistant coating
  - --tank thickness
  - --culverting, curbing, retention ponds
  - --sorbent materials
- --measures proposed to detect spills
  - --detection devices
  - --periodic level checks
  - --underlining
- --a written commitment of manpower, equipment and materials to control and remove hydrocarbons.

Eventually, existing storage and dispensing facilities should be incorporated in this program. These include:

Inland Storage Facilities - Outwash Plain

Cape & Vineyard Electric off State Road in Vineyard Haven - Storage of fuel oil and at the Martha's Vineyard Airport

Martha's Vineyard Airport - Airplane fuel storage and dispensing.

Grant Brothers Construction, Edgartown
Katama Airport Gas - Aviation Fuel, Edgartown
Goodale Construction, Oak Bluffs
Cape & Vineyard Electric, Oak Bluffs and West Tisbury
Martha's Vineyard Airport, Edgartown and West Tisbury
Up-Island Gas Station, West Tisbury

Waste Oil Recycling

Used waste oils contain heavy metals and organic compounds that are toxic or carcinogenic if ingested or inhaled. Land disposal may contaminate ground water supply by leaching. Disposal in storm drains can lead to severe surface water pollution.

Most waste oil on Martha's Vineyard generated commercially finds its way onto dirt roads. Dirt roads in the State Forest were generally used in the past. However, in more recent years, spreading on roads in subdivisions and even some use as fuel is more common. In the immediate future, methods of land disposal which assure no runoff into surface waters (such as road spreading) are recommended.

It is recommended that Massachusetts promote the economically viable recycling of waste oil to more important end-uses (i.e. chemicals, medicines, plastics). On the Island, it is suggested that used oil be used in asphalt production or that recycling efforts be established.

Off-Shore Spills

Martha's Vineyard is particularly susceptible to spills like the Argo Merchant and potential spills from the proposed Georges Bank oil development. Both our State and Federal legislators have noted that Martha's Vineyard is a unique national resource. It is recommended that these legislators, enact and enforce strict controls to protect our Island from off-shore oil spills and to provide adequate funding assistance to assure the clean up of contaminated shorelands.

9.2 Other Commercial - Industrial Enterprises

9.21 Existing Sources

Very few commercial-industrial enterprises on the Island have sufficient discharges to warrant their participation in the State and Federal NPDES Program (National Pollutant Discharge Elimenation System). This program regulates discharges into Navigable waters from all point sources of pollution. The core of the permits issued is a specific "schedule of compliance" which prescribes an enforceable sequence of actions to meet a required effluent limitation. For example, such a schedule might set dates for design, engineering construction or process changes. The process involves the applicant filling out a permit application, EPA and the state reviewing the permit and allowing public review and comment, and the state establishing a "Schedule of Compliance" and issuing the permit for no more than 5 years.

Issokson's Dry Cleaners on Main Street in Tisbury is involved in the permit program to allow discharge of heated water used in the dry-cleaning process into the storm sewers which flow into the Harbor. A recent check of this establishment by the Martha's Vineyard Commission and the Massachusetts Division of Water Pollution Control found that the discharge was well within the limits established in the permit.

Other sources have also been identified:

--Cottage City Fishmarket, Oak Bluffs (sample analysis in Table a6).
--State Lobster Hatchery (100-200 gpm of water from lobster growing tanks).
--Other Fishmarkets in Menemsha; Poole's and Larsen's

None of these sources are seen as being of major significance. They do, however, fit the definition of point sources. Additional sampling and a decision as to whether they should be included in the NPDES permitting program is recommended.

The Water Quality Program recommends that the following in-ground discharges be incorporated into the permit granting program.

1) The Edgartown Sewage Treatment Plant which handles between 12,000 and 120,000 gallons of waste per day, depending on the season. The treated effluent is discharged into sand filter beds. (see table a7)

2) The Martha's Vineyard Hospital treatment system which handles between 17,000 and 35,000 gallons of hospital wastewater per day. Wastewater is discharged through filter beds, collected and distributed to a leaching field. The treatment plant is situated at 5 to 10 feet above sea level and within 150 feet of Brush Pond. The pond was monitored during the summer of 1976 to delineate any effects of this wastewater discharge on the pond water quality. No major impacts were identified. It is recommended that the pond be kept open to Lagoon Pond to allow continous flushing. (see table a7)

9.22 Future Sources

In the next 20 years countless new proposed projects such as ocean outfall of sewage or offshore oil development will be originated off-Island which may potentially adversely impact water quality on and near Martha's Vineyard's waters

Also, new forms of harmful contamination from future on-Island activities undreamed of today in 1977, could potentially disrupt future water quality unless anticipatory planning actions proceed.

Wastes ultimately can only be disposed into the air, onto land or in water. The sea is the ultimate sink for contaminants that are not retained in the air and on the land. The concentration of pollutants often is highest in the coastal waters, where the impact is greatest on man's activities. (Gloyna, 1976).

One possible future commercial activity which will generate effluents is the seafood processing industry. These industries produce effluents carrying organic materials and bacteria. EPA, under 40CFR 4582, has established guidelines for both performance and pre-treatment standards. The majority of these industries are, and will probably continue to be, situated in fragile and often poorly circulated bays, inlets and harbors. Several areas of these regulations brought into force could potentially involve our future seafood industries.

Handshucked Clam Subcategory

For facilities which process more than 4,000 pounds of raw material per day on any day during a calendar year and for all new sources, the following effluent characteristics were required:

	On Any Day**	Average for 30 Consecutive Days --Maximum
Total Suspended Solids	59	18
Oil and Grease	0.6	0.23
pH	in the range 6 to 9	--

The standards for new sources are slightly more stringent.

Mechanized Clam Processing Subcategory

The following limitations establish the quality of pollutants to be discharged after applying the best treatment technology economically available.

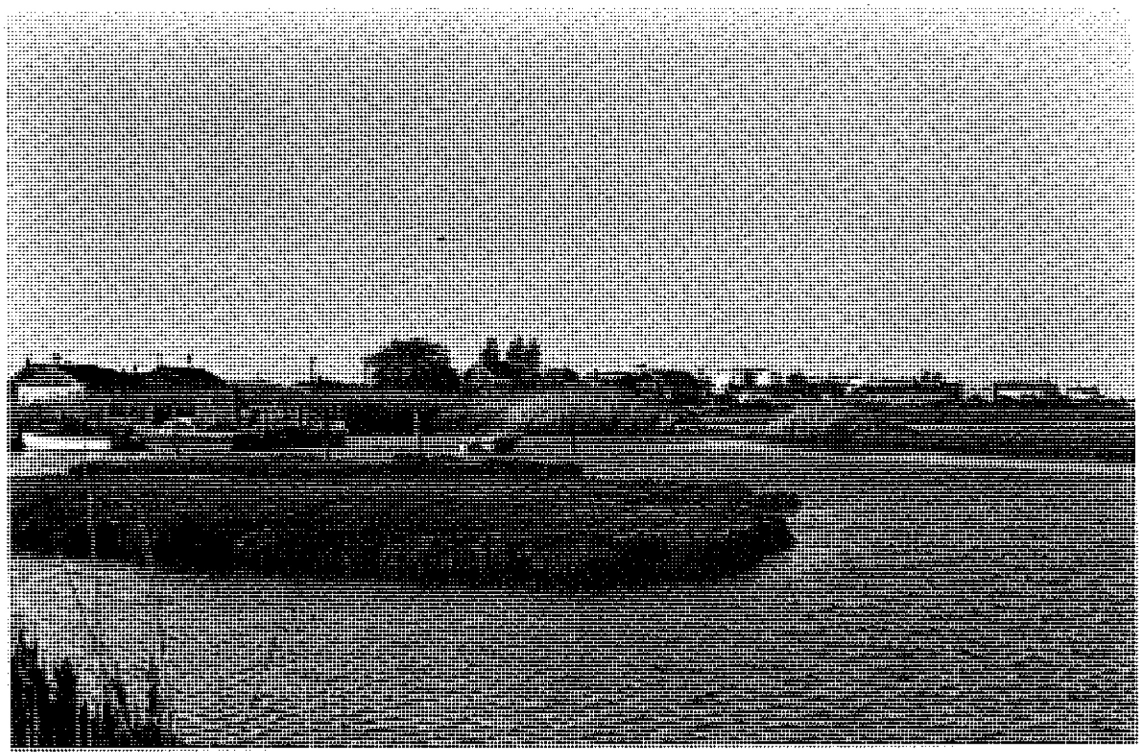
	Maximum for any 1 Day**	Average for 30 Consecutive Days
BOD_5	15	5.7
Total Suspended Solids	26	4.4
Oil and Grease	0.4	0.092
pH	6 to 9	--

The requirements are the same for new sources.

Non-Alaskan Scallop Processing Subcategory

After application of the best available technology

**measurements in pounds per 1000 pounds of product.



Both motorboating and industrial facilities can lead to hydrocarbon pollution of our ponds if not carefully controlled.

which is economically available, the following discharges of pollutants are established as the maximum:

	Maximum any 1 Day**	Average for 30 Consecutive Days
Total Suspended Solids	5.7	1.4
Oil and Grease	7.3	0.23
pH	6 to 9	--

9.23 Summary

Commercial and small-scale industrial activities are not yet of major concern on Martha's Vineyard. Many of these activities produce large volumes of sanitary sewage which is disposed in-ground. On-lot disposal systems for high volume users must be carefully sited to minimize adverse water quality impacts.

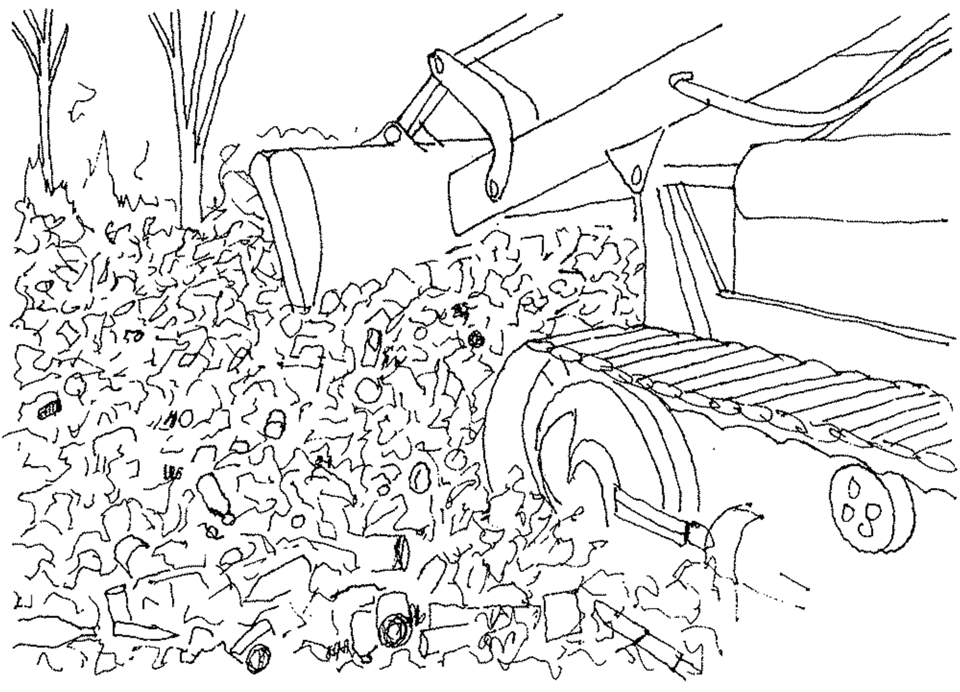
Present point sources include the fish markets and Lobster Hatchery. These establishments discharge process water used in fish tanks. It is generally not significantly contaminated. The Edgartown and Martha's Vineyard treatment plants both discharge into infiltration beds. Their participation in the NPDES program is recommended.

Presently, the Division of Water Pollution Control is involved in permitting only those oil storage facilities which directly threaten surface waters. We recommend that the State become more closely involved in permitting oil storage in areas where spills may threaten aquifers. All future installations of storage tanks which are situated near the coast or on valuable ground water recharge areas should be required to use fiberglass tanks or concrete vaults surrounding steel tanks.

Future sources are expected in the seafood industry. Each of those sources will be involved in the NPDES program. Each point source waste producer has a unique pollution potential. For this reason it is advisable for each such facility to perform an Industrial Waste Survey which will: a) establish current waste loadings and flows, pinpointing major individual sources of pollution; b) define water-elimination and reuse possibilities as well as locate produce-recovery and waste-reduction sources; and c) establish a material balance and flow diagram of all major pollutants before and after the volume and strength reduction.

**measurements in pounds per 1000 pounds of product.

Solid Waste Management



Landfills

are presently seven Island landfills accom-
n estimated 15,000 tons of solid waste per
bles 30, 31 and 32 include current estimates
solid waste generation. Total tonnage gen-
each landfill is estimated in table 33
estimates of the town populations served.
ures are considered approximate. The follow-
raphs discuss problems associated with land-
the town landfills, their problems, needs
mendations for improvement. (see figure 7)

lity Problems Associated with Solid Waste

ce is available that chemicals released from
wastes we throw away are not totally absorbed
il. Some, instead, are released by decay
and remain in the waste until rain water
ng down through the top of the landfill dis-
d flushes these wastes down into the ground
nce into the ground water the wastes may re-
a long period of time. These liquid wastes
collectively as leachate.

tes produced by percolation and infiltration
ater may cause ground water contamination.
characteristics may vary very widely. These
istics are influenced by the following fac-

l characteristics on site;
ure of infiltrating water;
l conditions (pH, temperature, age, oxygen
ilability, moisture content);
ure of solid waste in the fill.

leachate should reach ground water, dilution
achate may occur by mixing in the ground water
filtration of clean rainwater. Other contam-

inants are either filtered or chemically removed from ground water by the soils.

The water quality monitoring program at the Edgartown landfill was designed to provide information on contamination beneath a typical Island landfill. This landfill is situated in the silty sands and gravels of the outwash plain - eastern moraine margin. Four wells were installed at each of the 4 corners of the landfill as shown in figure a-16. This pattern was selected to offer the greatest possibility of at least one well intercepting the leachate plume from the landfill. Leachate released from a landfill tends to flow with the ground water as a confined stream which only gradually diffuses down-gradient. Materials penetrated in drilling included fine to coarse sands and silt --no evidence of the thick hardpan layer which supports Beetle Swamp to the north was found.

These wells have not as yet been surveyed so their relative elevations are unknown. Rough calculations indicate however, that ground water flow is from north to south.

Well #4, located in the southeast corner of the landfill, indicated the most constant levels of contaminants (see Table a5). This well lies in the expected direction of flow of the ground water. Well #2 also showed elevated nitrate and ammonia levels. This well is situated in the northwest corner of the landfill diametrically opposite Well #1. Two possible explanations of this phenomenon occur.

1) Flow is actually toward the northwest toward Sengekontacket Pond via Jernegans and Lily Ponds.

2) Flow is toward the southeast; but Well #2 being situated near the base of the old completed landfill, is experiencing a greater level of contamination from this nearby material.

The wells at the Edgartown landfill were installed to a depth of 5 feet into the water table to attempt to sample the most contaminated part of the ground water. The silt present in these wells has not, as yet, been completely cleared. In addition, a better sampling method is needed to avoid contaminating the sample with iron from the well casing. Iron, manganese, zinc and total solids readings in table a5 are <u>not</u> representative of the ground water. Nutrient levels are expected to be more representative of the quality of the ground water.

The following future program is <u>recommended</u> to continue to assess the potential for water supply contamination from this landfill area:

1) survey in wells--determine elevations;

2) measure water levels--determine direction of water table gradient and hence ground water flow;

3) pump all wells to remove silt and to obtain a more representative sample of ground water;

4) install an additional well(s) down-gradient from the landfill to determine the extent of the contamination plume.

This process should be carried out by the Water Resources Planner during the coming summer.

10.12 West Tisbury Landfill (see figure a-13).

The existing area in use is approximately 3 acres, while an estimated 11.2 more are available for use. With required 400 foot buffer, the available area is greatly reduced. The method used at the site is trenching with regular cover applied. Fill was noted in some areas at depth of 10' below grade.

The soils in the area are Riverhead sandy loam (45A) and Haven very fine sandy loam (60A). An examination of the site revealed approximately 3 feet of medium to fine sandy soil, 3 feet of low plasticity silty clay followed by 1 foot thick highly cemented coarse to fine gravel. The bottom of the pit examined showed stratified sands and gravels at a depth of 3 feet in which permeability is very rapid, allowing infiltration of leachate into the ground water supply. The water table is at a depth of 30-35 feet. 7'

Housing, relying on private water supply, lies within 500 feet of the disposal area. The town installed a well to monitor the landfill's impact on ground water. No pollution was evident. This may reflect the presence of the cemented layer which might cause lateral flow rather than vertical or it may simply reflect a well location which was not directly in line with the flow of leachate. Leachate can flow in a confined stream and is therefore difficult to detect. In areas where the fill penetrates the cemented layer, leachate may be able to move rapidly into the ground water; therefore, water quality samples were taken at nearby houses to assess any water problems.

Water analyses at a house to the west-south-west of the landfill revealed iron concentrations of 10 parts per million. A second house analyzed further north revealed no adverse iron contamination. Well depths for both houses were estimated at 35 to 40 feet. Iron levels are commonly found to be very high in the gound water near landfills. Not only is it released from the refuse itself, but it is also released from the surrounding soils by the leachate. The number of potential houselots in the area is a cause for concern.

The following actions are recommended:

--provide a buffer around the landfill for future private water supplies
--install monitoring wells around the perimeter of the landfill
--improve nightsoil disposal techniques to preclude over-loading the soils at the landfills
--consider fencing to prevent blown refuse

10.13 Chilmark Landfill (see figure a-14).

The area currently used is approximately 3 acres; however, roughly 4 additional acres are available for expansion, 8¼ total. Prior dumping occured across the road 400 feet to the north. Land is now being purchased further to the east of the existing landfill. The depth of fill is 30 feet. Ground water is 50 feet to 100 feet. The method used consists of slope face or area disposal with irregular cover. In 1975, there was little segregation of waste types; garbage, rubbish, scrap and wood were intermixed. Random location of trenches and pits on the property indicates some lack of planning. A dumpkeeper is available part-time.

The soils in the area are Chilmark sandy loam (17) and Plymouth loamy sand (35). The Chilmark soil is well drained and forms on sands underlain by clayey glacial till usually found at 2-3 feet. Permeability is moderately rapid in the upper sands and slow in the lower clay. Leachate might be expected to flow laterally in this soil type. Plymouth sands are sandy soils formed on stony sandy till. Permeability is rapid at the surface and very rapid in the underlying materials. Potential contamination of ground water by leachate is of some concern in Plymouth soils.

Lateral flow of leachate would seem to be the most likely source of pollution because of the steep topography and the presence of the landfill in a swale which feeds the Tiasquam River and the presence of some slowly permeable layers at depth. Observations during a very heavy rainfall in June indicate a large quantity of runoff flowing down the road in the northeastern corner of the landfill. This runoff contained a large concentration of suspended sediments and roughly 3 ppm of ammonia. Approximately 12-18 hours after the storm started ammonia levels in the Tiasquam River were found to be 1 ppm at the Tea Lane crossing. Further investigation of the potential contribution of leachate to this stream is recommended. A flowing stream crosses under the highway approximately 300 feet to the south. The presence of clay in the landfill would allow the inexpensive construction of a liner to limit the flow of leachate.

It is recommended that steps be taken to improve the operation of this landfill, including:

--provide regular cover of garbage;
--segregate wastes;
--keep nightsoil disposal sites well away from headwaters of Tiasquam River;
--consider fencing to prevent blowing refuse;
--conduct a thorough site investigation to assure the protection of the headwaters of the Tiasquam River;
--use available clay to provide liner for fill in sandy soils.

10.14 Oak Bluffs Landfill (see figure a-15).

The Oak Bluffs landfill is located off County Road. Site #1 is 3.8 acres and Site #2 is 12.9 acres. The dump is supervised by a full-time dumpkeeper with cover once per day. The present dump (Site #1) consists of a deep former gravel pit extending 40-50 feet below level of Site #2, a completed landfill site. Site #1 is level and occurs in sandy material.

Topographic depressions exist off to the west of the dump and toward Sengekontacket. Surface runoff has not been noted. Some runoff from Site #2 makes its way to Site #1. Most water is expected to infiltrate rapidly into the ground water at levels of 50-70 feet below Site #2, and 30 feet below Site #1. Flow direction is unknown but is assumed to be toward Sengekontacket Pond to the southeast. The town water supply is at least 4,000 feet away and is considered safe.

The soils in the area are Evesboro soils which form on deep sand and alluvial deposits composed of quartz sand with only small amounts of clay and very little silt. Slopes are mostly less than 10%. Permeability is rapid to very rapid and it is a somewhat excessively drained soil. Leachate would be expected to move directly into the ground water.

Steps that should be taken to improve the operation of this landfill include the following recommendations:

--provide fencing to reduce windblown refuse;
--assure adequate setback of any future private wells on adjoining lots;
--install monitoring wells or sample nearby private wells to define magnitude of leachate problem;
--locate nightsoil disposal area away from steep slopes where runoff is likely;
--improve interim nightsoil disposal techniques so that random disposal as well as repeated

dumping in one pit does not occur.

10.15 Edgartown Landfill (see figure a-16).

The site is located approximately 2,000 feet south of the West Tisbury Road at the location of Jernegans Pond at an elevation of 25 to 40 feet. Fifteen acres are now in use with 2-3 acres available for future disposal. Solid wastes are covered daily by a full-time dumpkeeper. The site is completely fenced in to preclude windblown refuse problems. The site has irregular topography ranging from a height of approximately 30 feet to man-made pits at an elevation of 5-10 feet. The site drains generally to the southwest The present site configuration consists of a topographic high from which wood, brush, grass clippings and other organics are pushed off a slip face in the southeast portion of the site. This area has recently been completely covered with earth. In the northeast portion of the site, scrap metal disposal occured and at a point between these two locations, sanitary landfill operations are now complete. Present sanitary landfill operations occur in the northeastern corner of the Pent lot, and future fill will occur in trenches along the eastern edge of the landfill.

It is believed the direction of ground water movement is generally southwestward, although the recharge area required for the Machacket well, based on average summer day use (Metcalf & Eddy, 1972) of 1.11 mgd and a method used by Strahler, is .8969 sq. miles, consisting of a circle of radius .534 miles. This recharge area includes the entire disposal area.

The cone of influence on the other hand, may not extend one quarter of this distance. As the new supply at Lily Pond is developed, less pumping at Machacket will reduce the area of influence. No evidence of any leachate contamination has occured in the analyses of the town supply well. An additional monitoring well between the landfill and the town well is recommended to determine the nature of leachate and its direction of flow.

The soils in the area are estimated to be Carver sandy loam, which is very drouthy (SCS category 51, B2). This soil is rated by SCS as having slight limitations for sanitary landfill.

The water table exists at a depth of 30 to 40 feet below the higher portions of the site, and only 10 feet below the lower excavated pits in the northeast section of the site. Ground water has reportedly been exposed in some previous excavations.

Beetle Swamp to the north of the site is believed to be perched as the Edgartown Water Company's drilling

Confusing

rig encountered surface water underlain by a hardpan layer extending from 2 to 25 feet below grade followed by a second water table at 26 feet. These perched conditions may extend under the existing site but it is believed much of the site extends below the level of this hardpan layer believed to be responsible for the perched table (no evidence of this layer is found in the excavated walls of the site).

In some of the cut faces, evidence of a more silty layer exists. This layer is occasionally contorted and shows some iron cementation. The fill operation extends through this layer.

It is recommended that steps be taken to improve the operation of this landfill, including:

--purchase Wilbur Lot to allow expansion of operation in future to the west;
--in using the trench landfilling technique, do not fill any deeper than within 10 feet of the expected ground water, to avoid miscalculation and to improve leachate quality;
--install monitoring well between landfill and town water supply;
--use impermeable baseliner and cover in all deep trenches.

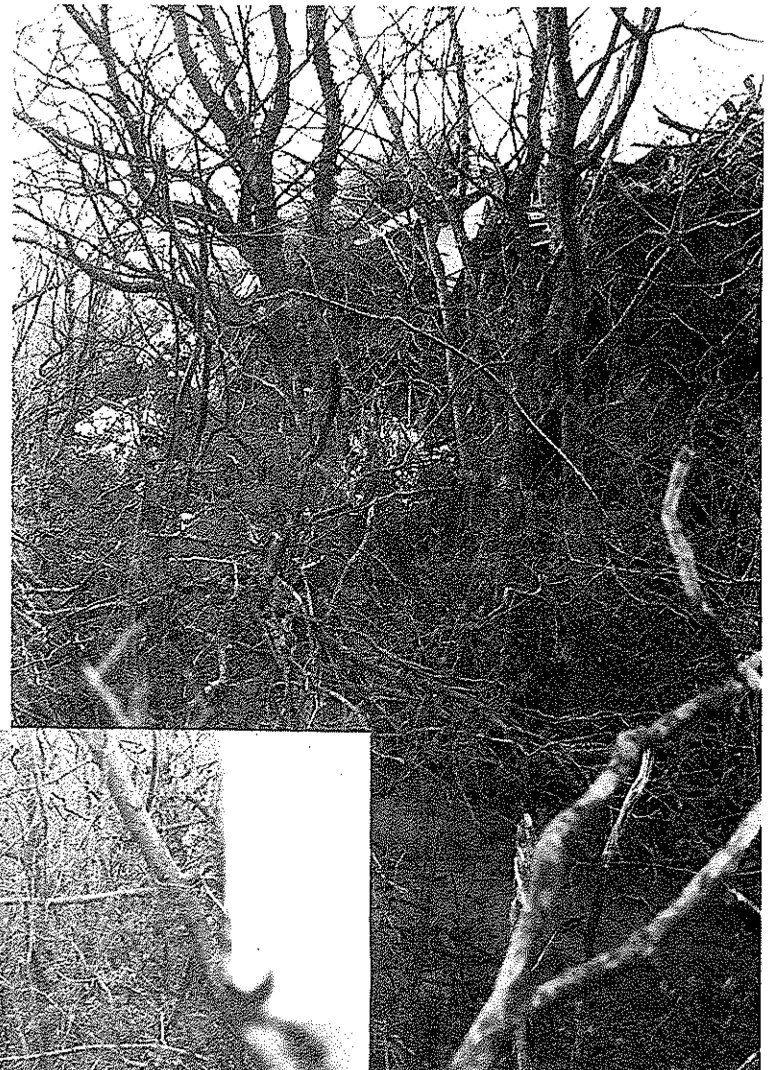
10.16 Chappaquiddick Landfill

The Chappaquiddick site is located west of School Road at an elevation of 20 to 25 feet. A wetland, perched on a cemented hardpan layer exposed in the cut and fill operation, lies immediately adjacent to the landfill. A slipface dump for appliances, scrap and vegetation is encroaching on the wetland in violation of the Wetlands Protection Act, Chapter 130. Garbage is placed in a trench which is irregularly covered with fill. The landfill receives widely varying volumes of refuse depending on the season, and the resources available to provide regular cover are limited. The following actions for improving this site are recommended:

--cease slipface dumping into the wetlands; move the appliance, wood and scrap disposal area to the south in the existing pit;
--during the summer months provide regular cover of garbage which is to be segregated from the other materials; in winter less frequent cover should be sufficient;
--make arrangements for future landfilling and reclamation of land for grazing with the owner from which the land is now leased.

10.17 Tisbury Landfill (see figure a-17)

The landfill is 40-60 years old. It is estimated



Chappaquiddick landfilling activities and adjacent wetland.

that the old fill layers extend to a depth of 20 to 25 feet below present grade.

Topographically, the dump consists of: 1) large flat area currently used for sanitary landfill and disposal of 12,000 yards of spoil from the recent harbor dredging project. Surface drainage here might trend either down the entrance road to the north into the scrap and fill pit or from the western landfill area to the west into the brush pit. The brush pit is 40-50 feet below grade and 70 feet below the sanitary fill site. 2) Drainage from the brush pit seems to be moderate to slow as a puddle of water was noted in October several days after the last rainfall.

Ground water--both town wells are within a distance of approximately 1500 feet of the dump. Each well is driven to a depth of 225 feet; the water level at the Spring Street well is 76 feet while at the Edgartown-Vineyard Haven Road, water is 110 feet below grade.

The water level below the dump is estimated at 100 feet while below the brush pit, the water table may be 30-40 feet. No evidence of leachate has thus far been found in analyses of the town water supply. Ground water flow is uncertain at this date. Topographically, flow might be directed in one or all of 3 directions:

1) east-southeast toward a depression extending westward from the Lagoon;

2) west toward south-southwest trending depression from Tashmoo Pond;

3) northwest toward the Tashmoo depression.

Soils--Carver (51B) soils are in evidence to the east bordering on the Edgartown-Vineyard Haven Road. Plymouth sandy loam (32B) is found to the west along the Vineyard Haven Road. Carver and Plymouth soils are excessively drained.

The 1925 survey classified the soils as of Haven series on nearly level to moderate slopes. These soils are well drained. Permeability is moderate at the surface and very rapid in the substratum.

Investigations of the site revealed that the soils consist of coarse to fine sands, intermixed with coarse to fine gravels. No surface or ground waters were visible. Any leachate which is generated at this site would percolate through the porous soils into the ground water system (Enviro/Earth Consulting Engineers). Anderson-Nichols Company estimated the flow of ground water as being toward the head of Lake Tashmoo and that the travel time for nutrients to the Spring Street well might be on the order of 60 years.

It is recommended that steps be taken to improve the operation of this site, including:

--install ground water monitoring wells between the site and the Spring Street well (approximate cost for 3 wells is $2,000);
--construct fencing to control blown refuse;
--cease disposing of nightsoil in the deep brush pit;
--improve interim nightsoil disposal capability by constructing a small infiltration lagoon;
--initiate depression landfilling in the deep brush pit. This pit is approximately 2 acres in size and 40 feet deep. It could conceivably accommodate the refuse from the community for several years (assumes 2,000 tons of refuse per acre, 10 feet deep);
--take steps to secure a new landfill or water supply location; in the interim, use recycling to minimize waste volume;
--consider feasibility of relocating town well(s) rather than the landfill. Even if landfilling ceases, leachate from the landfill will continue to flow into the ground water and might pollute the well in the future. If the wells were relocated, the landfilling operation could be expanded to water department land. These options should be carefully evaluated before major expenditures are made;
--if the landfill is relocated, install an impermeable cap on the exisitng landfill to divert rainfall which will generate additional leachate.

10.18 Gay Head Landfill (see figure a-18).

The site is an area fill of 2 acres with no regular covering. Wastes are not segregated. The available area for expansion is approximately 1-1 1/2 acres with a buffer. The site is at 110 foot elevation near the intersection of Lobsterville and South Roads. Carver soils at the site rest on deep sand deposits, perhaps allowing leachate infiltration to the ground water. Clayey Chilmark soils also present, can produce lateral movement of leachate. Surface runoff into nearby Black Brook Swamp can be a problem.

The depth to ground water is uncertain; however, the wetland at the rear of the site (possibly perched) is only 5 to 10 feet below the landfill. This wetland is part of the headwaters of Black Brook, which flows into Squibnocket Pond.

Water samples taken from the ground water near the disposal site showed high iron and manganese concentrations (12/14/76). Water analyses in the swamp water indicated no nutrients or metals above those which might be natural in a wetland.

It is recommended that steps be taken to improve the operation of this site, including:

--provide regular cover;
--segregate wastes;
--establish barriers to slow direct runoff of surface waters from the landfill into the wetland;
--improve flow of wetland with culvert under the road;
--assure proper setback of private wells on adjoining lots;
--consider acquiring additonal land for future expansion.

10.3 On-Going Programs to Upgrade Landfills

10.31 Resource Conservation and Recovery Act (1976)

The Resource Conservation and Recovery Act (1976) was enacted by Congress to promote the protection of health and the environment and to conserve valuable solid wastes and energy resources by: a) providing technical and financial assistance for the development of solid waste recovery plans and resource conservation systems. This includes new and improved methods of collection, separation and recovery of solid wastes and the environmentally safe disposal of non-recyclable residues; b) prohibiting future open dumping on the land and requiring conversion of existing open dumps to facilities posing no health or environmental dangers; c) promoting demonstration, construction and application of solid waste management, which preserve and enhance the quality of air, water and land resources; d) establishing cooperation between Federal, State and local government agencies and private enterprise to accomplish recycling and energy production from solid waste (Public Law 94-580). However, current Federal incentive programs for virgin resource use such as tax depletion allowances and freight cost reductions make recycling difficult to justify on the local level. We recommend that the Federal government establish incentives for the use of recycled materials rather than raw materials.

10.32 Massachusetts Landfill Regulations

Chapter 111 of the Massachusetts Genral Laws includes regulations for minimum disposal procedures for sanitary landfills. Several landfills on the Island do not yet comply with these regulations. Gay Head, Chappaquiddick and the Chilmark landfills should provide more regular cover. In these areas, the resources for regular cover are not available. Regulation 15 (Massachusetts General Laws, Chapter 111, Section 150A) requires the landfill operators to place a layer of cover at least 6 inches thick over the refuse before the end of each working day. Also, 2 feet of cover is required to provide support for vegetation after landfilling has ceased in one section of the landfill. The cover material should be free of materials which will attract flies, free of large objects that interfere with spreading and it should not be easily eroded. The purpose of the cover is to minimize vector (flies and rats) and blowing refuse problems. Between 15 March and 15 April burnable wood, brush, leaves and other products of land clearing operations may be disposed by burning but only on the sites from which they are generated.

Under Regulation 31 (Chapter 111), fines of 100 to 500 dollars per day can be levied on any municipality not operating a sanitary landfill in accordance with Regulation 15. To overcome these difficulties, it is recommended that segregation of refuse be required at these landfills into scrap, wood and vegetation, and garbage and that only the garbage be covered on a daily basis.

10.33 Recycling Programs

West Tisbury now recycles bottles, cans and newspapers from inexpensive separation bins made of cement and located at a convenient spot in the landfill. A privately sponsered paper recycling operation has been established by Bob Kinnecom of Oak Bluffs. Tisbury and Edgartown have committees examining the feasibility of establishing recycling programs to forestall the need for acquiring more land. An estimate of cost benefits which could accrue from recycling is outlined in Table 34. Freight charges for transportation are outlined in Table 35. This course is recommended for all towns to reduce the area required for landfill and the environmental threats.

10.4 New Landfills

It is important that new landfills be established in a manner which minimizes their impacts on water resources. If they are to be located on any of the towns' ground water recharge areas (figures 32-37) they must be underlined to minimize contamination of potential water supplies. Landfills should not be located on the shores of poorly circulated tidal ponds where seepage may adversely affect water quality. It is possible to site them near open-ocean coastlines where leachate will flow into the sea and where mixing can render the contaminants harmless.

Table 34 Recyclable Solid Waste on Martha's Vineyard

	Island (1975) Tonnage	Minimum Value/ton (1976 dollars)	Total Estimated Value (1976 dollars)
Cardboard	740	$7	5,200
Newspaper	1800	$7	12,600
Misc. Paper	3600	$7	25,200
Metals	1200	$8	9,600
Grease & Ceramics	1300	$8	10,400
Total Value of Recyclable Solid Waste			$ 63,000
Garbage	1440	composting	
Grass, Dirt, Leaves	2700	composting	
Wood & Brush	500	woodchipping	

Table 35 Freight Costs (SSA) for Recycled Materials

Junk Cars - .11¢/100 lbs.

Glass, metal cans, rubber, paper, rags, iron, steel, copper - .21¢/100 lbs.

Rate Minimums - truck and driver go free

Length of vehicle	Min. load
less than 25'	4 tons
25 - 32'	4 3/4 tons
32 - 38'	5½ tons
38 - 46'	7 tons
46-54'	10 tons
54' and over	14 tons

The considerations involved in choosing a new landfill site include:

--How much area is available and how long will this area last the town(s)?

--What is the nature of the soils and the depth to ground water?

--Are there impervious soils available which can minimize leachate problems?

--Is the site in an area not deemed a valuable recharge or supply area?

--What is the topography on the site? Will the process of landfilling be cut-and-cover or imported cover (flat land) or depression filling (on land with relief)? Is there cover material available on the site?

--Is the site convenient for transporting refuse by both town and private vehicles?

Once the site is selected, a careful planning process is vital by a competent engineering firm or by the Water Resources Planner at the Martha's Vineyard Commission. This planning process requires the following information:

1) a topographic survey;
2) test pits and soils analyses;
3) test borings to determine water table level and deeper soil conditions.

An examination of the map of the Island and its environmental limitations reveals very few areas which fit all of the requirements. The northeast and southern shorelines are bordered by fragile coastal ponds, while the property values along the northwest shore are prohibitive. Island soils in the eastern and southern areas are generally coarse sands which require some means of leachate control to avoid ground water contamination. In the western moraine, the presence of surface waters and drainage can lead to difficulties with leachate runoff. The likelihood of locating 1 or 2 ideal sites is far greater than locating 7. <u>A regional landfill</u> is therefore more desirable in terms of protecting the environment by allowing the selection of the best possible site and by limiting the number of waste sources. Several possible locations for a regional landfill exist:

1) land of unknown ownership in Oak Bluffs along the northern edge of the State Forest west of Barnes Road - previously considered for a regional sewage treatment facility (Tighe & Bond, 1975)

2) other land of unknown ownership lying between Barnes and County Roads in Oak Bluffs;

3) other land which a town or towns might take by eminent domain;

4) the State Forest--arrangements might be made to incorporate a landfill operation into a harvesting and replanting program of State Forest trees.

A regional landfill would require a regional health board or district or the county to manage the operation. Alternatively an intertown agreement could be worked out to allow the town in which the site is located to operate the site with compensation from participating towns. Options 1, 2 and 4 would all require leachate control to prevent contamination of prime aquifers. The areas with the greatest need for solid waste disposal sites are also the areas with prime aquifer areas which must be protected for future water supplies. The costs of establishing a regional landfill are estimated in table 36.

10.5 Solid Waste Management Options

The following section outlines alternative approaches to the solid waste disposal problem on Martha's Vineyard. Solid waste disposal operations are currently supervised by the Boards of Health in the respective towns. Major improvements in the operation of these landfills have been made during the recent past. There are still some improvements which need to be made to bring all of the landfills in line with State requirements under Chapter 111. To accomplish the goal of safe disposal of solid waste, there are two options available: to continue with seven separate landfills or to regionalize as 1 or 2 landfills.

It was not within the scope of this study to determine the most cost-effective way to solve the Island's solid waste problem. The state is currently designating areas to receive funds under the Resource Conservation and Recovery Act, 1976. It is recommended that Martha's Vineyard be designated as one study area. The options which could be considered in detail as part of this study are discussed below. They are not all mutually exclusive. For example, composting or recycling will enhance a landfill operation by decreasing the volume of refuse which must be buried. Each option involves advantages and disadvantages which are spelled out. The advantages, disadvantages, costs and benefits must all be carefully weighed in selecting a future management scheme.

10.51 Alternative 1: Continued Operation of Seven Separate Landfills

Table 36 Cost of Establishing a Proper Sanitary Landfill
Adapted from Schoffield Brothers, 1974

Land Acquisition -	60 acres @ $5,000/acre -	$300,000
Site Improvements -	clearing, stumping, excavation, fencing etc. -	70,000
Contingencies engineering -	20% -	50,000
Utilites		
Electrical	2000 feet @ $3/ft.	6,000
Transformer		800
Water Service	2inch well	5,000
Fire	5,000 gallon storage tank, fire pump	12,000
Contingencies	20%	5,000
Equipment		
Brush chipper 16" throat		8,000
Air compressor		1,000
Diesel fuel tank and pump		3,000
10,000 GVW Dump Truck		10,000
Contingencies	20%	4,400
Underlining		
Bentonite installed cost $1.26/square yard over 4 acres		25,000
TOTAL COST		$500,200

not quite

Concentrated nightsoil disposal can overload the soil and lead to contamination of groundwater supplies.

The costs of continued operation of the existing town landfills will become progressively more expensive as land, equipment and materials costs increase. In order to operate a proper sanitary landfill, fencing would be required for the Tisbury, Oak Bluffs, West Tisbury, Chilmark, Gay Head and Chappaquiddick landfills. Regular cover would be necessary at Gay Head, Chilmark and Chappaquiddick and additional land required at Edgartown and Tisbury. Present annual operation costs are outlined in Table 37 - a total of $130,000 per year plus costs of depreciation on town vehicles used in the operations. Advantages to this means of disposal are:

1) if well-designed and operated it can meet all public health and pollution requirements;

2) a low capital investment of $2500-3000/ton/day and low operating cost of $7/ton/day are required to process 5 to 20 tons per day;

3) a sanitary landfill is flexible to varying rates of waste disposal;

4) few skilled personnel are required (for 20 ton/day landfill only one person is required);

5) after fill is completed, the property can be used for play areas, parks, athletic fields and parking.

Disadvantages of this method include:

1) sanitary landfills are usually located outside town requiring longer hauling distances;

2) operating equipment can be adversely affected by inclement weather;

3) possible contamination of the ground water especially if leachate control measures are not taken for porous Island soils;

4) limited use for reclaimed area;

5) location in residential areas can generate public opposition;

6) duplicative costs of operating seven separate landfills;

7) environmental threat of seven sources of contamination increasing as each town requires a new disposal site;

8) requirements for additonal land are large (see table 33.

Table 37 Present Operating Costs: Island Landfills

Edgartown	$ 20,000
Tisbury (includes collection)	38,000
Oak Bluffs " "	54,000
West Tisbury	8,000
Chilmark	7,000
Gay Head	3,000
Island Total	$130,000 approx.*

*Does not include the added cost of use of town vehicles. A more realistic estimate of cost including vehicular depreciation might be nearer $200,000.

Table 38 Estimated Volumes and Cost of Landfill Operation

	1975		1975-1985 Total	
	Total Estimated Solid Waste (Tons)	Total Expected Cost @$7/ton	Tonnage	Ten Year $ cost
Chappaquiddick	400	$ 2,800	4,500	$ 31,500
Edgartown	3160	22,120	35,700	249,900
Chilmark	1220	8,540	13,800	96,600
Oak Bluffs	3480	24,360	39,300	275,100
Tisbury	3320	23,240	37,500	262,500
West Tisbury	1320	9,240	14,900	104,300
Gay Head	490	3,400	5,500	38,500
		$93,730*		$1,058,700

Assumes no new! land purchase site improvement equipment

*actual cost with collection is $130,000 which compares favorably with this estimate of operation alone

Table 39 Capital Investment for Landfill Operations

	Average 1975 Tonnage/Day	Estimated Capital Investment
Chappaquiddick	1	$ 2,500 - 3,000
Edgartown	8.7	22,000 - 26,000
Chilmark	3.3	8,250 - 9,900
Oak Bluffs	9.5	23,750 - 28,500
Tisbury	9.1	22,540 - 27,300
West Tisbury	3.6	9,000 - 10,800
Gay Head	1.3	3,250 - 3,900
Island Total	36.5 Tons/Day	$91,500 -109,400

Over the next 10 year period, costs are expected to experience approximately 110 per cent increase. For example during the period 1966-76, the costs of operating the Tisbury landfill more than doubled as reflected by the total Board of Health expenditures (not including Tighe and Bond engineering study). The costs of running seven landfills should approach a minimum of $300,000 in 1985, plus costs of depreciation of vehicles. Capital investments required can be estimated based on the number of tons handled per day (see table 38). Any approach which would limit this increase in cost or actually create a return (e.g. recycling) should be carefully considered for the future.

This approach has adverse impacts which include:

--added threat to the environment;

--costs of duplicative operation of seven landfills;

--added costs for bringing landfills into line with Chapter 111;

--costs of land.

The beneficial impacts associated with this approach include:

--requires limited labor

--continued disposal or refuse at accustomed sites by individuals.

The continued supervision of this disposal approach by the Boards of Health (Selectmen in Gay Head) is recommended. The Boards have shown increasing awareness of the most appropriate landfilling practices over the past several years. The Boards are also most closely in touch with the needs and problems of refuse disposal within each town. A regional agency could not offer the same kind of careful and informed supervision.

10.52 Alternative 2: Regional Sanitary Landfill

One or two large landfills could serve the entire Island. Refuse could be brought directly to the landfill(s) by private individuals and collection vehicles or transfer stations could consist of dumpsters or less expensive concrete holding bins. This would allow the public to continue to dispose of its waste at the accustomed sites resulting in no social disruption. It has been recommended (Enviro/Earth consulting engineers) that transfer stations are only important where round-trip-travel times are 110 minutes or more. This amount of travel is not likely on the Island. However, individual disposal of refuse at accustomed disposal sites is considered an important aspect to obtaining acceptance of this concept.

The advantages and disadvantages of a regional sanitary landfill are similar to those for individual landfills with generally lower costs to the towns and to the environment. Costs would be decreased because, instead of requiring six sets of equipment and six operators, two to four pieces of equipment and two to four operators would be needed (Tecton, 1976). First costs for establishing a 60 acre regional landfill would be in the vicinity of $500,000 (see table 36). Operating costs will be in the range of $6 per ton/day or, for an 18,000 ton/year landfill, $108,000/year. A regional landfill operational cost on Nantucket (180 acres) was estimated at $131,000 (Schofield Bros., 1974) to handle similar volumes of refuse.

If a new landfill site is selected, the site could be most appropriately located to minimize environmental impacts. The site could also be completely underlined to eliminate concerns for ground water contamination with leachate. A total of 60 to 65 acres would be required at a cost of 260,000-300,000 dollars (at $4-6,000/acre). The area required could be reduced if recycling and other volume reducing measures were taken. These approaches as described below are more readily achieved on a regional than on an individual basis, but certain aspects of each might contribute to the better operation of individual landfills.

1) Composting

An estimated 4,000 tons of organic wastes, grass and leaves are deposited in Island landfills each year. Separated and composted, this material would be transformed into a usable end product for soil conditioning. Mechanical composting plants are available, but construction costs ($1,500 - $6,000 per ton of capacity) and operating costs are high. An open air operation utilizing the windrow method could be carried out at each town landfill or the regional site as part of the landfill operator's regular duties, with rental of the necessary shredder at the end of the composting period (9 months).

2) Recycling

Recoverable solid wastes include glass, metal, paper and garbage for composting. They may either be separated at the source (the home) or at a specially designed plant. Our solid waste flow is far too low for a plant (EPA recommends a minimum of 150 tons per day). In addition recycling plants can cost up to $50,000 per ton capacity - a $2 million investment on the Island. Other areas where recycling was established have employed an ordinance to allow only separated materials to be collected and brought to the landfill. In areas with refuse collection, home separation requires either compartmentalized pick-up trucks or a collection schedule alternating types of refuse collected. Recyclable materials and minimum values are estimated in Table 34.

3) Solid Waste Transfer Stations

A regional sanitary landfill on the Island might be inconvenient for residents of outlying areas. Collection serving all homes on the Island would be prohibitively expensive. These problems can be alleviated by operating transfer stations at each of the old landfills.

Transfer stations can range in complexity from simple wire holding pens to standardized bulk containers serviced by a transfer truck.

Two relatively simple types of transfer stations provided with readily available components appear adaptable to the Island situation. The first would involve several medium-sized containers (6, 8 or 10 cubic yards). Each container would be designed to hold a different item for recycling efforts--glass, metal, paper, etc. The second approach would involve a single large container (30, 40 or 50 cubic yards).

Transfer containers would be placed in an area where:

1) they can be serviced by the transfer vehicle;

2) individual collection vehicles can unload their waste;

3) they are hidden from general view;

4) they are protected from wildlife and vandalism.

The density of waste in the containers without compaction would be about 170 pounds per cubic yard. If a packer truck were used for collection, the density could be increased to 300 pounds per cubic yard.

Capital costs of one transfer station, including the cost of dumpster, concrete pads, fencing and unloading area, would be approximately $20,000 with an annual depreciation cost of $800 (over 25 years). Transfer trucks cost in the $30,000 to $40,000 range with operating costs estimated at $2.25 to $3.33 per hour. Table 40 shows the cost of dumpsters for each town needed to meet peak solid waste volumes.

4) On-Site Incineration

To handle present volumes an 8 and a 15 ton capacity incinerator would be required at an approximate

Table 40 Total Estimated Dumpsters Required (1975)
Solid Waste Transfer Stations

	Peak Day Tonnage	Dumpsters ($3,000 per)	Cost/Dumpster	Total
Chappaquiddick	4	1 @ 50 c.y.	$ 3,000	$ 3,000
Edgartown	25	6 @ 50 c.y.	3,000	18,000
Chilmark	11	3 @ 50 c.y.	3,000	9,000
Oak Bluffs	30	7 @ 50 c.y.	3,000	21,000
Tisbury	22	6 @ 50 c.y.	3,000	18,000
West Tisbury	11	3 @ 50 c.y.	3,000	9,000
Gay Head	5	1 @ 50 c.y.	3,000	3,000
				$81,000

Table 41 Bioconversion Impacts

Positive

1. Fully enclosed, no fly or rodent problems, no windblown refuse.
2. Operating temperature above 155 degrees Farenheit ensures seeds destroyed.
3. Handles sludge and septic tank waste. (possible Federal aid)
4. 60% volume reduction of remainder, 30% reuseable as soil cover.
5. No air pollution.
6. Does not require additional land.
7. Least cost for petroleum and electricity.

Negative

1. Research is just beginning to expand end product use
2. Needs liquid to operate.
3. Governmental agencies have not committed themselves to the acceptability of bioconversion.
4. An additional unit must be added after an approximate 50% increase in volume.

cost of $125,000 plus operating costs of $170 to $300 per day.

A regional solid waste study conducted on Nantucket (Schofield Bros., 1974) concluded that the cost of installing 3 combust-all incinerators was approximately $1.2 million including weighing station and 40 acres of land for landfilling the residue. The yearly operational costs of a regional incinerator are estimated at $276,000 of which $100,000 is for fuel oil. Aside from this expense, other disadvantages include air pollution; the process still requires land, involves a large budget and the residue may contain a concentration of heavy metals.

Incineration reduces the volume of waste which must be landfilled by up to 90%. The final product is inert and can be safely landfilled.

5) Bioconversion

Bioconversion is a microbial decomposition of solid waste. The material is fed into a 3 compartment rotating digester tube. In the tube, the microbes act on the rubbish in each compartment for one day raising the temperature of the refuse to 155° F to 170° F and destroying harmful bacteria. The process can combine nightsoil and refuse thereby eliminating another of the Island's waste disposal problems. The estimated capital cost of a digester 13 feet in diameter and 120 feet long, capable of handling our solid waste, is $1.4 million. The annual operating cost of the facility is approximately $100,000. This system has no harmful environmental effects and produces a valuable soil conditioner. The process requires liquid (nightsoil) to operate and accomplishes a 60% volume reduction. It is a fully enclosed process which eliminates windblown refuse and rat, seagull and fly problems. It requires a minimum of petroleum and electricity. Impacts of this process are outlined in table 41.

10.6 Recommendations

Many possibilities exist for improving and economizing on local solid waste disposal practices. The alternatives available are evaluated in table 42 in terms of their social, environmental , economic and political impacts. It was not within the scope of this Program to determine the most cost-effective, long term solution to the Island's solid waste disposal problem. However, the state is currently designating areas to receive funds under the Resource Conservation and Recovery Act, 1976. It is recommended that Martha's Vineyard be designated as one study area.

Short Term:

--Improve existing landfill operations

Chilmark, Gay Head & Chappaquiddick provide separation of wastes and regular cover during peak dumping months.

Chappaquiddick- cease landfilling operations in the wetland.

--Assure availability of adequate land area for 10 year demands, especially, Edgartown, Tisbury, Chilmark and Gay Head landfills.

--Provide adequate buffer around existing and future landfills through purchase of abutting lots or setback of landfilling operations.

--Take steps to reduce volume of waste
- -encourage home composting
- -purchase woodchipper
- -educate homeowners to reduce volumes of waste
- -encourage recycling/composting efforts

--Establish an official committee to study feasibility of regionalization and propose course of action.

--Establish monitoring program of wells near existing landfills, especially Tisbury, Edgartown and West Tisbury landfills.

Mid-term:

--Establish regional landfill(s) - supervision by county or Regional Board of Health
--Begin recycling operations
--if recycling is not feasible, consider alternatives such as: incineration
bioconversion

Long Term:

--Depending on success of recycling/regionalization effort, consider necessity of a more permanent solution such as bioconversion which offers a combined disposal option for nightsoil and solid waste.

KEY

- * Very Positive
- \+ Positive
- 0 No Impact
- \- Negative
- = Very Negative

- G Good
- F Fair
- P Poor

TABLE 42
SOLID WASTE

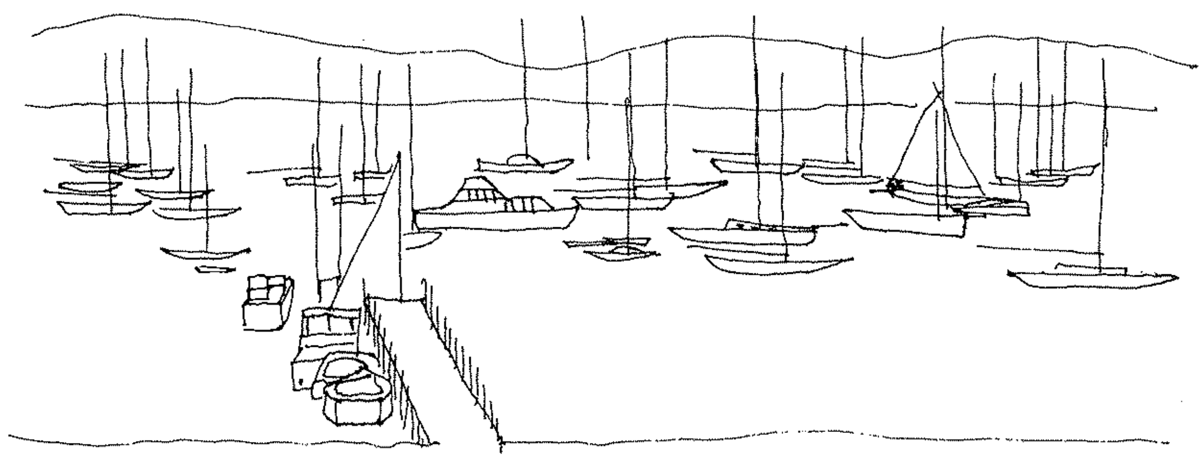
IMPACTS / ACTIONS	Do Nothing	Improve Present Methods	Install Monitoring Wells	Use Impermeable Cap	Use Impermeable Underliner	Eliminate Nightsoil Disposal	Encourage Recycling	Plan Future Disposal Sites	Regionalization Study Committee	Regionalize	Recycle/Landfill	Bioconversion	Incineration
1. WATER QUALITY GOALS													
A. Fulfills Clean Water Act	-	+	+	+	+	*	+	+	+	+	+	*	+
B. Summary Rating	P	G	G	G	G	G	G	G	G	G	G	G	G
2. ENVIRONMENTAL EFFECTS													
A. Hydrology													
1. Water Quality	-	+	0	*	*	*	+	+	0	+	+	*	+
2. Water Quantity	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Water Problems	-	+	0	+	+	+	+	+	0	+	+	+	+
4. Water Uses	-	+	+	+	+	+	+	+	0	+	+	+	+
5. Flood Hazards	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Biology													
1. Rare Species	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Aquatic Habitat	0	0	0	0	0	0	0	+	0	0	0	0	0
3. Aquatic Population	0	0	0	0	0	0	0	0	0	0	0	0	0
4. Benthic Community	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Air Quality	-	+	0	0	0	+	+	+	0	0	+	+	-
D. Land													
1. Change in Use	-	+	0	0	0	0	+	+	0	+	+	+	+
2. Planning & Controls	-[1]	0	0	0	0	0	+[2]	+[2]	0	+[2]	+[2]	0	0
3. Growth	0	0	0	0	0	0	0	0	0	0	0	0	0
4. Soil Erosion	-	+	0	+	0	0	0	+	0	+	0	+	+
5. Sensitive Areas	-	+	0	+	+	+	+	+	0	+	+	+	+
E. Wastewater Management Resources													
1. Energy	+[3]	+	0	-	-	-	+	+	0	*	+	-	=
2. Chemicals	+[3]	+	0	0	0	0	+	0	0	+	+	+	-
3. Land Commitment	=	-	0	0	0	0	*	+	0	+	*	+	+
F. Summary Rating	FP	G	G	G	G	G	G	G	G	G	G	FG	P
3. ECONOMICAL COSTS													
A. Cost													
1. First Cost	+	-	-	-	-	-	+	-	0	-	-	=	=
2. Annual Cost	+	-	0	-	-	-	+	0	0	+	+	-	-
3. External Cost	-	+	0	+	+	+	+	+	0	*	*	-	-
B. Value of Goods & Services													
1. Recreation	0	0	0	0	0	0	0	+	0	0	0	0	0
2. Water Supply	-	+	+	*	*	+	+	+	0	+	+	*	*
3. Fishing & Shellfishing	0	0	0	0	0	0	0	+	0	0	0	0	0
C. Jobs	0	+	0	+	+	0	+	0	0	-	-	-	-
D. Economic Base & Stability	0	+	0	+	+	0	+	0	0	0	0	0	0
E. Summary Rating	F	FG	F	FG	FG	F	G	G	0	FG	FG	P	P
4. SOCIAL EFFECTS													
A. Dislocation of People or Services	+	0	0	0	0	0	0	+	0	-	-	-	-
B. Public Health	-	+	+	*	*	*	+	+	0	+	+	+	+
C. Aesthetics	-	+	0	+	+	*	+	+	0	+	+	+	+
D. Educational & Cultural	0	0	0	0	0	0	0	0	+	0	0	0	0
E. Summary Rating	F	G	G	G	G	G	G	G	G	FG	FG	FG	FG
5. IMPLEMENTATION													
A. Legal Authority	+	+	+	+	+	+	+	+		+	+	+	+
B. Financial Capacity	*	-	-	-	-	-	+	+		-	+	=	=
C. Practicability	+	+	+	+	+	+	+	+		+	+	-	-
D. Public Accountability	-	+	+	+	+	+	+	*		+	+	+	+
6. PUBLIC ACCEPTABILITY	-	+	+	+	+	*	+	+		+	+	-	-

NOTES:

1. Implies less control.
2. Implies improved planning and controls.
3. Requires small amount of energy and chemicals.

11

Boating Wastes



11.0 Boating Wastes

During the summer months, large numbers of private boats flock to the harbors of Oak Blufs, Vineyard Haven, Menemsha, Edgartown and Tashmoo. An estimate made from photographs notes that Martha's Vineyard has slip and mooring facilities for 1,075 recreational boats. A count of boats in these harbors is included in Table 43.

Pollution observed in Vineyard harbors as described in Chapter 5, reflects both boating wastes and increased activity on shore. In Edgartown Harbor, prior to the installation of a sewer system, bacterial contamination occurred during summer months from roughly 100 overnight vessels, shoreline hotels, and restaurants. After sewers were installed samples taken in this harbor still revealed bacterial contamination (Aug. 31, 1976). The Oak Bluffs Harbor sampling program produced extremely high bacterial counts on occasion. Contributions of bacteria from shoreline cesspools may also be an important factor in Oak Bluffs Harbor. a little heavy

Samples taken in Menemsha Basin by the Wampanoag Fishery Project have also revealed very high fecal coliform counts. Boating wastes can pose a hazard to the health and well-being of persons utilizing the same water for bathing and shellfishing if improperly treated (EPA, 1975).

Another problem is the pumping of oily bilge water. This liquid includes concentrated salt and oil. Numerous fishing and other vessels in Menemsha and, more recently, Edgartown Harbors pump bilgewater while in harbor. Minor spills resulting from pumpouts can in time produce adverse effects on shellfish and finfish. Several options are available which include: 1. require filtration devices on all boats; 2. provide pumpout facilities and dispose or treat the bilge; 3. require pumpouts outside the harbors.

11.1 On-Going Programs to Minimize Boating-Waste Impacts

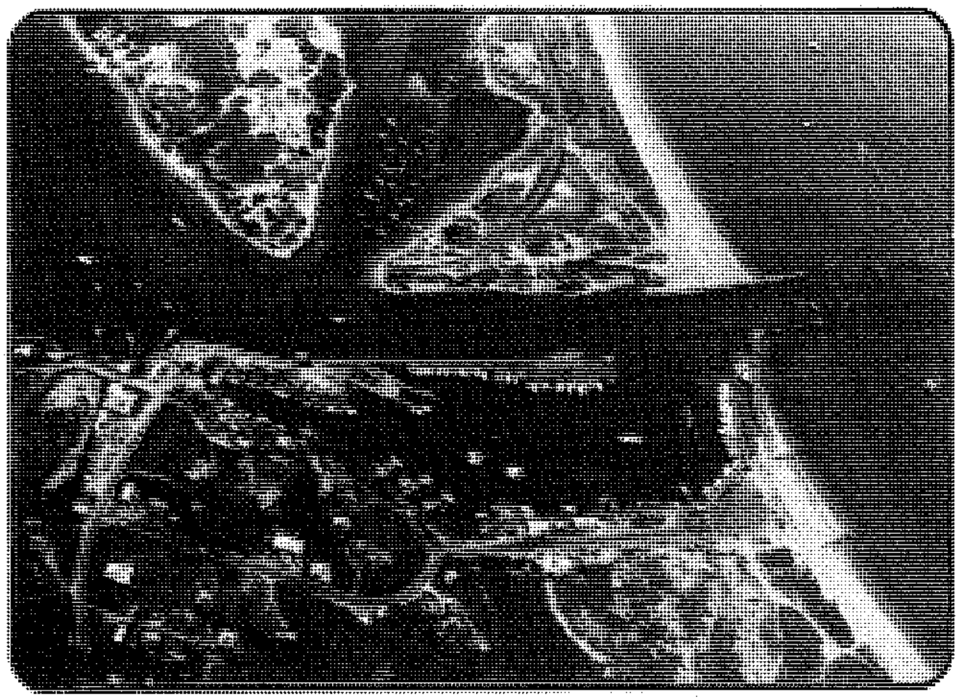
Federal guidelines require that vessels constructed prior to January 30, 1975 must be equipped by January 30, 1978 with a Coast Guard certified device for treating waste. This device will produce effluent with a fecal coliform count of less than 1000/100 milliliters and no visible floating solids. After January 31, 1980 the devices require fecal coliform of less than 200/100 ml. and suspended solids less than 150 parts per million. For vessels constructed after January 30, 1975, the former requirement must be attained by January 30, 1977 and advanced treatment by January 31, 1980. If vessels constructed have a device producing a fecal count

Table 43 Harbor Moorings

Location	Overnight	Day Moorings
Tashmoo	23	31
Tisbury Harbor	107	40
Oak Bluffs Harbor	74*	59
Menemsha Harbor	30	45**
Menemsha Pond	7	61
Edgartown	95	160***

Survey made Saturday and Sunday, August 28 and 29, 1976.

*12 additional empty spaces were available.
**Includes 10 fishing vessels.
***Includes 6 fishing vessels.



less than 1000 per 100 milliliters before January 31, 1980 they may use it for its operable life. Thus for the next 8 to 10 years there will be boats releasing discharges to Vineyard waters which will pose potential threats to shellfish resources.

A federal task force study recommends maceration-chlorination devices to grind the sewage and chlorine (household bleach) added for disinfection prior to discharge. The reliability and adequacy of the treatment is questionable however, since the effectiveness of the system depends on the vessel owners ability and willingness to operate and maintain the system (Water Pollution Control, 1975).

Under Title 40, part 140, Section 312 (f)(4), certain sensitive waters may be made no-discharge zones by EPA regulation if it is determined that the protection of the quality of these waters would require such protection. These sensitive waters include: marinas, drinking water intakes, areas of intensive swimming and shellfish beds.

Under Chapter 91, Section 59B, the Division of Water Pollution Control is to require pumpout facilities (and other solid waste disposal receptacles) and dock toilet facilities before issuing a license to a marina. The Division has never issued a license under this law and now believes that federal legislation supercedes the State Law. The Federal Water Pollution Control Act (33 USCA 1322 (f)(3)) states "...if any State determines that the protection and enhancement of the quality of some or all of the waters within such State require greater environmental protection such State may completely prohibit the discharge from all vessels of any sewage..." This is subject to the Regional EPA Administrators determination that adequate pumpout facilities exist.

Towns can regulate marine sanitation under their general power to regulate sanitation or under the powers reserved to them in the Motorboat Law (Chapter 90B, Section 15). Many towns have regulations which prohibit the discharge of sewage into enclosed waters and require that marine heads be sealed while the vessel is in enclosed waters. Conceivably, holding tanks could be required in certain fragile, restricted waters. As a prerequisite however, pump-out facilities for emptying holding tanks or on-shore toilets must be available. These restrictions might have adverse impacts on the part of our economy resulting from boaters because the installation of holding tanks is costly. Boaters might well go to other harbors.

The Department of Marine Recreational Vehicles regulations prohibit all discharge of raw sewage, garbage, rubbish or debris from motorboats into the

the waters of the Commonwealth. This regulation, too, cannot be enforced until pumpout facilites are available. Pumpout facilities currently exist in Vineyard Haven, Edgartown and Menemsha Harbors.

The U.S. Constitution guarantees to citizens the right to travel and reserves to the federal government jurisdiction over admiralty and interstate commerce. Towns, however, can set an absolute limit on the number of moorings which are allowed in a harbor if allocated on a first-come, first-serve basis. The basis for this limit must be a legitimate public purpose such as health or safety. The Harbormasters (under Chapter 102, Sections 21-27) have the authority to order a vessel to leave the harbor, and to regulate and station vessels within the harbor. It is possible to restrict overnight vessels to those portions of the pond or harbor where tidal flushing could remove wastes.

The Departments of Public Health and Environmental Quality Engineering have broad powers to investigate shellfishing areas to determine whether they are contaminated. A determination by either department that an area is contaminated effectively terminates local control of this area while it is contaminated and places control of shellfishing in the area in the hands of state authorities (130 MGLA 74.74A as amended by Chapter 706 of the Acts of 1975 Sections 215 and 216). In the recent past, Brush Pond has been closed to shellfishing due to bacterial contamination. Other areas have been temporarily closed by local Health Boards and Shellfish Constables due to concerns over both boating wastes and on-shore sewage disposal systems.

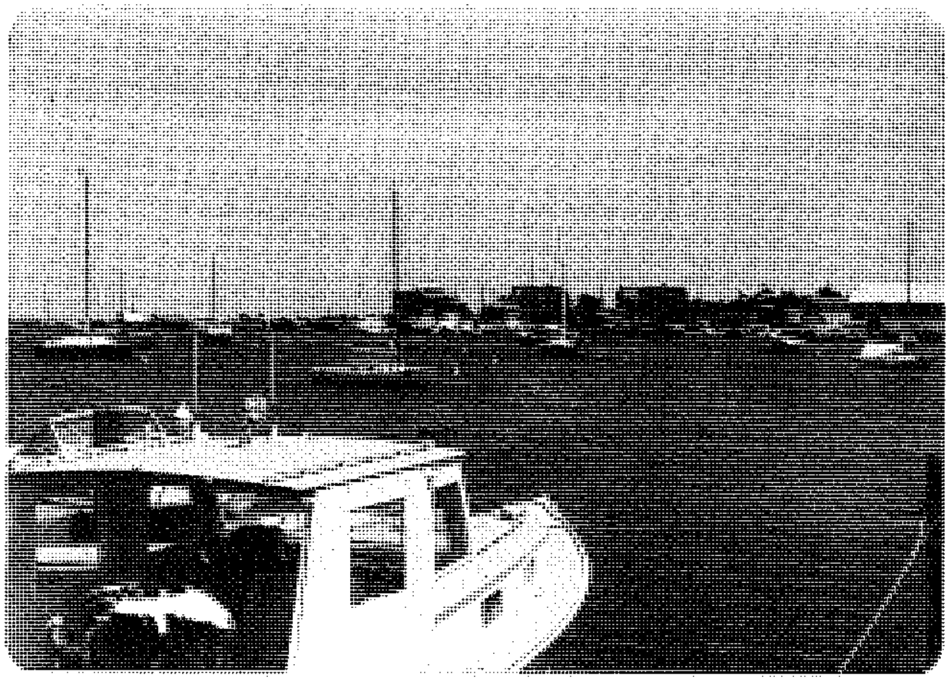
11.2 Recommendations to Prevent Boating Waste Impacts

Alternatives available to limit boating impacts are evaluated in Table 44 in terms of their environmental, social, economic and political impacts. The following actions are recommended to mitigate this problem.

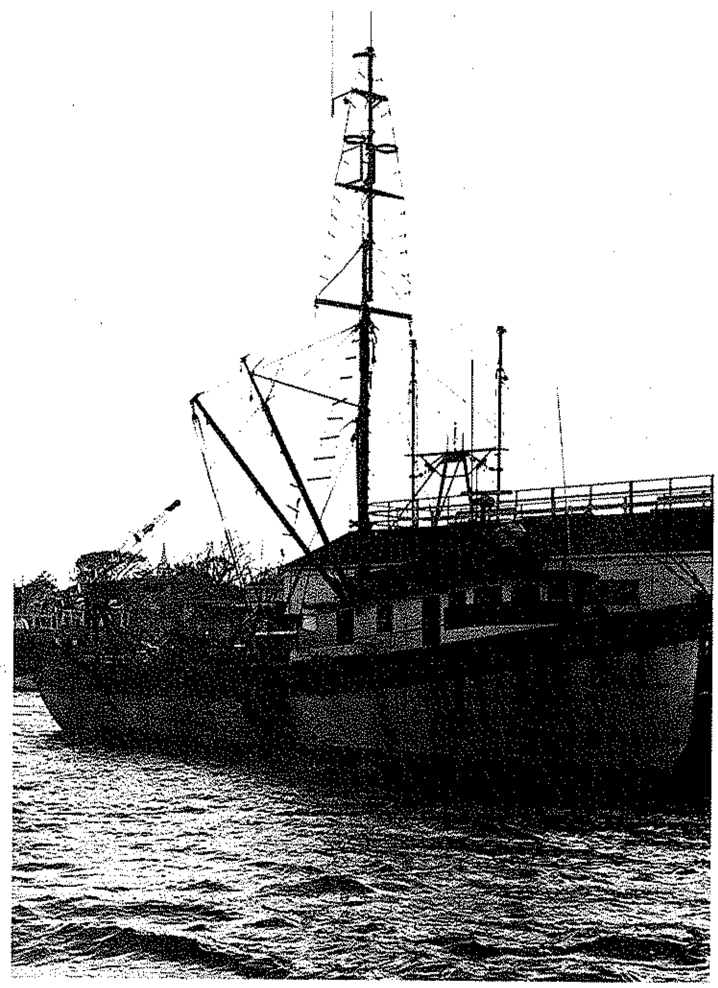
11.21 Minimize Impacts From Sanitary Wastes

There are several approaches available to minimize boating impacts. We can strictly enforce Federal and State guidelines on discharges, we can use harbor zoning to keep overnight boats away from fragile areas, or we can designate ponds as no discharge areas. All of these actions would improve the quality of our surface waters; however, some are difficult to implement and enforce.

It is recommended that an effective program be developed to implement existing Federal Standards to



Although bilge pumping is not considered a problem, boating septic wastes can contribute to bacterial pollution in our harbors. Careful watch by harbormasters is recommended.



minimize the impacts of sanitary wastes from boats. Title 40, part 140 forbids overboard discharge of untreated sewage. It is very difficult, however, to properly check all boats in our harbors for appropriate treatment devices. Currently, the Harbor Masters and the Coast Guard would be hard pressed to implement this program with the limited manpower available.

Considerable discussion has occurred recently in Oak Bluffs regarding the construction of toilet facilities and requiring tight heads on all boats in the Harbor. Many waters on the Island could benefit by eliminating boat wastes. These include productive shellfish areas such as: Cape Pogue Pond, Sengekontacket Pond, Lagoon Pond and parts of Tashmoo and Menemsha Pond. Marinas without adequate tidal flushing such as Oak Bluffs Harbor and Menemsha Basin might also be included.

It is <u>recommended</u> that Cape Pogue, Sengekontacket, Lagoon and Tashmoo Ponds be made no discharge waters by State petition to the EPA administrator. It is further <u>recommended</u> that continued limitations on the locations of mooring sites away from valuable shellfish resources be employed in Katama Bay and Menemsha Pond. Finally, it is <u>recommended</u>, that steps be taken to establish pumpout facilities in the poorly circulated parts of Oak Bluffs and Menemsha Basin. This should be followed by a requirement for tight heads in these harbors. In Edgartown and Tisbury Harbors, continued bacterial monitoring is <u>recommended</u>. These better circulated harbors do not appear to require these actions at this time. However, steps should be taken in Tisbury to provide pumpout facilities with a sewering project.

Bilge pumping is not viewed as a significant problem at this time. It is <u>recommended</u> that the Harbor masters and shellfish wardens continue to check for oily discharges and to enforce existing federal regulations against such pollution.

The effects of motorboat use of our coastal ponds has also been of concern. Without speed limits, numerous boats can cause severe erosion of coastal marshes and may also adversely effect scallop and other shellfish spat. The release of hydrocarbons from extensive use of our ponds may also cause some adverse impacts on shellfish. It is <u>recommended</u> that speed limits be established and that boat owners properly tune their engines to minimize oil discharges and that our harbor masters enforce speed limits.

KEY

- * Very Positive
- + Positive
- 0 No Impact
- - Negative
- = Very Negative

- G Good
- F Fair
- P Poor

TABLE 44
BOATING WASTES

IMPACTS \ ACTIONS	SANITARY WASTES: Do Nothing	Require Holding Tanks	Coast Guard Inspection - Require Flow-Through Treatment	Provide On-Shore Facilities	Require Use of Pump-Out Facilities at Marinas	Harbor Zoning	Conduct Bacterial Survey to Assess Impact of Flow-Through Devices	BILGE: Do Nothing	Require Pumping Outside Harbors	Provide Pump-Out Facilities	Require Filtration Equipment
1. WATER QUALITY GOALS											
A. Fulfills Clean Water Act	-	*	+	+	+	+	0	-	+	+	+
B. Summary Rating	P	G	G	G	G	G	0	P	G	G	G
2. ENVIRONMENTAL EFFECTS											
A. Hydrology											
1. Water Quality	-	*	+	*	+	0	0	-	+	+	+
2. Water Quantity	0	0	0	0	0	0	0	0	0	0	0
3. Water Problems	-	+	+	+	+	*	0	-	+	+	+
4. Water Uses	-	+	+	+	+	*	+	-	+	+	+
5. Flood Hazards	0	0	0	0	0	0	0	0	0	0	0
B. Biology											
1. Rare Species	-	+	+	+	+	+	0	-	+	+	+
2. Aquatic Habitat	-	+	+	+	+	+	0	-	+	+	+
3. Aquatic Population	-	+	+	+	+	+	0	-	+	+	+
4. Benthic Community	-	+	+	+	+	+	0	-	+	+	+
C. Air Quality	0	0	0	0	0	0	0	0	0	0	0
D. Land											
1. Change in Use	0	0	0	-[2]	0	0	0	0	0	-[2]	0
2. Planning & Controls	0	0	0	0	0	0	0	0	0	0	0
3. Growth	0	0	0	0	0	0	0	0	0	0	0
4. Soil Erosion	0	0	0	0	0	0	0	0	0	0	0
5. Sensitive Areas	0	0	0	0	0	0	0	0	0	0	0
E. Wastewater Management Resources											
1. Energy	0	-	0	0	0	0	0	0	0	-	0
2. Chemicals	+	+	-	0	0	0	0	0	0	-	0
3. Land Commitment	0	0	0	-[2]	0	0	0	0	0	-	0
F. Summary Rating	P	G	G	FG	G	G	G	P	G	F	G
3. ECONOMICAL COSTS											
A. Cost											
1. First Cost	+	=	-	=	-	+	-	+	+	=	-
2. Annual Cost	+	-	-	-	-	+	0	+	+	-	-
3. External Cost	=	-	+	+	+	+	*	-	+	-	-
B. Value of Goods & Services											
1. Recreation	-	-	+	+	+	*	*	-	+	+	+
2. Water Supply	0	0	0	0	0	0	0	0	0	0	0
3. Fishing & Shellfishing	-	+	+	+	+	*	*	-	+	+	+
C. Jobs	0	0	0	0	0	0	0	0	0	0	0
D. Economic Base & Stability	-	-	+	+	+	+	+	-	+	+	+
E. Summary Rating	P	P	FG	F	F	G	G	FP	G	FP	FP
4. SOCIAL EFFECTS											
A. Dislocation of People or Services	-	=	-	-[3]	-[3]	-	0	0	-	=	-
B. Public Health	-	+	+	+	+	+	0	-	+	+	-
C. Aesthetics	-	+	+	+	+	+	0	-	+	+	+
D. Educational & Cultural	-	-	+	-[3]	-[3]	+	+	-	+	+	+
E. Summary Rating	P	FP	G	F	F	FG	G	P	G	FG	FG
5. IMPLEMENTATION											
A. Legal Authority	-	-[1]	+	-[4]	-[4]	+	+	+	+	+	+
B. Financial Capacity	+	-[1]	+	-	+	-[5]	+	+	-[3]	=	=
C. Practicability	-	-[1]	+	+	+	+	+	+	+	-	-
D. Public Accountability	-	+	+	+	+	+	+	-	+	+	+
6. PUBLIC ACCEPTABILITY	-	+	+	*	+	+	*	-	+	+	+

NOTES:

1. Requires EPA designation of zero discharge area and added inspection to assure compliance.
2. Requires land for facility.
3. If Boaters are required to use facilities.
4. Added policing needed if 3 above applies.
5. Added inspection required.

12

Other Sources of Pollution

12.0 Other Sources of Pollution

12.1 Dredging

Dredging can create potentially adverse situations in surface waters by 1. releasing silt and clay and organic particulates into the water column, 2. by adversely altering circulation patterns, 3. exerting a large BOD, 4. releasing bacteria and heavy metals, 5. by changing the substrate material and altering the ecology of an area. These impacts can be minimized through careful selection and definition of public need for a particular dredging site, careful selection of disposal site and wise choice of dredging equipment.

In well circulated areas dredge material is largely sand and redeposition on nearby beaches is not a problem (i.e. Sengekontacket Dredging Project). In dredging harbors, however, lead (boat paints and oil and gas discharges), copper and chromium from paints and oils along with organic materials may cause water pollution. Chemical and particle size analysis should be conducted before a spoil disposal site is chosen. This can be incorporated into the engineering planning.

Locations which require periodic dredging include the following:

Tisbury Harbor - near jetty and possible future mooring areas;

Lagoon Pond - channel into pond;

Oak Bluffs Harbor - channel entrance;

Sengekontacket Pond - channel entrances and interior channels;

Edgartown Harbor - mooring areas;

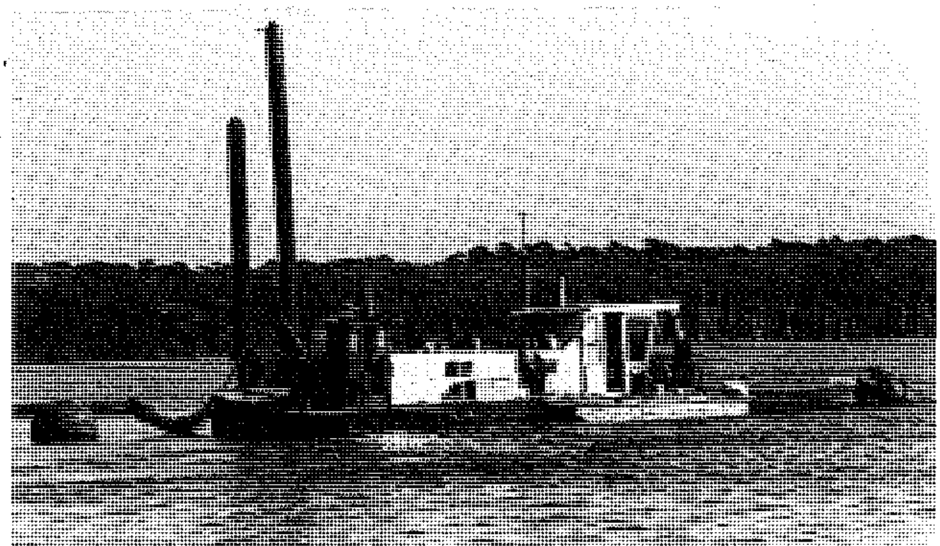
Katama Bay - possible future dredging;

Menemsha Pond - entrance channel;

Tashmoo - entrance channel.

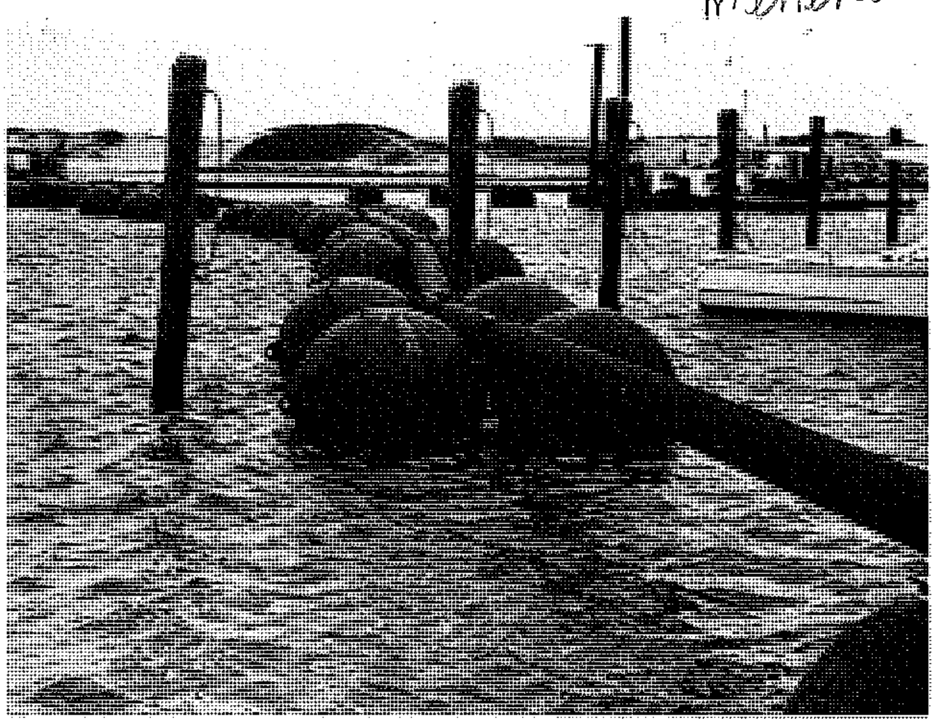
The Great Ponds may also be dredged in the future to maintain appropriate depth for shellfishing. Cost of dredging averages 3 dollars per cubic yard. Funding is available for dredging assistance through the Division of Waterways.

12.1.1. On-Going Programs to Minimize Environmental Effects of Dredging and Disposal



Selection of a site for dredge-spoil disposal requires preliminary analysis of bottom sediments to determine the presence and nature of any pollutants. Shown here is dredging of Lake Tashmoo.

Menemsha



1. Local Conservation Commissions under Chapter 131, Section 40, are required to review and issue conditions on any project involving the dredging or fill of wetlands. Before any alterations to wetlands are performed the Conservation Commission must be notified by certified mail. This order of conditions is issued after a public hearing on the impacts of the proposed project. Under Chapter 130, Section 105, the Commissioner of Conservation in the Department of Natural Resources has authority to adopt orders to regulate dredging, filling or alterations of wetlands.

NOT RIGHT K.SWIFT JACK DANIELS RESTRICTS & PROHIBITS W/ ORDER TAILORED TO EA. TOWN.

2. Massachusetts General Laws Chapter 91, Section 2, 52-55 and Chapter 347 of the Acts of 1976.

   All transportation and dumping of dredged material in the tidewaters of the Commonwealth must be approved by the Department of Environmental Quality Engineering. No dredging is allowed until approval is obtained. Also, if more than 1 acre is being dredged, a filing under the Massachusetts Environmental Policy Act is required. No authorization may be granted until a Wetlands Order of Conditions has been granted by the local Conservation Commission. Under Section 14, individuals are required to obtain a waterways permit before constructing a structure in tidewaters or Great Ponds.

3. Army Corps of Engineers Permit under 33 USC 403.

   Individuals are required to obtain permission from the Corps before a structure is built in any waters which are in fact navigable or which ebb and flow with the tide. In the application, a description of the proposed activity, the composition and quantity of spoil, the location, purpose and intended use of the activity as well as a schedule are required. All other local, state and federal permits must be obtained before this permit.

4. Marine Protection, Research and Sanctuaries Act of 1972, established a national policy "to regulate the dumping of all types of materials into ocean waters and to prevent or strictly limit the dumping into ocean waters of any material which would adversely affect human health, welfare or amenities of the marine environment, ecological systems or economic potentialities." This act reaffirms the U.S. Army Corps of Engineers to

issue permits for the disposal of dredge or fill material into the water. To safeguard water quality, dredge or fill material may only be dumped in specified disposal sites. EPA has issued guidelines for these sites. EPA has also issued guidelines for ocean disposal of pollutants which cover the effects of pollutants on human health and welfare, on marine life, shorelines and beaches.

5. The MVC reviews all dredging activities in our harbors and ponds over 10 acres in size.

   There is a need to streamline the review process of proposals as the review conducted by the Department of Environmental Quality Engineering and Army Corps of Engineers may take many months.

12.1.2. Browns Ledge Dredging Spoils Disposal Site

6.5?

Browns Ledge is the proposed regional disposal site for 1.8 million cubic yards of dredged materials from the Fall River Harbor Navigation Project. Fall River Harbor is a principle transfer point for petroleum products delivered to retail markets in this area. Deep draft commerce consists chiefly of petroleum for two electric generating stations and one major oil terminal in Somerset and Fall River, Massachusetts. Future very large LNG tankers will also be accomodated by the new deep water harbor. The Tiverton Channel portion of the Harbor services three major waterfront oil terminals in Tiverton, Rhode Island.

The Browns Ledge proposed disposal site is one square nautical mile in area, in 100 to 120 feet of water centered 41° 18.3'N, 71° 04.1'W. It lies 17 miles from the mouth of Narragansett Bay and eight miles to the northwest of Cuttyhunk Island.

The much closer Brenton Reef disposal site which was used for the disposal of Providence River dredging is not acceptable to the State of Rhode Island for disposal of Fall River dredging spoil. Project cost is 11.1 million dollars (Department of the Army, 1976).

out of place

Although 12.1 million cubic yards have been dredged from Fall River Harbor since 1910, the dumping of dredging spoils in the Browns Ledge proposed regional disposal site poses serious consequences to this region's fishing, shellfishing and recreational activities.

The site is not a stable area where sediments collect permanently, but rather is an area of active sediment transport and resuspension. The effects of winter storm wave activity on the ocean floor are just as critical as tidal forces in resuspending bottom material. Resuspension of fine sediment of the sort known to contain the highest levels of contaminants occurs at 20 cms/second. After suspension, the University of Rhode Island scientists suggest fine sediments will remain suspended in currents of only 10 cms/second (Clagett, 1976).

Storm events which would resuspend the spoil deposit permit the movement of the contaminated sediments and the area of impact toward Buzzards Bay and Vineyard Sound. These are productive areas which serve both the recreational and commercial fisheries. The possibility of biological accumulation in fish stock requires information on the maximum allowable toxin concentrations which will cause no impairment of human functions or of environmental biological systems.

Adverse impacts of the dredging would be transitory. Impacts of the dumping would be lasting, heavy metals would provide a continuing source of toxins to the benthic organisms, those which feed upon them and in turn us (Laws, 1976).

The Corps of Engineers and Environmental Protection Agency might find some means for the initial removal of the heavily contaminated sediments from the entire river and bay area. The remaining spoil might then be more easily disposed of, or be utilized in landfill or to satisfy other on-shore needs.

12.1.3. Recommendations

A number of ways are available to mitigate the environmental impacts of dredging. It is recommended that the following considerations be involved in any future dredging projects:

- Site Selection

  Locate navigation channels away from fragile areas such as marsh or estuary;

  locate channels far enough from the shoreline to minimize erosion and to avoid unstabilizing the shoreline;

  cut sides of channels at minimum size required.

- Disposal Site

  Dispose of polluted or soft muds in upland area;

  avoid overboard disposal of dredge spoil;

  certain dredge spoils are acceptable to add to beaches or build marshes (such as with the Sengekontacket Dredging Project, where the eroding State Beach will be stabilized with sandy dredge spoil);

As a first step find out what is to be dredged and whether or not it is polluted. Will the dredging project expose undesirable bottom sediments which can not be populated with shellfish?

- Equipment

Both mechanical and hydraulic dredges are available. The hydraulic dredge causes the least adverse impacts from release of polluting sediments. There is, however, a potential for a problem in disposing of the spoil from this process. Contaminated or muddy wastes should not be redeposited in fragile areas when the release of nutrients and bacteria may adversely effect aquatic life. Pumping contaminated spoil inland away from the coast may be prohibitively costly and mechanical operations may be more feasible (as with the recently completed dredging project in Tisbury Harbor). If the spoil is clean and sandy it may be easily redeposited in a desirable area by a hydraulic dredge (as with the Sengekontacket Project).

12.2 Non-Organic Pesticide Application

All towns currently participate in insect control programs including spraying and ditch-digging. Due to the potential for biological accumulation of toxicants and ground water and surface water contamination, these non-organic pesticides must be controlled in their application. Sprays are commonly used in salt marshes with possible adverse effects on the juvenile stage of many of our sport fish or their prey. Individuals and towns using these toxic substances should consider biological control of pests and continue with open marsh water management programs.

Salt marsh mosquitos cannot breed in low salt marsh which is regularly flooded by the tide. They require high marsh areas where occasional tidal floodings with retention of water in depressions for many days allows the larvae to reach maturity. Management of the marsh is required involving ditches connecting only breeding depressions to the tidewater and not ditching permanent ponds. This kind of program maximizes the use of mosquito eating fish.

It is recommended that:

- the use of biocides be reduced to ecologically benign products;

- indiscrinimate ditching be eliminated and a more effective open marsh management program be established.

12.3 Sedimentation and Erosion

Construction work on steep slopes (over 5 to 8%) especially in the western moraine where wetlands may be nearby may have adverse impacts on water quality because:

- organic materials from the eroded soils are introduced;

- siltation occurs;

- wetlands can be filled;

- streams and ponds become clouded;

- aquatic wildlife may be severely effected.

It is recommended that erosion control be required on all construction where erosion may adversely effect surface waters. This may be accomplished by the Planning Board and/or the Martha's Vineyard Commission requiring an erosion control plan for subdivisions on steep slopes.

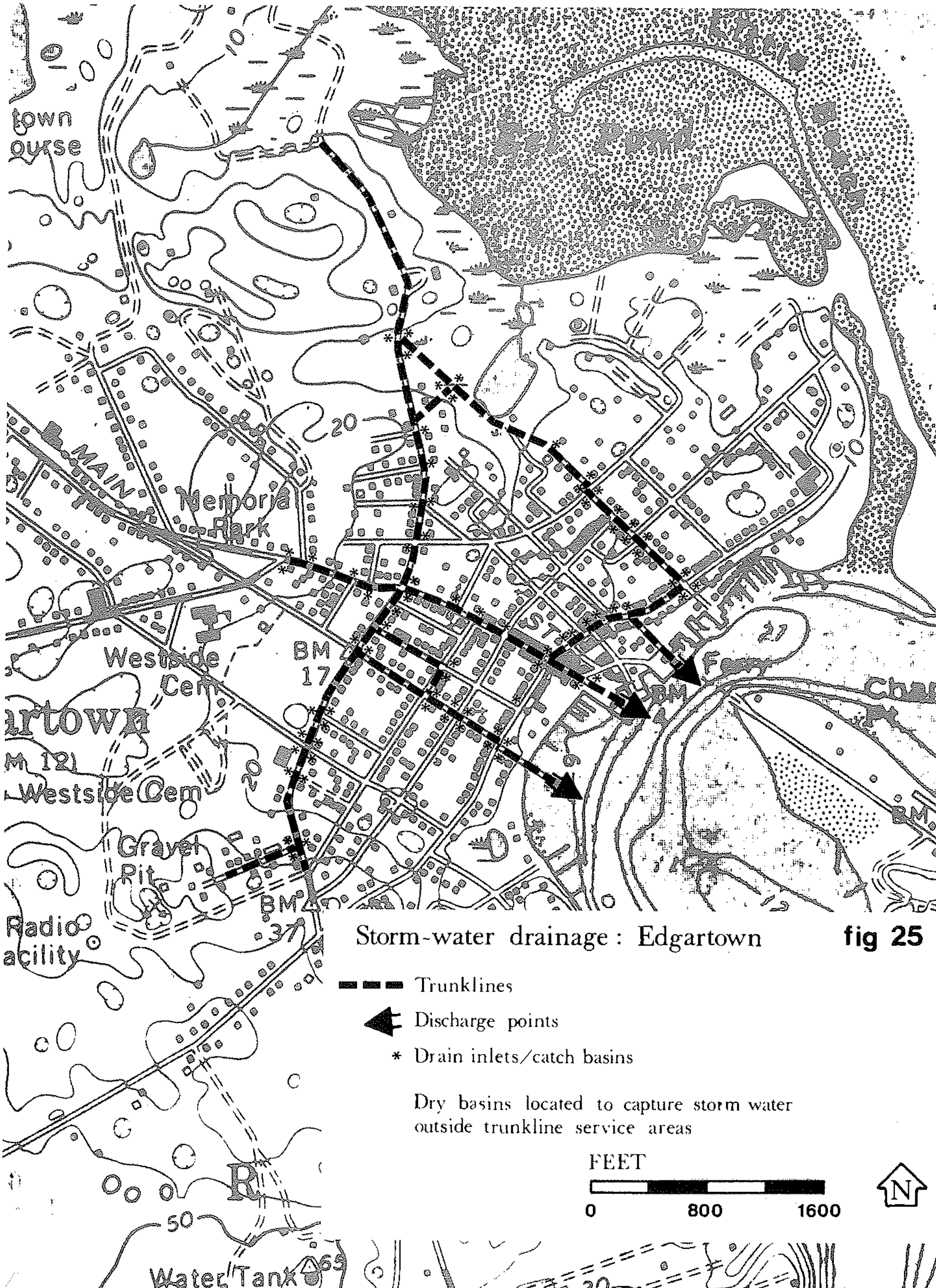
The local Conservation Commissions and the Dukes Conservation District as well as the Soil Conservation Service should be consulted. Techniques required to reduce erosion and its impacts are site specific and include: use of straw bales, flow diversion, retention ponds and vegetative buffers. Figure a-1 illustrates where steep slopes and wetlands are in close proximity and where these actions should be considered.

12.4 Gay Head Cliffs

Clay in the water off Gay Head affects fish much like an oil spill. Erosion of the cliffs is caused by rainfall, human activity (due to the tourist attraction) and by springs that undermine them from below. The Army Corps of Engineers has studied the situation and outlined preventative measures which may be effective but are costly.

12.5 Runoff

On Martha's Vineyard the wastes generated by human activity are mostly disposed of in the landfills or into the ground. However, there also is an accumulation of wastes along the roads, streets and in the more intensively used areas of the town centers. These areas often have the least permeable surfaces. Consequently, the waste materials become



Storm-water drainage: Edgartown **fig 25**

- Trunklines
- Discharge points
- * Drain inlets/catch basins

Dry basins located to capture storm water outside trunkline service areas

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suspended in rainwater and tend to runoff with surface water. In towns, this water is channeled by curbs and frequently drained off, most commonly into the town harbors. Figures 25 through 27 show storm water drainage in Edgartown, Oak Bluffs, and Tisbury.

The nature of wastes carried by storm water runoff are very similar to sewage wastes with additional materials resulting from automobile emissions and the inorganic solids, dirt and dust generated by traffic and adjacent use. While no study of the dust and dirt of Martha's Vineyard has been made, the subject has received attention in larger cities where road crews remove most of the larger materials by frequent sweeping of the principal streets in the summer and with occasional sweeping the remainder of the year. Vacuum sweepers more thoroughly pick up fine particles which are frequently most polluting. At this time the need for such a vehicle is not clear. Catch basins are cleaned one to four times per year. Most of the bacteria and occurrence of fecal material originates from pets. Table 45 contains estimates of the magnitude of the daily contributions to the nutrient flow to the harbors from street runoff. These are based on the area drained to each discharge.

At this time the amount of the contaminants from storm runoff is estimated to be only a fraction of the contaminants contributed to the harbors from the recreational boats (Laws, 1977).

12.6 Water Supply Pipes

Liners for Asbestos Cement Water Pipe

This 208 Water Quality Program recommends that cement liners or vinyl coating be used in asbestos cement pipes carrying public water supplies to preclude potential health effects. Although no studies have established a definite link between asbestos fibers released from the pipe and cancer in humans, asbestos-related cancer in other applications is well documented (Healy, 1977). The water companies and departments in Edgartown, Oak Bluffs and Tisbury are now installing lined pipes. It is recommended that they begin to replace existing pipes which are unlined.

12.7 Air Pollution

Martha's Vineyard receives air pollution from New York City or the Boston area depending on currents. Summer traffic congestion is the only significant on-Island source of air pollution which may in turn affect water quality.

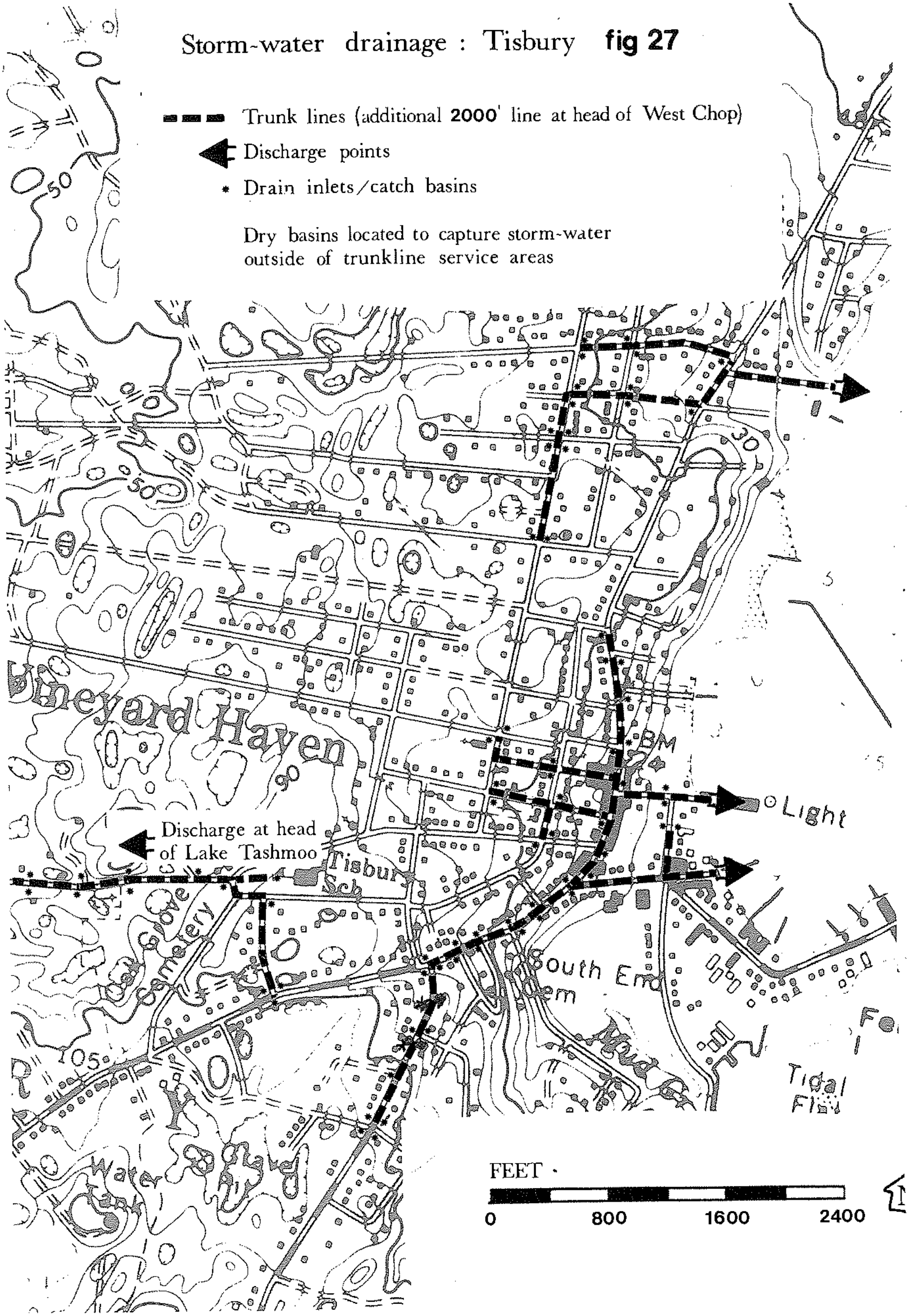
Storm-water drainage : Tisbury fig 27

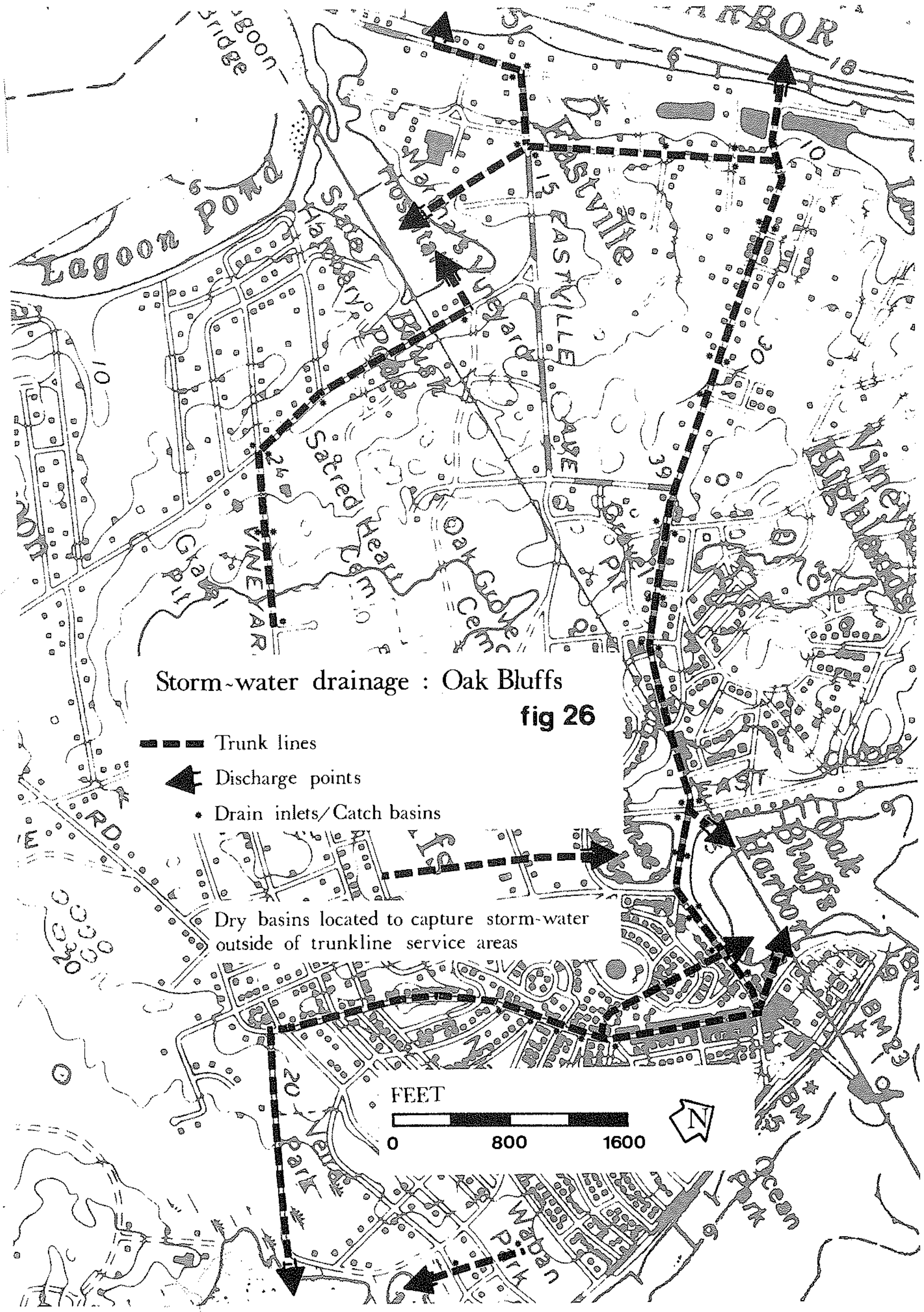
Trunk lines (additional **2000**' line at head of West Chop)

Discharge points

* Drain inlets/catch basins

Dry basins located to capture storm-water outside of trunkline service areas





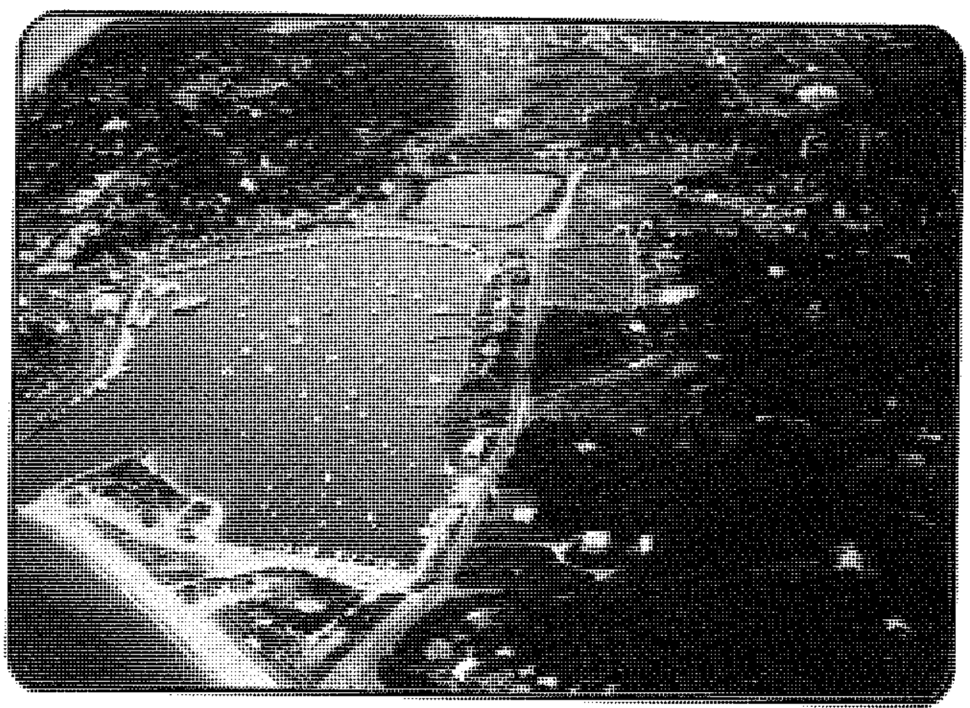
Storm-water drainage : Oak Bluffs

fig 26

Table 45 Runoff Characteristics

Town	Length of Streets Drained to the Harbor Area (approx.)	N total	P (phosphate)
Edgartown	34,500 feet	~~.240~~ .276	~~.276~~ .0225
Oak Bluffs	24,500 feet	.196	.016
Vineyard Haven	23,000 feet	.184	.015

Storm-water runoff from densely built-up areas can be a short-term source of pollution



One of the consequences of industrial air pollution from off-Island is the acidification of rain falling on Martha's Vineyard. In the Northeast, for example, the pH of rain has dropped from a neutral pH7 to between 3.91 and 4.03, with occasional rainstorms measuring as low as pH3. Acidity of precipitation is attributable primarily to SO_4 produced from man's sulfur dioxide (SO_2) producing activities. Nitric and hydrocloric acid also contribute to acid rain.

Acid rain may change the chemical properties of surface waters and it tends to cause faster leaching of nutients through the soil, aggravating the problems of leachates in water supply. However, more understanding of this phenomenon is needed. What is understood includes measured reductions in net productivity of forests in Scandinavia and New Hampshire as well as damage to fresh water fish populations in Canada and Scandinavia (Nisbet, 1974).

Clearly air quality studies must reflect potential water quality damage, and possible lowered productivity from acid rain. Proposals to burn light-sulfur fuel should include estimates of damage to agriculture, forestry and water quality from acid rain fallout. Implications of public and private decisions on the level of air quality and its affects on water quality need to be assessed. Open burning activities must be appropriately timed to assure that weather conditions will minimize air quality problems. Becuase of the large volume of a landfill which can be consumed by brush, we recommend the following steps:

1. that the State Department of Environmental Quality Engineering allow burning of brush only at the landfills at the discretion of local boards of health.

2. that leaves, grass clippings and soil be composted, either at the dump or at home.

3. that brush from large subdivisions be required to be chipped or buried on the site by the MVC and/or the local Planning Board.

The impacts of these sources are summarized in table 46 in terms of their environmental, social, economic and political aspects.

KEY

- * Very Positive
- \+ Positive
- 0 No Impact
- \- Negative
- = Very Negative

- G Good
- F Fair
- P Poor

table 46

MISCELLANEOUS

ACTIONS

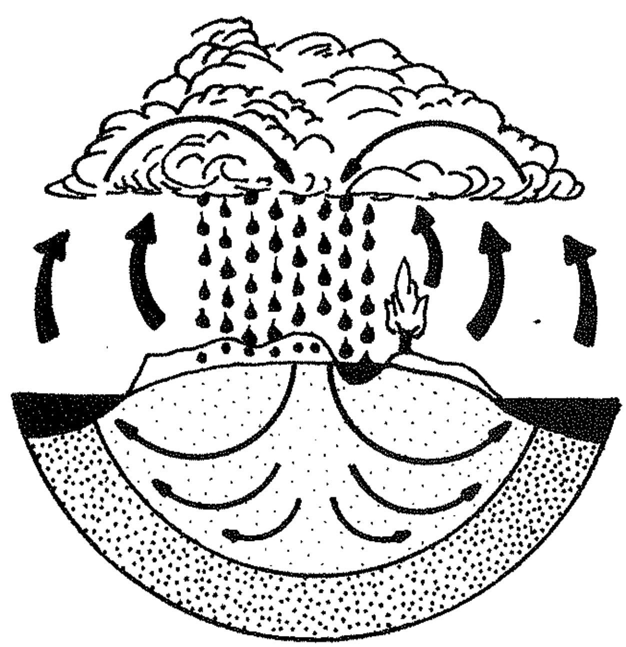
IMPACTS	PROTECT FRAGILE AREAS	Improve Health Code	Purchase	Conservation Easements	Transfer Development	Plan Growth Areas	SUBDIVISION CONTROL	Require Borings	Require Perc Tests	Require Well Levels	Require Erosion Control Plans	NEW CRITICAL DISTRICTS	DRI CONTROL	STORMWATER RUNOFF	Street Cleaning	Basin Cleaning	Limit Direct Run-off To Surface Waters	Promote Recharge	HYDROCARBONS	Coast Guard Inspections	Direct Fuel Storage Away From Aquifers
1. WATER QUALITY GOALS																					
A. Fulfills Clean Water Act		+	+	+	+	+		+	+	+	+	+	+		+	+	+	+		+	+
B. Summary Rating		G	G	G	G	G		G	G	G	G	G	G		G	G	G	G		G	G
2. ENVIRONMENTAL EFFECTS																					
A. Hydrology																					
1. Water Quality		*	+	+	+	+		+	+	+	+	*	*		+	+	+	0		+	+
2. Water Quantity		0	+	+	+	+		0	0	+	+	*	*		0	0	0	+		0	0
3. Water Problems		*	+	+	+	+		0	0	0	0	+	+		+	+	+	+		+	0
4. Water Uses		+	+	+	+	+		0	0	0	0	+	+		+	+	+	+		+	+
5. Flood Hazards		0	+	+	+	+		0	0	0	+	+	+		0	0	+	+		0	0
B. Biology																					
1. Rare Species		+	+	+	+	+		0	0	0	0	0	0		0	0	0	0		+	0
2. Aquatic Habitat		+	+	+	+	+		0	0	0	+	+	+		+	+	+	+		+	0
3. Aquatic Population		+	+	+	+	+		0	0	0	+	+	+		+	+	+	0		+	0
4. Benthic Community		+	+	+	+	+		0	0	0	+	+	+		+	+	+	0		+	0
C. Air Quality		0	0	0	0	0		0	0	0	0	0	0		+	+	+	0		0	0
D. Land																					
1. Change in Use		-	-	-	0	+		0	0	0	0	-	0		0	0	0	0		0	0
2. Planning & Controls		+	+	+	+	+		+	+	+	+	+	+		0	0	0	+		0	+
3. Growth		-	-	-	+	+		0	0	0	0	-	0		0	0	0	0		0	0
4. Soil Erosion		0	+	+	+	+		+	0	0	*	+	+		0	0	+	+		0	0
5. Sensitive Areas		+	+	+	+	+		+	+	+	+	*	*		0	0	*	+		+	+
E. Wastewater Management Resources																					
1. Energy		+	0	0	0	+		0	0	0	0	0	0		-	-	0	0		0	0
2. Chemicals		+	0	0	0	+		0	0	0	0	0	0		0	0	0	0		0	0
3. Land Commitment		+	0	0	0	+		0	0	0	0	0	0		0	0	0	+		0	0
F. Summary Rating		G	FG		G	G		G	G	G	G	FG	G		G	G	G	G		G	G
3. ECONOMICAL COSTS																					
A. Cost																					
1. First Cost		-	-	-	0	0		-	0	-	-	0	0		-	-	-	-		0	0
2. Annual Cost		0	0	0	0	0		0	0	0	-	0	0		-	-	0	0		0	0
3. External Cost		*	*	*	*	*		*	*	*	*	+	+		*	*	*	+		+	+
B. Value of Goods & Services																					
1. Recreation		+	+	+	+	+		0	0	0	0	+	+		+	+	+	0		+	0
2. Water Supply		+	+	+	+	+		+	+	+	0	+	+		0	0	0	+		0	+
3. Fishing & Shellfishing		+	+	+	+	+		0	0	0	0	+	+		+	+	+	0		+	0
C. Jobs		+	0	0	0	0		0	0	0	0	+	+		+	+	+	+		0	0
D. Economic Base & Stability		+	+	+	+	+		0	0	0	0	+[1]	+[1]		+	+	+	+		0	0
E. Summary Rating		FG	FG	FG	G	G		F	G	F	F	G	G		G	G	G	G		G	G
4. SOCIAL EFFECTS																					
A. Dislocation of People or Services		-	0	0	+	+		0	0	0	0	-	-		0	0	0	0		0	-
B. Public Health		*	+	+	+	+		+	+	+	0	+	+		+	+	+	0		+	+
C. Aesthetics		+	*	*	*	*		0	0	0	+	+	+		+	+	+	0		+	0
D. Educational & Cultural		+	+	+	+	+		+	+	+	+	+	+		+	+	+	0		+	+
E. Summary Rating		FG	G	G	G	G		G	G	G	G	G	G		G	G	G				
5. IMPLEMENTATION																					
A. Legal Authority		+	+	+	-[2]	+		+	+	+	+	+	+		+	+	+	+		+	+
B. Financial Capacity		+	=	-	0	0		+	+	+	+	0	0		+	+	+	+		+	+
C. Practicability		+	+	*	+	*		+	+	+	+	+	+		+	+	+	+		+	+
D. Public Accountability		+	+	+	+	+		+	+	+	+	+	+		+	+	+	+		+	+
6. PUBLIC ACCEPTABILITY		+	+	+	+	+		+	+	+	+	+	+		+	+	+	+		+	+

NOTES:

1. Effects uncertain
2. Requires local ordinance

13

Water Supply



13.0 Water Supply

We depend completely on ground water for our water supply. It is a poorly understood, not as readily visible as a reservoir or pond which fluctuates with use and rainfall. Just like a reservoir though, it reacts to our consumption and to variations in rainfall. In our soils, variations in rainfall of 1 inch over a year may result in a change in the water table of 5 inches. Over the past two years we have had a deficit of rainfall amounting to some 20 inches which could account for a fall in the water table of up to seven feet. Clearly, both our use of the available water supply and the climate will have potential impacts on our future supply. At this time, we only have the capability to influence our consumption of water.

Rainfall is our only source of future water supply. Annual rainfall and its variations are illustrated in Figure 1 and 2. Our annual average is approximately 45 inches. Of this total, somewhere between 12 and 20 inches percolates into the ground water. Metcalf & Eddy (1972) calculated an average daily recharge for the entire Island as 57.6 million gallons. It was estimated that one-half or 28.8 million gallons per day was available for consumption.

During summer months, however, recharge might be zero, whereas during the fall and spring months it might greatly exceed the average. In their calculations, Metcalf & Eddy (1972) assumed a runoff rate of 15% for the loamy soils of the western moraine. A survey of two major Island streams and their discharges (the Tiasquam and Mill Brooks) indicated that runoff values were on the order of 25% to 30% of rainfall (MVC, 1976). Clearly the subject of available water supply has not been definitively studied.

A recently initiated United States Geological Survey Water Study has installed one deep well into our main aquifer, the outwash plain, approximately one mile east of the Martha's Vineyard Airport. This well has revealed a much more limited aquifer than was originally believed. It is limited by two problems: iron concentration increasing with depth and a large percentage of fine materials. The first problem would require treatment to meet recommended Public Health Service drinking water standards (0.3 ppm). In the second case, water withdrawal would become uneconomical at depth because a well could not draw water quickly enough for public supply purposes. Luckily, 75 feet of saturated, good aquifer was encountered at the top of the boring sufficient to supply shallow public and private wells. Indications from this well are that the recharge rate is on the order of three feet per year, much greater than originally estimated. The increasing fine material with depth may limit the vertical movement of this recharge and cause increased horizontal flow and a very large discharge rate into the Great Ponds. Further investigation is needed on this subject.

The vertical sequence of water quality analyses made during this boring indicate that below 120 feet iron levels exceed 1 ppm, reaching 5 ppm at a depth of approximately 175 feet. The source of the iron is possibly the olive, green sand encountered below 100 feet (see Figure a-4). If we assume that this sequence is typical of the outwash plain, we can estimate the quantity of available potable supply in storage. The outwash plain aquifer contains approximatley 14,325 acres useable for public water supply (above the 20 feet contour). If the vertical sequence is the same at all points, there are approximately 65 billion gallons of water in storage (assumes that water comprises 20% of the entire soil column). This is equivalent to the estimated recharge from 15 years of rainfall.

In the outwash plain area there are 2 major supply wells and approximately 250 houses, drawing an estimated 225 million gallons per year. At this pace of consumption a five year drought could lead to lowered water tables by some six feet. Recent water level drops of five feet have in fact been reported in the Otis Basset Road - Germantown Road area in West Tisbury. We have had a rainfall deficit of some 28 inches over the past four years. It is probable that the major cause of the observed decline is lack of recharge but withdrawal for consumption will play an increasing role in the future.

In summary, we feel that in view of the many uncertainties concerning our water supply, 1/4 of the recharge estimates of Metcalf and Eddy (1972) rather than 1/2, should be used to establish upper levels of water consumption (see Table 47). Until better evidence becomes available, we should assume the worst case in the interest of protecting future water supplies. Even this value, some 14 million gallons per day, exceeds our average daily demands by nearly a factor of nine. Clearly, if water supplies are carefully sited, not over-used and protected from sources of contamination, we should have no foreseeable difficulties with water supply over the 20 year planning period.

13.1 Existing Public Water Supplies

The areas served by public water supply are mapped in Figure 28-31. Current consumption figures

Table 47 Available Water Resources and Current Withdrawals
(Adapted from Metcalf and Eddy 1972)

Hydrologic areas	Catchment area, sq. mi.	Recharge rate for safe yield computation mgd/sq.mi.	Total recharge mgd.	Safe yield mgd.	Withdrawals 1970 mgd: Public supply Ave. yearly	Public supply Max. monthly	others Ave. yearly	others Max. monthly
Martha's Vineyard								
Eastern area	39.6	1.0	40	10	1.0	2.3	e 0.1	e0.4
Western area	25.2	0.6	15	3.75	0.01	0.02	e 0.02	e0.11
Chappaquiddick	2.7	0.5	1.4	.35	-	-	-(1)	-(1)
Nashaquitsa	0.7	0.2	0.14	.035	-	-	-(2)	-(2)
Squibnocket	0.6	0.2	0.12	.03	-	-	-(2)	-(2)
Gay Head	4.4	0.2	0.9	.2	-	-	e 0.01	e0.01
Elizabeth Islands								
Cuttyhunk	0.6	0.5	0.3	0.15	0.01	0.03	-	-
Nashawena	2.4	0.2	0.48	0.24	-	-	Unknown	Unknown
Pasque	1.2	0.5	0.6	0.3	-	-	Unknown	Unknown
Naushon	7.4	0.5	3.7	1.9	-	-	Unknown	Unknown
Uncatena	0.3	0.5	0.15	0.08	-	-	Unknown	Unknown
Nonamesset	0.7	0.5	0.35	0.18	-	-	Unknown	Unknown

1. Included in totals for Eastern area.
2. Included in totals for Western area.
e estimated

Forgot to change

Table 48 Monthly Water Consumption (millions of gallons)

	1970-1973 Oak Bluffs	1972-1976 Edgartown	1970-1973 Tisbury
January	5.8 - 6.93	4.8 - 5.8	6.6 - 7.9
February	5.08- 6.90	4.03- 5.02	6.4 - 7.8
March	5.32- 7.72	4.56- 7.02	7.87- 8.88
April	5.57- 7.99	6.05- 8.12	8.0 -10.5
May	7.99-10.05	9.18-14.1	10.5 -18.0
June	10.62-17.74	13.8 -18.9	12.8 -21.6
July	18.70-26.11	24.4 -32.2	19.4 -29.8
August	19.06-23.61	21.7 -32.3	20.3 -24.4
September	9.69-14.58	11.5 -15.9	6.7 -19.6
October	6.92-10.97	6.6 -10.1	6.6 - 9.9
November	5.17-14.32	4.6 - 6.7	6.4 - 7.6
December	5.53-11.21	4.4 - 6.6	6.6 - 7.8

are outlined for Edgartown, Oak Bluffs, and Tisbury from water company data in Table 48 . An estimate of current total private and public consumption based on population estimates is included in Table 49.

13.11 Chilmark--Menemsha Water Company

1. Investor-owned
2. $25/year fee; no meters
3. Estimated 85 families; town comfort station and docks
4. 10,000 gallon cement holding tank fed by 2 spring-fed wells 12 feet deep and 120 gpm pump

Untreated water is pumped directly from the two wells off North Road to a 10,000 gallon storage tank where it flows by gravity through mains of 1 1/4 to 5 inches in diameter. The system is not metered.

Present and future water demands will require a new source of supply by 1980 and additional pump capacity by 1990. Additional storage capability is required to meet peak domestic demands at this time. Future connections to the system are expected to be confined to the immediate area now served (see Figure 28).

13.12 Edgartown Water Company

The Edgartown Water Company is a privately-run company. The company supplied approximately 1,450 people in 1970 and will serve an estimated 1,700 in 1980 and 2,000 in 1990 (Metcalf & Eddy, 1972). There are presently an estimated 1,500 hookups, increased from 1,034 in 1972. Very few services are metered (mainly the hotels and other commercial establishments).

Services

The water system obtains its supply from two sources.

Name of Well	Type	Diameter	Depth	Estimated Safe Yield
Wintucket	Dug	15 feet	19 ft.	0.3 mgd
Shurtleff	Drilled	12 inches	57 ft.	0.5 mgd
Machacket	Gravel Packed	24 inches	98 ft.	1.0 mgd

Additional storage capacity was recommended and some exploration for additional supply sites has been conducted in response to concern over the location of the Wintucket well near a saline pond and occasional

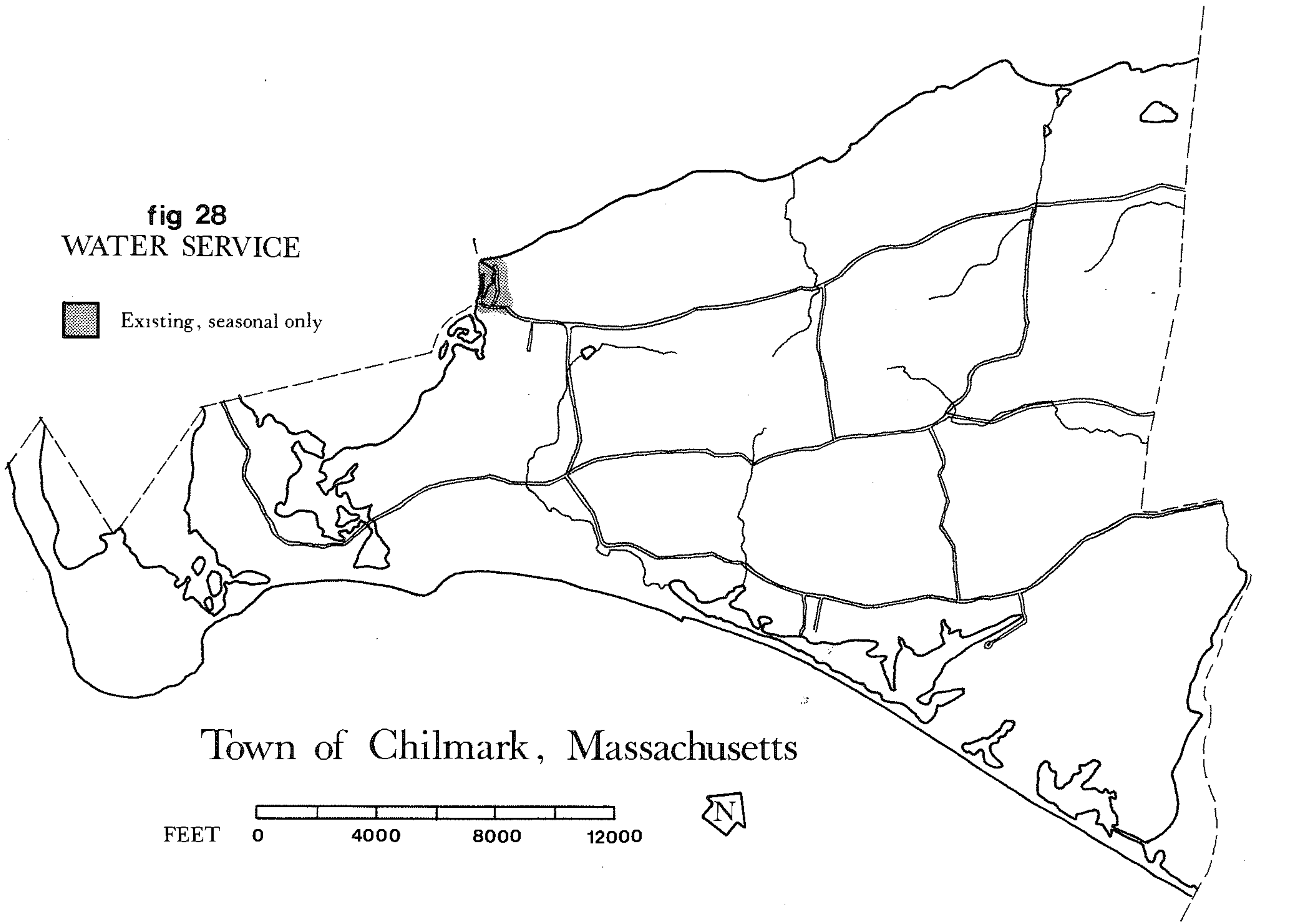


fig 28
WATER SERVICE
Existing, seasonal only
Town of Chilmark, Massachusetts
N
FEET 0 4000 8000 12000

are outlined for Edgartown, Oak Bluffs, and Tisbury from water company data in Table 48 . An estimate of current total private and public consumption based on population estimates is included in Table 49.

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4. 10,000 gallon cement holding tank fed by 2 spring-fed wells 12 feet deep and 120 gpm pump

Untreated water is pumped directly from the two wells off North Road to a 10,000 gallon storage tank where it flows by gravity through mains of 1 1/4 to 5 inches in diameter. The system is not metered.

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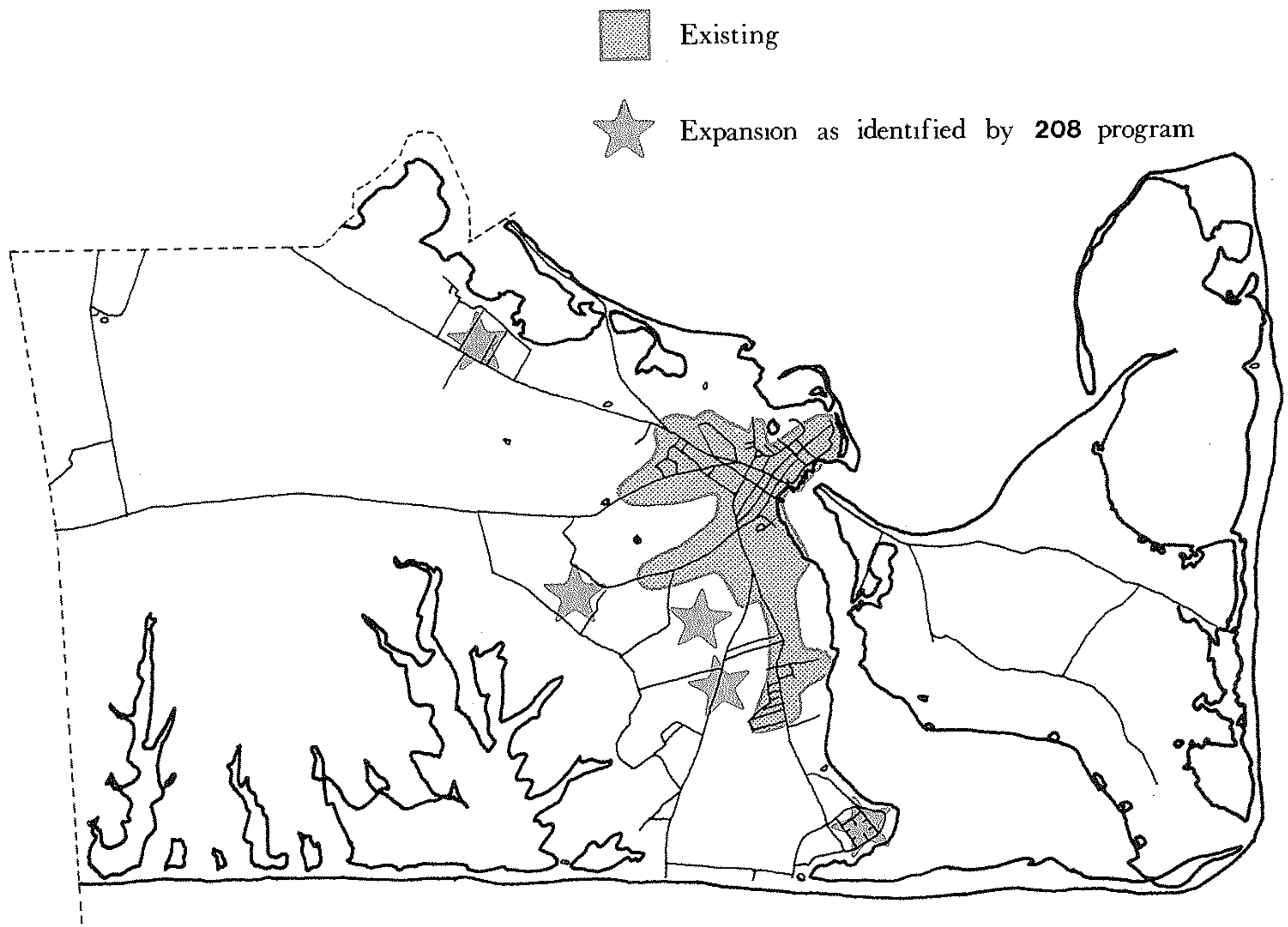
fig 29
WATER SERVICE



Town of Edgartown, Massachusetts

FEET 0 6000 12000 18000

N

Table 49 Estimated Total Island Water Demand (1975 MVC)

Chilmark	36	million gallons/year
Edgartown	142	
Gay Head	10	
Oak Bluffs	127	
Tisbury	146	
West Tisbury	35	
	527	Million Gallons/Year

Table 50 Water Conservation Potential Savings

Water Use	Water Conservation Methods	Potential Savings
Residential		
Indoor	voluntary saving through public education	1% starting in 1978 increasing to a maximum of 10% after 1985
	install water saving devices	26%
	faucet aerators	2%
	flow-limiting shower heads	12%
	water saver toilets	12%
Outdoor	landscaping new developments with native plants and efficient irrigation	10% saving in sprinkling
Distribution System	Leak detection and repair	1% of total present delivery
	Pressure regulation	2% of total present delivery
Industrial & Commercial	Good Housekeeping	5% of total use
Agricultural	Groundwater charges	19% of normal requirements

Metcalf and Eddy (July 1976) Water Savings, Santa Clara Valley Water District

Table 51 Summary of Results Pertaining to Water-Saving Devices

Device	Total Savings	Household Savings	Savings to Wastewater Industry	Savings to Water Industry	Public*** Acceptance	Legal Constraints
Faucet Aerators	5	5	8	8	+	+
Thermostatic Mixing Valves	7	7	7	7	NA*	0
Flow-limiting Shower Heads	3	3	4	4	+	+
Dual Cycle Toilets	1	1	3	3	0	0
Shallow Trap Toilets	4	4	6	6	0	0
Vacuum Flush Toilets	8	8	2	2	NA	0
Toilet Inserts	2	2	5	5	+	0
Recycling for Flushing	6	6	1	1	0	-
Public Education	N**	N	N	N	+	+

The numbers 1 through 8 are rankings, 1 being the best.
*NA = no data available
**N = not applicable
***Favorable response +
Unfavorable response -
Mixed response 0
(Chan, M.L. & Heare, S., 1976)

nitrate levels in excess of recommended public health standards at the Shurtleff facility. Two potential supply areas have been defined at this time (see Map): Lily Pond and Beetle Swamp. The Lily Pond site has been selected for a future supply well.

Future expansion of service is expected to follow these steps (see Map 29):

1. immediate expansion to serve the subdivision to the west of the Machacket supply well;

2. near future expansion to service an expected development on Mill Hill;

3. expansion to either the Ocean Heights or the Mattakesett developments. The Mattakesett area is less dense and consists mostly of seasonal residences while the Ocean Heights area is more dense and consists mainly of winter residences. Both developments are situated along salt water bodies and some danger of salt intrusion exists at each. The possibility seems to be greater at the Mattakesett area due to the more porous outwash sediments in which it is sited, the lower elevations there (less than 15 feet) and the consequent lower hydraulic gradient. Some danger of well contamination from on-lot sewerage exists at Mattakesett, as indicated by elevated nitrate levels (Massachusetts Division of Water Pollution Control, August and November, 1975).

   The Mattakesett area is situated closer to existing service areas and due to the more gentle topography would seemingly offer less installation difficulties. It is estimated that both areas will be serviced within the 10-year planning period.

13.13 Oak Bluffs Water Department

1. Owned and operated by the Town

2. Water is metered, 2,200 hookups (1976 est.)

3. 1974 - 144,000,000 gallons per year
   1975 - 165,000,000 gallons per year

4. Average peak:

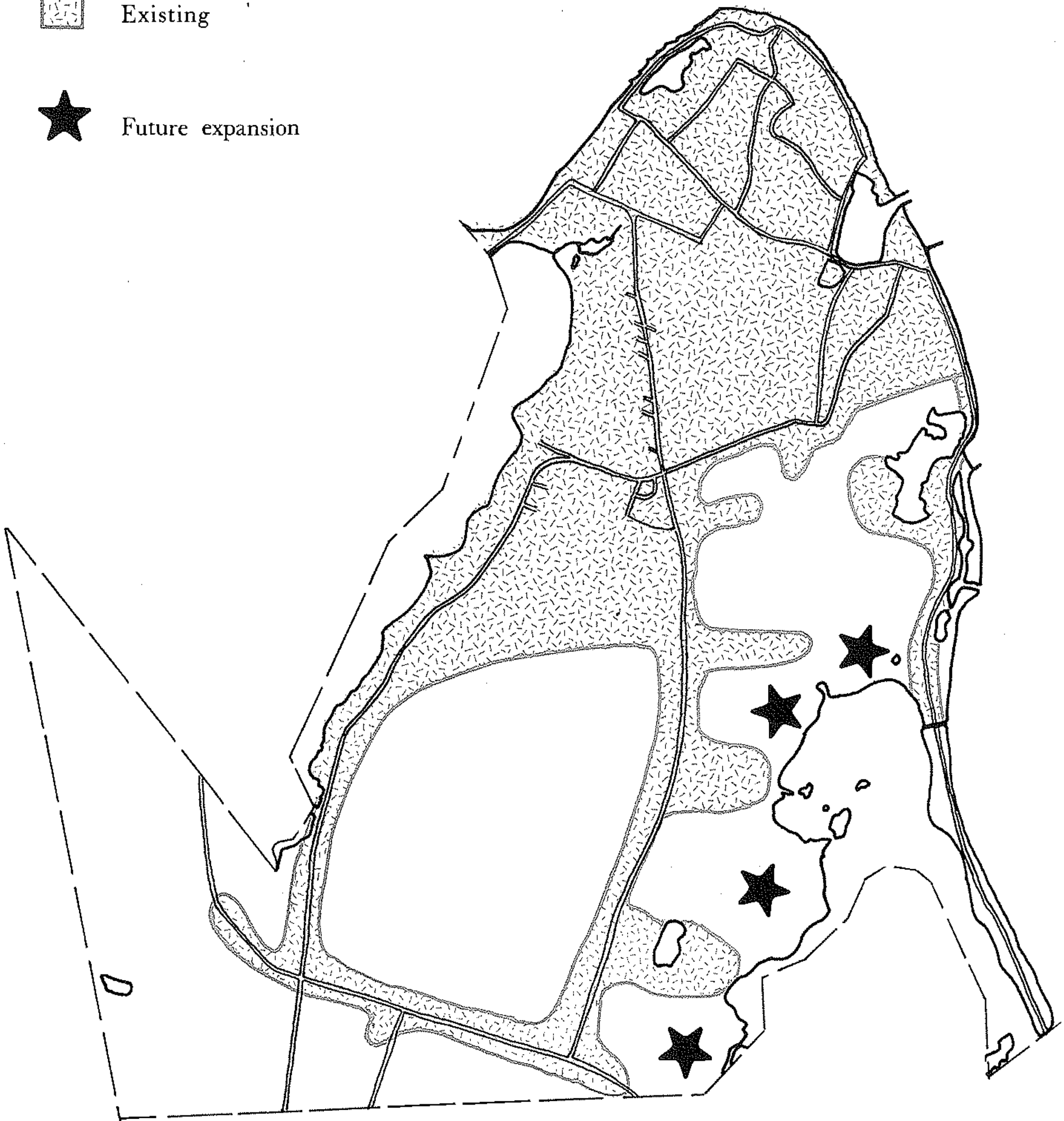
summer peak	-	1,000,000 gpd
winter	-	350,000 gpd
dry summer	-	1,500,000 gpd
summer low	-	300,000-550,000 gpd

5. Estimated 95% of townspeople use town water

WATER SERVICE
fig 30

Existing

Future expansion



Town of Oak Bluffs, Massachusetts

FEET 0 2000 4000 6000 8000

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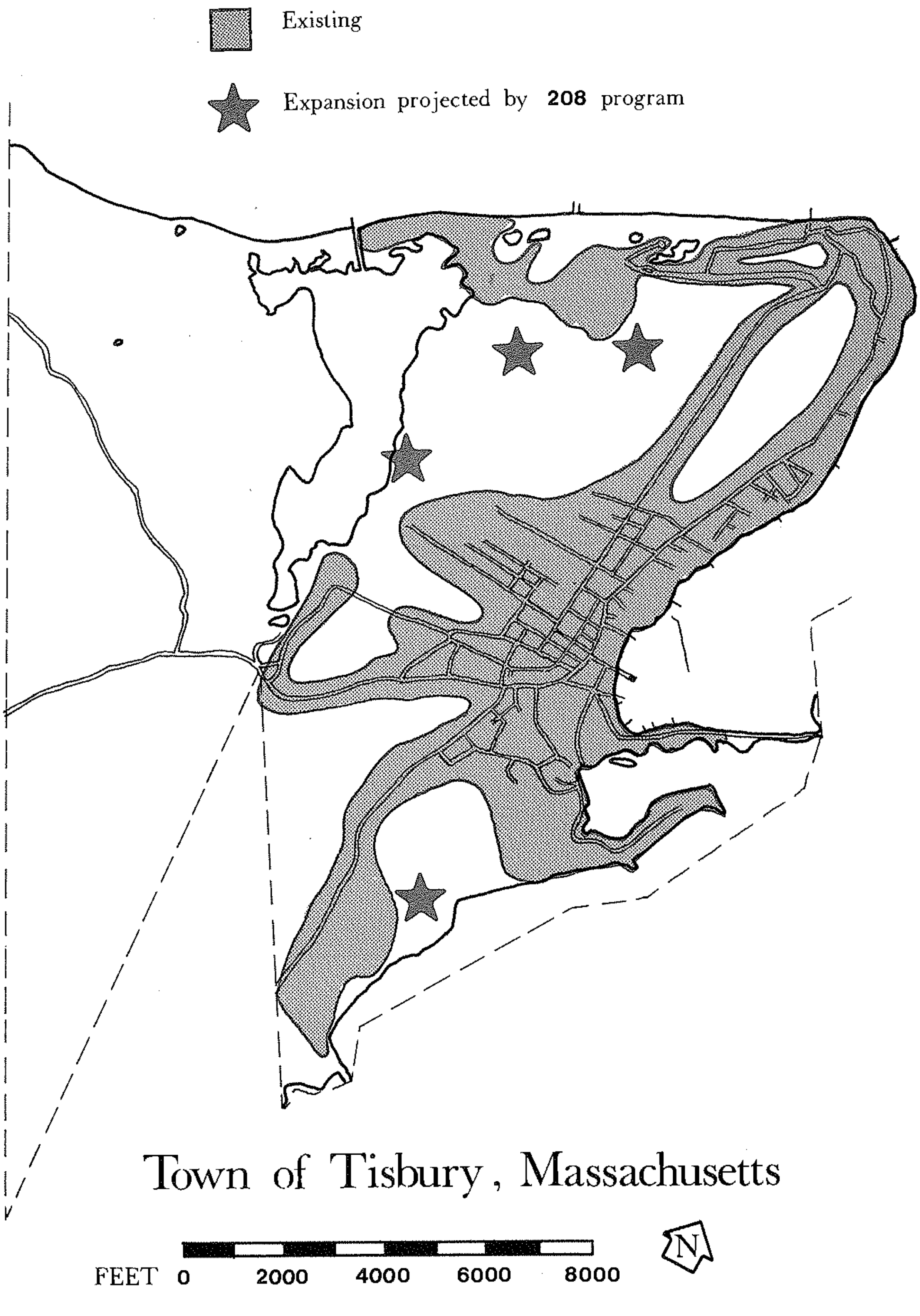
WATER SERVICE
fig 31



Town of Tisbury, Massachusetts

6. Problems: inadequate standpipe storage (capacity - 360,000 gallons), consideration given to new 1.5 million gallon storage); one-time contamination from metaphosphates and chlorine addition; one-time contamination from road salt at Lagoon Pond well. Now roads are not salted near the water supply at Farm Neck Road.

7. Potential problems: nearby on-lot waste disposal systems at the Wing Road - Farm ~~Neck~~ Pond well.

Wells:

Location	Number of Wells	Type	Diameter	Estimated Yield
Lagoon Pond	5	gravel packed	8"	1.3 mgd
Farm Neck Rd.	2		24"	1.2 mgd

Consideration is being given to the construction of an additional storage tank to be situated south of Sacred Heart Cemetery. An additional supply source has also been given consideration and several sites explored in the morainal area west of County Road. No problems have as yet occurred at either supply source although the Lagoon Pond well is situated near sea level close to a salt pond and the Farm Pond well is sited down gradient from a developed area where on-lot sewage disposal is used (see Figure 30).

Future expansion of service expected in the following areas:

1. to subdivided but as yet unbuilt lots along Sengekontacket Pond within the 5 year period;

2. continual addition of new services on exist-lots in the areas now served;

3. expansion of the supply area along Lagoon Pond on subdivided but as yet unbuilt lots.

13.14 Tisbury Water Department

1. Owned and operated by the Town

2. Water is not metered, 2,000 hookups (estimated 1980)

3. 1975 - 160,412,000 gallons per year

4. Use: July 2, 1975 - peak day - 1,392,000 gal.
   July 4-10, 1975 - peak week - 7,287,000 gal.

Average winter use - 300,000-347,000 gpd

Average summer use - 700,000-1,000,000 gpd
Estimated 40% of summer use to water lawns, 4:00-8:00 p.m. only.

5. Estimated 90% of persons use town water

6. Problems: inadequate standpipe storage (capacity 360,000 gallons), consideration now being given to replacement; proximity of landfill to both wells; numerous deadends in the system

7. Potential problems: both wells are sited near the town landfill

8. Present service area: see Figure 31.

Wells:

Location	Type	Diameter	Yield	Pump
off Edg. Road	gravel packed	8"	1,600 gpm w/out head	100 horse electric
Spring St.	gravel packed	8"	1,000 gpm w/out head	60 horse

Two wells serve the system. One is situated east of Lake Tashmoo and is driven to approximately 225 feet. The other is situated off the State Road and is driven to a similar depth (see Map). A back-up spring-fed source exists at the head of Lake Tashmoo but its use was discontinued in 1954 due to possible salt water intrusion. Total dependable yield of both wells is 2 mgd.

No plans exist for expanding or improving the system at this time. However, a large number of dead-ends exist and, it is felt, these should be connected as loops to improve the flow. The system also does not meet required storage needs. There have been some problems with bacterial quality (Metcalf & Eddy, 1972).

Expected future expansion of the system will be located along the eastern shore of Lake Tashmoo and the western shore of the Lagoon Pond (Metcalf & Eddy, 1972).

13.2 Protection of Water Supply Wells

The most important policy recommendation for the future is that all public supply wells be carefully located, sufficiently sized and buffered from waste-water-producing areas. Two water supply management policies of the State are important to the Martha's Vineyard supply situation:

1. water utility systems must continue to give priority to health and safety over all other considerations;

2. guidance and control of supply planning by water utilities is through conditional grants, financial incentives and State review and approval procedures (Massachusetts Water Supply Policy Study, 1977).

13.21 State Water Supply Requirements

Chapter 111, Section 17 as amended by Chapter 706 of 1975, states that cities, towns and persons shall submit to said Department (Department of Environmental Quality Engineering)for its advice and approval, their proposed system of water supply ... and no such system shall be established without such approval. This law applies to community water systems which serve at least 15 service connections used year-round or at least 25 year-round residents. Under the Safe Drinking Water Act of 1974 (Public Law 93-523) the Commonwealth has clear authority to regulate all sources of public water supply and requires regular chemical and bacterial analyses of the public water supplies on the Island.

In seeking new sites, the towns are to contact the State Regional Water Supply Engineer to discuss the proposed program. A sketch of the proposed test sites should be available and a plan for appropriate lab and analytical work during testing. Upon completing the test, an engineering report of the program must be submitted to DEQE for review and comment. The test well site should meet the following requirements:

1. ground elevation such that flooding will not occur and that it is accessible in all seasons;

2. minimum land area (variable with topography);

3. no wells shall be located within 1/2 mile of potential sources of pollution (e.g., sanitary landfills, fuel storage facilities, road salt stockpile areas and hazardous substance storage areas) without specific written approval of DEQE. Any such well is subject to additional monitoring requirements.

A pump test is required during which the test well is pumped for a minimum of five days at a rate of not less than 50% of the design rate for the permanent works. Three observation wells are required for pump rates less than 350 gpm. Four are required

A view of the watershed for the Oak Bluffs reservoir at upper Lagoon Pond. Properly managed farmland is an appropriate land-use in such areas.

for greater rates, with one at a minimum of 400 feet from the test site. A flow measurement device must be used to minimize recirculation. Several samples are taken for chemical analysis during the 5-day period and 2 bacterial analyses are also to be performed. An engineering report is required summarizing the test results.

Safe yield determination is made by the following calculation:

Safe Yield = Specific Yield X Available Water X .75 Safety Factor

$$\text{Specific Yield} = \frac{\text{Pumping Rate (gpm) of Test Well}}{\text{\# Feet of Draw Down in Test Well}}$$

Available Water = Depth of Well minus Length of Screen minus Static Water Level minus 5 Foot Safety Factor.

In locating supplies, Chapter 40, Section 38, 39A, 39B and 39C gives the towns the right, with the approval of DEQE, to purchase, take, develop, establish, construct and operate a water supply. Chapter 40, Section 41, as amended, requires that the consent and approval of DEQE be obtained before acquiring lands for the protection of water supply source. The acquisition is subject to a public hearing which is waived if that land is already owned by the town.

In addition to these recommendations for locating wells, this study <u>recommends</u> that wells should be protected from sources of on-lot waste water disposal especially in areas where permissible densities are greater than 1 dwelling/acre. Future supply wells should be located in areas where future development will not adversely affect the quality of existing water supply. Such is the case with the Shurtleff well in Edgartown which is buffered by the required 400 foot State setback from sources of waste water. However, an area of fairly dense housing within 500-600 feet of the well has led to occasional nitrate contamination. Future supply wells should be situated upstream from densely populated areas or potential sources of pollution. In areas where ground water development is potentially favorable the spread of home sites on lots of less than 1 acre, especially 1/2 acre or less, should be eliminated. This will eliminate the degradation of potential supply from on-lot wastewater disposal. Locations of important recharge zones and areas where zoning is in conflict with maintaining their purity are outlined in figures 32-37.

It is <u>recommended</u> that the Martha's Vineyard Commission work with local Conservation Commissions and Planning Boards as information regarding critical recharge zones becomes known, in order to develop a program to protect these fragile resources from contamination. Also, state-wide standards for land use in recharge areas should be developed.

Water supply wells must also be protected from concentrated waste generation sources such as landfills and wastewater treatment plants. The Tisbury and Edgartown supply wells are very near landfills which may be sources of future contamination. Ground water monitoring wells installed at the Edgartown landfill indicate that contaminants are leaching from the solid waste via percolating rainwater. Where the water table has a seaward slope, as it does on much of the Island, the leachate will migrate as a contamination plume toward the sea. The pollution plume may be diverted by a pumping well which effectively changes the slope of the water table in its vicinity. As both the Tisbury and Edgartown landfill sites are completed, impermeable caps should be applied and deep-rooting trees and shrubs planted to minimize leachate. It is also recommended that monitoring wells be installed between existing (and future) supply wells and nearby landfills or wastewater treatment plants.

may be mutually exclusive

13.22 Federal Programs to Protect Water Supply Sources

The Safe Drinking Water Act of 1974 provides, for the first time, for the setting of national drinking water quality standards. The Congress authorized EPA to support State and local community drinking water programs by providing financial and technical assistance and to undertake research and study efforts. The new law provides the means for expanding the scope and level of water utility service and for improving the quality and dependability of drinking water for future generations of Americans.

The Safe Drinking Water Act is designed to provide for the safety of drinking water supplies throughout the United States by establishing and enforcing national drinking water standards. The Federal government-EPA-has the primary responsibility of establishing the national standards; the States are responsible for enforcing the standards and otherwise supervising public water supply systems and sources of drinking water supply systems and sources of drinking water.

A public water system is one that provides piped water for human consumption that has at least 15 service connections or that regularly serves at least 25 people. One of the provisions of this law sets maximum levels of bacterial, organic and inorganic contaminants, turbidity and radioactivity. The limits established are outlined in Table 10.

This act also places a large sampling and reporting burden on local water companies. These companies are required to monitor regularly for the parameters listed in Table 10 and must give notice to their consumers if it:

1. fails to meet a primary drinking water regulations;
2. fails to perform required monitoring;
3. has a variance or exemption;
4. fails to comply with a schedule imposed with a variance or exemption.

The notice must be given at least every three months in newspapers of general circulation, and must be included in customers' water bills. Other communications media must also be notified.

<u>It is recommended</u> that the Water Resources Planner meet with the water companies to assist them in devising an effective program to meet these requirements.

13.3 <u>Water Supply Considerations</u>

13.31 <u>Water Conservation</u>

In the interests of protecting our public and private water resources from over-consumption, conservation measures should be promoted. To offset the need for new sources of water supply to satisfy increasing demand, individuals can make better use of the Island's water resources. Use-reduction measures include decreasing water flow from faucets and toilets. Less water also prevents overloading of on-lot waste disposal systems. The use of faucet aerators, flow reducing showers and dry toilets should be encouraged. Potential savings are outlined in Table 50. Alternatives are outlined in Table 51.

Water conservation is emphasized in the Massachusetts Water Supply Policy Study (1977), indicating that it is the policy of the Commonwealth to:

1. "Require statewide water conservation efforts ... and to encourage ... local water suppliers to institute mandatory conservation measures based on state determined estimates of minimum water needs."

2. "Require metering of all water utility deliveries and accelerate programs to install, maintain and replace meters in all local systems ...."

Metering is now used only in Oak Bluffs where it has been found to significantly reduce water consumption. The meter costs $50 plus roughly 1 hour of a plumber's time for installation. The flat rate of $55 per year for the first 30,000 gallons consumed and 40¢ for each additional 1,000 gallons. Fees are based on the number of water-using fixtures in the household. In both Edgartown and Tisbury there is no metering and therefore no incentive to reduce consumption. The costs of meter installation have been a factor, as well as the need for a complete revision of billing procedures. Nevertheless, it is the recommendation of this program that meters be installed on all new services to help limit future water demands. At the least, meter spaces should be installed to allow for eventual metering.

Public education is needed to explain to people why it is important to conserve.

13.32 Management Considerations

New Locations for Supply Wells - It would appear that in all towns there are ample open areas able to supply sufficient quantities of water for a municipal supply.

Changes in Pumping Rates - Not enough quantitative data is available to make an accurate estimation of the need for revision of pump rates.

Well Density Limits - The number and proximity of wells is now being controlled in the two most difficult areas to obtain water supply - West Tisbury and Chilmark. In West Tisbury there are requirements for a pumping well prior to the issuance of a sanitary permit. The same is accomplished through zoning low density in the morainal area of Chilmark. In other towns well densities should be such that the possibility of eventual contamination is excluded. In those areas where eventual public supply is not planned the application of Bernhart's rule is recommended (see app.5).

Changes in Pricing Policies - Water is such a vital necessity that a small change in price will not usually produce a large change in demand (California study). However, a rate increase accompanied by education in water saving techniques could affect consumption. The Massachusetts Water Supply Policy Study (1977) recommends an immediate State agency study in an attempt to answer some of the following questions:

1. Which elements of water department costs should be recovered in rates?

2. How can environmental costs be quantified and reflected in water rates?

3. Is it equitable to charge differently for dif-

ferent classes or sizes of water uses?

These questions do need to be answered before embarking on a water use reduction campaign on Martha's Vineyard. An exccess use rate may have some applicability here. The Fairfax Company Water Authority, Virginia, has adopted a new rate structure such that the base rate of 60¢/1,000 gallons would have a surcharge of $2.00/1,000 gallons in excess of 1.3 times each customer's winter use. This approach attempts to cut back on such water uses as lawn watering, golf course irrigation and other peak summer season uses (Water Policy Study, 1977).

Cisterns - The supply of potable water through the collection of rainfall has been used in many water-short areas to provide needed supplies. Cistern water is not comparable with present ground water quality and treatment may be required prior to consumption.

13.33 Asbestos Cement Supply Pipe

Currently the three major water companies use asbestos-cement supply pipes lined with vinyl. There is no definitive evidence yet available that asbestos liberated from un-lined pipe can be carcinogenic, but the concern exists. It is recommended that these campanies continue to use lined pipe and begin to replace any older pipe which may be unlined.

13.4 Future Water Supply

In the area of the eastern moraine and the outwash plain we have our greatest future potential for ground water development. Large-scale withdrawals of 500 gpm or more are possible without salt water intrusion provided that the wells are located well away from tidal areas (Metcalf & Eddy suggested at least 500 feet for wells of 0.3 mgd). The recharge area for a well pumping 1 mgd is 1.3 square miles (assumes 16 inches of recharge per year). Within this area, all water entering the ground together with any pollutants will move toward the well (Strahler, 1972). Wells of 0.5 mgd average and 1 mgd for short periods can and have been developed in the eastern moraine. All future studies to establish supply wells should closely consider the possibility of salt intrusion in siting the well. Pilot wells should be installed first to assure that the public supply well is not completed near salt water. Estimates of recharge available for consumption are included in Table 47.

On Chappaquiddick optimum well yields are not expected to exceed 200 gpm. Well yields in the western moraine are not expected in excess of 100 gpm (Metcalf & Eddy, 1972). At this time, Chappaquiddick is zoned for 3 acre lots which should provide adequate water on an individual basis over the 20-year planning period. A complete build-out of 3,000 homes on 9,000 acres (not forecasted for the 20-year period) would account for a peak demand of 1.8 mgd and average summer demand of 0.9 mgd, both of which exceed the recommended limit of 0.35 mgd. At this high growth rate 600 houses requiring a peak of 0.35 would occur in the early 1990's, while at the low growth rate, this level would not be reached in the planning period. Should growth occur at a rate which will outpace available supplies, steps should be taken to limit ultimate growth.

In the western moraine, the complex geology precludes the estimation of safe lot sizes adequate to assure plentiful future water supply. A study of streamflow in the Mill and Tiasquam Brooks in West Tisbury and Chilmark indicates that, during the time of the study, approximately 3 mgd were recharged to the ground. If we assume 1/4 of this available for consumption, then we have a recommended limit of 0.75 mgd for consumption in these stream basins. This total is equivalent to approximately 3,500 year-round homes on roughly 4,100 acres (the area of the basins). While the available water is sufficient to supply these dwellings, the discharge of nutrients from them would have adverse impacts on stream and pond waters (now rated Class B). Additional surveying of Island streams should be done in the near future to determine whether these figures are accurate. If so, they suggest an ultimate density of approximately 1 3/4 acres in the western moraine. The best approach for this area, as the zoning is already at 1 1/2 acres or more, is to continue to apply performance requirements. If a lot owner or subdivider is required to prove the availability of water and a careful watch is kept on well and pond levels in the area, a continuation of the present development pattern is feasible based on the information available at this time.

Monitoring of the nutrient budgets of these basins is recommended and if it appears that a given subdivision will have adverse impacts then improved treatment levels should be required.

The high projected growth rates in Chilmark and West Tisbury are 125 and 195 dwellings per 5-year period respectively. There are an estimated 698 dwellings in West Tisbury and 740 houses in Chilmark. In Chilmark in the year 2000, there could conceivably be 1,365 dwellings requiring 0.4 mgd as an average during summer. In West Tisbury, even if all future dwellings were located in the morainal area, a peak of 1,673 dwellings requiring 0.5 mgd is possible.

Even a peak demand assumption of 600 gallons per dwelling per day only results in 1.8 mgd which is half the estimated recharge for the western moraine. It would appear that if houses are carefully sited, the water demands of the future can be met.

In Gay Head there are approximately 300 existing dwellings requiring an estimated average summer day water supply of 0.09 mgd. At the projected high growth rate, 150 new dwellings would be added for a peak possible demand of 0.27 mgd (assumes 600 gallons per dwelling per day). The estimated safe yield for the area is 0.2 mgd which will not be exceeded during the average summer demand of 0.14 mgd. Some determination of runoff characteristics of the Gay Head area is recommended to assess the accuracy of this estimated limit. Such clayey soils may lead to large percentages of runoff and hence less available supply

The risks of contamination are also of concern to our future water supply. The State recommends 1/2 mile separation of a public supply well from a landfill or sewage treatment plant. Metcalf & Eddy (1972) recommended that lot sizes of less than 1/2 acre be excluded from areas of potential future supply. Also, some re-zoning to protect future potential public water supply is needed in Edgartown and Oak Bluffs. In these two areas, it is suggested that some area be set aside for the location of a future supply well in an area zoned for at least 1 acre.

13.41 Future Demands

Future water demands have been predicted by Metcalf & Eddy (1972) based on projected population growth. The summer average day projection was based on the present ratio of winter to summer consumption. Should greater proportion of seasonal dwellings be constructed in the future these estimates might be low. In addition, our year-round growth rates have outpaced Metcalf & Eddy's estimate. These projections are therefore believed to be somewhat low. In addition, Metcalf & Eddy projected the development of a new community whose water needs have been allocated to the remaining towns in the following manner: 6.5% - Chilmark; 25.6% - Edgartown; 2.4% - Gay Head; 20.8% - Oak Bluffs;33.6% - Tisbury; 11.1% - West Tisbury (based on relative proportions of year-round population) see Table 52.

Newly developing areas in Edgartown and Tisbury may require water service in the near future, thereby shifting the demand from private toward public supply. These projected water demands are summarized in Table 53. These figures are based on a high growth prediction and should approximate maximum available supply required.

Table 52 Future Public and Private Water Demands (mgd)

	1980			1990		
	Private	Pub.--Summer		Private	Pub.--Summer	
	Ave. Summer Day	Ave. Day	Max. Day	Ave. Summer Day	Ave. Day	Max. Day
Chilmark	.25	.06	.21	.29	.10	.32
Edgartown	.36	1.29	2.74	.63	1.61	3.49
Gay Head	.06	-	-	.09	-	-
Oak Bluffs	-	1.54	2.89	-	1.82	3.42
Tisbury	.29	1.51	2.66	.51	1.98	3.61
West Tisbury	.29	-	-	.31	.26	.72
TOTAL	1.25	4.40	8.50	1.83	5.77	11.56

(Adapted from Metcalf & Eddy, 1972)

Table 53 Town of Edgartown Public Water Demand--Maximum Day (Only for Dwellings Potentially Connected to Public Water)

	1975	1980	1985	1990	1995	2000
Village	.98	1.01	1.04	1.07	1.1	1.13
Eel Pond	.066	.071	.076	.081	.086	.091
Ocean Heights		.13	.19	.24	.30	.35
Mattakesett			.11	.17	.24	.30
Herring Creek	.036	.044	.112	.15	.19	.22
Clevelandtown	.044	.068	.092	.12	.14	.17
Total Projected	1.13	1.32	1.62	1.83	2.06	2.26
Safety Factor		1.65	2.03	2.29	2.58	2.83

--Total existing safe yield 1.5 mgd.
--Basis of Calculation: Projected High Growth in Housing; Demand = 300 gal/unit
Maximum Day Demand = 2 times ave. summer demand
Safety Factor includes a 25% add-on available to meet unforeseen demands.

(New source, After Lily Pond Site, Recommended for 1990-1995)

Town of Oak Bluffs Public Water Demand--Maximum Day

	1975	1980	1985	1990	1995	2000
Total Connections	2200	2465	2730	2995	3260	3525
Total Demand	1.32	1.48	1.64	1.8	1.96	2.12
Safety Factor*	1.65	1.85	2.05	2.25	2.45	2.65

*Safety Factor includes a 25% add-on, total existing safe yield--2.25 mgd, new source recommended for 1990-1995.
--Basis as above.

Town of Tisbury Public Water Demand, Maximum Day (mgd)

	1975	1980	1985	1990	1995	2000
Total Connections	1650	1872	2094	2316	2538	2760
Total Demand	1.4	1.59	1.78	1.97	2.16	2.35
Safety Factor*	1.75	1.99	2.22	2.46	2.70	2.93

*Safety Factor includes a 25% add-on; total existing safe yield 2 mgd.
--Basis as above except: peak day as recorded is substantially greater than 600 gallons per hook-up per day--850 gallons is used.
--New source of supply recommended for 1990-1995.

13.42 Costs and Potential Locations of New Sources of Supply

Present costs of water supply including wells and distribution systems have been made by Metcalf & Eddy (1972). These costs were designed to include added costs for the Island. Projected increase in costs are on the order of 10% per year. Costs are outlined in Table 54.

Future potential supply locations are, at present, readily available in all three of the major Island towns. It is recommended that steps be taken to secure potential future supply areas where they are not already owned.

Edgartown - The area which lies between the Edgartown-Vineyard Haven and Edgartown-West Tisbury Roads (see Figure 33) is a definite aquifer recharge area and could easily be developed to supply Ocean Heights when and if the need arose. It is now only sparsely developed but is zoned for 1/2 acre lots. It is recommended that steps be taken to either 1. purchase or acquire conservation easements on a parcel of land in the area or 2. increase the zoning in the area such that the supply will not be degraded by on-lot wastewater and private supply can occur. Conservation-owned land has in the past been effectively used for water supply in the town.

Oak Bluffs - Several town-owned lots and lands of unknown ownership exist in the area west of the County Road near its intersection with the Edgartown-Vineyard Haven Road. These areas could be readily developed for water supply (see figure 35). Any futue landfilling activities in these areas should be underlined to prevent leachate from degrading a potential supply.

Tisbury - The valley extending away from the head of Lake Tashmoo provides water to produce numerous springs at the head of the pond. This valley south of the Vineyard Haven Road might provide adequate flow for a public supply well (see Figure 36). The western moraine begins to encroach in this area and some exploration for a likely aquifer might be required. This area is now zoned for 50,000 square feet, a size which should be adequate to prevent degradation of the ground water.

That portion of the town south of the present well of the Edgartown-Vineyard Haven Road is the eastern moraine and should yield sufficient water for a public supply. Much of this area is presently zoned for 20,000 square foot lots which are not compatible with maintaining high quality water supply. Steps should be taken to secure town-owned land or

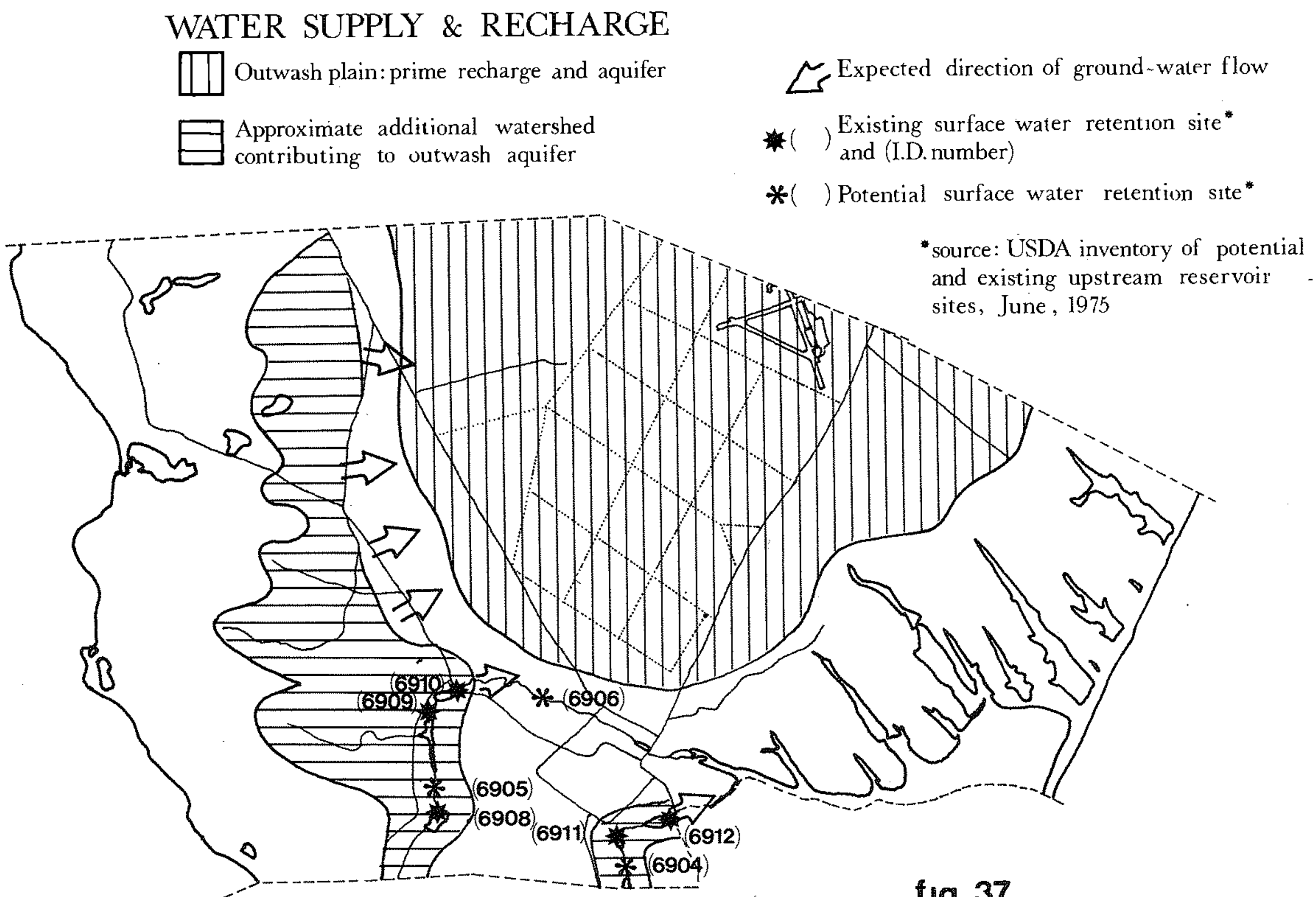


fig 37

Town of West Tisbury, Massachusetts

Restut these fig's in Town water supply file

Table 54 Future Public Water Supply Costs

Element	Unit Cost (1)	MVC 1985 Estimated Costs
Source of supply	$250,000/mgd	$575,000/mgd
Transmission mains	31/foot (2)	71/foot
Storage	300,000/mil.gal.	690,000/mil.gal.
Distribution system		
Expansion of existing service areas	1,125,000/sq.mi.	2.6 mil./sq.mi.
New service area	1,875,000/sq.mi.	4.3 mil./sq.mi.

(1) Includes cost updated to ENR 1800 except pipework where an equivalent ENR 1450 is used and the added cost for Island work, engineering, contingencies, legal and administrative fees.
(2) The above unit price assumes a 12-inch CI pipe.

(Adapted from Metcalf & Eddy, 1972)

Table 55 Energy Costs of Furnishing Drinking Water in California (Roberts, 1975)

Source of Water	Power Requirements kilowatt-hours per acre-foot
Local Groundwater	450
Imported Colorado River Water	2000
Imported No. California Water	3400
Reclaimed Wastewater	4860
Demineralized Wastewater (reverse osmosis)	3300
Demineralized Wastewater (electrodialysis)	2600
Desalination	50,000

TABLE 56

WATER SUPPLY RESERVOIR SITES

1) Potential Site IS-6901	On Mill Brook about 2,100 feet downstream from the Gay Head Road in Chilmark, Mass. Several facilities including barns and houses would be affected. Water holding capabilities--fair. Drainage area--864 acres.
2) Potential Site IS-6902	On the Tiasquam River about 300 feet upstream from Middle Road in Chilmark. Several facilities including houses, barns and roads would be affected. Water holding capabilities fair to poor.
3) Potential Site IS-6903	On Paint Mill Brook about 100 feet upstream from North Road in Chilmark. One house and one shed are affected. Water holding capabilities--good. Drainage area--582 acres.
4) Potential Site IS-6904	On the Tiasquam River about 600 feet downstream from the Chilmark-West Tisbury town line, West Tisbury. Several houses and barns affected. Water holding capabilities --good. Drainage area--1,626 acres.
5) Potential Site IS-6905	On Mill Brook about 500 feet downstream from Fisher Pond in West Tisbury. One road and one house affected. Water holding capabilities--fair. Drainage area--883 acres.
6) Potential Site IS-6906	On Mill Brook about 4,800 feet upstream from the Edgartown-West Tisbury Road, West Tisbury. Several houses, barns and roads affected. Water holding capabilities--fair to good. Drainage area--3,731 acres.

(United States Department of Agriculture)

1. a program of matching grants to fund regional and local water supply studies;

2. a program of matching grants to fund regional and local water supply facilities construction;

3. a program of direct State loans to small rural systems.

13.5 Summary

Table 57 evaluates alternatives available to protect existing and future sources of water supply. These alternatives are evaluated in terms of their economic, social, environmental, and political impacts. It is noted that we presently have an abundant supply of high quality ground water available in most parts of the Island.

This chapter recommends planning measures which are needed to conserve and to protect this high quality supply. These measures include: protecting aquifer recharge areas through the Critical District Planning Process; providing adequate buffers around supply wells through conservation easements or other land acquisition measures; conserving water supply through public education and metering; and properly siting future supply wells through careful engineering surveys. It is also recommended that the Water Resource Planner assist local Water Companies to meet the requirements of the Safe Drinking Water Act.

KEY

- * Very Positive
- \+ Positive
- 0 No Impact
- \- Negative
- = Very Negative

- G Good
- F Fair
- P Poor

table 57

WATER SUPPLY

IMPACTS / ACTIONS	PRESENT SERVICE	Install Monitoring Wells	Continue Lined Asbestos-Cement Supply Pipe	Provide Meter Spaces	Encourage Water Conservation	Develop Better Estimates of Existing Supply	Conduct Thorough Siting & Safe Yield Analysis on Future Wells	Protect Potential Supply Areas	Increase Storage Capacity	FUTURE SERVICE	Do Nothing	Add New Supply as Needed	Adjust Lot Sizes to Allow Private Supply - Limit Service	Provide Multi-Unit Wells Where Needed	Regionalize	Meter	Desalinization	Imported Supply	Reservoirs	Provide Funding for Best Supply Capability
1. WATER QUALITY GOALS																				
A. Fulfills Clean Water Act		+	+	0	+	+	+	+	0		+	+	+	+	0	+	0	0	0	+
B. Summary Rating		G	G	0	G	G	G	G	0		G	G	G	G	0	G	0	0	0	G
2. ENVIRONMENTAL EFFECTS																				
A. Hydrology																				
1. Water Quality		0	+	0	+	0	*	*	0		0	0	*	+	+	+	+	+	-	+
2. Water Quantity		0	0	+	*	+	*	+	+		-	+	+	+	+	+	+	+	+	+
3. Water Problems		0	0	0	+	+	+	+	+		-	+	+	+	+	+	+	+	+	+
4. Water Uses		+	+	+	+	+	+	+	+		-	+	+	+	+	+	+	+	+	+
5. Flood Hazards		0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0
B. Biology																				
1. Rare Species		0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0
2. Aquatic Habitat		0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	+	0
3. Aquatic Population		0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	+	0
4. Benthic Community		0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	+	0
C. Air Quality		0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0
D. Land																				
1. Change in Use		0	0	0	0	0	0	- [1]	0		0	- [5]	- [6]	+	+	0	+	0	- [8]	0
2. Planning & Controls		+	0	+	0	+	0	- [2]	0		- [4]	+	+	-	+	+	-	0	- [8]	0
3. Growth		0	0	0	0	+	0	- [3]	0		-	+	- [7]	+	+	+	-	-	0	+
4. Soil Erosion		0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0
5. Sensitive Areas		+	0	0	+	+	*	*	0		-	0	+	+	+	+	-	0	+	+
E. Wastewater Management Resources																				
1. Energy		0	0	-	+	0	0	0	0		0	-	+	-	+	+	=	=	+	0
2. Chemicals		0	-	0	+	0	0	0	0		0	0	0	-	+	0	=	=	0	0
3. Land Commitment		0	0	0	+	*	+	- [9]	0		-	+	* [10]	+	+	+	+	+	+	+
F. Summary Rating		G	G	G	G	G	G	FG	G		FP	FG	G	FG	G	G	FP	FP	FG	G
3. ECONOMICAL COSTS																				
A. Cost																				
1. First Cost		-	-	-	0	-	-	-	-		+	-	-	-	=	-	=	=	-	+
2. Annual Cost		0	0	0	+	0	0	0	0		+	-	0	-	+	+	-	=	-	+
3. External Cost		*	+	0	*	*	*	*	+		-	+ [11]	*	+	+	*	-	=	-	+
B. Value of Goods & Services																				
1. Recreation		0	0	0	0	0	0	+	0		0	0	0	0	0	0	-	-	+	+
2. Water Supply		+	+	+	+	*	*	*	+		- [13]	+	+	+	*	+	+	+	+	+
3. Fishing & Shellfishing		0	0	0	0	0	0	0	0		0	0	0	0	0	0	-	0	+	0
C. Jobs		+	0	+	0	0	+	- [12]	+		0	+	- [12]	+	0	+	+	+	-	+
D. Economic Base & Stability		0	0	0	0	0	0	0	0		- [14]	0	0	0	0	0	-	-	0	0
E. Summary Rating		G	G	FG	G	G	G	FG	G		F	FG	FG		G	G	P	P	F	G
4. SOCIAL EFFECTS																				
A. Dislocation of People or Services		0	0	0	0	0	0	-	0		- [15]	+	- [16]	+	+	- [17]	- [17]	- [17]	0	0
B. Public Health		+	+	0	+	0	+	*	0		-	+	+	+	+	+	+	+	+	+
C. Aesthetics		0	0	0	0	0	0	0	0		0	0	0	0	0	0	-	0	+	0
D. Educational & Cultural		+	0	+	+	+	*	0	0		0	0	0	0	0	-	-	-	0	+
E. Summary Rating		G	G	G	G	G	G	FG	0		P	G	F	G	G	FG	P	P	G	G
5. IMPLEMENTATION																				
A. Legal Authority		+	+	+	0	0	+	+	+		+	+	+	- [18]	- [18]	+	+	-	-	+
B. Financial Capacity		+	-	-	0	-	-	0	-		+	-	-	-	- [19]	-	=	=	-	+
C. Practicability		+	+	+	+	+	+	+	+		+	+	+	+	+	+	=	=	-	+
D. Public Accountability		+	+	+	+	*	*	*	*		=	+	*	+	+	+	-	-	-	+
6. PUBLIC ACCEPTABILITY		*	+	+	+	*	+	+	+		-	+	+	+	-	+	=	=	-	*

NOTES:

1. Potential Decrease in intensity of use.
2. Requires added controls.
3. Reduces ultimate growth in protected areas.
4. Implies some loss in control of protection of supply.
5. Added land required for supply protection.
6. Requires larger lot sizes in some areas
7. May reduce total growth.
8. May require protected buffer and added land.
9. Requires protection of added land.
10. Less land committed to supply areas.
11. Provides quality water.
12. May reduce economic activity.
13. May lead to poor quality or overpumping.
14. Poor supply may lead to decreased tourist activity.
15. Towns may not have capacity to provide needed service.
16. Requires individuals to supply their water.
17. Will lead to reduction in accustomed use.
18. Requires added authority or supervision
19. Requires large first cost.

GLOSSARY OF TERMS

Abbreviations--

BOD--Biochemical Oxygen Demand
DEQE--Department of Environmental Quality Engineering
EPA--Environmental Protection Agency
LNG--Liquified Natural Gas
mg/l--milligrams per liter (equals ppm)
mgd--million gallons per day
MVC--Martha's Vineyard Commission
OSP--Office of State Planning
ppm--parts per million
WPC--Divison of Water Pollution Control
EIS--Environmental Impact Statement

ACIDITY--is the quantitative capacity of aqueous solutions to react with hydroxyl ions. It is measured by titration with a standard solution of a base to a specified end point. Usually expressed as milligrams per liter of calcium carbonate.

pH--is the measure of the hydrogen ion concentration of a solution on an inverse logarithmic scale ranging from 0 to 14. Values from 0 to 6.9 indicate acidic solutions, while values from 7.1 to 14 indicate alkaline solutions. A pH of 7.0 indicates a neutral solution. Natural streams usually show pH values between 6.5 and 7.5, although higher and lower values may be caused by natural conditions.

ADSORBED--a process where by ions in solution form complexes with organic material in the soil or by CEC which are resistent to leaching.

AEROBIC--implying the presence of oxygen.

ALKALINITY--is the capacity of water to neutralize acids, a property imparted by the water's content of carbonates, bicarbonates, hydroxides, and occasionally borates, silicates, and phosphates. It is expressed in milligrams per liter of equivalent calcium carbonate.

AMMONIA (NH_3)--is a compound of nitrogen and hydrogen which is part of the nitrogen cycle. Its presence in sufficient amounts in a stream can indicate a wastewater discharge. It is toxic in sufficient amounts, especially to fish.

ANAEROBIC--implying the lack of oxygen; the anaerobic soil community of micro-organisms recycles nutrients at a slower rate than the aerobic community.

AQUIFER--a rock layer capable of holding and transmitting ground water freely.

AQUIFER RECHARGE ZONE--an area where the ground water contained in an aquifer is replenished by rainfall or surface waters.

GLOSSARY OF TERMS

Abbreviations--

BOD--Biochemical Oxygen Demand
DEQE--Department of Environmental Quality Engineering
EPA--Environmental Protection Agency
LNG--Liquified Natural Gas
mg/l--milligrams per liter (equals ppm)
mgd--million gallons per day
MVC--Martha's Vineyard Commission
OSP--Office of State Planning
ppm--parts per million
WPC--Divison of Water Pollution Control
EIS--Environmental Impact Statement

ACIDITY--is the quantitative capacity of aqueous solutions to react with hydroxyl ions. It is measured by titration with a standard solution of a base to a specified end point. Usually expressed as milligrams per liter of calcium carbonate.

pH--is the measure of the hydrogen ion concentration of a solution on an inverse logarithmic scale ranging from 0 to 14. Values from 0 to 6.9 indicate acidic solutions, while values from 7.1 to 14 indicate alkaline solutions. A pH of 7.0 indicates a neutral solution. Natural streams usually show pH values between 6.5 and 7.5, although higher and lower values may be caused by natural conditions.

ADSORBED--a process where by ions in solution form complexes with organic material in the soil or by CEC which are resistent to leaching.

AEROBIC--implying the presence of oxygen.

ALKALINITY--is the capacity of water to neutralize acids, a property imparted by the water's content of carbonates, bicarbonates, hydroxides, and occasionally borates, silicates, and phosphates. It is expressed in milligrams per liter of equivalent calcium carbonate.

AMMONIA (NH_3)--is a compound of nitrogen and hydrogen which is part of the nitrogen cycle. Its presence in sufficient amounts in a stream can indicate a wastewater discharge. It is toxic in sufficient amounts, especially to fish.

ANAEROBIC--implying the lack of oxygen; the anaerobic soil community of micro-organisms recycles nutrients at a slower rate than the aerobic community.

AQUIFER--a rock layer capable of holding and transmitting ground water freely.

AQUIFER RECHARGE ZONE--an area where the ground water contained in an aquifer is replenished by rainfall or surface waters.

ARTESIAN--a situation where ground water flows up toward the surface through its own hydraulic pressure.

BACTERIA--the simplest independent form of living creature. These single celled organisms are responsible for transforming pollutants into protoplasm and atmospheric gasses.

BARRIER BEACH--An elongate body of sand extending parallel to shore and rising slightly above high tide. They typically separate a tidally dominated bay from a wave dominated shoreline.

BIOCHEMICAL OXYDEN DEMAND (BOD)--is the quantity of oxygen used in the biochemical oxidation of organic matter in a specified time, at a specified temperature, and under specified conditions.

CATION EXCHARGE CAPACITY (CEC)--a property of soils whereby cations in solution (such as ammonium ion from sewage) can be exchanged for cations absorbed in the mineral. This property depends on the presence of clays and organics. Coarse sandy soils have very low CEC.

CESSPOOL--an on-lot sewage disposal system consisting of a perforated tank into which the waste water flows. The solids settle to the bottom and the liquids infiltrate into the soil. This type of system does not yield high quality effluent.

CHEMICAL OXYGEN DEMAND (COD)--refers to the measure of the oxygen-consuming capacity of inorganic and organic matter present in water or wastewater. It is expressed as the amount of oxygen consumed from a chemical oxidant in a specific test. It does not differentiate between stable and unstable organic matter and thus does not necessarily correlate with biochemical oxygen demand.

CHLORINATION--refers to the application of chlorine to water or waste water, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results.

CLAY--a soil particle size which is finer than 10,000 per inch.

COLIFORM--are bacteria found in abundance in the intestinal tract of warmblooded animals. They are not harmful in themselves, but their presence indicates that pathogenic bacteria may be present. Since they can be detected by relatively simple test procedures, coliforms are used to indicate the extent of bacterial pollution from sewage. Bacterial tests usually measure the fecal and total coliforms. Fecal coliform make up about 90 percent of the coliforms discharged in fecal matter. Non-fecal coliforms may originate in soil, grain, or decaying vegetation.

COMPOSITE WATER SAMPLE--is a combination of individual samples of water or waste water taken at selected intervals, generally hourly, for some specified period, to minimize the effect of the variability of the individual sample. Individual samples may have equal volume or be proportioned to the flow at the time of sampling.

CONE OF DEPRESSION--an area surrounding a pumping well where the water table is lowered. The area increases in size with increased pumping rate.

DENSITY INCENTIVES-- a provision whereby a developer dedicates open space in exchange for agreater overall density than is normally allowed by the zoning.

DRAWDOWN--a phenomenon where a pumping well causes a reduction in pressure surrounding the well point leading to a decline in the water table.

EVAPOTRANSPIRATION--the process wherein precipitation is returned to the atmosphere as water vapor by direct conversion from liquid to gas or by the use and release of water by plants.

EXTENDED AERATION--refers to a biological treatment process commonly used to treat small waste water flows. The aeration period is generally 24 hours or greater.

GRAB SAMPLE--is a single sample of waste water taken at neither a set time nor flow.

GROUND WATER--refers to water found underground in porous rock strata and soils.

ICE CONTACT SANDS--a class of glacially related sediments characterized by their deposition adjacent to glacial ice.

INDUSTRIAL WASTES--refers to the liquid wastes from industrial processes, as distinct from domestic or sanitary wastes.

IRON--is a metal generally found in most waters. Silt and clay in suspension may contain acid-soluble iron. Iron oxide particles are sometimes collected with a water sample as a result of flaking of rust from pipes.

LANDFILL (SANITARY)--a method of disposing of solid wastes on land consisting of reducing the wastes to the smallest possible volume and covering them with a layer of fill.

LEACHATE--a contaminated liquid resulting from the percolation of rain water through a landfill.

MANGANESE--is a metal which generally occurs in surface waters both in suspension in the quadrivalent state and in the trivalent state in a relatively stable, soluble complex. Although rarely present in excess of 1 mg/l, manganese imparts objectionable and tenacious stains to laundry and plumbing fixtures.

METHYLENE BLUE ACTIVE SUBSTANCE (MBAS)--is a measure of apparent detergents. This determination depends on the formation of a blue color when methylene blue dye reacts with synthetic detergent compounds.

MILLIGRAMS PER LITER (mg/l or ppm)--is used to express concentrations in water chemistry because it allows simpler calculations than the English System. The basis of the metric system is the unit of weight and volume of water at standard conditions (20°C). At these conditions, one milliliter of water equals one cubic centimeter and weighs one gram. One milligram per liter is therefore essentially equal to one part per million by weight or volume.

MORAINE--a land form deposited at the end or sides of a glacier consisting of poorly sorted sediments which form a high, wide and hummocky ridge (the northeastern and northwestern portions of Martha's Vineyard).

NIGHTSOIL (ALSO SEPTAGE)--the concentrated sewage pumped from a properly functioning septic tank or cesspool.

NIGHTSOIL DISTRICTS--areas of poorly functioning on-lot sewage disposal systems where, it is recommended in this report, that an inspection and rehabilitation program be instituted.

NITROGEN--is a common non-metallic element that in free form is normally a colorless, odorless, tasteless, insoluble, inert, diatomic gas. In the combined form, it has a wide range of valences and is a constituent of biologically important compounds (as proteins) and hence of all living cells as well as industrially important substances (as cyanides, fertilizers, and dyes).

NITROGEN, NITRATE (NO_3)--represents the most highly oxidized phase in the nitrogen cycle and normally reaches important concentrations in the final stages of biological oxidation. Nitrogen in this form is readily available to plants.

NON-POINT SOURCES--sources of pollution which emanate from diffuse points and which are not readily identifiable - such as urban or agricultural runoff, decaying vegetation and private sewage disposal systems.

OUTWASH PLAIN--a gently sloping, relatively featureless plain consisting of stream deposits from a receding glacier (the southern and central portions of Martha's Vineyard.

OXIDATION--refers to the addition of oxygen to a compound. More generally, any reaction which involves the loss of electrons from an atom.

PATHOGENIC BACTERIA--are bacteria that may cause disease in the host organisms by their parasitic growth.

PERCHED WATER TABLE--a secondary water table formed above the water table where an impermeable layer prevents the infiltration of rain water.

PERCOLATION--the capacity of an aquifer to allow the movement of water;increases with increasing interconnected pore spaces.

PHOSPHORUS--is a non-metallic multivalent element of the nitrogen family that occurs widely in combined form, especially as inorganic phosphates in minerals, soils, and natural waters, and as organic phosphates in all living cells; it exists in several allotropic forms. The majority of the phosphorus contained in domestic sewage and industrial wastes comes from detergents.

POINT SOURCES--sources of pollution which emanate from an identifiable point - either a pipe or an industrial or municipal discharge.

POROSITY--The presence of pore or open spaces within an aquifer (not necessarily interconnected).

RECHARGE--the process of replenishment of ground water supplies.

RESIDUAL CHLORINE--is the chlorine remaining in water or waste water at the end of a specified contact time as combined or free chlorine.

SA--salt waters of the highest quality suitable for swimming and shellfishing.

SAMPLER--is a device used with or without flow measurement to obtain an adequate portion of water or waste for analytical purposes. May be designed for taking a single sample (grab), composite sample, continuous sample, or periodic sample.

SAND--particles of soil which fall in the size range of 10 to 1000 per inch.

SEPTIC TANK SYSTEM--an on-lot sewage disposal system consisting of a tight tank of 1000 to 1500 gallon capacity which collects the sewage solids and a network of perforated pipe through which the liquid is discharged to the soil.

SILT--particles of soil which fall in the range of sizes of from 1000 to 10,000 per inch.

SOLIDS SUSPENDED--refers to solids that either float on the surface of, or are in suspension in, water, waste water, or other liquids and which are largely removable by laboratory filtering.

SOLIDS TOTAL--is the sum of dissolved and undissolved constituents in water or waste water, usually stated in milligrams per liter.

SOLID WASTE--the sum of refuse from food wastes and wrappings, street cleaning, demolition and construction, sewage treatment residue, from households, restaurants, stores and other institutions.

SPECIFIC CONDUCTANCE--is a measure of the ability of water to conduct an electrical current and is expressed in micromhos per centimeter at 25^{o}C.

TANNIN--an astringent vegetable substance used in tanning animal hides.

VIRUSES--the smallest pathogens which are parasites on bacteria.

WASTE WATER SURVEY--is an investigation of the quality and characteristics of each waste stream, as in an industrial plant or municipality.

WATER TABLE--the upper surface of the saturated zone or ground water.

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Appendix 1

Natural Resources

TABLE a1

SURFACE WATER BODIES OF MARTHA'S VINEYARD

Town	Pond	Type	Acreage	Altitude
Chilmark	Black Point Pond	tidal when adjoining Tisbury Great Pond is opened; brackish to saline	68	sea level
	Bliss Pond	fresh; stream fed	4	121'
	Chilmark Pond	regularly open; tidal; brackish to saline; stream fed	228	sea level
	Fulling Mill Brook			
	Harlock Pond	fresh; feeds a stream	14	100'
	Menemsha	see Gay Head		
	Mill Brook			
	Nashaquitsa Pond	tidal salt	92	sea level
	Noman's Land East Pond			
	Noman's Land South Pond			
	Noman's Land West Pond			
	Paint Mill Brook			
	Paint Mill Brook Pond	fresh	5	2'
	Prospect Brook			
	Quenames Cove	fresh to brackish	17	3'
	Roaring Brook			
	Squibnocket Pond	fresh to brackish	609	3'
	Squibnocket Ridge Pond	fresh; feeds a stream	13	21'
	Stonewall Pond	tidal salt	23	sea level
	Tiasquam River			
	Tisbury Great Pond	see West Tisbury		
Edgartown	Caleb's Pond	tidal salt	34	sea level
	Cracktuxet Cove	tidal salt	44	sea level
	Dodger Hole	fresh	1	15'
	Edgartown Great Pond	brackish to salt when open	911	3' to 0'
	Eel Pond	tidal	115	sea level
	Jacobs Pond	fresh	8	3'

Town	Pond	Type	Acreage	Altitude
Edgartown (continued)	Jernegan Pond	fresh	3	20'
	Jobs Neck Pond	fresh to brackish	68	3'
	Jobs Neck Pond, East	fresh to brackish	17	3'
	Jobs Neck Pond, West	fresh to brackish	6	3'
	Lily Pond	fresh	1	20'
	Little Pond	fresh	1	20'
	Oyster Pond	fresh to salt tidal	207	10'
	Paqua Pond	fresh to brackish	14	3'
	Pease Pond	fresh	6	sea level
	Poucha Pond	tidal salt	199	sea level
	Sengekontacket Pond	tidal salt	716	sea level
	Shear Pen Pond	tidal salt	40	sea level
	Trapps Pond	tidal; brackish	45	sea level
Gay Head	Black Pond	fresh	5	42'
	Black Brook			
	Lily Pond	fresh	3	6'
	Menemsha Pond	tidal salt	640	sea level
	Occooch Pond	fresh	4	15'
	Squibnocket Pond	see Chilmark		
Oak Bluffs	Brush Pond	tidal	5	sea level
	Crystal Lake	fresh	12	10'
	Duarte Pond	fresh	5	18'
	Farm Pond	tidal salt	33	10'
	Fresh Pond	fresh	9	8'
	Hamlin Pond		5	sea level
	Lagoon Pond	see Tisbury		
	Sengekontacket (Anthier's) Pond	see Edgartown		
	Sunset Lake	tidal salt	5	10'
Tisbury	Duarte Pond			

Town	Pond	Type	Acreage	Altitude
Tisbury (continued)	Lagoon Pond	tidal; salt to brackish	535	sea level
	Mink Meadows Pond	tidal salt	5	10'
	Lake Tashmoo	tidal salt	259	sea level
West Tisbury	Blackwater Brook			
	Blackwater Brook Pond	fresh; feeds the brook	12	98'
	Crocker Pond	fresh; part of Mill Brook	8	54'
	Davis Pond		4	22'
	Daggetts Pond	fresh	10	4'
	Fisher Pond	fresh; part of Mill Brook	10	67'
	Grey Pond	fresh; feeds a stream	5	6'
	Homers Pond		38	4'
	James Pond	tidal salt	37	sea level
	Lily Pond		2	10'
	Long Cove	fresh to brackish	83	10'
	Looks Pond	fresh	4	15'
	Mill Brook	stream		
	Old House Pond	fresh	11	83'
	Priester Pond	fresh; part of Mill Brook	5	46'
	Seths Pond	fresh	12	43'
	Tiasquam River	stream		
	Tisbury Great Pond	brackish to salt when open	772	10' to sea level
	Watcha Pond-Fresh Pond	fresh to brackish	68	4'
	Witch Brook	stream		

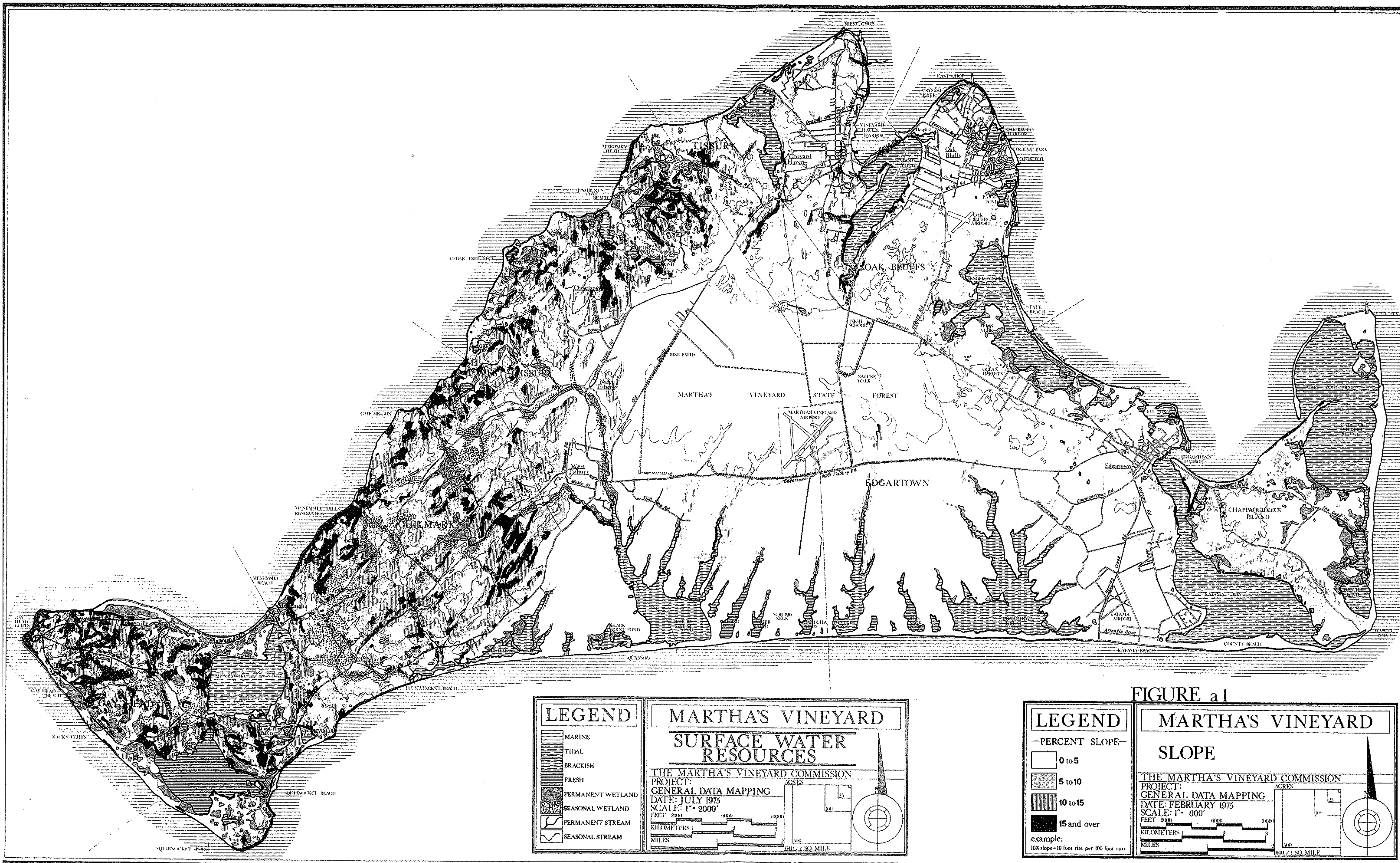

WEST CHOP
EAST CHOP
TISBURY
Vineyard Haven
VINEYARD HAVEN HARBOR
Oak Bluffs
OAK BLUFFS
OAK BLUFFS AIRPORT
WEST TISBURY
MARTHA'S VINEYARD STATE FOREST
MARTHA'S VINEYARD AIRPORT
EDGARTOWN
Edgartown
EDGARTOWN HARBOR
CHAPPAQUIDDICK ISLAND
CHILMARK
GAY HEAD
KATAMA AIRPORT
KATAMA BAY
Atlantic Drive
KATAMA BEACH
COUNTY BEACH
BLACK POINT POND
SQUIBNOCKET BEACH
CEDAR TREE NECK
LEGEND
MARINE
TIDAL
BRACKISH
FRESH
PERMANENT WETLAND
SEASONAL WETLAND
PERMANENT STREAM
SEASONAL STREAM
MARTHA'S VINEYARD
SURFACE WATER RESOURCES
THE MARTHA'S VINEYARD COMMISSION
PROJECT: GENERAL DATA MAPPING
DATE: JULY 1975
SCALE: 1" = 2000'
FEET
KILOMETERS
MILES
ACRES
640 / 1 SQ. MILE
LEGEND
PERCENT SLOPE
0 to 5
5 to 10
10 to 15
15 and over
example:
10% slope = 10 foot rise per 100 foot run
MARTHA'S VINEYARD
SLOPE
THE MARTHA'S VINEYARD COMMISSION
PROJECT: GENERAL DATA MAPPING
DATE: FEBRUARY 1975
SCALE: 1" = 000'
FEET
KILOMETERS
MILES
ACRES
640 / 1 SQ. MILE

FIGURE a1

TABLE a2

CHARACTERISTICS OF THE BASINS

	Mill Brook	Tiasquam River
Basin Area square kilometers (km^2)	9.03	7.79
Headwaters Elevation meters (m)	34	40
Length of Stream Above Gauge m	4,820	5,830
Average Stream Slope	0.7%	0.7%
Major Impoundments	4	5
Volume of Rain, 27 August to 20 November 1975 thousands of cubic meters (10^3m^2)	2,048	1,567
Estimated "Average" Flow* liters per second (l/s) cubic feet per second	89.41 3.14	48.80 1.75
Estimated Annual Average Runoff as % of rain	32%	23%

*Average rate of estimated runoff.

(Laws, 1976)

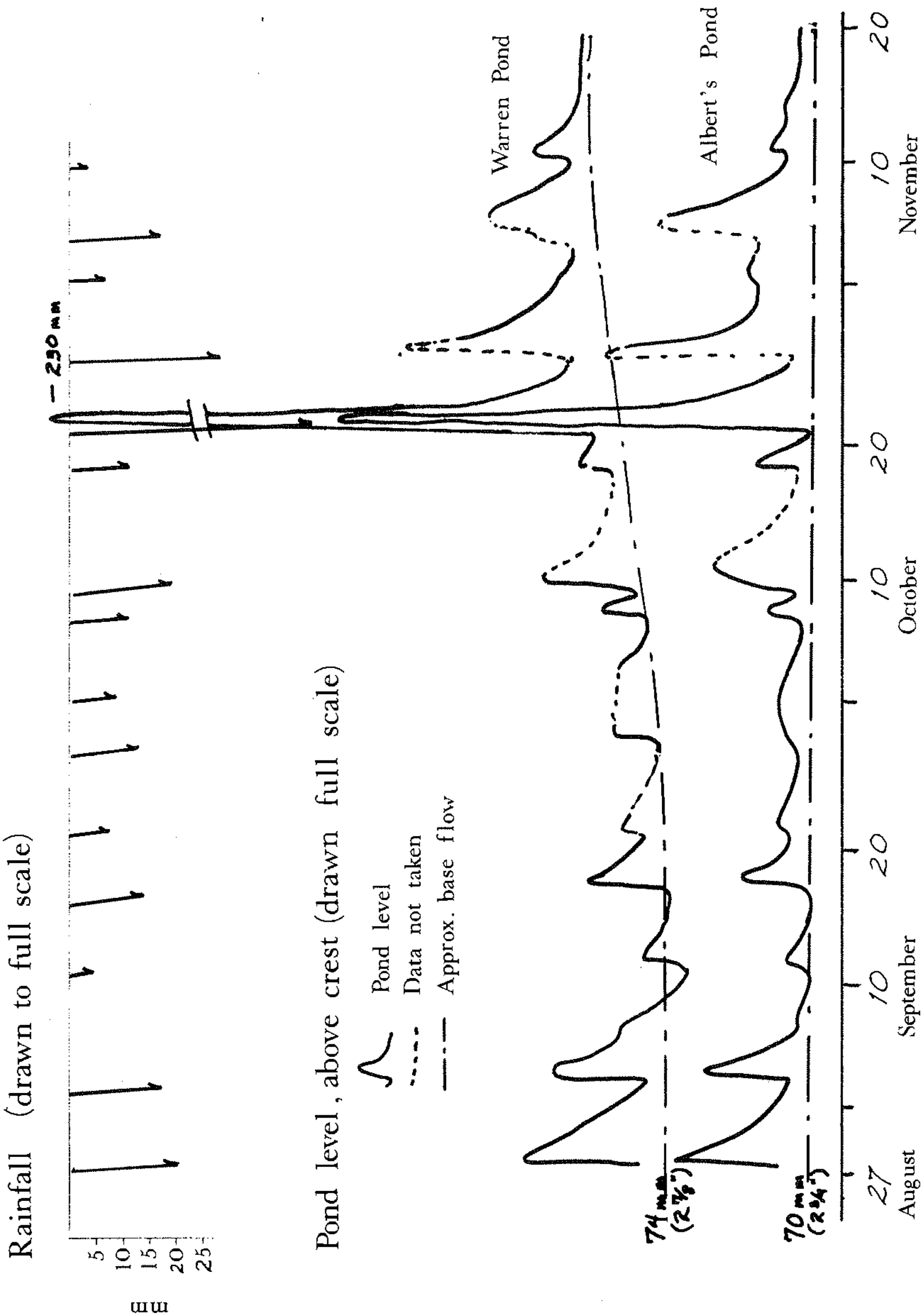
OBSERVED AND ESTIMATED AVERAGE RUNOFF VALUES

	Mill Brook	Tiasquam River
(Observed 85 day period)		
Rain Volume thousands of cubic meters (10^3m^3)	2,048.5	1,567.3
Storm Flow (10^3m^3)	80.47	46.68
Base Flow (10^3m^3)	479.40	268.65
Average Observed Flow Rates (l/s) (cfs)	65.28 2.31	42.94 1.52
ESTIMATED "AVERAGE" RAIN CONDITIONS		
Storm Flow (10^3m^3)*	100.59	54.15
Base Flow (10^3m^3)**	555.78	311.63
Total (10^3m^3)***	656.37	365.78
Runoff as % of Rain	32%	23%

(Laws, 1976)

*obs. times 1.25, ** obs. times 1.16, *** est. ave. 85 day runoff.

FIGURE a2
Pond levels and rainfall



LEGEND FOR Figure a-3

GENERALIZED HYDROLOGY BY C. KAYE

Zone A

Very good aquifer. Ample supply of groundwater for most domestic developments. Water table generally over 20 feet deep. In places, water is high in iron.

Horizontally-bedded sand and gravel. Glacial outwash derived from glacier front on the north side of Martha's Vineyard; thin at margins of outwash plain on northeast and northwest and thicker to south. Freshwater lens probably over 200 feet thick in center of Island, thinning at coast and shores of brackish ponds. Heavy groundwater withdrawal in coastal zone will produce salt water intrusion.

Recharge area is zone itself, as well as adjoining parts of surrounding moraines (Zones B and C). Groundwater flow is southward.

Zone B

Good to fair aquifer. In places inadequate for large groundwater withdrawals. Depth to water table varies from 0 to 35 feet, but in most places is less than 30 feet. Water locally high in iron.

Stratified sand and gravel, some silts and clays and non-stratified gravelly silty sand with boulders. Consists of morainic material and outwash deposits laid down on top of wasting ice front.

Heavy pumping may produce salt water intrusion at depth, particularly within a few hundred yards of the shore.

Recharge is limited to the area of the moraine. Groundwater flows towards the coast. Groundwater divide probably coincides with topographic divide, as shown on accompanying map.

Zone C

Poor aquifer. Very variable from place to place, even within distances of 25 feet. Capacity of individual aquifers generally small. Depth to water varies from 10 feet to 300 feet. Quality of water varies from excellent to high in dissolved minerals and fine sediment.

A glacial moraine consisting of alternating thick strata of clay, sand, gravel, silt, till, greensand, etc., all steeply inclined downwards to the north in Gay Head and northwest in Chilmark and Tisbury. Some of these beds are good aquifers, some poor, and it is the difficulty of predicting which will underlie any particular site that makes water supply so uncertain in this Zone.

Recharge area is the Zone itself.

Zone D

Variable aquifer. Mostly sandy zones interbedded with clay, complexly folded and tilted. Water table varies from 10 feet to 100 feet in depth. Quality of water good.

This Zone consists largely of a thick gray clay overlain by medium-grained sands that were pushed by a lobe of glacial ice out of the Menemsha Basin and Menemsha Bight and in consequence are much deformed. Ridges are generally underlain by thick clay, intervening valleys by sand. All deposits dip northerly.

Zone E

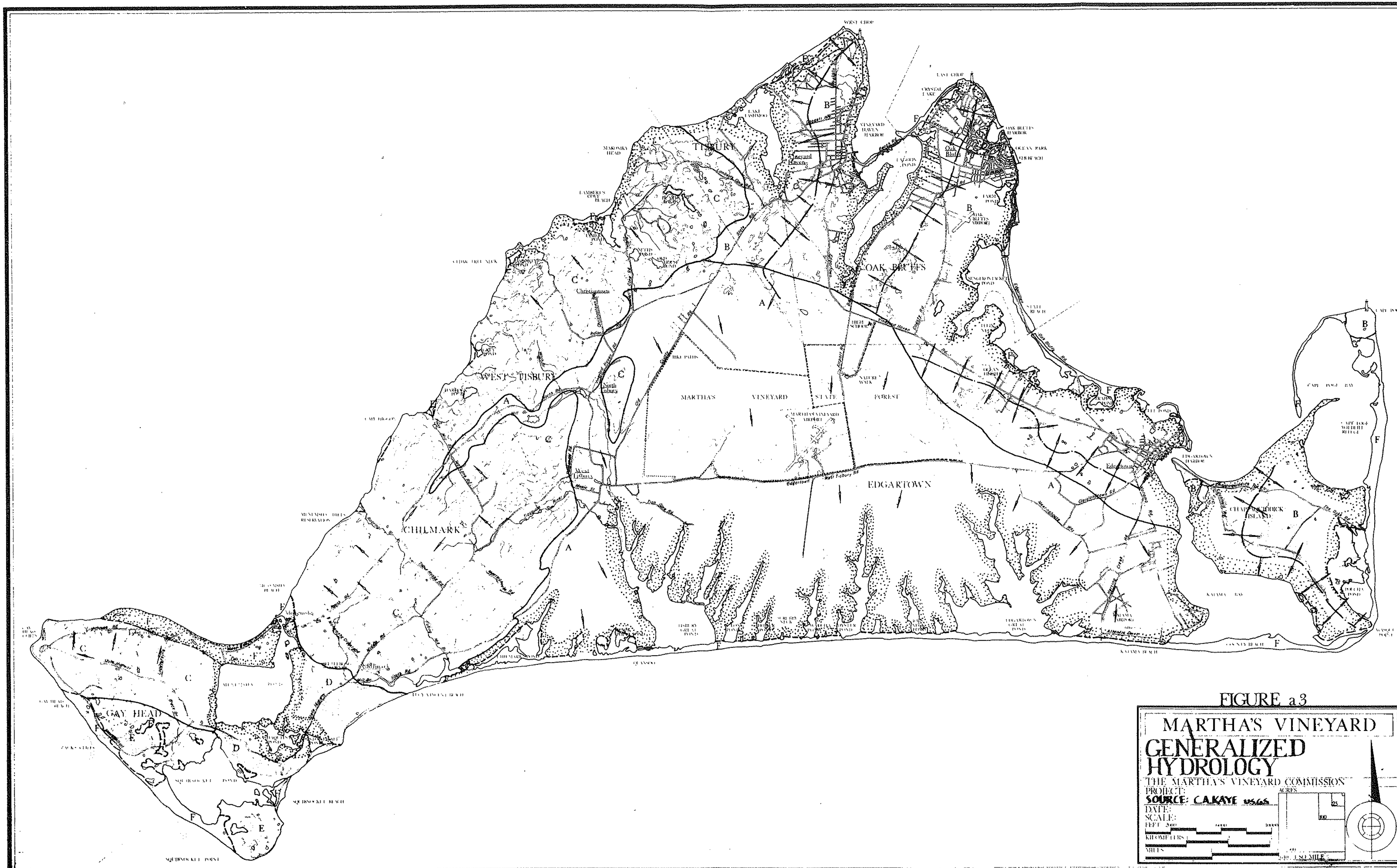
Generally a poor aquifer. In places, shallow water table and limited amounts of groundwater occur in thin sand and gravel and sandy till than overlies very compact glacial till. This till, which makes up the main mass of this moraine, yields little if any water.

Recharge is area of Zone E and Squibnocket Pond.

Zone F

Very poor aquifer. Beach sands, sand dunes, marshes and artificial fill over marshes and shallow offshore.

Very limited amounts of fresh water from large dune field north of Menemsha Pond and Cranberry Bog of Gay Head. These areas are very vulnerable to salt water intrusion.



TISBURY
OAK BLUFFS
WEST TISBURY
CHILMARK
EDGARTOWN
GAY HEAD
MARTHA'S
VINEYARD
STATE
FOREST
CHAPPAQUIDDICK ISLAND
Vineyard Haven
Oak Bluffs
West Tisbury
Edgartown
Christiantown
FIGURE a 3
MARTHA'S VINEYARD
GENERALIZED HYDROLOGY
THE MARTHA'S VINEYARD COMMISSION
PROJECT:
SOURCE: C.A.KAYE USGS
DATE:
SCALE:
FEET
KILOMETERS
MILES
ACRES

PRELIMINARY SURFICIAL GEOLOGIC MAP OF MARTHA'S VINEYARD

BY C.A. KAYE

United States Geological Survey Open File

LEGEND

A : Gay Head Moraine-
Imbricated thrust sheets of Cretaceous, Miocene and pleistocene deposits.
Thrusts dip steeply northwest in Chilmark and North in Gay Head. Boulders (up to 30' diameter) are common on the surface

B : Martha's Vineyard Moraine-
somewhat stratified silty, fine to coarse sand with pebbles and cobbles

B* : Martha's Vineyard Moraine-
thin, bouldery, sandy till overlying deformed grey clay and fine to medium clean sand

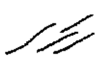
C : Martha's Vineyard Outwash - from Martha's Vineyard Moraine-
Interbedded sand and gravel; top 5 to 10 feet is silty with boulders and many siderite nodules

C* : Martha's Vineyard Outwash overlying Martha's Vineyard Moraine

D : Beach Deposits - medium to coarse sand and fine gravel

E : Squibnocket Moraine overlain by thin Martha's Vineyard Moraine (less than 15 feet thick). Very compact and sandy, pink, mauve and purple-grey till.

F : Swamp Deposits - peat and organic silt and fine sand

 : outcrops of individual thrust plates

 : dry-valleys cut in post-glacial time

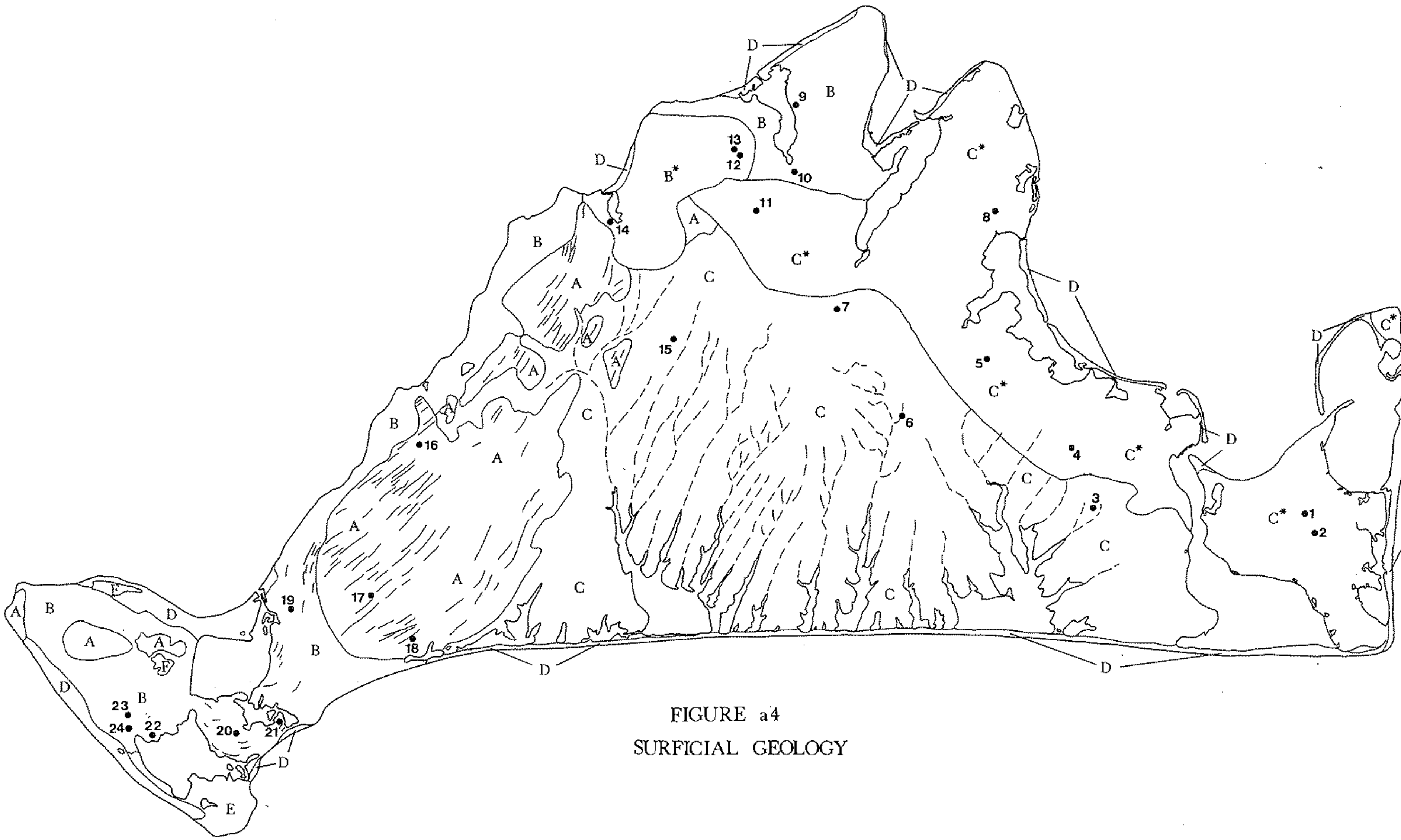


FIGURE a4
SURFICIAL GEOLOGY

Selected Borings

to accompany figure a.4

Boring number: 1

Town: Edgartown

stratum depth	soil description	symbol	remarks
10"	yellow-brown silty sand		
21"	yellow-brown coarse to fine sandy gravel		
33"	yellow to brown fine sand with some medium sand		
83"	fine to coarse sand with gravel		
107"	clayey fine to medium sand		
127"	fine to medium sand with some silt		
	bottom of boring, no water encountered		

Boring number: 6

Town: Edgartown

stratum depth	soil description	symbol	remarks
	fine to very coarse interbedded brown sand and gravel; some cobbles		water level @ 20'
110'	pale olive green clay, silt and fine sand		
130'	fine to coarse olive green sand		
160'	coarse sand, fine gravel &shell		
163'	fine to medium olive green sand		
198'			

Boring number: 12

Town: Tisbury

stratum depth	soil description	symbol	remarks
	medium to coarse sand some pebbles		
40'	silty sand, some clay		
55'	gray clay, some lignite		
100'			

Boring number: 17

Town: Chilmark

stratum depth	soil description	symbol	remarks
1'	topsoil and subsoil		water level at 80'
36½	coarse brown sand; occasional boulders		
80'	coarse brown sand and gravel		
110'	fine sand and silt		

Boring number: 20

Town: Chilmark

stratum depth	soil description	symbol	remarks
1'	topsoil and subsoil		
6'	clay (hardpan)		water level at 82'
34'	coarse sand and gravel with some boulders		
85'	coarse sand		
116'	fine sand and clay		
120'	gray clay and gravel		

Boring number: 22

Town: Gay Head

stratum depth	soil description	symbol	remarks
	topsoil and subsoil		water levels at 138"
24"	sandy gravel with some silt and pockets of sand		
144"			

Boring number: 23

Town: Gay Head

stratum depth	soil description	symbol	remarks
	topsoil and subsoil		seeping water at 60"
30"	clay and silt		
72"			

IMPORTANT WILDLIFE HABITATS ON MARTHA'S VINEYARD

Legend for Figure a5

Prime Areas--

Areas which, due to their size and varied or unique environment, comprise a significant ecosystem. These areas provide nesting or feeding areas for waterfowl, productive shellfish flats or sport-fish areas.

I. Squibnocket
II. Cranberry Acres
III. Sengekontacket
IV. Katama Plains
V. Wasque and Cape Pogue
VI. Chilmark and Black Point Ponds

Key Areas of Small Size--

These areas provide valuable wildlife habitat in the form of small fresh water wetlands, potholes, scrub brush areas or open fields.

1. Lobsterville Bog
2. Nashaquitsa Pond & Uplands
3. Zacks Cliffs- Moshup Trail
4. Menemsha
5. Chilmark South Road
6. Roaring Brook
7. Tea Lane area
8. Point Mill Brook area
9. Harlocks Pond
10. Mill Brook
11. Seven Gates Farm
12. Tiasquam River
13. Town Cove & Carl's Cove
14. James Pond Area
15. Seth's and Old House Ponds
16. Herring Creek & Tashmoo Pond
17. Mink Meadows
18. Sheriff's Meadow & Eel Pond
19. Jane's Cove & Sleepy Snake Brook
20. Beach of Edgartown Great Pond
21. Crackatuxet
22. Swan Neck
23. Jacobs Pond
24. Jobs Neck Cove & Ponds
25. Paqua Pond
26. Watcha Pond
27. Long Cove
28. Tississa Point
29. Deep Bottom Cove
30. Cove Meadow
31. Interior Wetlands
32. Katama Shoreline
33. Long Point
34. North Neck
35. Snows Point
36. Calebs Pond

Smaller Areas--

a. Indian Hill Road
b. Christiantown
c. Blackwater Brook
d. West Chop
e. Duarte's Pond
f. Little Pond
g. Dodgers Hole
h. Farm Pond
i. Hamlin's Pond
j. Trapps Pond
k. Lily Pond
l. Menemsha Wetlands
m. Cedar Tree Neck
n. Teah's Cove Road
o. Crystal Lake
p. Norton Point
q. Little Neck

*Note more detailed information is available at the Martha's Vineyard Commission offices.

Source: Vineyard Conservation Society, et al.

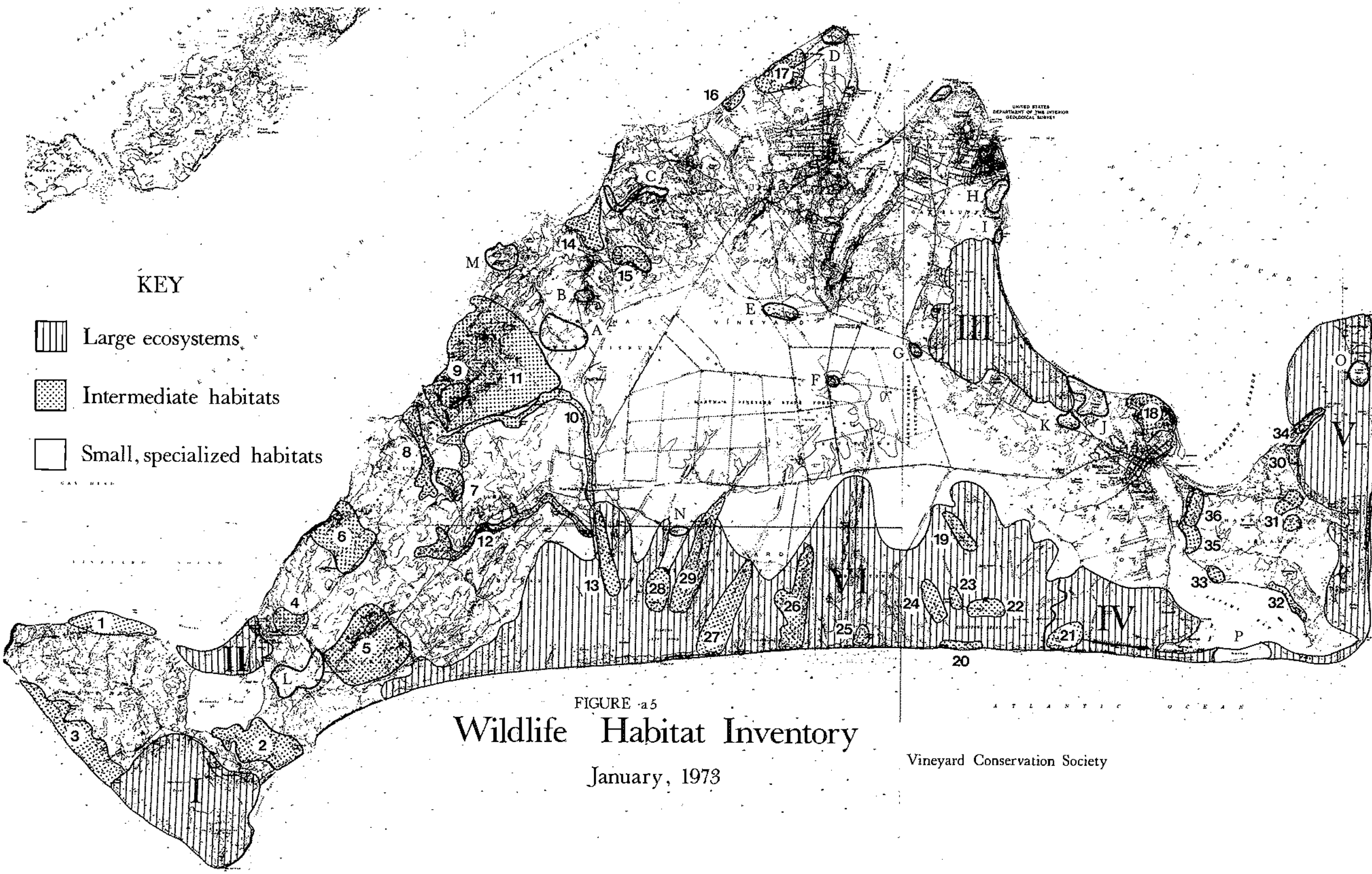


FIGURE a5
Wildlife Habitat Inventory
January, 1973

Vineyard Conservation Society

Appendix 2

Land Use

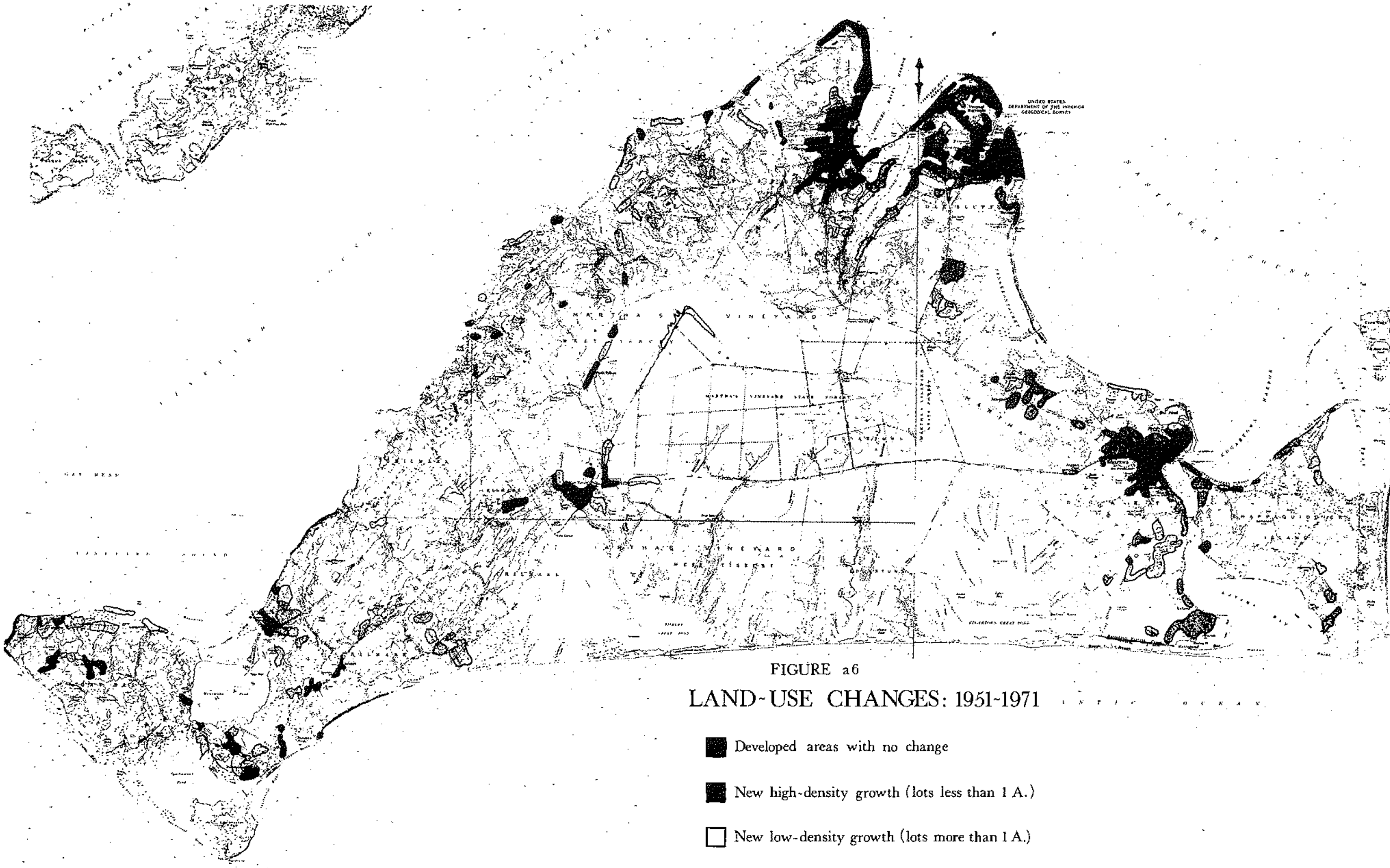


FIGURE a6

LAND-USE CHANGES: 1951-1971

- ■ Developed areas with no change
- ■ New high-density growth (lots less than 1 A.)
- □ New low-density growth (lots more than 1 A.)

source: Mass. CZM
U. of Mass Agric. Exper. Sta.

FOOTNOTES--Table a3

1. Estimates can be increased significantly if current low zoning densities are raised by voluntary or court-order amendments, and if existing subdivided lots and properties that are smaller than Zoning Minimums and exempted from them are added into the calculations.

2. District Areas divided by Minimum Lot Sizes; includes both Seasonal and Year-Round Dwellings.

3. Maximum Total Dwelling Units x3.5 People/Dwelling Unit (1970 National Average). These numbers can be reached as Seasonal Peaks if future Island residents in summer represent whole Country in 1970. Could also be reached as a Permanent Level if dominant activities shift from summer recreation to year-round employment based on intensive resource development (e.g. off-shore oil extraction), and if all houses are winterized.

4. Maximum Total Dwelling Units x 2.0 People/Dwelling Unit/Year (1975 Tisbury Equivalent Permanent Residents' Average Rate of Increase--Balances seasonal occupancy levels; Philip Herr & Associates, "Planning Studies for Tisbury"), or x 2.0 People/Dwelling Unit (Possible Permanent Island Average). A Maximum Average Year-Round Level that assumes continuations of the Island's present economy and estimated summer/winter occupancy levels (but does not indicate seasonal highs or lows under those conditions). Can also be reached as an actual Permanent Level, if Island's dominant character completely shifts from summer family recreation to year-round retirement and all houses are winterized. Seasonal levels could be better estimated if actual studies of Island summer and winter occupancy patterns were projected in relation to sound predictions of socio-economic behavior.

5. Assumes Minimum Lot Size same as R-5 District and no Dwellings at Martha's Vineyard Airport.

6. Includes Business District.

7. Assumes Minimum Lost Size same as R-10 District.

8. Assumes no Residences in any Industrial, Commercial or Business Districts (except Oak Bluffs', which is not distinguished from R-1 on available maps and is probably too small to significantly affect measurements). This allows maximum commercial development.

9. Preserved under State Law.

10. Designated by U.S. Department of Housing and Urban Development under the Federal Flood Protection Insurance Act, which requires that towns regulate land uses (to qualify for Federal Insurance). Such regulations may explicity or implicity prohibit development in these Areas. No map of Areas in Oak Bluffs is available, so its data are not included; but Chilmark (which has not and probably will not participate - - according to its Executive Secretary) is covered. Areas also include most (perhaps all) coastal wetlands, which are simultaneously regulated by some town zoning by-laws and the State Wetlands Acts (through town Conservation Commissions).

TABLE a3

MARTHA'S VINEYARD: LEGAL RESIDENTIAL DEVELOPMENT CAPACITIES[1]

1. GROSS = Maximum use of existing Zoning Districts and allowed Lot sizes without other limitations.

TOWNS	ZONING DISTRICTS	MINIMUM LOT SIZES	DISTRICT AREAS	MAXIMUM TOTAL DWELLING UNITS[2]	MAXIMUM TOTAL POPULATIONS POSSIBILITY 1[3]	POSSIBILITY 2[4]
CHILMARK	A-R IV	1.5 acres	194 acres	129	451	258
	A-R III & V	2 "	2,322 "	1,161	4,064	2,322
	A-R I, II A-B & VI	3 "	9,065 "	3,022	10,577	6,044
Subtotals			11,598 acres	4,312	15,092	8,624
EDGARTOWN	B II[5]	5,000 s.f.	184×10^4 s.f.	369	1,291	738
	R-5	5,000 s.f.	$1,288 \times 10^4$ s.f.	2,576	9,016	4,152
	R-20	20,000 s.f.	$28,420 \times 10^4$ s.f.	14,210	49,735	28,420
	R-60	60,000 s.f.	$6,424 \times 10^4$ s.f.	1,071	3,749	2,142
	R-120 & RA-120	120,000 s.f.	$37,868 \times 10^4$ s.f.	3,156	11,046	6,312
Subtotals			$74,184 \times 10^4$ s.f.	21,382	74,837	42,764
GAY HEAD	R-R	2 acres	3,132 acres	1,566	5,481	3,132
OAK BLUFFS	R-1[6]	.25 acre	803 acres	3,212	11,242	6,424
	R-2	.5 acre	860 "	1,720	6,020	3,440
	R-3	1.5 acre	3,104 "	2,069	7,242	4,138
Subtotals			4,767 acres	7,001	24,504	14,002
TISBURY	B 1 & 2[7]	10,000 s.f.	636×10^4 s.f.	636	2,226	1,272
	R-10	10,000 s.f.	$2,988 \times 10^4$ s.f.	2,988	10,458	5,976
	R-20	20,000 s.f.	$1,600 \times 10^4$ s.f.	800	2,800	1,600
	R-25	25,000 s.f.	$1,484 \times 10^4$ s.f.	594	2,079	1,188
	R-50	50,000 s.f.	$11,824 \times 10^4$ s.f.	2,365	8,278	4,730
Subtotals			$18,532 \times 10^4$ s.f.	7,383	25,841	14,766
WEST TISBURY	Business	1 acre	32 acres	32	112	64
	A-R, A-R 1A-1C	1.5 acres	13,228 "	8,819	30,867	17,638
	A-R2	3 acres	2,454 "	818	2,863	1,636
Subtotals			15,714 acres	9,669	33,842	19,338
ISLAND TOTALS		1.10 acres (Weighted Average)	56,495 acres	51,313	179,597	102,626

Table a3

II. SEQUENTIAL REDUCTIONS

TOWNS	ZONING DISTRICTS	MINIMUM LOT SIZES	DISTRICT AREAS	MAXIMUM TOTAL DWELLING UNITS[2]	MAXIMUM TOTAL POPULATIONS POSSIBILITY 1[3]	POSSIBILITY 2[4]
A. Subtract Business Districts[8]						
Island Subtotals			220 acres	1,037	3,630	2,074
REDUCED ISLAND TOTALS			56,275 acres	50,276	175,967	100,552
B. Subtract State Forest[9]						
WEST TISBURY	A-R	1.5 acres	2,447 acres	1,632	5,712	3,264
EDGARTOWN	R-20	20,000 s.f.	$8,452 \times 10^4$ s.f.	4,226	14,791	8,452
	RA-120	120,000 s.f.	353×10^4 s.f.	29	102	58
Island Subtotals			4,416 acres	5,887	20,605	11,774
REDUCED ISLAND TOTALS			51,859 acres	44,389	155,362	88,778
C. Subtract Federal Flood Hazard Areas[10]						
CHILMARK	A-R IV	1.5 acres	43 acres	29	102	58
	A-R III & V	2 "	20 "	10	35	20
	A-RI, IIA-B & VI	3 "	1,903 "	634	2,219	1,268
Subtotals			1,966 acres	673	2,356	1,346
EDGARTOWN	R-5	5,000 s.f.	660×10^4 s.f.	1,320	4,620	2,640
	R-20	20,000 s.f.	$3,380 \times 10^4$ s.f.	1,690	5,915	3,380
	R-60	60,000 s.f.	$3,588 \times 10^4$ s.f.	598	2,093	1,196
	R-120 & RA-120	120,000 s.f.	$17,200 \times 10^4$ s.f.	1,433	5,016	2,866
Subtotals			$24,828 \times 10^4$ s.f.	5,041	17,644	10,082
GAY HEAD	R-R	2 acres	112 acres	56	196	112

Table a3

II. SEQUENTIAL REDUCTIONS (CONT'D)

TOWNS	ZONING DISTRICTS	MINIMUM LOT SIZES	DISTRICT AREAS	MAXIMUM TOTAL DWELLING UNITS[2]	MAXIMUM TOTAL POPULATIONS POSSIBILITY 1[3]	POSSIBILITY 2[4]
TISBURY	R-10	10,000 s.f.	$88x10^4$s.f.	88	308	176
	R-20	20,000 s.f.	$260x10^4$s.f.	130	455	260
	R-25	25,000 s.f.	$380x10^4$s.f.	152	532	304
	R-50	50,000 s.f.	$2,332x10^4$s.f.	466	1,631	932
Subtotals			$3,060x10^4$s.f.	836	7,026	1,672
WEST TISBURY	A-R, A-R 1B-1C	1.5 acres	238 acres	159	557	318
	A-R2	3 acres	900 acres	300	1,050	600
			1,138 acres	459	1,607	918
Island Subtotals			9,618 acres	7,065	24,729	14,130
REDUCED ISLAND TOTALS		1.13 acres (Weighted Average)	42,241 acres	37,324	130,570	74,648

ISLAND NEIGHBORHOODS

Names as used in the text. Growth is projected for each neighborhood in Figure a9

1. West Tashmoo, Tisbury
2. Mink Meadows, Tisbury
3. West Chop, Tisbury
4. Village Center, Tisbury
5. Lagoon Heights, Tisbury
6. Upper Lagoon, Oak Bluffs
7. Lagoon Heights, Oak Bluffs
8. Village Center, Oak Bluffs
9. Waterview, Oak Bluffs
10. Ocean Heights, Edgartown
11. Eel Pond, Edgartown
12. Village Center, Edgartown
13. Clevelandtown, Edgartown
14. Herring Creek, Edgartown
15. Mattakeset, Edgartown
16. Chappaquiddick-1, Edgartown
17. Chappaquiddick-2, Edgartown
18. Chappaquiddick-3, Edgartown
19. Outwash, Edgartown
20. Outwash, West Tisbury
21. Village, West Tisbury
22. Germantown, West Tisbury
23. Lamberts Cove, West Tisbury
24. North Shore, West Tisbury
25. North Tisbury, West Tisbury
26. North Shore, Chilmark
27. Middle Road East, Chilmark
28. Outwash, Chilmark
29. Middle Road West, Chilmark
30. Nashaquitsa, Chilmark
31. Menemsha, Chilmark
32. Gay Head, Chilmark

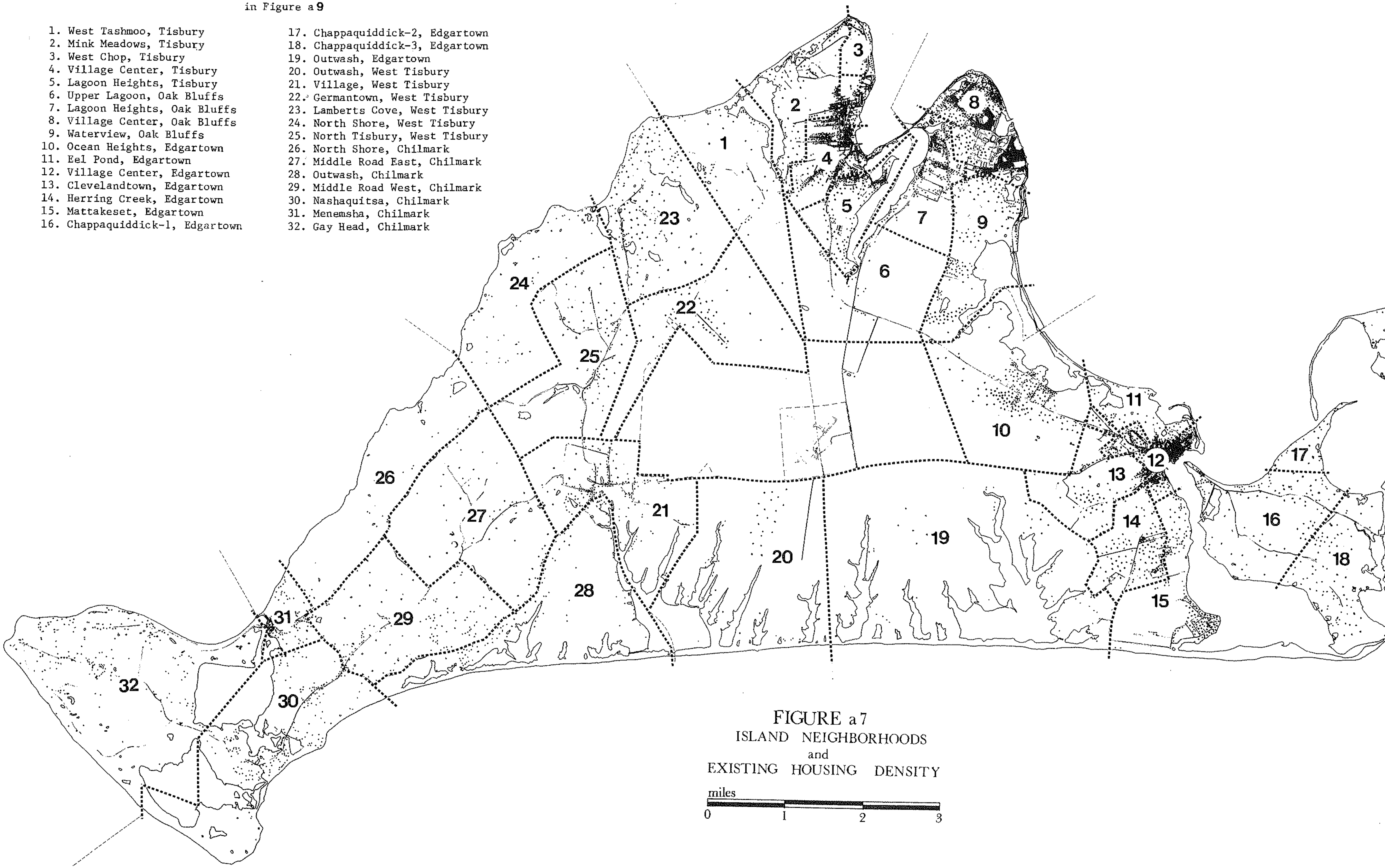


FIGURE a7
ISLAND NEIGHBORHOODS
and
EXISTING HOUSING DENSITY

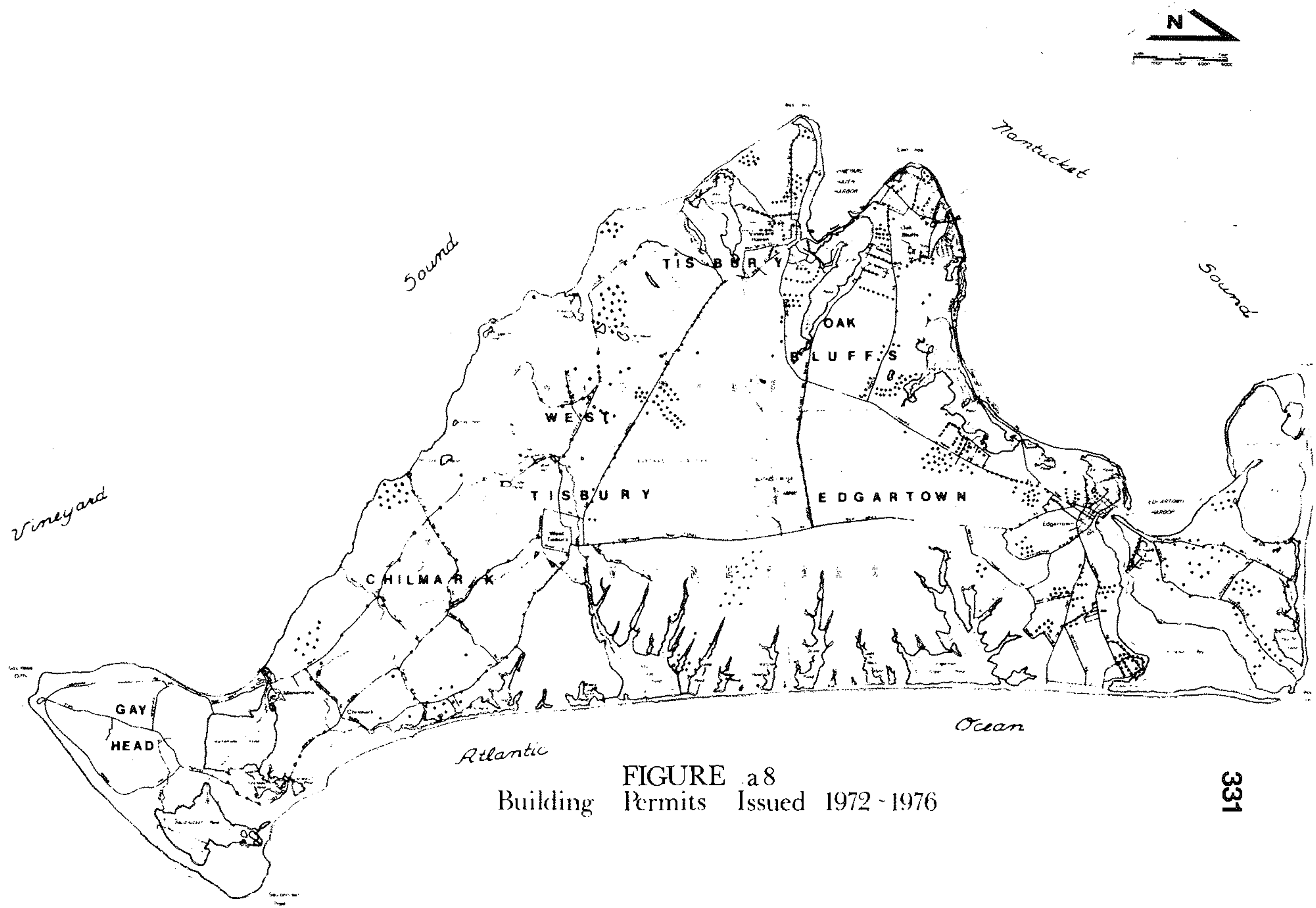


FIGURE a8
Building Permits Issued 1972 - 1976

figure a9

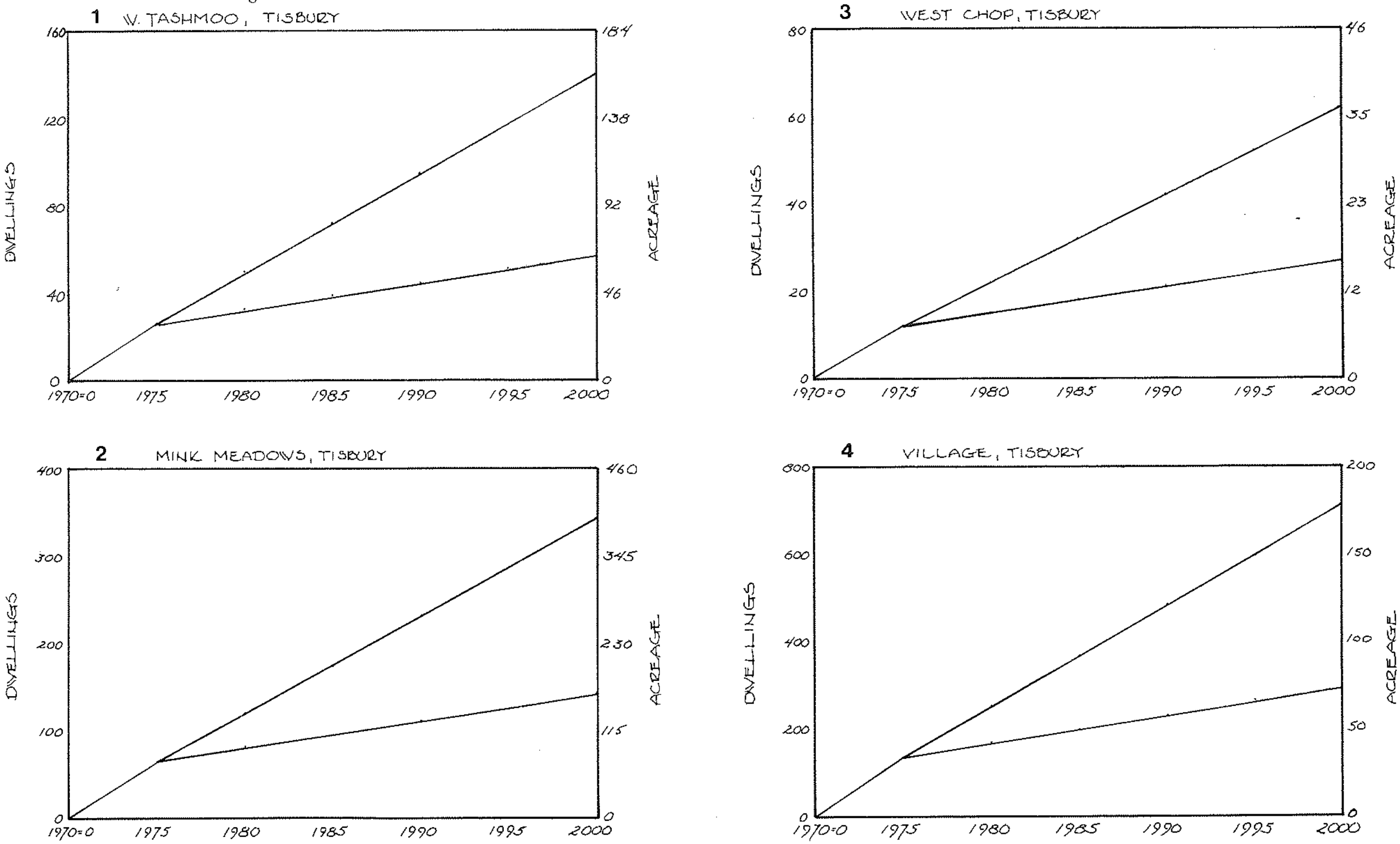
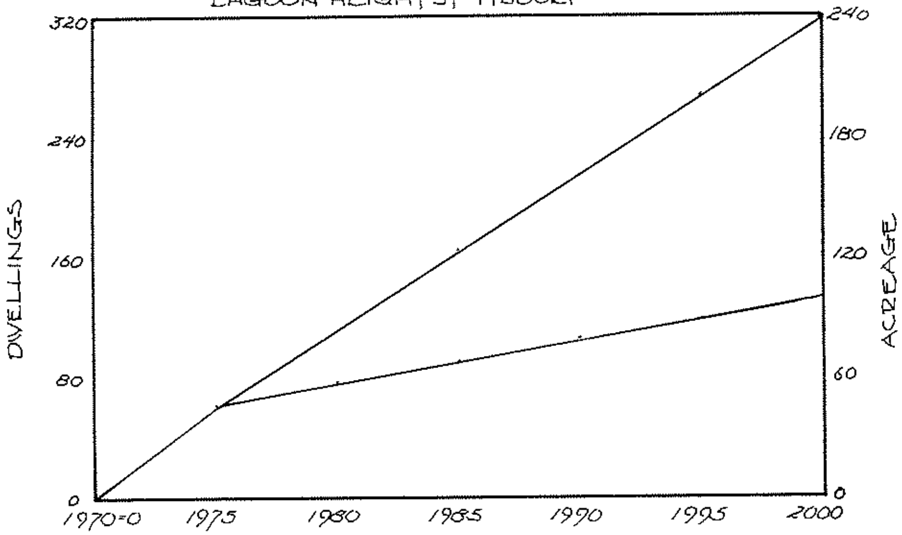

1 W. TASHMOO, TISBURY
DWELLINGS
0
40
80
120
160
ACREAGE
0
46
92
138
184
1970=0
1975
1980
1985
1990
1995
2000
2 MINK MEADOWS, TISBURY
DWELLINGS
0
100
200
300
400
ACREAGE
0
115
230
345
460
3 WEST CHOP, TISBURY
DWELLINGS
0
20
40
60
80
ACREAGE
0
12
23
35
46
4 VILLAGE, TISBURY
DWELLINGS
0
200
400
600
800
ACREAGE
0
50
100
150
200

figure a9

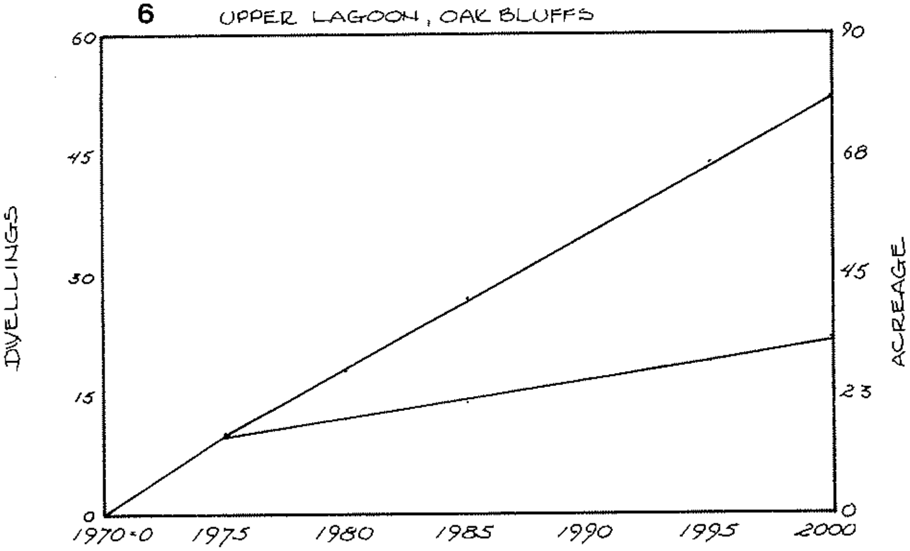
5

LAGOON HEIGHTS, TISBURY



6

UPPER LAGOON, OAK BLUFFS



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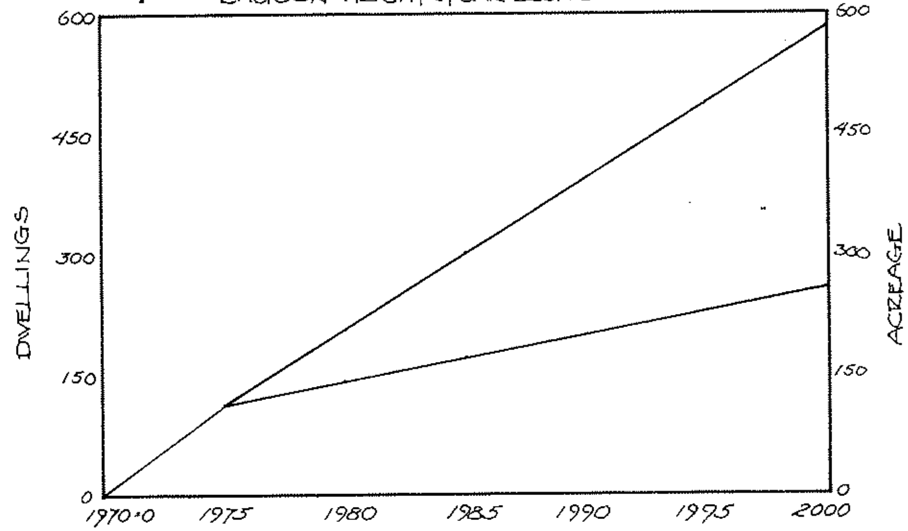
LAGOON HEIGHTS, OAK BLUFFS



8

VILLAGE, OAK BLUFFS

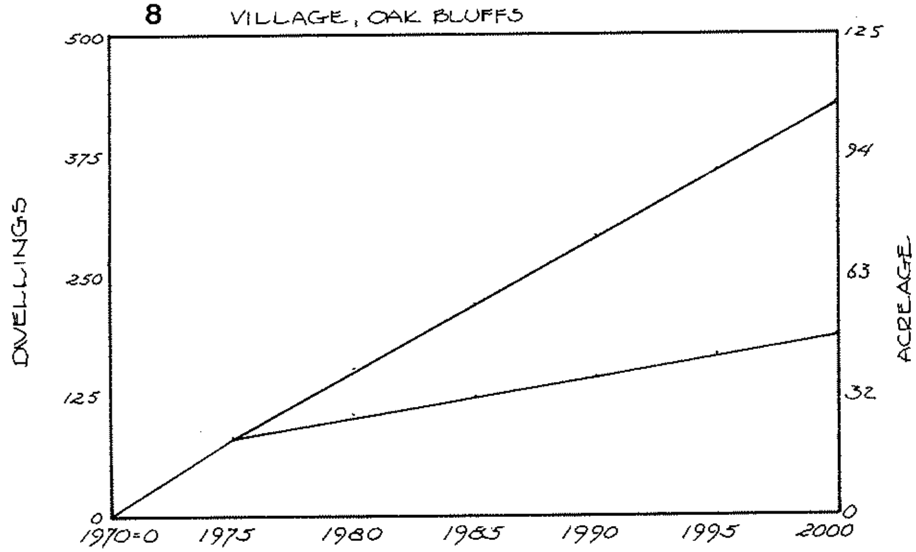
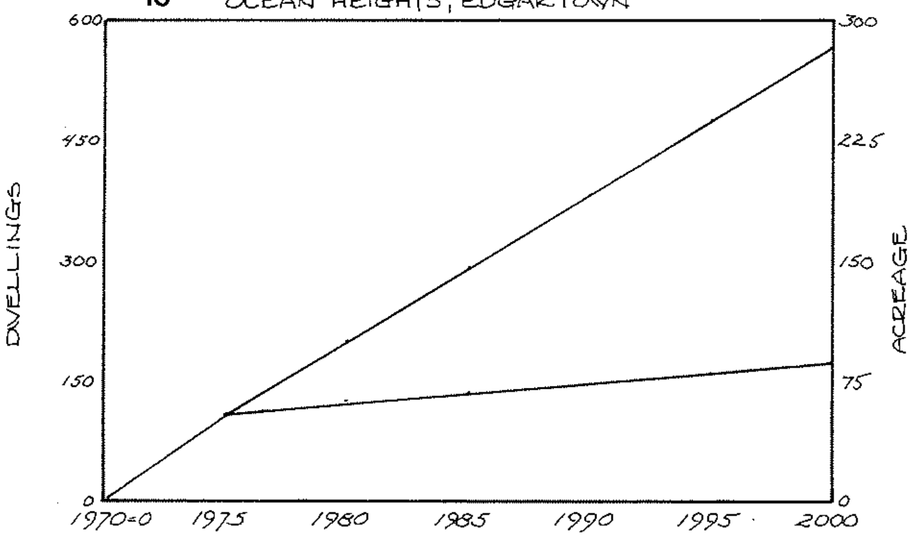


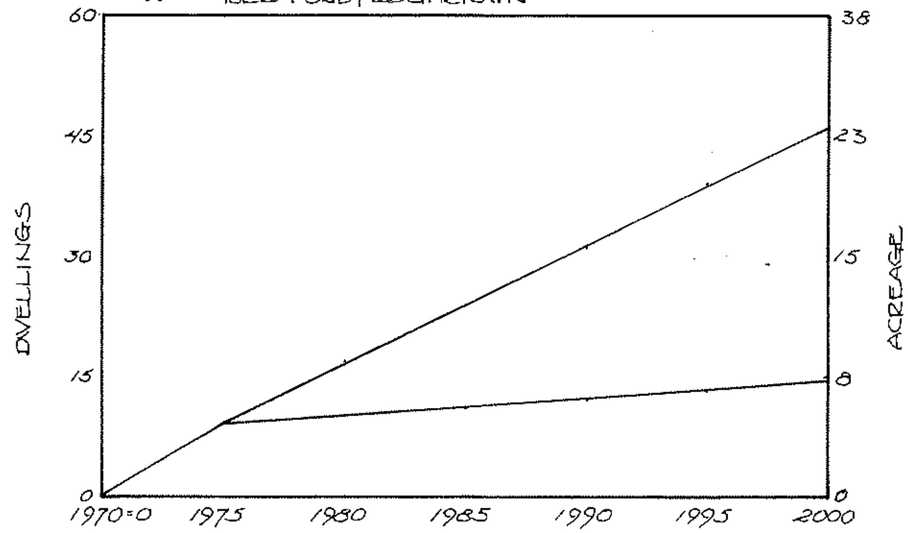
figure a9

9 WATERVIEW, OAK BLUFFS

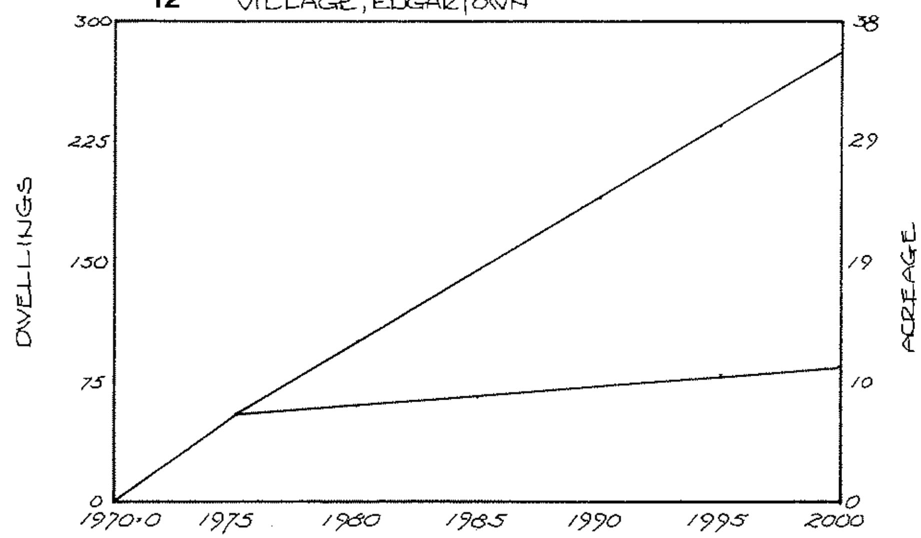
10 OCEAN HEIGHTS, EDGARTOWN



11 EEL POND, EDGARTOWN



12 VILLAGE, EDGARTOWN



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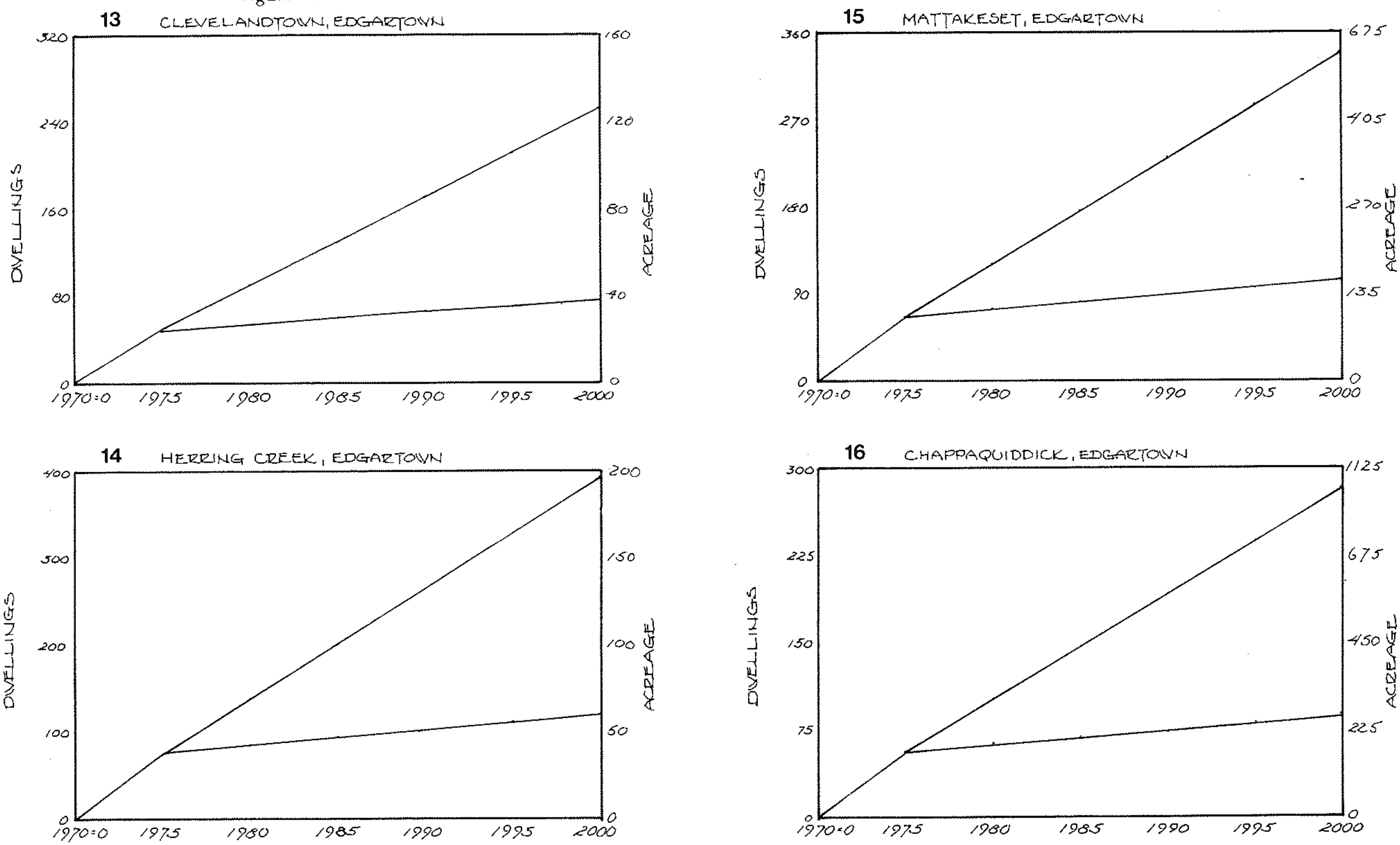

13 CLEVELANDTOWN, EDGARTOWN
DWELLINGS
320
240
160
80
0
ACREAGE
160
120
80
40
0
1970=0
1975
1980
1985
1990
1995
2000
15 MATTAKESET, EDGARTOWN
DWELLINGS
360
270
180
90
0
ACREAGE
675
405
270
135
0
14 HERRING CREEK, EDGARTOWN
DWELLINGS
400
300
200
100
0
ACREAGE
200
150
100
50
0
16 CHAPPAQUIDDICK, EDGARTOWN
DWELLINGS
300
225
150
75
0
ACREAGE
1125
675
450
225
0

figure a9

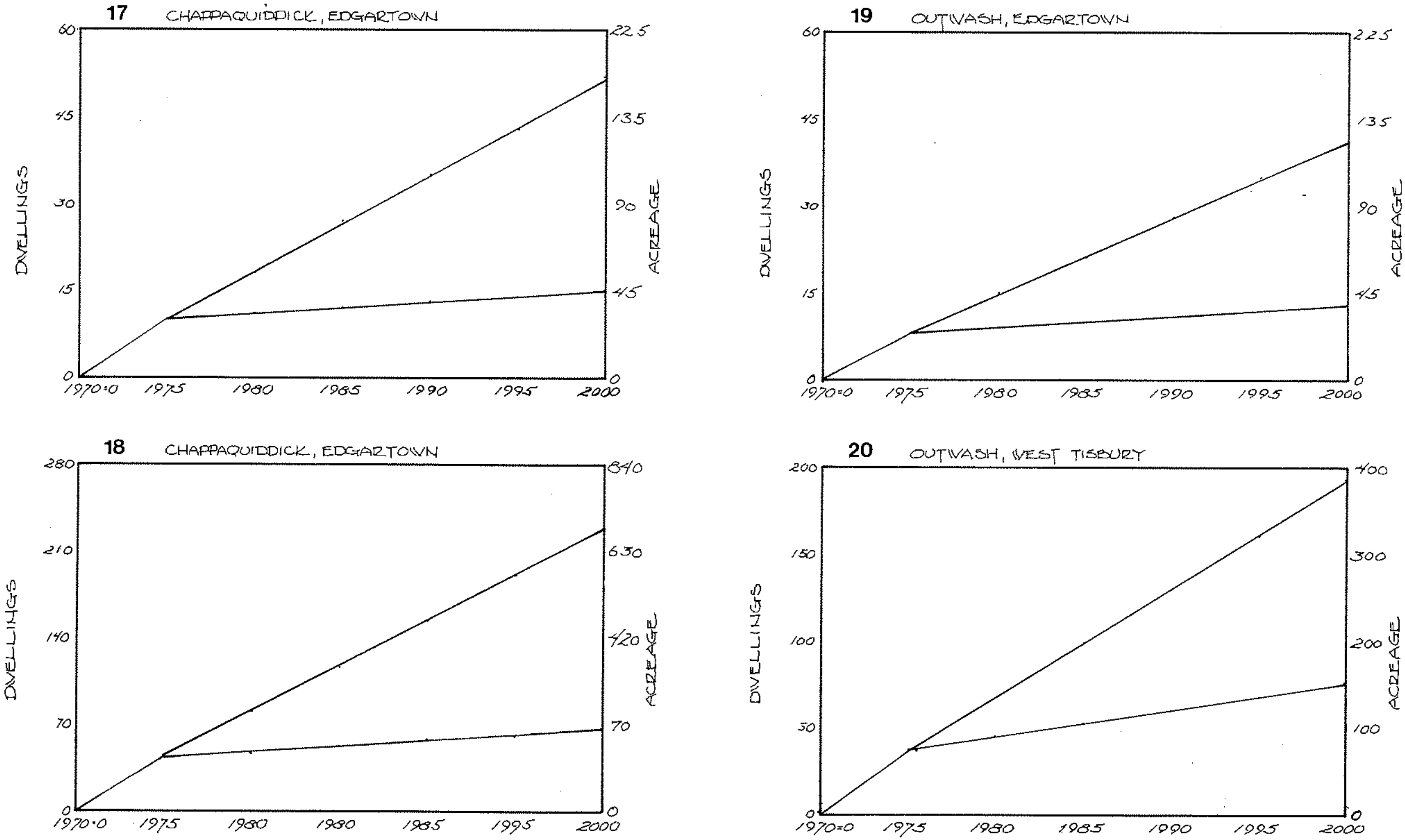
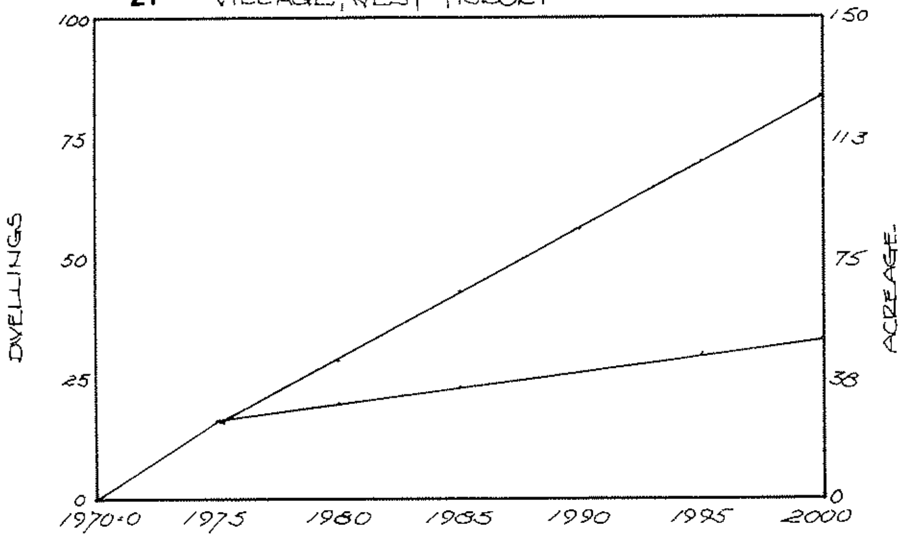
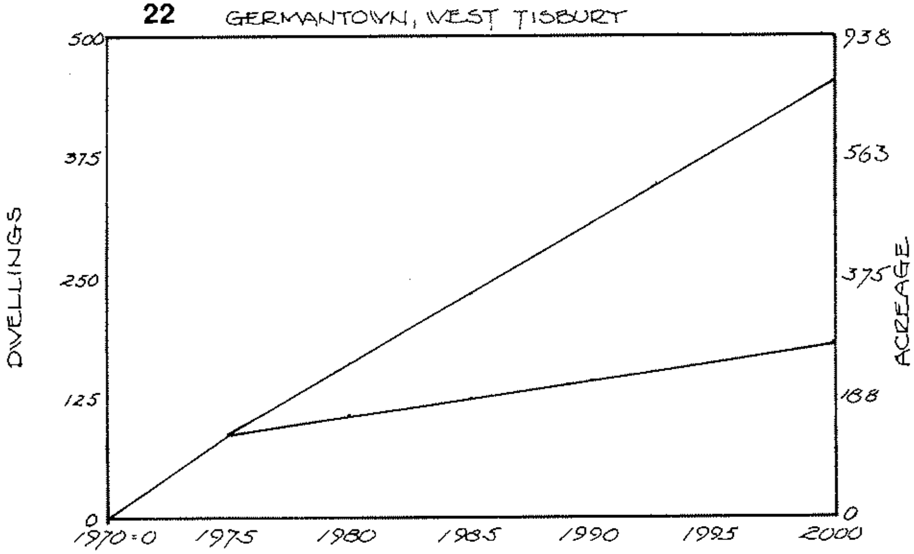

17
CHAPPAQUIDDICK, EDGARTOWN
DWELLINGS
ACREAGE
60
45
30
15
0
22.5
135
90
45
0
1970=0
1975
1980
1965
1990
1995
2000
18
CHAPPAQUIDDICK, EDGARTOWN
DWELLINGS
ACREAGE
280
210
140
70
0
840
630
420
70
0
1970=0
1975
1980
1980
1985
1995
2000
19
OUTWASH, EDGARTOWN
DWELLINGS
ACREAGE
60
45
30
15
0
225
135
90
45
0
1970=0
1975
1980
1985
1990
1995
2000
20
OUTWASH, WEST TISBURY
DWELLINGS
ACREAGE
200
150
100
50
0
400
300
200
100
0
1970=0
1975
1980
1985
1990
1995
2000

figure a9

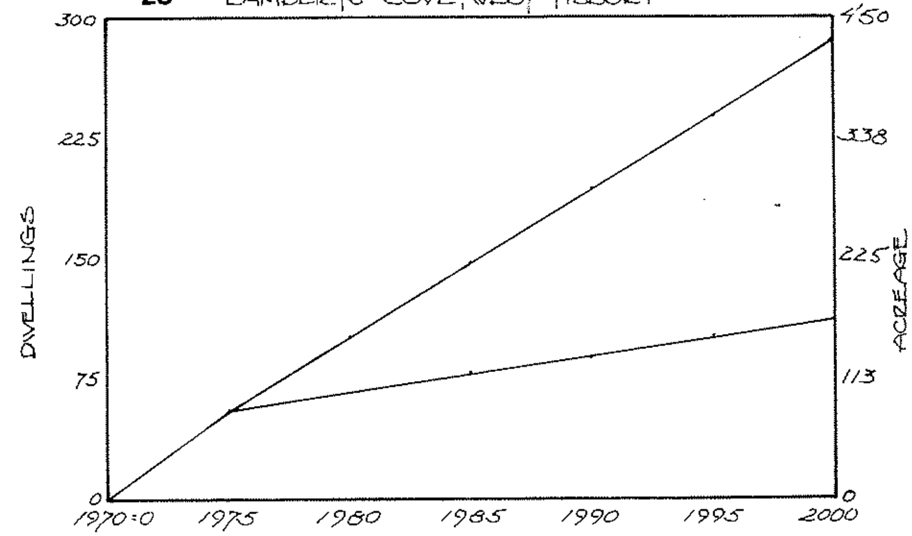
21 VILLAGE, WEST TISBURY



22 GERMANTOWN, WEST TISBURY



23 LAMBERTS COVE, WEST TISBURY



24 NORTH SHORE, WEST TISBURY

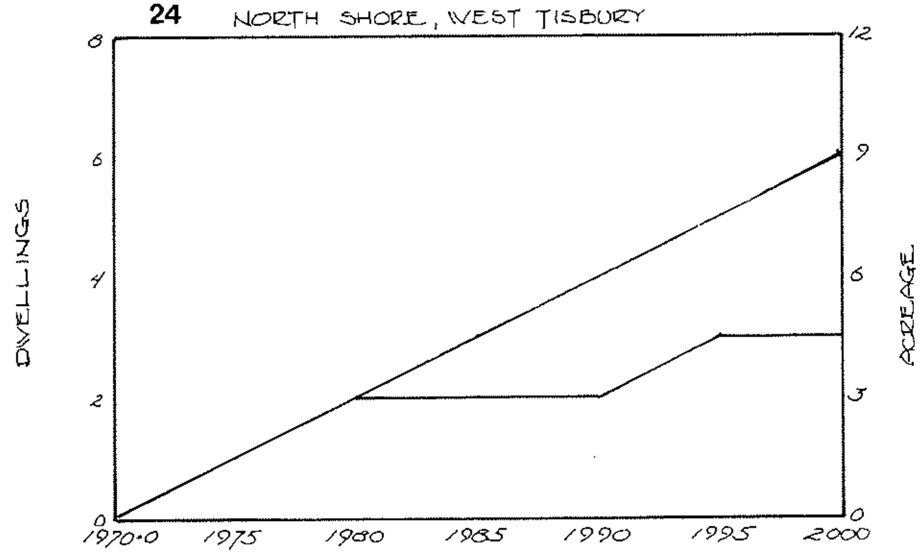
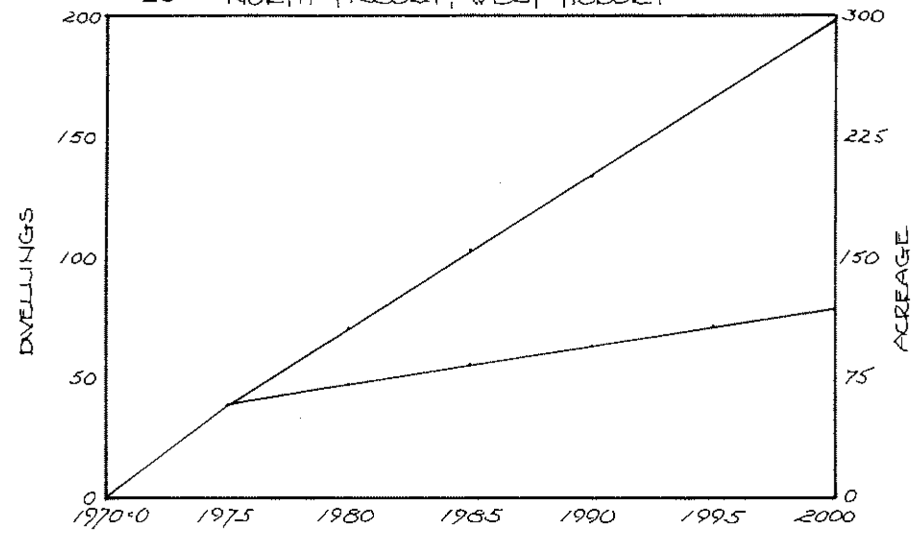
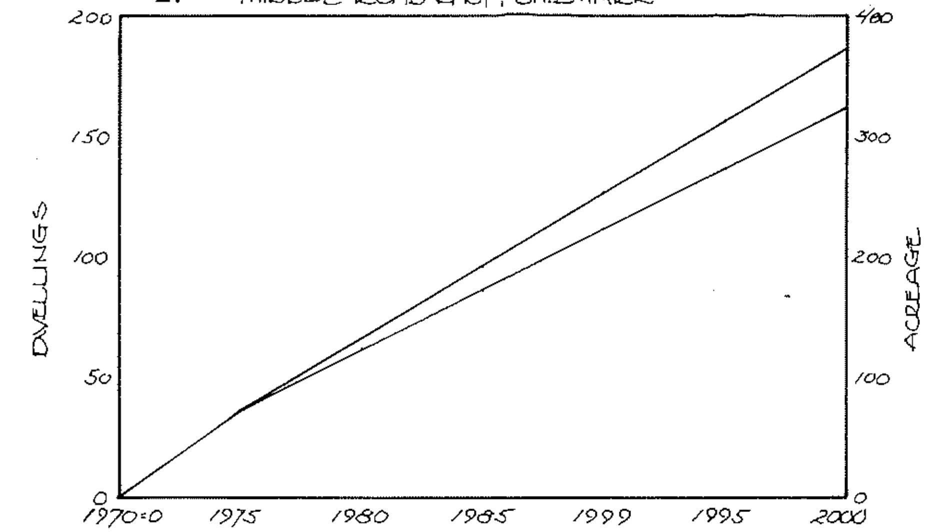


figure a9

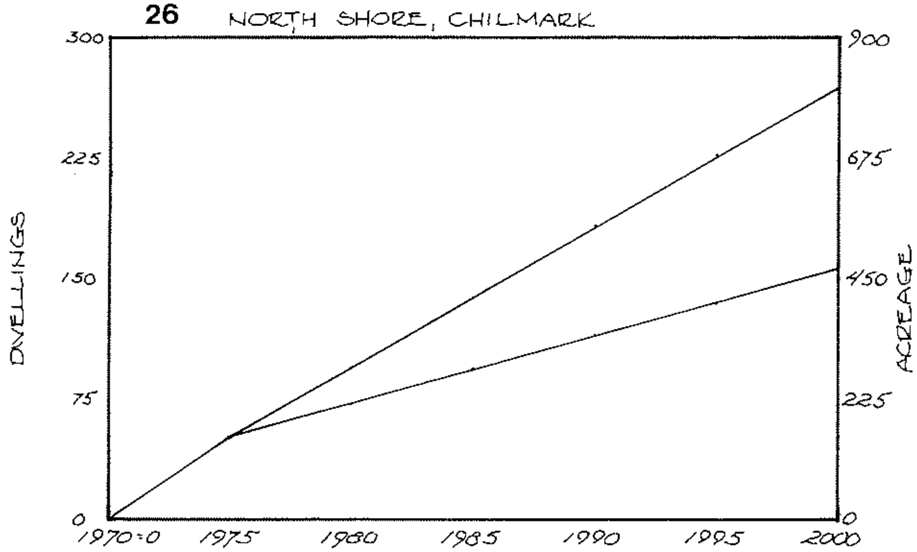
25 NORTH TISBURY, WEST TISBURY



27 MIDDLE ROAD EAST, CHILMARK



26 NORTH SHORE, CHILMARK



28 OUTWASH, CHILMARK

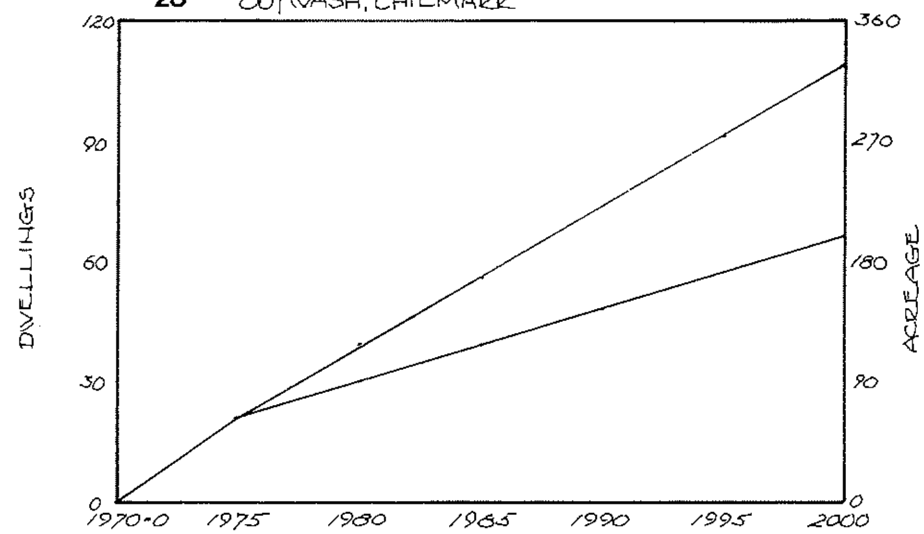
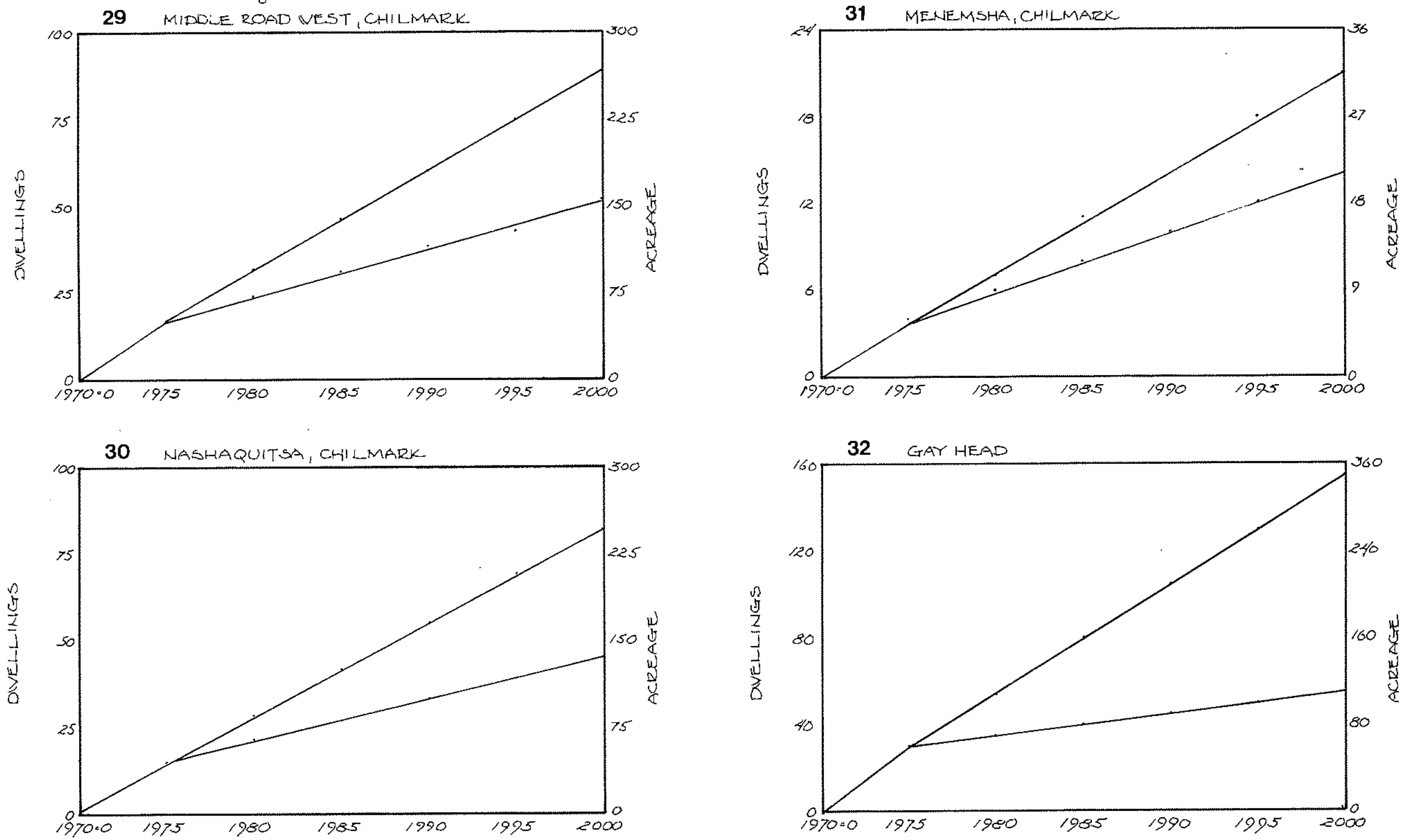


figure a 9


29 MIDDLE ROAD WEST, CHILMARK
DWELLINGS
ACREAGE
0 25 50 75 100
0 75 150 225 300
1970=0 1975 1980 1985 1990 1995 2000
31 MENEMSHA, CHILMARK
DWELLINGS
ACREAGE
0 6 12 18 24
0 9 18 27 36
1970=0 1975 1980 1985 1990 1995 2000
30 NASHAQUITSA, CHILMARK
DWELLINGS
ACREAGE
0 25 50 75 100
0 75 150 225 300
1970=0 1975 1980 1985 1990 1995 2000
32 GAY HEAD
DWELLINGS
ACREAGE
0 40 80 120 160
0 80 160 240 360
1970=0 1975 1980 1985 1990 1995 2000

Appendix 3

Water Quality Samples

TABLE a4

MARTHA'S VINEYARD WATER QUALITY STUDY

CHILMARK GROUNDWATER MONITORING STATIONS

WATER QUALITY DATA (mg/l)

PARAMETER	GC01	GC01	GC01	GC01	GC02	GC02	GC02	GC02
Date of Sample	11/19/75	7/27/76	8/18/76	12/14/76	11/19/75	4/6/76	7/27/76	8/18/76
Time (hours)	1235	1115	1105	1155	1550	1305	1125	1150
pH (Standard Units)	5.8	6.1	5.8	5.6	6.7	5.9	6.3	6.1
Total Alkalinity	6.0	8.0	8.0	5.0	20	8.0	7.0	11
Suspended Solids	0.5	0.5	2.5	0.0	1.5	0.5	1.0	1.5
Total Solids	50	62	44	46	158	100	112	80
Ammonia-Nitrogen	0.00	0.22	0.15	0.01	0.07	0.01	0.00	0.00
Nitrate-Nitrogen	1.4	1.9	1.6	0.0	0.5	1.5	2.3	2.3
Total Phosphorus	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.01
MBAS	0.00	0.00	0.01	0.03	0.00	0.03	0.03	0.01
Chloride	12	12	13	17	55	44	26	25
Specific Conductance (micromhos/cm)	86	100	108	125	300	190	150	155
Total Iron	0.30	0.12	1.7	0.15	0.70	0.03	0.13	0.15
Total Manganese	0.03	0.05	0.03	0.00	0.10	0.50	0.05	0.02
Total Coliform/100 ml	3.6	<10	0	0	3.6	0	<10	0
Fecal Coliform/100 ml	3.6	<5	0	0	3.6	-	<5	0

TABLE a4 (CONTINUED)

PARAMETER	GC03	GC03	GC03	GC03	GC04	GC05	GC06	GC06
Date of Sample	11/19/75	4/6/76	7/27/76	12/14/76	4/6/76	4/6/76	7/27/76	8/18/76
Time (hours)	1325	1255	1135	1005	1145	1045	1100	1115
pH (Standard Units)	5.4	5.6	5.7	7.8	7.3	6.3	6.8	5.4
Total Alkalinity	5.0	12	5.0	130	79	13	18	3.0
Suspended Solids	0.5	0.5	1.0	0.0	0.5	2.0	24	0.5
Total Solids	116	84	90	86	210	90	350	110
Ammonia-Nitrogen	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00
Nitrate-Nitrogen	0.2	0.6	0.6	0.00	1.9	0.0	0.1	0.1
Total Phosphorus	0.00	0.01	0.01	0.00	0.04	0.33	0.06	0.02
MBAS	0.05	0.03	0.03	0.03	0.01	0.00	0.03	0.01
Chloride	27	26	27	29	31	14	44	49
Specific Conductance (micromhos/cm)	360	140	270	140	370	137	200	190
Total Iron	0.06	0.05	0.07	0.15	0.35	0.90	0.85	0.05
Total Manganese	0.05	0.03	0.05	0.02	0.00	0.05	0.03	0.05
Total Coliform/100 ml	3.6	0	<10	0	0	0	<10	0
Fecal Coliform/100 ml	3.6	-	<5	0	-	-	<5	0

TABLE a4

MARTHA'S VINEYARD WATER QUALITY STUDY

GAY HEAD GROUNDWATER MONITORING STATIONS

WATER QUALITY DATA (mg/1)

PARAMETER	GG01	GG01	GG01	GG01	GG02	GG02	GG02
Date of Sample	11/19/75	4/6/76	7/27/76	8/17/76	11/19/75	7/27/76	8/17/76
Time (hours)	1155	1215	1230	1305	1140	1215	1315
pH (Standard Units)	6.5	6.9	6.7	6.8	5.9	6.2	6.4
Total Alkalinity	34	35	38	34	7.0	18	16
Suspended Solids	0.5	0.5	3.0	1.5	11	24	11
Total Solids	110	98	116	110	78	90	120
Ammonia-Nitrogen	0.00	0.04	0.00	0.00	0.23	0.46	0.34
Nitrate-Nitrogen	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Total Phosphorus	0.75	0.65	0.90	0.95	0.12	0.03	0.11
MBAS	0.02	0.00	0.03	0.00	0.00	0.05	0.03
Chloride	24	22	21	22	22	18	19
Specific Conductance (micromhos/cm)	150	200	170	210	100	100	1600
Total Iron	0.05	0.12	0.25	0.10	10	16	14
Total Manganese	0.33	0.27	0.35	0.36	0.08	0.08	0.10
Total Coliform/100 ml	3.6	0	<10	40	23	<10	<10
Fecal Coliform/100 ml	3.6	-	<5	<5	3.6	<5	<5
Sulfate	-	-	-	15	-	-	1.0

TABLE a4 (CONTINUED)

PARAMETER	GG03	GG03	GG03	GG03	GG04	GG04	GG05
Date of Sample	11/19/75	4/6/76	7/27/76	8/17/76	7/27/76	8/18/76	8/17/76
Time (hours)	1125	1225	1150	1245	1200	1255	1340
pH (Standard Units)	6.1	6.7	6.3	6.9	6.9	6.7	6.7
Total Alkalinity	17	28	13	12	36	23	14
Suspended Solids	0.5	0.5	0.5	3.5	2.0	2.0	2.5
Total Solids	90	88	84	64	116	90	74
Ammonia-Nitrogen	0.16	0.02	0.04	0.08	0.06	0.13	0.00
Nitrate-Nitrogen	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Total Phosphorus	0.06	0.03	0.02	0.04	0.07	0.08	0.01
MBAS	0.00	0.00	0.06	0.01	0.07	0.02	0.00
Chloride	22	23	19	19	22	21	18
Specific Conductance (micromhos/cm)	100	146	96	340	140	130	1600
Total Iron	2.5	0.55	0.80	1.0	0.60	1.8	0.17
Total Manganese	0.13	0.00	0.02	0.02	0.05	0.05	0.00
Total Coliform/100 ml	23	0	<10	5	<10	10	<10
Fecal Coliform/100 ml	3.6	-	<10	<5	<5	<5	<10
Sulfate	-	-	-	3.0	-	2.0	-

TABLE a4

MARTHA'S VINEYARD WATER QUALITY STUDY

WEST TISBURY GROUNDWATER MONITORING STATIONS

WATER QUALITY DATA (mg/1)

PARAMETER	GW01	GW02	GW02	GW03	GW03	GW04	GW04	GW04
Date of Sample	11/19/75	11/19/75	4/6/76	11/17/75	4/6/76	11/17/75	4/6/76	7/27/76
Time (hours)	1630	1615	0955	1615	1015	1605	1005	1045
pH (Standard Units)	5.9	5.9	6.0	5.6	6.2	5.6	6.1	6.1
Total Alkalinity	5.0	5.0	5.0	7.0	9.0	6.0	8.0	9.0
Suspended Solids	0.5	0.5	1.2	0.5	0.4	0.5	0.8	1.0
Total Solids	28	50	32	32	24	34	14	70
Ammonia-Nitrogen	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00
Nitrate-Nitrogen	0.7	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Total Phosphorus	0.02	0.01	0.01	0.01	0.00	0.00	0.01	0.00
MBAS	0.04	0.02	0.00	0.21	0.00	0.03	0.00	0.03
Chloride	10	11	11	13	12	12	10	7.0
Specific Conductance (micromhos/cm)	52	122	67	66	76	64	66	64
Total Iron	0.15	0.10	0.05	0.10	0.10	0.05	0.10	0.09
Total Manganese	0.03	0.03	0.03	0.04	0.05	0.04	0.03	0.02
Total Coliform/100 ml	-	3.6	0	3.6	0	3.6	0	<10
Fecal Coliform/100 ml	-	3.6	-	3.6	-	3.6	-	<5

TABLE a4 (CONTINUED)

PARAMETER	GW07	GW08	GW09	GW10	GW11	GW12	GW13
Date of Sample	7/27/76	4/6/76	7/27/76	7/27/76	12/14/76	12/14/76	12/14/76
Time (hours)	1010	1020	1030	1345	1010	1050	1150
pH (Standard Units)	6.6	6.2	6.4	9.9	6.2	9.2	7.3
Total Alkalinity	15	10	9.0	48	7.0	39	7.0
Suspended Solids	18	0.4	3.0	2.5	0.0	0.5	0.0
Total Solids	112	50	72	100	34	60	118
Ammonia-Nitrogen	0.00	0.00	0.00	0.02	0.01	0.00	0.00
Nitrate-Nitrogen	0.0	1.8	0.1	0.0	0.0	0.0	0.0
Total Phosphorus	0.43	0.02	0.01	0.01	0.11	0.01	0.01
MBAS	0.02	0.01	0.02	0.01	0.01	0.01	0.02
Chloride	11	15	11	12	12	12	24
Specific Conductance (micromhos/cm)	98	106	68	140	80	120	140
Total Iron	5.0	0.04	39	0.05	0.05	0.00	0.00
Total Manganese	0.15	0.05	0.09	0.06	0.00	0.00	0.00
Total Coliform/100 ml	<5	0	<10	<10	0	0	0
Fecal Coliform/100 ml	<5	-	<5	<5	0	0	0
phth Alkalinity	-	-	-	-	-	5.0	-

TABLE a4

MARTHA'S VINEYARD WATER QUALITY STUDY

OAK BLUFFS GROUNDWATER MONITORING STATIONS

WATER QUALITY DATA (mg/1)

PARAMETER	G001	G001	G002	G002	G 02	G 02	G 03	G003	G003
Date of Sample	11/18/75	4/7/76	11/17/75	4/7/76	7/27/76	8/18/76	11/17/75	4/7/76	7/27/76
Time (hours)	0945	1345	1215	1105	0900	1010	1220	1100	0900
pH (Standard Units)	5.9	6.2	6.0	6.2	6.2	6.8	5.6	6.0	6.0
Total Alkalinity	12	11	7.0	11	13	12	6.0	7.0	7.0
Suspended Solids	0.5	1.2	0.5	0.4	0.5	0.5	2.0	0.8	1.0
Total Solids	118	34	98	48	86	34	50	62	32
Ammonia-Nitrogen	0.28	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00
Nitrate-Nitrogen	0.7	0.6	0.9	1.2	1.1	1.2	1.7	4.9	2.4
Total Phosphorus	0.00	0.02	0.00	0.04	0.01	0.01	0.01	0.02	0.01
MBAS	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.00	0.02
Chloride	12	13	11	17	12	8.0	13	15	12
Specific Conductance (micromhos/cm)	230	73	220	97	100	100	94	106	92
Total Iron	0.07	0.20	0.05	0.27	0.00	0.02	0.15	0.09	0.11
Total Manganese	0.00	0.03	0.02	0.08	0.02	0.01	0.06	0.03	0.05
Total Coliform/100 ml	3.6	0	3.6	0	<10	0	3.6	0	<10
Fecal Coliform/100 ml	3.6	-	3.6	-	<5	0	3.6	-	<5

TABLE a4 (CONTINUED)

PARAMETER	G003	G003	G004	G004	G004	G004	G005	G006
Date of Sample	8/18/76	12/14/76	11/17/75	4/7/76	7/27/76	8/18/76	8/18/76	12/14/76
Time (hours)	1005	1315	1235	1115	0915	1015	1700	1400
pH (Standard Units)	7.0	6.5	5.8	6.2	6.2	6.9	6.8	5.8
Total Alkalinity	7.0	10	6.0	8.0	7.0	8.0	11	6.0
Suspended Solids	1.0	1.5	1.0	0.8	1.0	2.0	1.0	0.0
Total Solids	38	62	46	52	82	34	64	34
Ammonia-Nitrogen	0.10	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Nitrate-Nitrogen	1.7	0.0	1.3	5.7	1.5	1.3	0.3	0.0
Total Phosphorus	0.01	0.01	0.00	0.01	0.01	0.03	0.02	0.01
MBAS	0.05	0.01	0.05	0.01	0.01	0.02	0.01	0.01
Chloride	10	15	10	8.0	11	7.0	22	12
Specific Conductance (micromhos/cm)	100	110	86	94	92	100	120	66
Total Iron	0.19	0.10	0.22	0.14	0.14	0.58	0.45	0.03
Total Manganese	0.03	0.04	0.03	0.03	0.02	0.01	0.03	0.00
Total Coliform/100 ml	0	<5	3.6	0	<10	0	0	0
Fecal Coliform/100 ml	0	<5	3.6	–	<5	0	0	0

TABLE a4

MARTHA'S VINEYARD WATER QUALITY STUDY

EDGARTOWN GROUNDWATER MONITORING STATIONS

WATER QUALITY DATA (mg/l)

PARAMETER	GE01	GE02	GE03	GE04	GE05	GE05	GE05	GE05	GE05
Date of Sample	8/14/75	8/14/75	8/14/75	11/17/75	11/17/75	4/7/76	7/27/76	8/18/76	12/13/76
Time (hours)	1200	1200	1300	1445	1415	1450	1415	1455	1115
pH (Standard Units)	6.2	6.6	6.0	6.1	6.0	6.8	6.3	6.3	6.9
Total Alkalinity	12	18	5.0	10	7.0	13	6.0	8.0	11
Suspended Solids	0.5	2.0	1.5	4.0	1.5	1.2	0.5	0.5	0.5
Total Solids	368	140	220	46	78	80	134	176	148
Ammonia-Nitrogen	0.33	0.88	0.00	0.00	0.05	0.08	0.00	0.20	0.04
Nitrate-Nitrogen	1.0	2.0	3.2	0.0	5.5	7.4	2.5	2.5	5.2
Total Phosphorus	0.01	0.04	0.02	0.00	0.00	0.01	0.01	0.00	0.00
MBAS	-	-	-	0.03	0.09	0.00	0.00	0.06	0.00
Chloride	30	28	60	16	19	17	57	52	18
Specific Conductance (micromhos/cm)	350	176	245	80	122	120	230	240	180
Total Iron	0.05	0.50	0.10	1.0	0.70	0.15	0.00	0.05	0.06
Total Manganese	-	-	-	0.05	0.05	0.08	0.02	0.01	0.03
Total Coliform/100 ml	-	-	-	3.6	3.6	0	<10	0	-
Fecal Coliform/100 ml	-	-	-	3.6	3.6	-	<5	0	-

TABLE a4 (CONTINUED)

PARAMETER	GE06	GE06	GE07	GE08	GE08	GE08	GE08	GE09
Date of Sample	11/17/75	4/7/76	11/17/75	11/17/75	7/27/76	8/18/76	12/13/76	11/17/75
Time (hours)	1425	1455	1355	1400	1440	1445	1125	1250
pH (Standard Units)	5.9	6.7	5.7	5.6	6.6	6.1	6.7	6.1
Total Alkalinity	8.0	15	5.0	10	17	11	8.0	18
Suspended Solids	1.5	0.8	0.5	0.5	0.5	1.0	3.0	1.0
Total Solids	54	54	52	86	110	74	70	190
Ammonia-Nitrogen	0.00	0.01	0.00	0.00	0.09	0.03	0.04	0.06
Nitrate-Nitrogen	0.6	1.0	1.8	4.8	4.7	2.2	2.4	1.0
Total Phosphorus	0.00	0.00	0.02	0.01	0.02	0.02	0.01	0.01
MBAS	0.07	0.01	0.12	0.06	0.04	0.05	0.00	0.04
Chloride	15	17	15	17	15	10	15	18
Specific Conductance (micromhos/cm)	88	100	86	138	150	130	115	340
Total Iron	0.10	0.13	0.05	0.05	0.10	0.20	0.10	0.05
Total Manganese	0.01	0.02	0.00	0.01	0.02	0.01	0.03	0.03
Total Coliform/100 ml	3.6	0	3.6	3.6	<10	0	-	3.6
Fecal Coliform/100 ml	3.6	0	3.6	3.6	<5	0	-	3.6

TABLE a4 (CONTINUED)

PARAMETER	GE12	GE13	GE14	GE15	GE16	GE16	GE17	GE17
Date of Sample	12/13/76	4/21/76	4/21/76	4/21/76	7/27/76	8/18/76	7/27/76	8/18/76
Time (hours)	1100	1245	1300	1300	1500	1450	1520	1420
pH (Standard Units)	7.6	6.0	6.5	6.0	6.6	6.3	6.7	6.5
Total Alkalinity	8.0	6.0	9.0	9.0	75	68	55	55
Suspended Solids	0.5	0.5	2.5	0.5	0.5	0.5	1.0	0.5
Total Solids	72	54	66	72	242	222	138	146
Ammonia-Nitrogen	0.00	0.00	0.09	0.02	8.8	7.1	7.8	4.1
Nitrate-Nitrogen	0.8	1.3	1.0	2.6	7.5	6.1	2.0	1.9
Total Phosphorus	0.00	0.00	0.01	0.01	0.07	0.08	0.03	0.02
MBAS	0.00	0.00	0.00	0.00	0.13	0.09	0.13	0.11
Chloride	22	25	28	23	41	38	21	19
Specific Conductance (micromhos/cm)	140	117	128	136	380	320	210	215
Total Iron	0.03	0.10	0.80	0.10	0.18	0.10	0.04	0.05
Total Manganese	0.03	0.00	0.07	0.00	0.50	0.50	0.37	0.33
Total Coliform/100 ml	<5	0	0	0	<10	0	<10	0
Fecal Coliform/100 ml	<5	-	-	-	<5	0	<5	0

TABLE a4 (CONTINUED)

PARAMETER	GE09	GE09	GE10	GE11	GE11	GE12	GE12	GE12
Date of Sample	8/18/76	12/13/76	2/17/76	2/17/76	4/7/76	4/21/76	7/27/76	8/18/76
Time (hours)	1405	1035	1545	1615	1430	1230	1400	1505
pH (Standard Units)	6.6	8.0	6.1	6.4	6.9	6.0	6.3	6.0
Total Alkalinity	17	23	24	10	15	8.0	8.0	7.0
Suspended Solids	0.5	1.0	1.0	1.0	2.4	0.5	1.0	0.5
Total Solids	96	144	100	50	38	88	84	62
Ammonia-Nitrogen	0.00	0.00	0.01	0.01	0.00	0.00	0.04	0.00
Nitrate-Nitrogen	2.0	11	1.4	0.2	0.1	5.1	0.3	0.5
Total Phosphorus	0.00	0.00	0.01	0.00	0.02	0.01	0.01	0.00
MBAS	0.16	0.00	0.05	0.01	0.02	0.03	0.00	0.03
Chloride	17	24	15	14	11	26	22	20
Specific Conductance (micromhos/cm)	150	190	160	70	69	148	120	130
Total Iron	0.05	0.05	0.15	0.25	0.15	0.05	0.05	0.05
Total Manganese	0.01	0.07	-	-	0.03	0.10	0.06	0.03
Total Coliform/100 ml	160	-	0	0	0	0	<10	0
Fecal Coliform/100 ml	0	-	-	-	-	-	<5	0

Table a5 Martha's Vineyard Water Quality Study Experimental Groundwater Monitoring Water Quality Data (mg/l)

Parameter	EW01	EW01	EW02	EW02	EW02	EW03
Date of Sample	2/17/76	8/18/76	2/17/76	8/17/76	12/13/76	8/18/76
Time (hours)	1545	1520	1530	1630	1530	1545
pH (Standard Units)	6.4	6.8	6.8	6.2	6.4	7.8
Total Alkalinity	230	58	39	74	93	88
Suspended Solids	2,900	0.5	500	188	428	-
Total Solids	3,200	150	545	306	680	-
Ammonia-Nitrogen	0.03	0.06	1.0	0.20	0.04	0.07
Nitrate-Nitrogen	0.1	0.2	2.5	0.5	0.0	0.0
Total Phosphorus	-	0.18	-	0.11	0.02	0.15
MBAS	-	-	-	-	0.11	-
Chloride	23	9.0	17	20	20	-
Specific Conductance (micromhos/cm)	400	165	14	1,700	380	-
Iron	300	0.72	30	170	200	-
Manganese	1.5	0.90	0.45	0.75	1.0	-
Copper	0.15	-	0.08	-	-	-
Lead	0.25	-	0.10	-	-	-
Zinc	100	-	25	-	-	-

Parameter	EW03	EW04	EW04	EW04	EW05
Date of Sample	12/13/76	2/17/76	8/17/76	12/13/76	8/17/76
Time (hours)	-	1435	1615	1545	1530
pH (Standard Units)	7.0	6.7	6.8	6.4	6.7
Total Alkalinity	97	77	95	7.0	43
Suspended Solids	314	1,750	1,232	43,230	408
Total Solids	406	1,800	1,380	46,960	680
Ammonia-Nitrogen	0.04	0.75	0.20	0.13	0.50
Nitrate-Nitrogen	0.3	0.8	0.5	0.5	29
Total Phosphorus	0.06	-	0.82	0.01	0.11
MBAS	0.22	-	-	0.18	-
Chloride	10	9.0	8.0	13	27
Specific Conductance (micromhos/cm)	145	170	330	5,700	700
Iron	3.0	100	160	3,500	300
Manganese	0.25	1.0	2.5	13	0.50
Copper	-	0.10	-	-	-
Lead	-	0.30	-	-	-
Zinc	-	50	-	-	-

TABLE a6

1976 Martha's Vineyard Water Quality Study

Wastewater Discharge Pipe - Oak Bluffs Harbor

Date: 8/17/76

Time: 0940 hrs. (grab sample)

Parameter	Concentration (mg/l)
BOD_5	4.0
pH (std. units)	7.9
Total alkalinity	109
Suspended solids	4.0
Total solids	32,060
Chlorides	17,250
NH_3-N	0.26
NO_3-N	0.0
Total P	0.11
Total coliform/100 ml.	150
Fecal coliform/100 ml.	20
Spec. cond. (µmhos/cm)	37,000
Iron	0.20
Manganese	0.03
MBAS	0.02

Table a7

WASTEWATER DISCHARGE MONITORING

Table a7

MARTHA'S VINEYARD WASTEWATER DISCHARGE MONITORING

EDGARTOWN WASTEWATER TREATMENT PLANT

APRIL SURVEY

LOCATION:	Off West Tisbury Road, Edgartown
DATE SAMPLED:	7 April 1976
RECEIVING WATER:	Groundwater
TREATMENT PROCESS:	Extended Aeration, Final Clarification, Chlorination, Sand Beds
DESIGN FLOW:	0.25 MGD
TYPE OF SAMPLE:	Eight hour composite

LABORATORY ANALYSES (mg/l)

PARAMETER	INFLUENT	EFFLUENT[1]
pH (Standard Units)	7.4	7.5
Total Alkalinity	150	89
BOD_5	222	9.6
COD	288	48
Suspended Solids	96	4.5
Settleable Solids (ml/l)	-	0.1
Total Phosphorus (as P)	7.0	3.2
Ammonia-Nitrogen	20	12
Nitrate-Nitrogen	0.4	1.5
Total Coliform/100 ml	-	430
Fecal Coliform/100 ml	-	430

Flow = 15,000 Gpd

[1] Effluent samples collected prior to chlorination and sand bed application.

Table a7

MARTHA'S VINEYARD WASTEWATER DISCHARGE MONITORING

MARTHA'S VINEYARD HOSPITAL WASTEWATER TREATMENT PLANT

APRIL SURVEY

LOCATION:	Off Beach Road, Oak Bluffs
DATE SAMPLED:	7 April 1976
RECEIVING WATER:	Groundwater
TREATMENT PROCESS:	Modified Secondary Aeration
DESIGN FLOW:	26,000 Gpd
TYPE OF SAMPLE:	Six hour composite

LABORATORY ANALYSES (mg/l)

PARAMETER	INFLUENT	EFFLUENT[1]
pH (Standard Units)	5.9	6.5
Total Alkalinity	33	24
BOD_5	210	21
COD	400	82
Suspended Solids	63	12
Settleable Solids (ml/l)	-	0.0
Total Phosphorus (as P)	12	7.0
Ammonia-Nitrogen	5.0	4.0
Nitrate-Nitrogen	0.5	1.5
Total Coliform/100 ml	-	< 36
Fecal Coliform/100 ml	-	< 36

Flow = 17,700 Gpd

[1] Effluent samples collected prior to chlorination.

Table a7

MARTHA'S VINEYARD WASTEWATER DISCHARGE MONITORING

EDGARTOWN WASTEWATER TREATMENT PLANT

AUGUST SURVEY

DATE SAMPLED: 17 August 1976

TYPE OF SAMPLE: Eight hour composite

LABORATORY ANALYSES (mg/l)

PARAMETER	INFLUENT	EFFLUENT[1]
pH (Standard Units)	7.5	7.5
Total Alkalinity	214	80
BOD_5	510	19
COD	862	73
Suspended Solids	494	13
Total Phosphorus (as P)	13	4.5
Ammonia-Nitrogen	38	11
Nitrate-Nitrogen	0.4	0.4
Total Coliform/100 ml	-	430
Fecal Coliform/100 ml	-	430

Flow = 90,000 Gpd

[1] Effluent samples collected prior to chlorination and sand bed application.

Appendix 4

Land-Use Regulations

COMPARISON OF TOWN SUBDIVISION RULES & REGULATIONS

PROVISIONS \ TOWNS	CHILMARK	EDGARTOWN	OAK BLUFFS	TISBURY	WEST TISBURY
GENERAL					
Effective date	6/14/75		3/1/75	3/15/75	
Purpose	●	●			●
Planning board adoption of rules authority	●	●	●	●	●
Applicability	●	●	●	●	●
State standard subdivision definitions	2 LOTS	2 LOTS	2 LOTS	2 LOTS	2 LOTS
Street definitions			●	●	
PLAN SUBMISSION AND APPROVAL PROCEDURES AND REQUIREMENTS — GENERAL					
Deadline	●		●	●	
Endorsement of plats not involving subdivision ①	●	●	●	●	●
Small project threshold			6 LOTS ②	6 LOTS ②	
PRELIMINARY PLAN					
Pre-submission review recommended	●		●	●	
Submission recommended	●	●	●	●	●
Application details	●		●	●	
Scale and other form details	1"=100'	SUITABLE	1"=100'	1"=100'	SUITABLE
State standard contents	●	●	●	●	●
Additional contents	③	④			
Suggested contents	⑤	⑤c	⑤	⑤	
Approval with or without modification/disapproval	REQUIRED	OPTIONAL	REQUIRED	REQUIRED	OPTIONAL
Relation to definitive plan & binding provisions			●	●	
DEFINITIVE PLAN					
Form details	●	●	●	●	●
Filing details	●	●	●	●	●
Standard contents	●	●	●	●	●
Special contents	⑥	⑦	⑧	⑧	⑨
Street/road plan & profile details	●		●	●	
Environmental impact analysis threshold	5 LOTS	5 AC. OR 6 LOTS	30 LOTS	30 LOTS	2 LOTS
Environmental plan contents	●		●	●	
Environmental impact statement contents	●	●	●	●	
Additional submittals	●		●	●	
Small project submittals			●	●	
Board of health suitability review	●	●	●	●	●
Mandatory board of health approval			●	●	
Public hearing	●	●	●	●	●
Optional public hearing waiver criteria		3 LOTS ②			
Financial or legal performance guarantee	●	●	●	●	●
Criteria for approval			●	●	
Approval/disapproval notification	●	●	●	●	●
State statutory appeal period	20 DAYS	20 DAYS	20 DAYS	20 DAYS	20 DAYS
Approval rescission criteria			●	●	
DESIGN STANDARDS — GENERAL					
Design guides	OPTIONAL		REQUIRED	REQUIRED	
Typical street cross section			●	●	
STREETS & PATHS					
Location and alignment	●	●	●	●	●
Width	●	●	●	●	●
Grade	ROADS	STREETS	STREETS	STREETS	STREETS
Sight distances			●	●	
Dead-end streets		●	●	●	●
EASEMENTS					
Utilities	●	●	●	●	●
Storm water drainage	20' OPTIONAL	OPTIONAL	20' OPTIONAL	20' OPTIONAL	OPTIONAL
Storm water drainage outside subdivision	OPTIONAL		OPTIONAL	OPTIONAL	
OTHER REQUIREMENTS					
Cut and fill slopes	●		●	●	
Storm water management	●		●	●	
Water supply	●		●	●	
Sewage disposal	●		●	●	
Fire protection	●		●	●	
Planning board option recreational open space	NO LIMITS	NO LIMITS	5% AREA/3 YRS.	5% AREA/3 YRS.	NO SIZE/3 YRS.
Protection of natural features	●	●	●	●	●
Utilities approved	●		●	●	
Underground wiring	●	5 ACRES/4 LOTS		●	BOARD OPTION
REQUIRED IMPROVEMENTS					
Street/road preparation & surfacing	BOARD OPTION	MODERATE	EXTENSIVE	EXTENSIVE	MINIMAL
Drainage berms & [illegible]	BOARD OPTION		●	●	
[illegible] and [illegible] materials			●	●	
Water supply system	WELLS/BOARD SPECS, ⑩	PUBLIC/BOARD SPECS.	PUBLIC/WORKS SPECS.	PUBLIC/WORKS SPECS.	AGENCY SPECS.
Sewer system	BOARD OPTION	BOARD SPECS.			AGENCY SPECS.
Sewage disposal system	BOARD OPTION				
Storm water management system	SPECS.	BOARD SPECS.	SPECS.	SPECS.	AGENCY SPECS.
Cable utilities	⑪	●	●	●	
Sidewalks	BOARD OPTION	BOARD OPTION			BOARD OPTION
Monuments	●	●	●	●	●
Street/road signs	BOARD OPTION				
Street/road lights	BOARD OPTION	BOARD OPTION	BOARD OPTION	BOARD OPTION	
Street trees		BOARD OPTION			BOARD OPTION
Tree landscaping	BOARD OPTION		BOARD OPTION	BOARD OPTION	
Stabilizing vegetation	●		●	●	
Cleaning up	●	●	●	●	
Ownership of streets/roads	DEVELOPER AND TOWN OPTION		BOARD OPTION	BOARD OPTION	
Record plans	●			●	
ADMINISTRATION					
Small project waivers			BOARD OPTION	BOARD OPTION	
Development work schedule	●		●	●	
Inspections	●		●	●	
Variations/waivers	BOARD OPTION	BOARD OPTION	BOARD OPTION	BOARD OPTION	BOARD OPTION
More than one dwelling per lot	BOARD OPTION		BOARD OPTION	BOARD OPTION	BOARD OPTION
Building permits		●			●
Required approval: Planning board	●	●	●	●	●
Required approval: Board of health			●	●	●
Required approval: Water commission			●	●	●
Required approval: Fire chief	●		●	●	
Optional approval: Board of health	BOARD OPTION	BOARD OPTION			
Optional approval: Conservation commission		BOARD OPTION			
Optional approval: Advisory committee		BOARD OPTION			
APPENDICES					
Statutory reference		●	●	●	●
Landscape type development guides			●	●	
Development suggestions	●				
Forms	●	●	●		
Road construction specifications	●				
Inspection procedures	●				
Filing fees	●				
Legal references	●				
Typical street cross section			●	●	

GAY HEAD: GAY HEAD HAS NO SUBDIVISION REGULATIONS

① REQUIREMENT FOR DEED RESTRICTION LEFT IMPLICITLY TO TOWN CLERK

② SUPPLEMENTAL CRITERIA ALSO

③ a. AREAS WITHIN WETLANDS AND WATER PROTECTION DISTRICTS
   b. PHYSICAL, GEOLOGICAL & ENVIRONMENTAL AND OTHER CHARACTERISTICS UNIQUE TO THE SITE
   c. TWO-FOOT TOPOGRAPHIC CONTOUR INTERVAL

④ a. PREFERRED BUILDING LOCATIONS
   b. IF IMPACT STATEMENT REQUIRED:
      1. INCREASE IN LEGAL RESIDENTS
      2. OPEN SPACE TO BE SET ASIDE IF ANY

⑤ a. LOCUS PLAN WITH AREA STREET CONFIGURATION
   b. GENERAL DEVELOPMENT PLAN OF ALL OWNER'S PROPERTY IN AREA
   c. PRELIMINARY ENVIRONMENTAL ANALYSIS OR IMPACT STATEMENT IF REQUIRED.

⑥ b, c, d, e1, f (SEE ⑨)

⑦ a, e2, f1, g1 (SEE ⑨)

⑧ c (SEE ⑨)

⑨ a, e, f, g
   a. AT PLANNING BOARD DISCRETION, EXISTING AND PROPOSED TOPOGRAPHY AT SUITABLE CONTOUR INTERVAL
   b. TOPOGRAPHY AT TWO-FOOT CONTOUR INTERVALS
   c. EXISTING AND PROPOSED WATER COURSES, PONDS, AND WETLANDS
   d. ALL AREAS WITHIN OR ADJACENT . . . AND SUBJECT TO WETLANDS PROTECTION ACT . . . FEDERAL WATERSHED PROTECTION AND FLOOD PREVENTION AND COASTAL ZONE MANAGEMENT ACTS OR WITHIN WETLAND AND WATER-SHED PROTECTION DISTRICTS
   e. PROPOSED LOCATION OF SEWAGE DISPOSAL SYSTEMS
      1. DETAILED RESULTS OF SOIL PERCOLATION TESTS ON EACH
      2. PIPE LENGTHS AND DIAMETERS
   f. PROPOSED LOCATION OF WATER SUPPLY SYSTEMS
      1. PIPE LENGTHS AND DIAMETERS
   g. PROPOSED LAYOUT OF STORM DRAINAGE SYSTEMS
      1. PIPE LENGTHS AND DIAMETERS

⑩ PRIOR TO SALE OF EACH LOT

⑪ PRIOR TO SALE OF ANY LOT

TABLE a8

Appendix 5

Lot-Size Determination

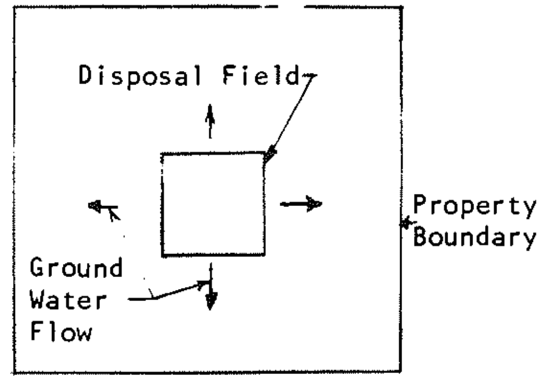


Figure A - On-site disposal, public water, 0% slope

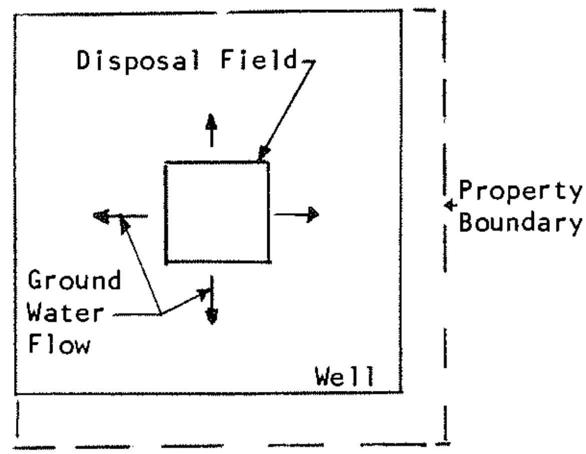


Figure B - On-Site disposal private water, 0% slope

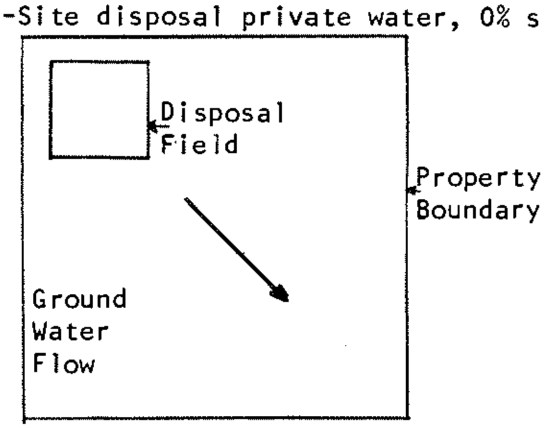


Figure C - On-site disposal, public water, 15% and 2% slope

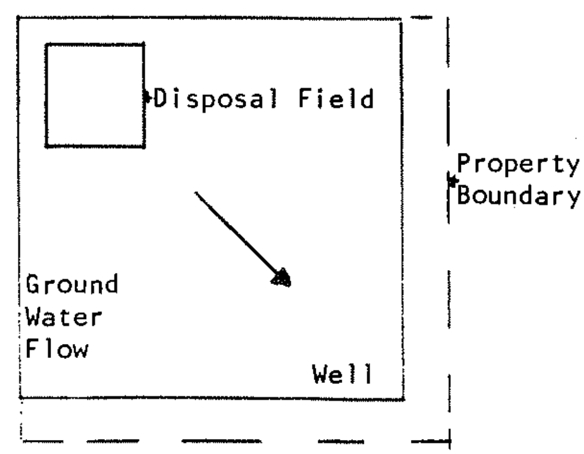


Figure D - On-site disposal, private water, 15% and 2% slope

Case 2 - 15% Ground Water Table Slope

Case 2 is where the ground water table slope is greater than 15%. In this case the disposal field would be located in a corner of the lot with the ground water flow as shown in Figures C & D.

Case 3 - 2% Ground Water Table Slope

Case 3 is where the ground water table slope is 2%. In this case the disposal field would also be located in a corner of the lot as shown in Figures C & D.

The computations presented in the tables are based on the effluent leaving the property being 1/10 of the drinking water standards for nitrate and less than 1/10 of the drinking water standards for the other parameters.

Table 1 presents the average lot size for developments with private water and private sewage systems for 0 slope and varying depths to ground water and no anticipated public sewage in the future.

Table 2 presents the average lot size for developments with private water and private sewage systems for >15% slopes for which the direction of the flow is known and there is no anticipated public sewage in the future.

Table 3 presents the average lot size for developments with private water and private sewage systems for 2% slopes for which the direction of the flow is known and there is no anticipated public sewage in the future.

Table 4 presents the average lot size for developments with public water and private sewage systems for 0 slope and no anticipated public sewage.

Table 5 presents the average lot size for developments with public water, private sewage and slope >15 % with no anticipated public sewage.

Table 6 presents the average lot size for developments with public water, private sewage and slope 2% with no anticipated public sewage.

Table 7 presents the average lot size for developments with public water, private sewage, 0 slope and public sewage anticipated in 20 years.

Table 8 presents the average lot size for developments with public water, private sewage, >15% slope and public sewage anticipated in 20 years.

Table 9 presents the average lot size for developments with public water, private sewage, 2% slope and public sewage anticipated in 20 years.

Table 10)
Table 11) are based on an assumption of a total of 15 points being required to result in no increase in nitrates at the property line.

the removal of nitrate is logarithmic and the removal of the last 1 mg/l would require double or triple the travel distance needed to reduce concentrations from 2 mg/l to 1 mg/l. The increase in travel distance increases lot sizes 4 to 9 times. Also, background nitrate is present in ground water and varies with location. Without knowing background values, only changes in total concentrations can be assessed.

TABLE a-15

AVERAGE LOT SIZE IN ACRES

1. Private water
2. Private sewage
3. 0% slope
4. No anticipated public sewage

Soil Type \ Depth to Ground Water in Feet	5	10	20	30	40	50
Coarse Gravel	65.0 Acres	20.5 Acres	7.07 Acres	4.34 Acres	2.89 Acres	2.14 Acres
Coarse Sand	8.4 Acres	5.85 Acres	3.23 Acres	1.86 Acres	1.38 Acres	1.06 Acres
Fine Sand w/ some Clay	2.4 Acres	1.74 Acres	1.06 Acres	0.79 Acres	0.79 Acres	0.79 Acres
Silt	1.6 Acres	1.38 Acres	0.87 Acres	0.79 Acres	0.79 Acres	0.79 Acres
Clayey Sand	1.6 Acres	1.38 Acres	0.87 Acres	0.79 Acres	0.79 Acres	0.79 Acres
Clay	1.9 Acres	1.49 Acres	0.96 Acres	0.79 Acres	0.79 Acres	0.79 Acres

TABLE a-16

AVERAGE LOT SIZE IN ACRES

1. Private water
2. Private sewage
3. >15% slope
4. No anticipated public sewage

Soil Type \ Depth to Ground Water in Feet	5	10	20	30	40	50
Coarse Gravel	58.4 Acres	18.4 Acres	4.05 Acres	2.35 Acres	1.67 Acres	1.32 Acres
Coarse Sand	5.51 Acres	3.14 Acres	1.74 Acres	1.21 Acres	0.92 Acres	0.74 Acres
Fine Sand w/ some Clay	1.43 Acres	1.11 Acres	0.74 Acres	0.55 Acres	0.48 Acres	0.48 Acres
Silt	1.06 Acres	0.73 Acres	0.59 Acres	0.48 Acres	0.48 Acres	0.48 Acres
Clayey Sand	1.06 Acres	0.83 Acres	0.59 Acres	0.48 Acres	0.48 Acres	0.48 Acres
Clay	1.21 Acres	1.01 Acres	0.70 Acres	0.48 Acres	0.48 Acres	0.48 Acres

TABLE a-17

AVERAGE LOT SIZE IN ACRES

1. Private water
2. Private sewage
3. 2% slope
4. No anticipated public sewage

Soil Type	Depth to Ground Water in Feet: 5	10	20	30	40	50
Coarse Gravel	63.3 Acres	20.0 Acres	6.89 Acres	4.23 Acres	2.81 Acres	2.08 Acres
Coarse Sand	8.2 Acres	5.70 Acres	3.15 Acres	1.81 Acres	1.34 Acres	1.03 Acres
Fine Sand w/ some Clay	2.3 Acres	1.69 Acres	1.03 Acres	0.77 Acres	0.77 Acres	0.77 Acres
Silt	1.5 Acres	1.34 Acres	0.85 Acres	0.77 Acres	0.77 Acres	0.77 Acres
Clayey Sand	1.5 Acres	1.34 Acres	0.85 Acres	0.77 Acres	0.77 Acres	0.77 Acres
Clay	1.8 Acres	1.45 Acres	0.93 Acres	0.77 Acres	0.77 Acres	0.77 Acres

TABLE a-18

AVERAGE LOT SIZE IN ACRES

1. Public water
2 Private sewage
3. 0% slope
4. No anticipated public sewage

Soil Type	Depth to Ground Water in Feet: 5	10	20	30	40	50
Coarse Gravel	63.3 Acres	19.4 Acres	6.45 Acres	3.86 Acres	2.50 Acres	1.80 Acres
Coarse Sand	7.72 Acres	5.29 Acres	1.43 Acres	1.55 Acres	1.11 Acres	0.83 Acres
Fine Sand w/ some Clay	2.07 Acres	1.43 Acres	0.83 Acres	0.59 Acres	0.59 Acres	0.59 Acres
Silt	1.32 Acres	1.11 Acres	0.66 Acres	0.59 Acres	0.59 Acres	0.59 Acres
Clayey Sand	1.32 Acres	1.11 Acres	0.66 Acres	0.59 Acres	0.59 Acres	0.59 Acres
Clay	1.55 Acres	1.21 Acres	0.74 Acres	0.59 Acres	0.59 Acres	0.59 Acres

TABLE a-19

AVERAGE LOT SIZE IN ACRES

1. Public water
2. Private sewage
3. Slope >15%
4. No anticipated public sewage

Depth to Ground Water in Feet

Soil Type	5	10	20	30	40	50
Coarse Gravel	56.6 Acres	17.4 Acres	3.58 Acres	2.0 Acres	1.38 Acres	1.06 Acres
Coarse Sand	4.96 Acres	2.73 Acres	1.43 Acres	0.96 Acres	0.70 Acres	0.55 Acres
Fine Sand w/ some Clay	1.16 Acres	0.87 Acres	0.55 Acres	0.39 Acres	0.39 Acres	0.39 Acres
Silt	0.83 Acres	0.63 Acres	0.42 Acres	0.33 Acres	0.39 Acres	0.39 Acres
Clayey Sand	0.83 Acres	0.63 Acres	0.42 Acres	0.33 Acres	0.39 Acres	0.39 Acres
Clay	0.96 Acres	0.79 Acres	0.52 Acres	0.33 Acres	0.39 Acres	0.39 Acres

TABLE a-20

AVERAGE LOT SIZE IN ACRES

1. Public water
2. Private sewage
3. 2% slope
4. No anticipated public sewage

Depth to Ground Water in Feet

Soil Type	5	10	20	30	40	50
Coarse Gravel	61.6 Acres	18.9 Acres	6.28 Acres	3.75 Acres	2.43 Acres	1.75 Acres
Coarse Sand	7.52 Acres	5.15 Acres	1.39 Acres	1.51 Acres	1.08 Acres	0.81 Acres
Fine Sand w/ some Clay	2.02 Acres	1.39 Acres	0.81 Acres	0.57 Acres	0.57 Acres	0.57 Acres
Silt	1.30 Acres	1.08 Acres	0.64 Acres	0.57 Acres	0.57 Acres	0.57 Acres
Clayey Sand	1.32 Acres	1.08 Acres	0.64 Acres	0.57 Acres	0.57 Acres	0.57 Acres
Clay	1.51 Acres	1.18 Acres	0.72 Acres	0.57 Acres	0.57 Acres	0.57 Acres

TABLE a-21

AVERAGE LOT SIZE IN ACRES

1. Public water
2. Private sewage
3. 0% slope
4. Public sewage anticipated within 20 years

Soil Type	Depth to Ground Water in Feet					
	5	10	20	30	40	50
Coarse Gravel	61.7 Acres	18.6 Acres	5.97 Acres	3.49 Acres	2.21 Acres	1.55 Acres
Coarse Sand	7.20 Acres	4.86 Acres	2.50 Acres	1.32 Acres	1.11 Acres	0.66 Acres
Fine Sand w/ some Clay	1.80 Acres	1.21 Acres	0.66 Acres	0.45 Acres	0.45 Acres	0.45 Acres
Silt	1.11 Acres	0.92 Acres	0.52 Acres	0.45 Acres	0.45 Acres	0.45 Acres
Clayey Sand	1.11 Acres	0.92 Acres	0.52 Acres	0.45 Acres	0.45 Acres	0.45 Acres
Clay	1.32 Acres	1.01 Acres	0.59 Acres	0.45 Acres	0.45 Acres	0.45 Acres

TABLE a-22

AVERAGE LOT SIZE IN ACRES

1. Public water
2. Private sewage
3. Slope >15%
4. Public sewage anticipated within 20 years

Soil Type	Depth to Ground Water in Feet					
	5	10	20	30	40	50
Coarse Gravel	55.1 Acres	16.8 Acres	3.23 Acres	1.74 Acres	1.16 Acres	0.87 Acres
Coarse Sand	4.55 Acres	2.42 Acres	1.21 Acres	0.79 Acres	0.55 Acres	0.42 Acres
Fine Sand w/ some Clay	0.96 Acres	0.70 Acres	0.41 Acres	0.28 Acres	0.28 Acres	0.28 Acres
Silt	0.66 Acres	0.48 Acres	0.30 Acres	0.23 Acres	0.28 Acres	0.28 Acres
Clayey Sand	0.66 Acres	0.48 Acres	0.30 Acres	0.23 Acres	0.28 Acres	0.28 Acres
Clay	0.79 Acres	0.63 Acres	0.39 Acres	0.23 Acres	0.28 Acres	0.28 Acres

TABLE a-23

AVERAGE LOT SIZE IN ACRES

1. Public water
2. Private sewage
3. 2% slope
4. Public sewage anticipated within 20 years

Soil Type	Deptn to Ground Water in Feet: 5	10	20	30	40	50
Coarse Gravel	60.1 Acres	18.1 Acres	5.81 Acres	3.40 Acres	2.15 Acres	1.51 Acres
Coarse Sand	7.01 Acres	4.73 Acres	2.43 Acres	1.29 Acres	1.08 Acres	0.64 Acres
Fine Sand w/ some Clay	1.75 Acres	1.18 Acres	.64 Acres	.44 Acres	.44 Acres	.44 Acres
Silt	1.08 Acres	0.90 Acres	.51 Acres	.44 Acres	.44 Acres	.44 Acres
Clayey Sand	1.08 Acres	0.90 Acres	.51 Acres	.44 Acres	.44 Acres	.44 Acres
Clay	1.29 Acres	0.98 Acres	.57 Acres	.44 Acres	.44 Acres	.44 Acres

TABLE a-24

AVERAGE LOT SIZE IN ACRES

1. Private water
2. Private sewage
3. 0% slope
4. No anticipated public sewage

Soil Type	Depth to Ground Water in Feet: 5	10	20	30	40	50
Coarse Gravel	>383 acres	>383 Acres	>383 Acres	383 Acres	142 Acres	32.2 Acres
Coarse Sand	>383 Acres	>383 Acres	218 Acres	57.0 Acres	10.8 Acres	7.07 Acres
Fine Sand w/ some Clay	65.2 Acres	20.5 Acres	7.33 Acres	4.34 Acres	2.89 Acres	0.83 Acres
Silt	17.6 Acres	9.26 Acres	5.18 Acres	2.89 Acres	1.86 Acres	0.66 Acres
Clayey Sand	17.6 Acres	9.26 Acres	5.18 Acres	2.89 Acres	1.86 Acres	0.66 Acres
Clay	27.0 Acres	14.15 Acres	5.85 Acres	3.58 Acres	2.42 Acres	0.74 Acres

TABLE a-25

AVERAGE LOT SIZE IN ACRES

1. Private water
2. Private sewage
3. >15% slope
4. No anticipated public sewage

Soil Type	Depth to Ground Water in Feet: 5	10	20	30	40	50
Coarse Gravel	>100 Acres	>100 Acres	>100 Acres	>100 Acres	100 Acres	58.4 Acres
Coarse Sand	>100 Acres	>100 Acres	>100 Acres	38.5 Acres	8.13 Acres	4.05 Acres
Fine Sand w/ some Clay	82.4 Acres	25.1 Acres	4.05 Acres	2.35 Acres	1.67 Acres	1.32 Acres
Silt	18.4 Acres	6.32 Acres	2.5 Acres	1.67 Acres	1.21 Acres	0.92 Acres
Clayey Sand	18.4 Acres	6.32 Acres	2.5 Acres	1.67 Acres	1.21 Acres	0.92 Acres
Clay	38.5 Acres	13.0 Acres	3.14 Acres	1.93 Acres	1.43 Acres	1.11 Acres

TABLE a-26

AVERAGE LOT SIZE IN ACRES

1. Private water
2. Private sewage
3. 2% slope
4. No anticipated public sewage

Soil Type	Depth to Ground Water in Feet: 5	10	20	30	40	50
Coarse Gravel	>373 Acres	>373 Acres	>373 Acres	373 Acres	138 Acres	31.4 Acres
Coarse Sand	>373 Acres	>373 Acres	212 Acres	41.6 Acres	10.5 Acres	6.89 Acres
Fine Sand w/ some Clay	63.5 Acres	20.0 Acres	7.13 Acres	4.23 Acres	2.81 Acres	0.81 Acres
Silt	17.1 Acres	9.01 Acres	5.04 Acres	2.81 Acres	1.81 Acres	0.64 Acres
Clayey Sand	17.1 Acres	9.01 Acres	5.04 Acres	2.81 Acres	1.81 Acres	0.64 Acres
Clay	26.3 Acres	13.8 Acres	5.70 Acres	3.49 Acres	2.36 Acres	0.72 Acres

Appendix 6

Solid Waste Disposal

FIGURE a13
WEST TISBURY LANDFILL

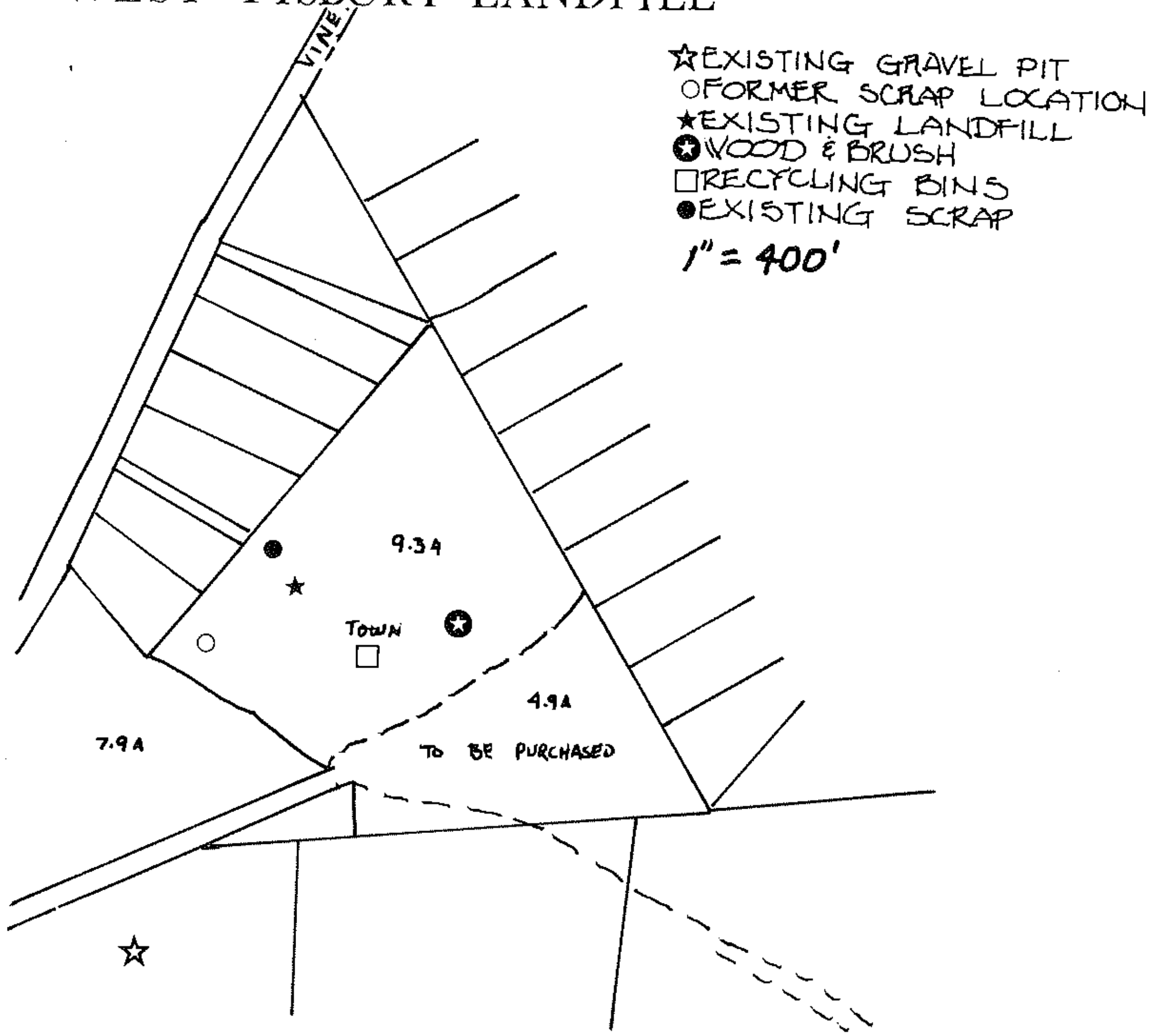


FIGURE a14

TOWN of CHILMARK
SANITARY LANDFILL

APPROX. 8 1/4 ACRES 1" = 800'

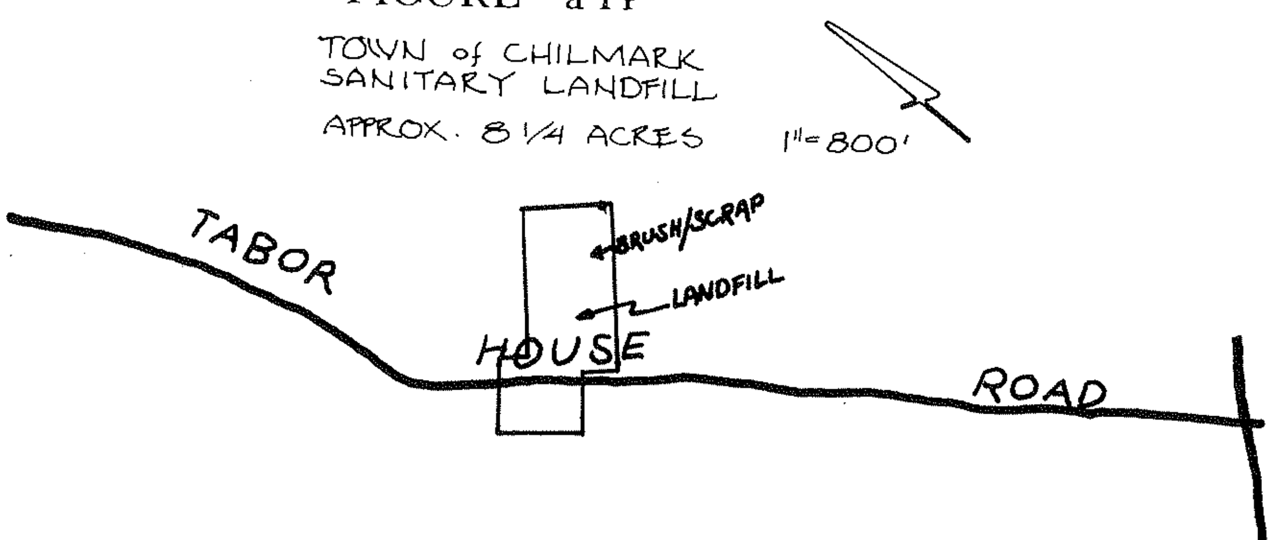


FIGURE a15

TOWN of OAK BLUFFS
SOLID WASTE DISPOSAL SITE 1" = 500'

★ EXISTING SANITARY LANDFILL APPROX. 17.6 AC.
● SCRAP
☆ NIGHTSOIL DUMP
○ OLD LANDFILL
✪ ROAD-SCRAP, TAR

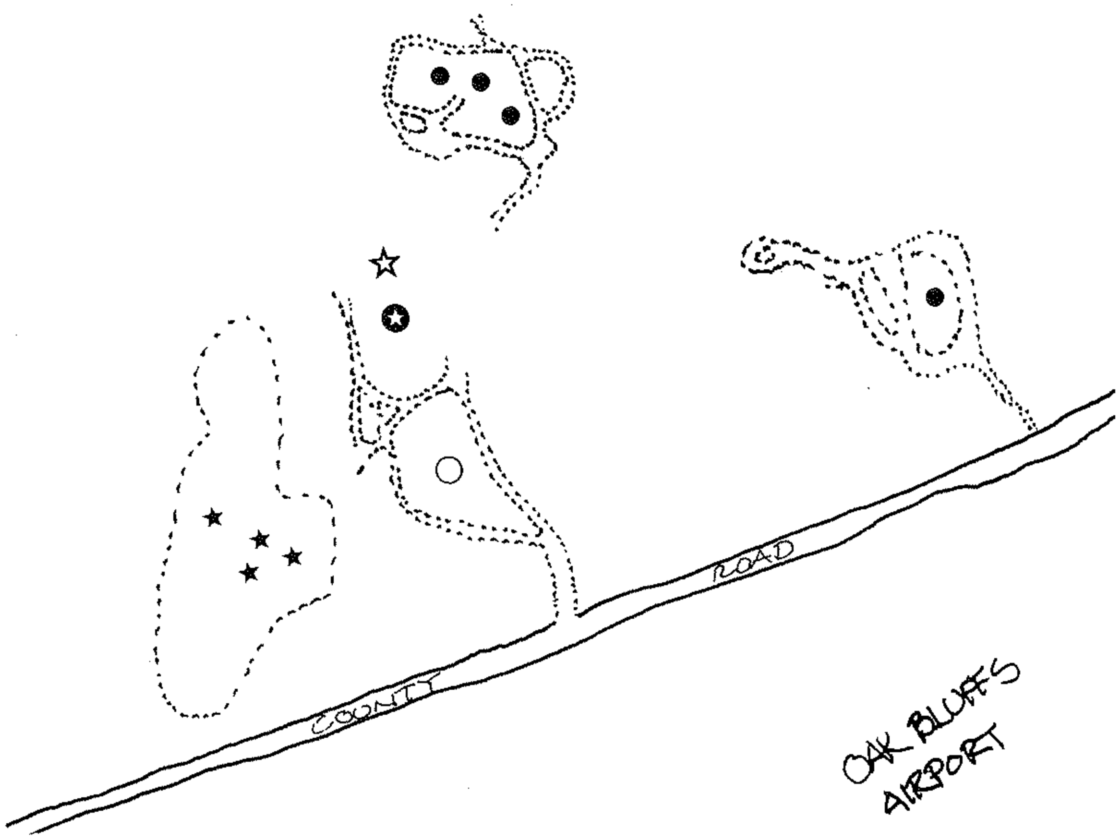
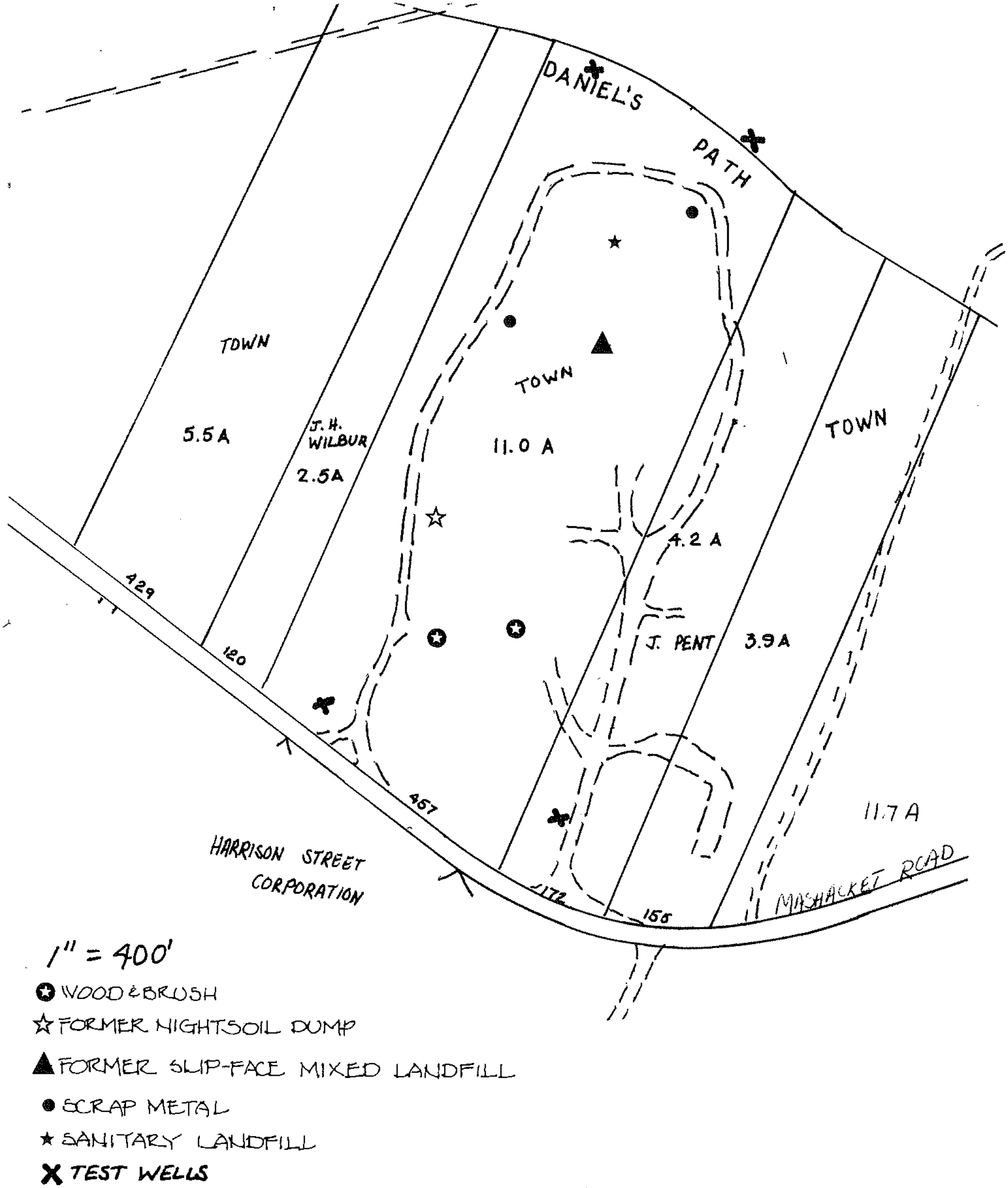


FIGURE a16
EDGARTOWN LANDFILL



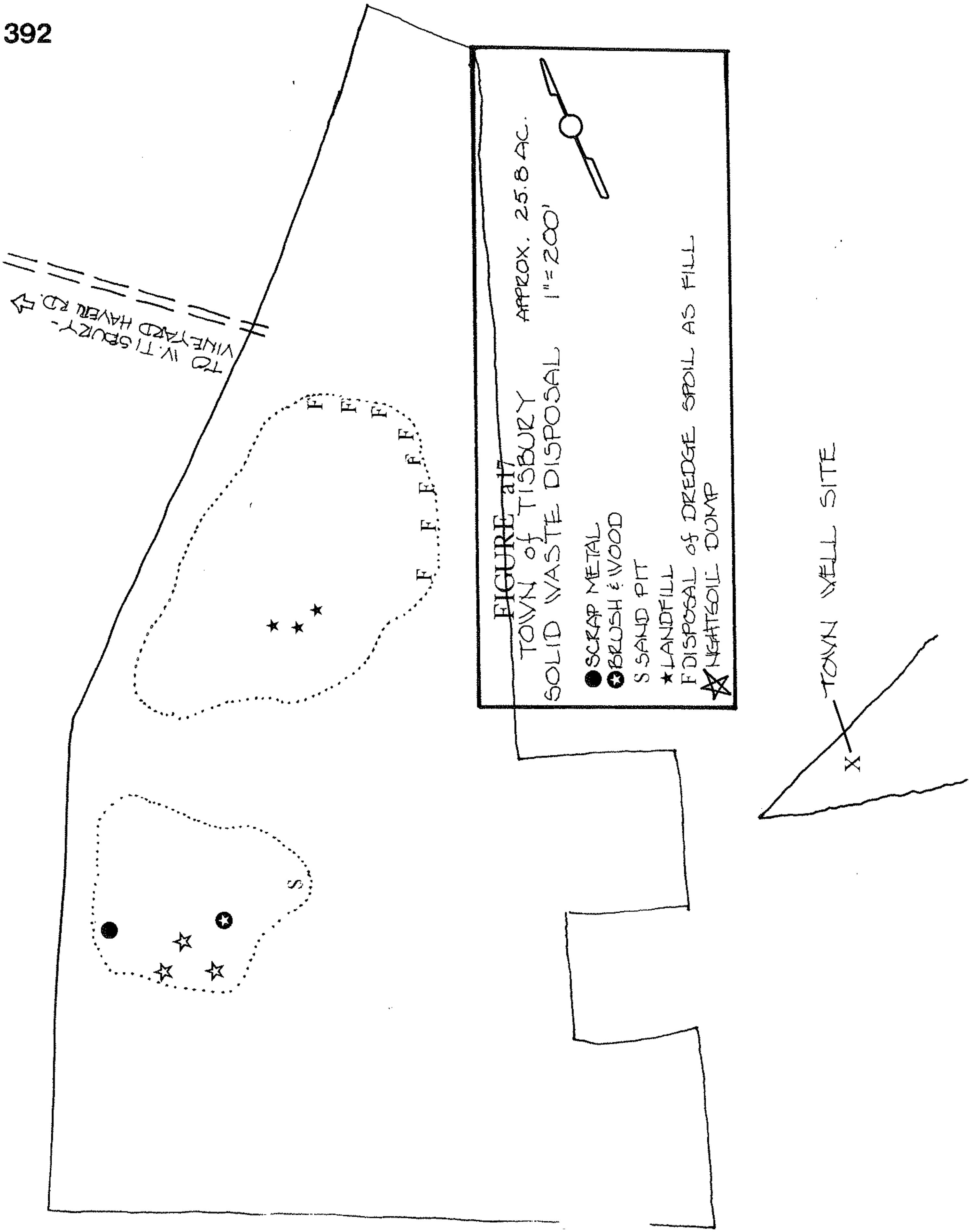


FIGURE a17
TOWN of TISBURY
SOLID WASTE DISPOSAL
APPROX. 25.8 AC.
1"=200'
SCRAP METAL
BRUSH & WOOD
S SAND PIT
LANDFILL
F DISPOSAL of DREDGE SPOIL AS FILL
NIGHTSOIL DUMP
TO W. TISBURY-VINEYARD HAVEN RD.
TOWN WELL SITE

Appendix 6

Solid Waste Disposal

FIGURE a13
WEST TISBURY LANDFILL

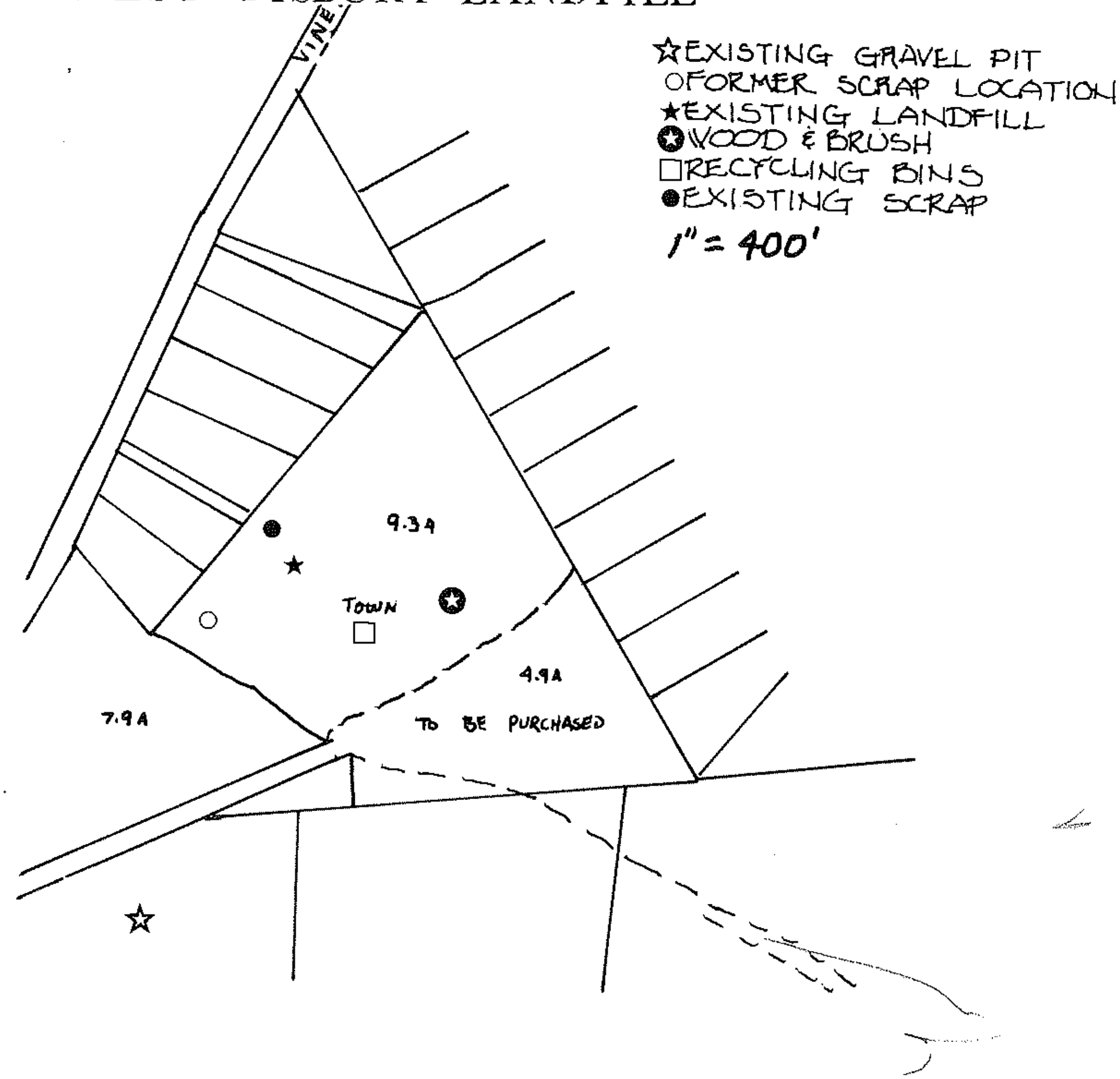


FIGURE a14

TOWN of CHILMARK
SANITARY LANDFILL
APPROX. 8 1/4 ACRES 1" = 800'

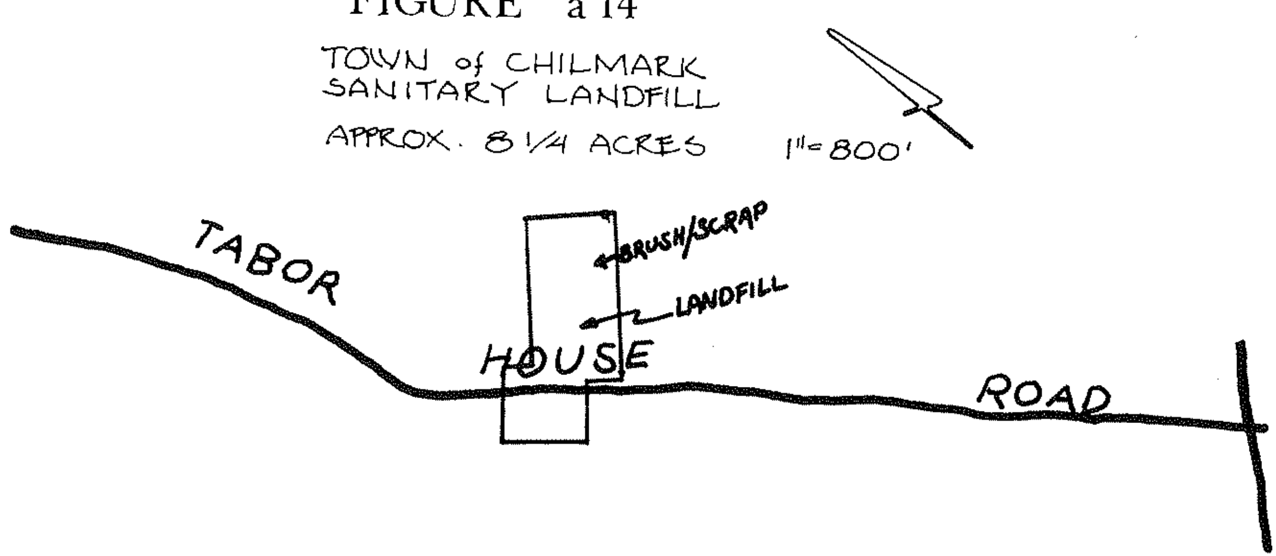


FIGURE a15

TOWN of OAK BLUFFS
SOLID WASTE DISPOSAL SITE 1" = 500'

- ★ EXISTING SANITARY LANDFILL APPROX. 17.6 AC.
- ● SCRAP
- ☆ NIGHTSOIL DUMP
- ○ OLD LANDFILL
- ✪ ROAD-SCRAP, TAR

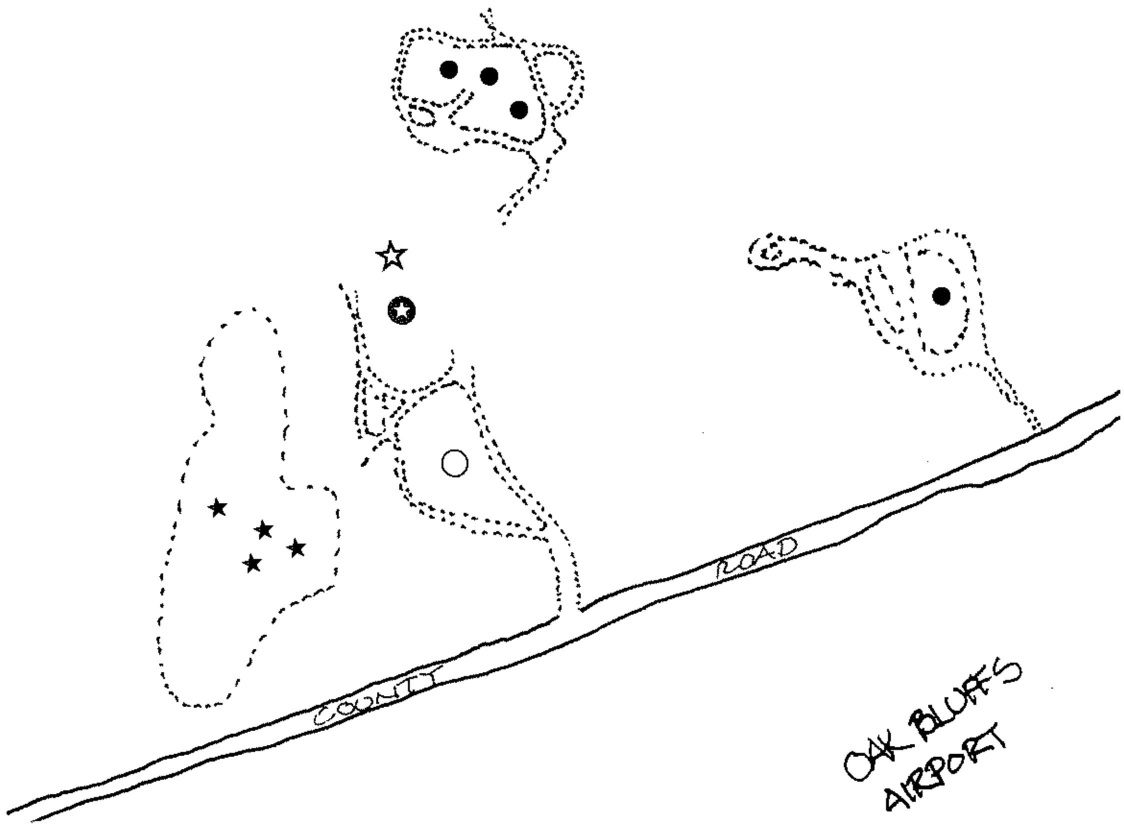
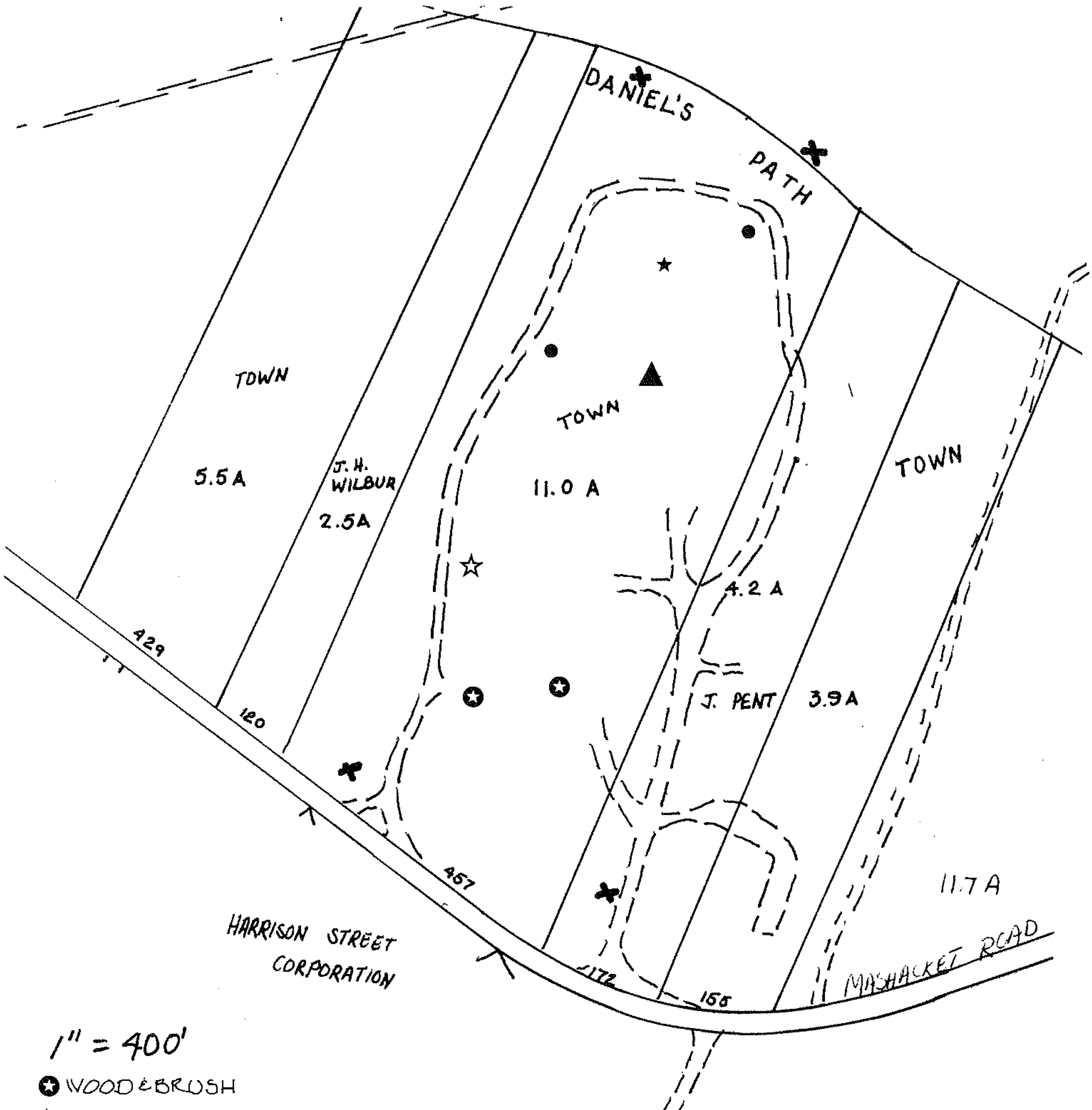
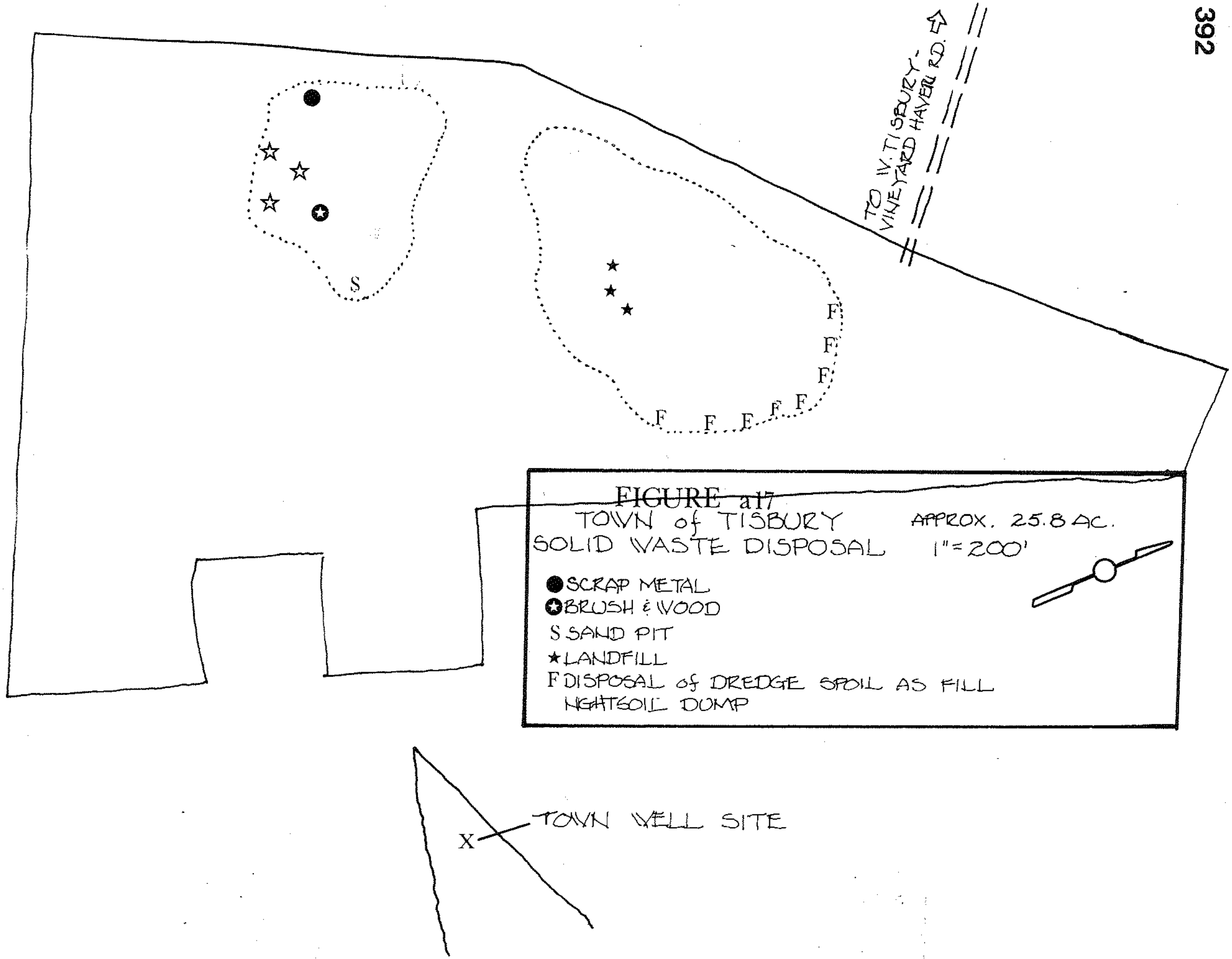


FIGURE a16
EDGARTOWN LANDFILL



1" = 400'

- WOOD & BRUSH
- FORMER NIGHTSOIL DUMP
- FORMER SLIP-FACE MIXED LANDFILL
- SCRAP METAL
- SANITARY LANDFILL
- X TEST WELLS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APPROX. 25.8 AC.
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TOWN WELL SITE
TO W. TISBURY-VINEYARD HAVEN RD.

FIGURE a17

FIGURE a18
GAY HEAD LANDFILL

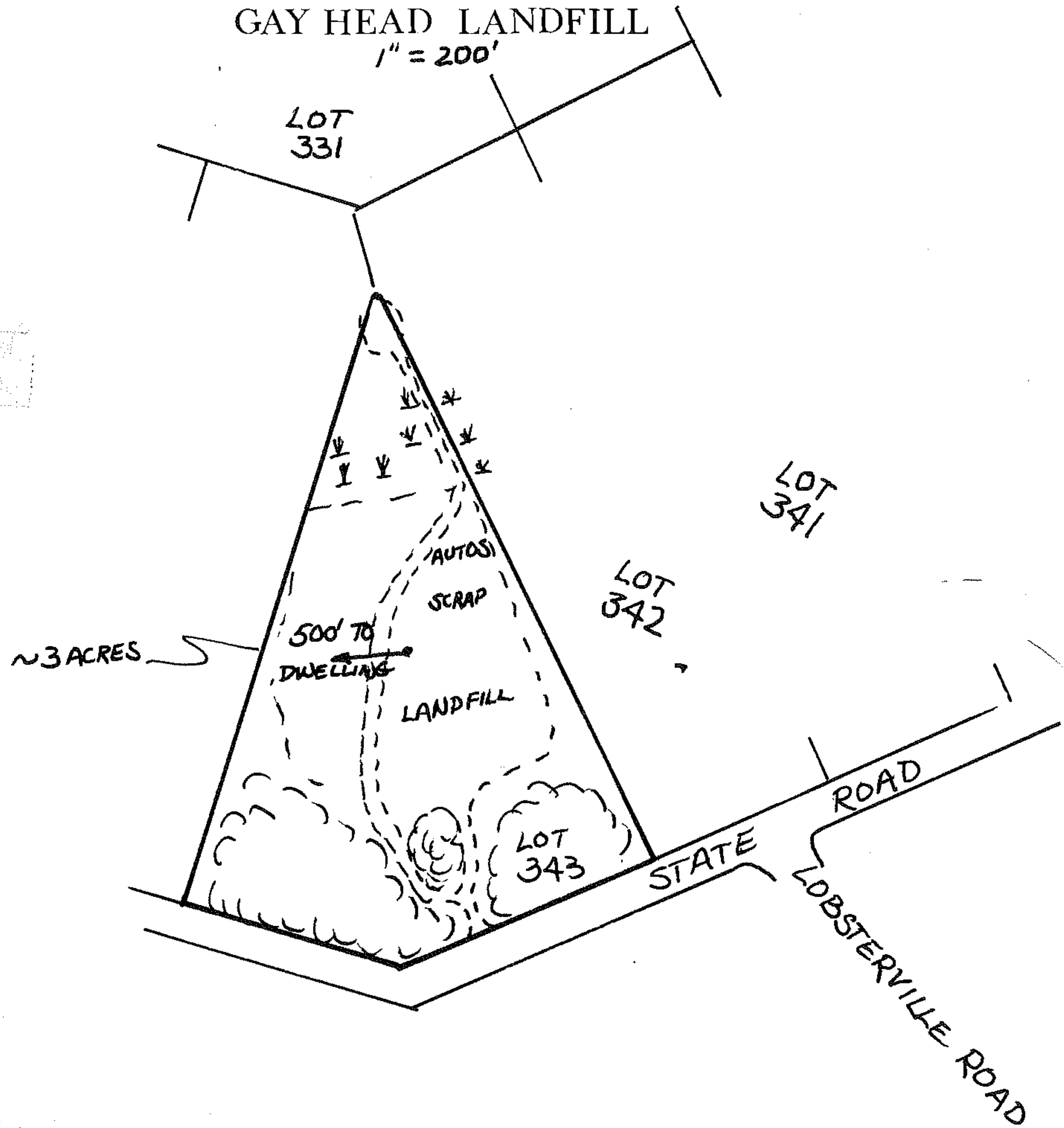


TABLE a-25

AVERAGE LOT SIZE IN ACRES

1. Private water
2. Private sewage
3. >15% slope
4. No anticipated public sewage

Soil Type	Depth to Ground Water in Feet					
	5	10	20	30	40	50
Coarse Gravel	>100 Acres	>100 Acres	>100 Acres	>100 Acres	100 Acres	58.4 Acres
Coarse Sand	>100 Acres	>100 Acres	>100 Acres	38.5 Acres	8.13 Acres	4.05 Acres
Fine Sand w/ some Clay	82.4 Acres	25.1 Acres	4.05 Acres	2.35 Acres	1.67 Acres	1.32 Acres
Silt	18.4 Acres	6.32 Acres	2.5 Acres	1.67 Acres	1.21 Acres	0.92 Acres
Clayey Sand	18.4 Acres	6.32 Acres	2.5 Acres	1.67 Acres	1.21 Acres	0.92 Acres
Clay	38.5 Acres	13.0 Acres	3.14 Acres	1.93 Acres	1.43 Acres	1.11 Acres

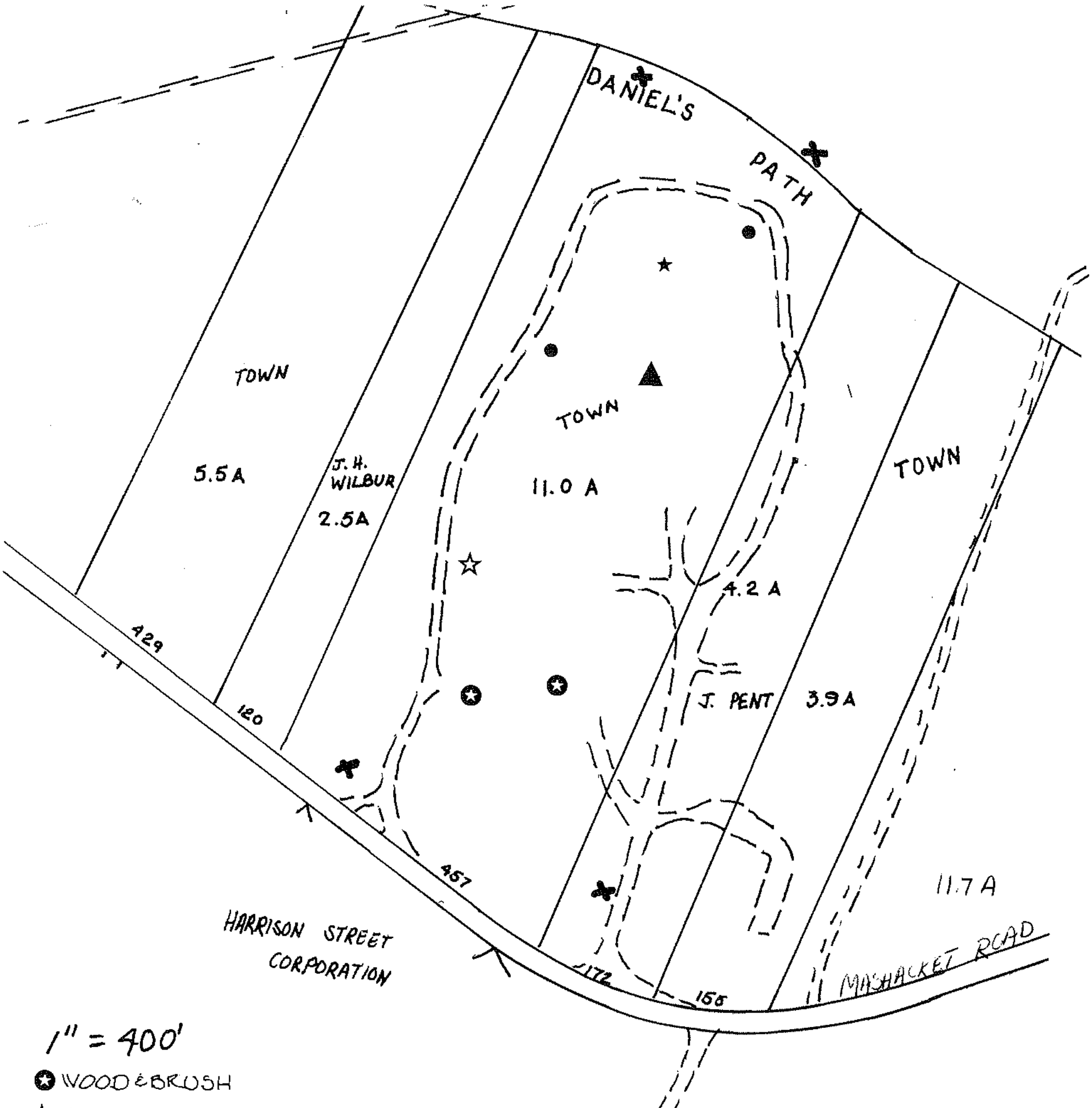
TABLE a-26

AVERAGE LOT SIZE IN ACRES

1. Private water
2. Private sewage
3. 2% slope
4. No anticipated public sewage

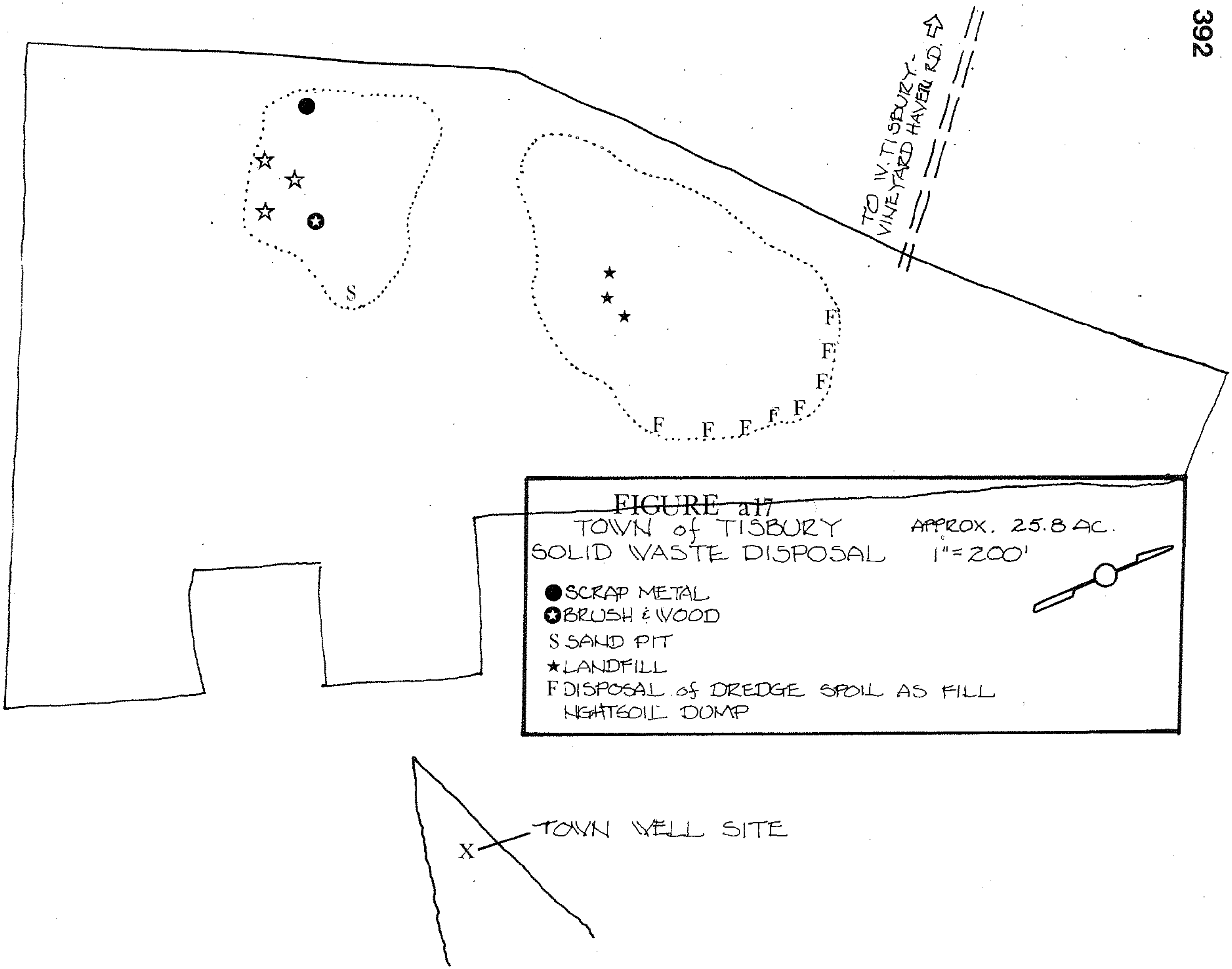
Soil Type	Depth to Ground Water in Feet					
	5	10	20	30	40	50
Coarse Gravel	>373 Acres	>373 Acres	>373 Acres	373 Acres	138 Acres	31.4 Acres
Coarse Sand	>373 Acres	>373 Acres	212 Acres	41.6 Acres	10.5 Acres	6.89 Acres
Fine Sand w/ some Clay	63.5 Acres	20.0 Acres	7.13 Acres	4.23 Acres	2.81 Acres	0.81 Acres
Silt	17.1 Acres	9.01 Acres	5.04 Acres	2.81 Acres	1.81 Acres	0.64 Acres
Clayey Sand	17.1 Acres	9.01 Acres	5.04 Acres	2.81 Acres	1.81 Acres	0.64 Acres
Clay	26.3 Acres	13.8 Acres	5.70 Acres	3.49 Acres	2.36 Acres	0.72 Acres

FIGURE a16
EDGARTOWN LANDFILL



1" = 400'

- ✪ WOOD & BRUSH
- ☆ FORMER NIGHTSOIL DUMP
- ▲ FORMER SLIP-FACE MIXED LANDFILL
- ● SCRAP METAL
- ★ SANITARY LANDFILL
- ✖ TEST WELLS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GAY HEAD LANDFILL
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