

ACTING LOCALLY

MUNICIPAL TOOLS — FOR — ENVIRONMENTAL PROTECTION

ANJEC wishes to thank the Victoria Foundation
for its generous grant that made this publication possible.

ASSOCIATION OF NEW JERSEY ENVIRONMENTAL COMMISSIONS (ANJEC)
PO Box 157, Mendham, NJ 07945
2002

Sandy Batty, *Executive Director*

ACKNOWLEDGMENTS

Several authors researched and wrote the different chapters of this book:

“Open Space” and “Materials Conservation” by Priscilla E. Hayes,

“Streams” and “Wetlands” by Penny Hinkle,

“Lakes” by Kim Ball Kaiser,

“Coasts,” “Estuary,” “Ground Water,” “Steep Slopes” and “Trees” by Margaret McGarrity, and

“Air” by Kathy Moser.

Thanks to Sally Dudley, past Executive Director of ANJEC, who guided this publication through the many years it took to get it to press.

Thanks also to reviewers Abbie Fair and Kerry Miller of ANJEC, Jan Larson of Ocean County, Lew Goldshore, Esq., Dery Bennett of the American Littoral Society, Michael Calvin of American Lung Association, and Penny Jones of Morris County MUA.

Penny Hinkle and Sandy Batty, editors
Association of New Jersey Environmental Commissions (ANJEC)
PO Box 157
Mendham, NJ 07945
Sandy Batty
Executive Director

CONTENTS

Acknowledgements	.....	ii
Chapter 1	Acting Locally	.....1
Chapter 2	Groundwater Protection	.....5
Chapter 3	Streams and Rivers	.....20
Chapter 4	Wetlands	.....34
Chapter 5	Lakes	.....44
Chapter 6	Preserving Forests and Trees	.....55
Chapter 7	Protecting Steep Slopes	.....70
Chapter 8	Open Space	.....79
Chapter 9	Coastal Protection	.....97
Chapter 10	Estuaries: Coastal Cornucopia	.....110
Chapter 11	Reducing Waste	.....121
Chapter 12	Air Quality	.....132
Appendix	Contact Information for Organizations Mentioned in This Book	.....142
Index	.....	146

CHAPTER 1

ACTING LOCALLY

For the long-term future of the planet, environmentalists have urged us all to “think globally.” For that reason, many environmental regulations are promulgated at the national, state, regional or county level.

The reciprocal admonition to “act locally” is the mandate of the local municipal agencies, often with reinforcements from volunteer groups and nonprofit agencies in the community. Our national and State laws either do not safeguard or only partially protect many local natural resources. Municipalities need to use their powers to ensure preservation of their local assets.

New Jersey’s 566 towns derive their environmental clout from the concerted action of their municipal boards and committees. Every town has the power to preserve the natural resources within its borders. It will take the combined effort of all boards to accomplish this.

MUNICIPAL POWERS

The governing body has the legislative power to pass ordinances governing issues such as land use and police enforcement. The zoning ordinance implements the master plan by assigning specific uses to different areas, or zones, of the community. Because the ordinance outlines what is permitted in each zone and the density of development, it can protect environmentally sensitive areas. The governing body can pass additional land use ordinances to set standards for development. It also can adopt a stormwater management plan to control flooding, reduce soil erosion and curtail nonpoint source pollution.

The governing body has several other important powers that it can use to protect the environment. It has the authority to hire and supervise police and other personnel to assure the ordinances are enforced. It oversees the public works department’s use of pesticides, herbicides and road salt. In addition, the governing body sets priorities when it drafts and adopts its budget. It can appropriate funds for open space protection and public education on environmental issues. The governing body may also apply for county or state grants to purchase and protect sensitive lands.

Finally, the governing body has the power to establish the town’s boards and commissions. It should appoint dedicated, knowledgeable members to each board and make provisions so that they receive the proper training to fulfill their mandates.

The planning board has primary authority for land use planning in the town. New Jersey law gives municipalities the power to direct and control land use and thus protect natural resources, in coordination with the over-arching State laws. The *Municipal Land Use Law* (MLUL) (N.J.S.A. 40:55D-1 et. seq.) requires every planning board to create, adopt and periodically update a master plan to guide present and future development. Careful, methodical preparation of the master plan provides a logical and legally defensible basis for zoning and zoning ordinances. It can help protect sensitive environmental features of the town by steering development away from them.

The municipal master plan must include a statement of objectives, policies and standards, and a

land use element The land use element identifies the physical characteristics of the municipality — existing land use, soils, geology, topography, forests, rivers, and wetlands. In preparing the land use element, planning boards often use the environmental resource inventory (ERI), also called a natural resource inventory, prepared by the environmental commission. The master plan can contain plans for conservation areas, greenways, stream corridor protection and open space preservation.

The subdivision, site plan review and variance process gives the **planning board and zoning board of adjustment** ongoing opportunities to apply and weigh the effectiveness of local zoning and land use ordinances. In reviewing development plans, the planning and zoning boards can work to ensure that development does not harm the environment. This will have the long-term benefits both for the environment and for the town, which will not have to repair damage that results from improper development. The planning and zoning boards should use the research and information provided by the environmental, historic preservation and shade tree commissions and the scientific and technical expertise of the board of health and municipal utilities authority.

To assure that all necessary permits are obtained, the planning board or board of adjustment should refrain from signing final subdivision plans until they have received State permits, certifications of septic systems from the board of health and other governmental agency requirements. Boards can include measures to protect environmentally sensitive features in site plan and subdivision approvals. They can encourage conservation easements, require official approval of each phase of construction, secure agreements for future maintenance activities, encourage minimal use of pesticides and herbicides, and require use of native, pest-resistant plant species.

The State legislation that enables municipalities to create **environmental commissions** specifies that they should work to protect the natural resources in their communities. They can gather and distribute information including data on

the town's natural resources and environmental factors.

The environmental commission should create or update the environmental resources inventory, as needed. The commission should encourage the planning board to incorporate the ERI into the conservation element of the master plan. The commission must complete an index of the town's public and private open spaces. It can then develop an open space protection plan, with preservation of significant environmental features as a goal. The commission should recommend that the planning board also adopt this plan as part of the master plan.

Once it has completed an ERI, the MLUL states that the environmental commission should receive copies of all development applications for review. After studying the plans and accompanying documents, the commission should prepare a statement with its findings and recommendations. In addition, the member of the commission who also serves on the planning board can bring the commission's concerns on site plans and subdivision proposals. If a site is particularly sensitive, the commission should meet with the applicant as early as possible in the process.

A network of contacts with people at the NJ Department of Environmental Protection (NJ DEP), on neighboring environmental commissions, and in conservation groups can be helpful. They can furnish early warning of activities in neighboring communities that could negatively impact local environmental features, become partners in open space and greenway protection efforts, and contribute information that may not be available readily at the local level.

Educating the public on environmental matters is another environmental commission mandate. A commission may choose to:

- print fact sheets or brochures or publish articles in the community newspaper or newsletter;
- involve school children;

- sponsor educational meetings on local environmental issues and ways that citizens can help.

The board of health can pass ordinances on health issues, including water supply, sewage and septic systems, and solid waste disposal. The local board, a regional health officer or the county under the *County Environmental Health Act* can carry out enforcement of these ordinances.

In towns with septic systems, the board of health has an important responsibility of approval of plans for septs and oversight of maintenance of existing systems. This has a direct effect on the ground and surface waters in the town. Planning board approval of a proposed development project should be conditional on board of health approval of the septic system and wells, if needed. The board of health may, possibly jointly with the environmental commission, suggest a program of pesticide reduction or septic system management for the town. To educate residents about existing programs, the board of health and environmental commission could co-sponsor public information meetings or distribute informational fact sheets.

Municipal utilities authorities (MUAs) are responsible in many communities for water supply and for wastewater treatment, which gives them a vested interest in protecting rivers, streams and wetlands. Wastewater from an MUA plant is considered a “point source” discharge, which is regulated by the State. In many older communities stormwater runoff is piped to the same plant that treats domestic

wastewater. Pollution prevention programs for this runoff can help an MUA avoid a treatment plant upgrade. MUAs can also provide engineering expertise to help a town clean up its stormwater.

ABOUT THIS BOOK

Chapters of this book cover important local resources that need protection such as trees, groundwater, lakes, air, coasts and estuaries. Often ANJEC gets calls from municipal officials asking how they can protect a specific natural resource. This book is in answer to those calls for help. It incorporates many creative solutions implemented by municipalities around the state.

Each chapter first gives information on the specific resource: why it is important and the threats that face it. Without an understanding of the benefits of and difficulties facing the resource it is difficult to take action. The municipal official can use this information to explain the problem and resource to the town residents.

The chapter then touches on federal and state laws and programs concerning the natural resource, especially as they affect local action. ANJEC's *Environmental Manual for Municipal Officials* covers federal and State laws in greater detail.

Finally each chapter outlines the practical, specific actions and techniques local officials can take to protect the environmentally significant features in their towns. These include ordinances, development standards, data collection and public education. The solutions presented are based on the successful experience of many towns throughout New Jersey. ANJEC can provide copies of all the ordinances described and further information on the topics covered. Throughout this book are references for further information with phone numbers and helpful websites. The appendix has addresses for organizations mentioned in this book.

Natural resources, such as lakes, streams, wetlands and groundwater, are interrelated. Even

The legal responsibilities, policies and operations of municipal boards and commissions are discussed in detail in ANJEC's Environmental Manual for Municipal Officials, which also describes State laws, regulations and programs. The Environmental Commissioner's Handbook furnishes more specific guidance for Environmental Commissions. Both are available from ANJEC, 973-539-7547 or www.anjec.org

though the chapters present them as specific units, they must be seen as part of the whole ecosystem. Therefore, the subject matter of the chapters will overlap. Protection of one resource requires techniques that are applicable to protection of several. In particular, controlling nonpoint source pollution, carried in stormwater runoff from diffuse (nonpoint) sources, will benefit all water resources — groundwater, wetlands, streams, lakes, estuaries and the coast. In addition, open space protection measures will benefit any sensitive environmental features found in the land preserved — so a reading of open space protection techniques will give tools applicable in the other chapters. Rather than repeat information, we have provided cross-references of these subjects in the different chapters. In addition, the index shows where to find specific information within this manual.

CHAPTER 2

GROUNDWATER PROTECTION

New Jersey's biggest lake, Hopatcong, holds 12.8 billion gallons of water. The state's biggest river, the Delaware, carries an average 7.5 billion gallons past Trenton each day. But for every gallon of surface water in New Jersey, approximately 20-30 gallons are underground.

Nationwide and in New Jersey, 95 percent of all fresh water is groundwater. Half of New Jersey's residents — up to 100 percent in rural areas — get their water from the ground.

Like many lakes and rivers in the United States, our state's two largest bodies of surface water, Lake Hopatcong and the Delaware River, are managed to protect the quantity and quality of their waters. Protection of the state's groundwater, however, has been somewhat random and casual.

THE HYDROLOGIC CYCLE, GEOLOGY AND AQUIFERS

Water is a finite resource. The earth's water circulates continuously from the atmosphere to the land, to groundwater, to streams, lakes and oceans, and back to the atmosphere. In the hydrologic cycle, precipitation falls onto the land, where it evaporates, runs off or soaks into the ground. Evaporation also occurs from surface waters and oceans.

Of New Jersey's average annual 44 inches of precipitation, 1-2 inches run off the land to surface waters and oceans, about 24 inches are recycled through evapotranspiration, and about 17 inches recharge groundwater supplies.

As water moves down through the soil, its path is influenced by gravity, friction and in certain geologic formations, hydraulic pressure. The movement of water underground can be extremely complex and difficult to determine. It often — but not always — follows the gradient of the land.

Water filtering into the ground first travels through an unsaturated zone where both air and water fill the voids in soil and rock. Sometimes this is referred to as soil water. Plants use much of this soil water and transpire it to the atmosphere through their leaves.

Below the unsaturated zone is the saturated zone, where water fills all available spaces. The top of this zone is known as the water table, which lies at varying depths beneath the surface. In the saturated zone, some aquifers yield minimal amounts of water, perhaps enough for a single household, while others can supply large public water systems. Any aquifer should be pumped for only its safe yield, the amount that can be replenished and sustained for continuing use. If this yield is exceeded, the aquifer will be depleted and yield less water. This over-pumping is sometimes called "mining" an aquifer.

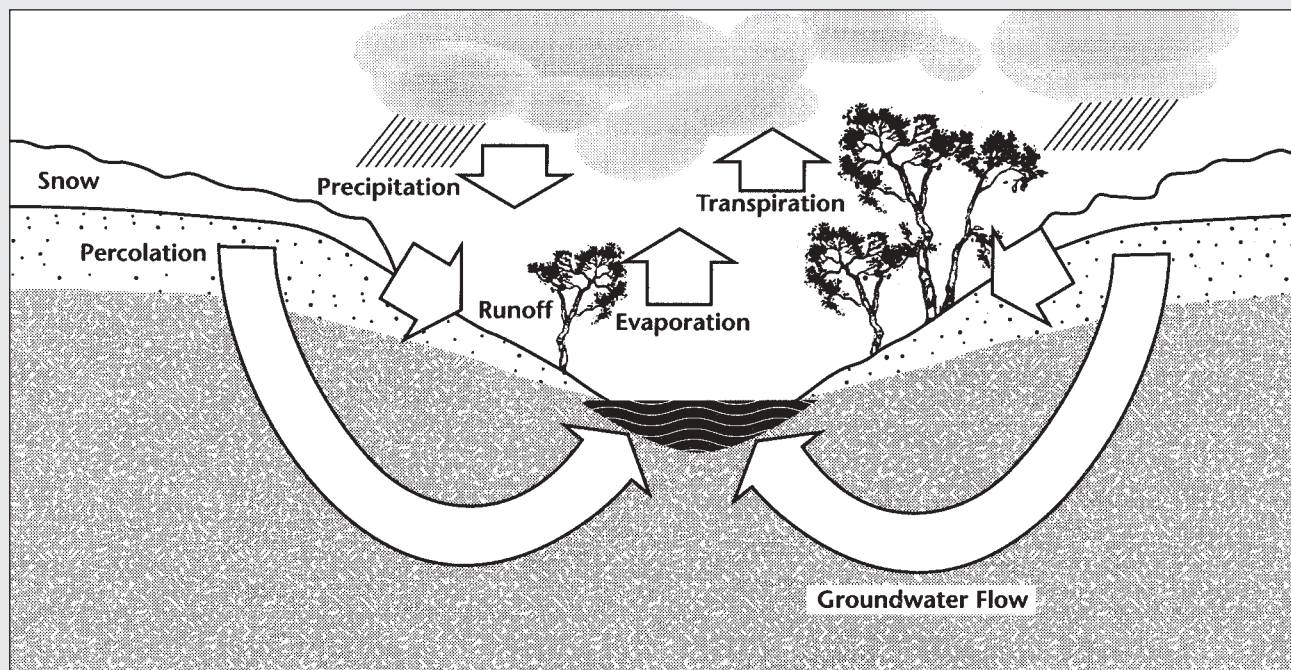
Water moving under the ground eventually finds a point of discharge where the water table intersects the land surface in streams, lakes, wetlands or springs, or where pressurized groundwater pushes to the surface. The journey from recharge to discharge can take days, decades or millennia. Depending on the geologic formation, groundwater can move several feet a day, only inches a year, or virtually not at all.

The Hydrologic Cycle

Many climate, soil and vegetation factors influence the hydrologic cycle. The most important climatic factors are the amount, intensity and form of precipitation. Wind, humidity and air temperature also influence the cycle through their effect on evapotranspiration. Soil properties, including permeability, water-holding capacity, water content prior to precipitation, and depth of plant roots, affect the recharge process. The type of vegetation influences recharge through its effects on evapotranspiration, interception of precipitation and surface runoff. At many points, the hydrologic cycle is vulnerable to human impacts, and these impacts can be detrimental to the quality and the quantity of groundwater.

Poorly designed or inappropriate development can interrupt the recharge of surface water to groundwater, contaminate water supplies, and deplete groundwater through withdrawals.

Pumping water from a well creates a cone of depression, a dip in the water table where the well draws from the aquifer, the geologic formation that contains readily obtainable water. The depression can alter the way groundwater flows, pull surface water into the water table, reduce the yields of nearby wells and draw contamination toward the well. Overuse of groundwater can reduce or dry up streams, because groundwater, not precipitation, supplies the base flow, the constant supply of water that sustains streams, many lakes and wetlands.



Hydrologic Cycle

It is a misconception to picture groundwater as a system of underground lakes and rivers, although eroded limestone bedrock can contain caverns and channels somewhat similar to lakes and streams. In consolidated rock formations, such as shales, sandstones, granites and gneisses, water is

contained in fractures, fissures or fault lines. Softer or weathered bedrock, such as sandstone, also holds water in the pores between rock grains.

Unconsolidated geologic formations — gravels, sands, silts, and clays — also hold water in the pores between rock grains. How much water

these formations contain depends on grain size and how exactly they are sorted into homogeneous layers. Well-sorted sands and gravels can hold large amounts of water.

Fine, compact clays typically contain very little water, and often act as impenetrable layers known as aquitards that partly or completely seal off other water-bearing formations. Aquifers that are sealed or protected by aquitards are called confined aquifers, and are usually under pressure.

Unconfined aquifers are at atmospheric pressure, and are sometimes called water table aquifers. Unconfined aquifers are very susceptible to contamination, especially in unconsolidated deposits near the surface and in limestone areas where caverns may connect in unexpected ways or lead directly to the surface.

Confined aquifers enjoy better natural protection against contamination. However, their recharge or outcrop areas may be located quite a distance from the rest of the aquifer. In some parts of southern New Jersey, recharge areas for the underlying aquifers are 40 or 50 miles to the west. Some aquifers are totally confined and cannot be recharged. Once pumped, the water is not replenished.

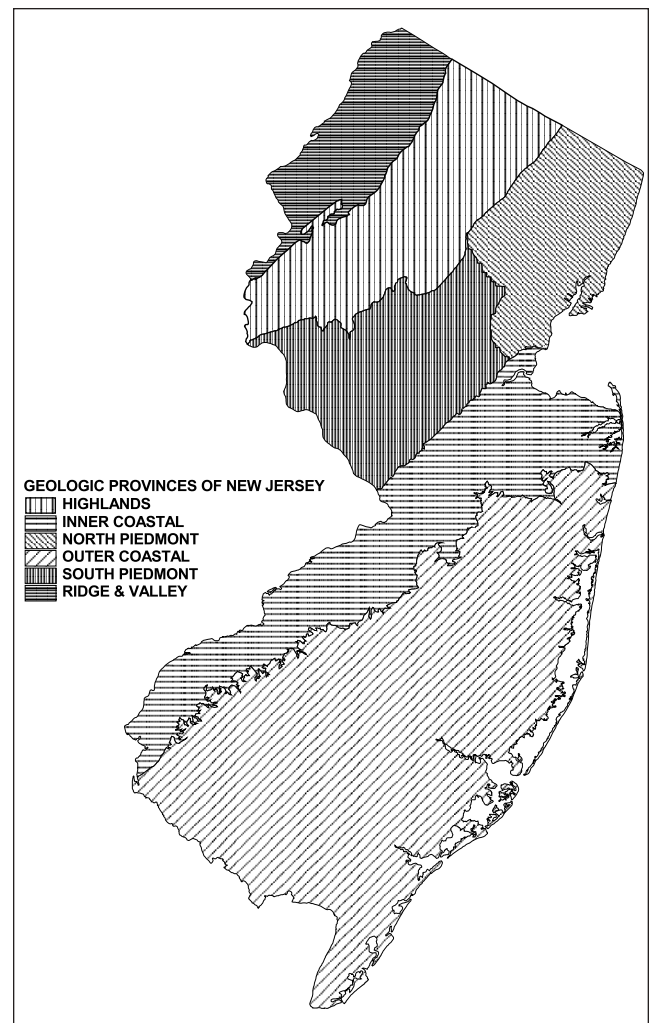
Although direct precipitation and runoff from the land help fill lakes, streams and wetlands, the constant base flow of most streams and a portion of the water in many lakes and wetlands is provided by groundwater seeping in from the sides and bottom. Overuse of groundwater can diminish or even dry up streams, lakes and wetlands. Polluted groundwater can contaminate surface water. The flow of water — and pollutants — can go in the other direction as well, from surface to groundwater.

New Jersey's Geology

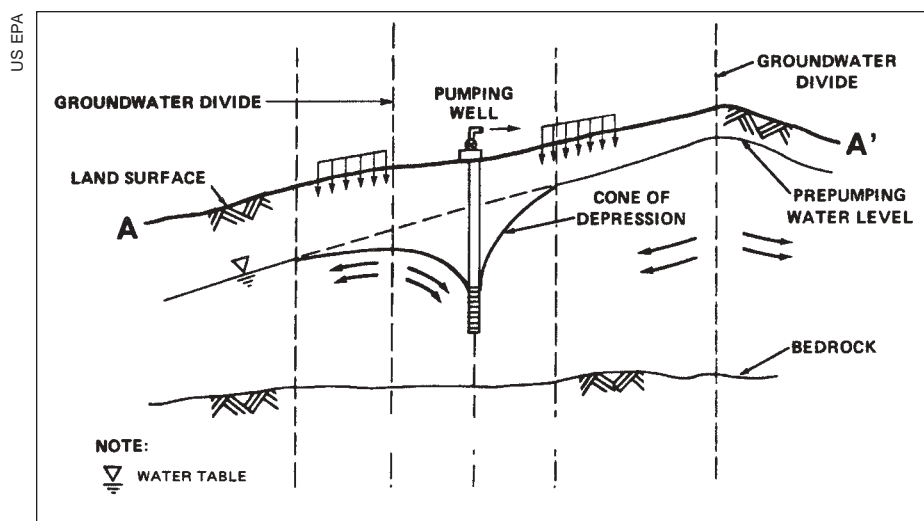
New Jersey is divided into four basic geologic zones or provinces characterized by different rocks, topography, and groundwater conditions. See also Chapter 7 on slopes.

The upper portions of Sussex and Warren counties, in the northwestern New Jersey, is the Ridge

and Valley province, consisting largely of sedimentary limestones and dolomites, sandstones and shales. These formations contain water in rock fractures. Limestone also holds water in solution channels formed by dissolving limestone, which can supply enormous quantities of water. However these underground channels can be complex and the surrounding limestone may include such features as disappearing rivers, sinkholes or areas of general subsidence, where the surface has sunk or collapsed into voids in the bedrock. Because of these connections with the surface, aquifers in limestone can be easily contaminated. In the maze of underground channels the contaminants can move fast and be difficult to trace.



New Jersey Geophysical Provinces



A pumping well creates a cone of depression where the water level drops.

To the east, the Highlands province lies in the southern portions of Sussex and Warren counties and the northern portions of Passaic, Morris and Hunterdon counties. The geologic formations consist primarily of gneisses and granites, hard crystalline bedrock that can hold water only in fractures and fault lines. These formations typically supply minimal well yields, adequate only for a single household. Yields can be much greater where the rock is extensively fractured or faulted. These areas also may be important recharge areas. Wells drawing from hard bedrock formations typically pull water from several fractures. A two-part pump test is recommended to make sure well yields are adequate.

For Further Information

Two-Part Pump Test for Evaluating the Water Supply Capabilities of Domestic Wells, NJGS GWR 1, 1986. NJ DEP, Office of Maps and Publications, 609-292-1185 or www.state.nj.us/dep/njgs/index.html

The Piedmont province lies above New Jersey's fall line, an imaginary line that stretches across the center of Mercer and Middlesex counties, where the topography dips down to the coastal plain. Piedmont geology consists largely of sedimentary slates, shales, and sandstones, with some

harder volcanic rocks. Water supply in the Piedmont is often poor, but also can be very good where there are extensive fractures and faults.

In these three provinces, glacial deposits left long after the bedrock was formed can provide good sources of water, especially where they fill long valleys, as in the Ridge and Valley province. In other areas, many of these lowland glacial deposits are too small to supply much water. Glacial tills, the unsorted mixture of sand, clay and boulders found on upland areas, are not good aquifers.

New Jersey's fourth geologic province is the Coastal Plain, which includes the southern portions of Mercer and Middlesex and the nine southern counties. Rock formations consist of unconsolidated deposits of silt, sand, and clay. The five principal aquifers in the coastal plain lie on top of one another with the lower four aquifers being confined by layers of silt and clay. This sandwich of aquifers tilts steeply toward the coast. Recharge areas for the confined aquifers are located along Route 1. In the Coastal Plain, 85 percent of the population depends on groundwater, which also supplies 90 percent of the water to the streams.

FEDERAL AND STATE PROGRAMS

Federal and state programs to protect groundwater have been fragmented and occasional. Perhaps this is because few people noticed the water table being lowered by overuse. No one saw groundwater pollution. The general public assumed that soils would absorb contaminants before they reached groundwater. However, in the last two decades, rapid development of rural and suburban areas has increased the state's dependence on groundwater and also increased the risks of contamination and depletion.

At the same time, better testing methods have revealed more and more chemicals in groundwa-

ter. Many are carcinogens or mutagens; some are considered toxic if ingested over long periods in concentrations as small as several parts per billion. Despite this accumulating evidence of extreme toxicity, US Environmental Protection Agency (USEPA) and NJ Department of Environmental Protection (NJ DEP) regulate only a few of the 60,000 or more chemicals now in use.

Nor has much been done to stop groundwater depletion, except when the problem has already become critical. The nation's largest single underground water supply, the Ogallala Aquifer, which covers 156,000 square miles from South Dakota to Texas at a depth of 200 to 1,200 feet, is contaminated by agricultural chemicals and is permanently depleted by over-pumping. It is easy to imagine how New Jersey's smaller, local aquifers, some only a few acres in size or consisting of water-filled cracks and fissures in bedrock, can be mismanaged and damaged.

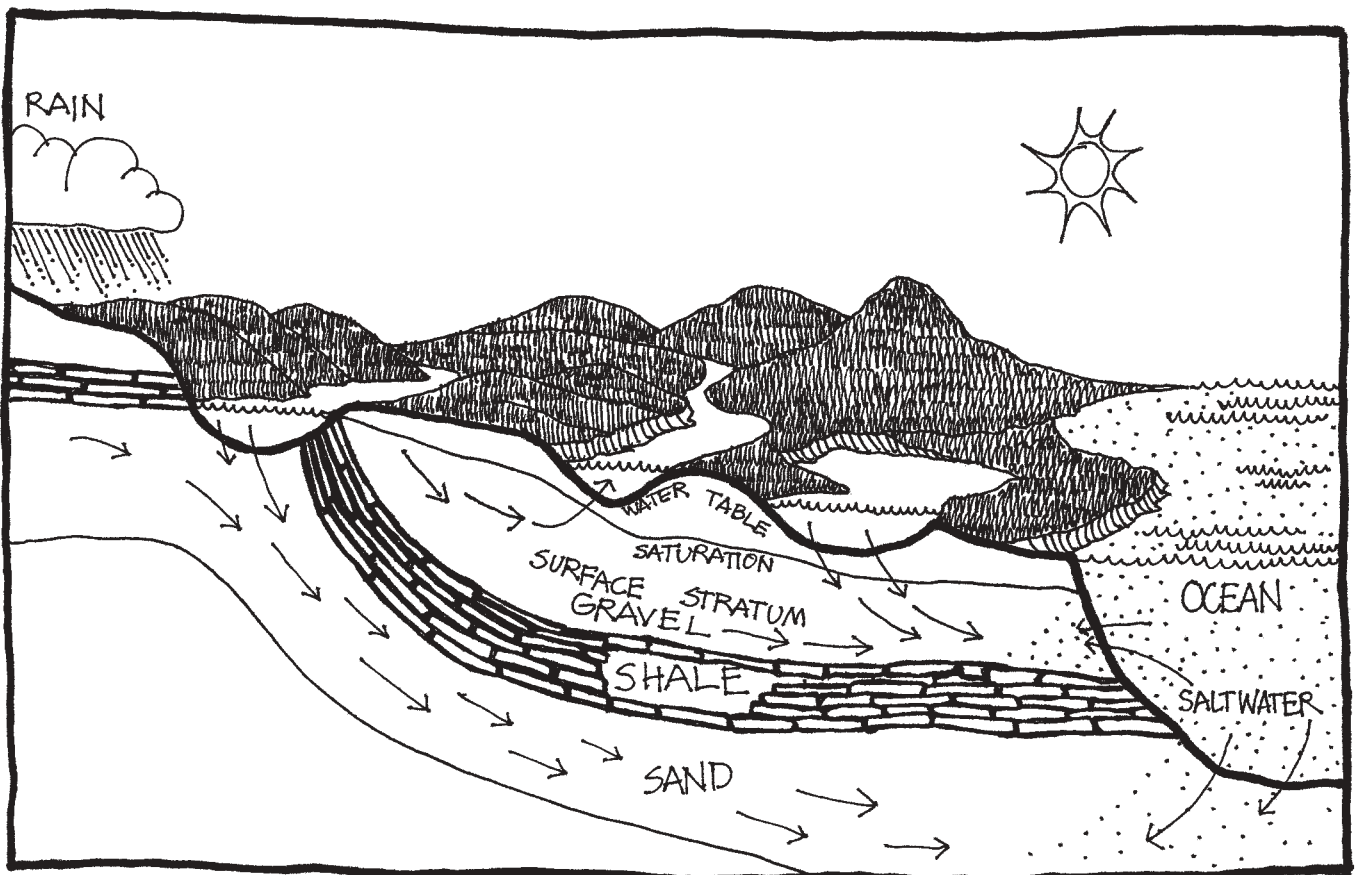
Failure to protect the quality and quantity of groundwater threatens the health of New Jersey's people and its ecosystems and also the state's economy and quality of life. Finding new water sources is expensive; cleaning up contaminated groundwater is extremely costly and often impossible. Threats to groundwater also threaten surface water, because all water is connected by the hydrologic cycle.

For Further Information

US EPA 800-426-4791 or www.epa.gov/ogwdw/

Regional Programs

The groundwater and aquifers in three large areas in the Coastal Plain are subject to special State regulations and restrictions because of their importance as water sources, their susceptibility



Subsurface Water Movement

BARBARA PRETZ

Typical Groundwater Contaminants

Contaminants in groundwater can be inconsistent, difficult to trace, and very costly or impossible to remove. Because groundwater moves without the turbulence and mixing seen in surface water, groundwater contamination typically moves in self-contained plumes, like the smoke from a stack. Without sunlight and aeration to help combat pollutants and because of this plume-like movement, levels of biological or chemical contamination in groundwater are often much higher than in surface water. The slower movement of groundwater also means that contaminants persist longer. In general, wells downslope of a source of contamination are more at risk.

Some groundwater contaminants occur naturally, including radon, nitrates, iron, chlorine, hydrogen sulfide and methane, but they usually don't occur in toxic concentrations.

Major sources of manmade contamination include:

- underground storage tanks at commercial and industrial establishments, farms or homes, which may leak motor fuels, heating oil, solvents, pesticides or other hazardous materials;
- poorly designed, poorly used, and poorly maintained septic systems, which can be a source of bacteria, viruses, heavy metals and hazardous substances found in many household, hardware, automotive, cosmetic and medical products. All septs also generate nitrate contamination, which can be controlled by basing residential lot sizes on the nitrate dilution factor of different soils;
- small businesses such as laundries, dry cleaners, auto repair and body shops, gas stations, printers, photo processors, furniture strippers, and other establishments that use septs to discard hazardous substances or that allow hazardous substances to enter soils or surface waters;
- leaking pipelines, including sewer pipes;
- runoff from roads and parking lots, which may contain petroleum and other automotive chemicals and de-icing salts;
- fertilizers and pesticides from lawns and gardens, farms or orchards;
- improper disposal, on lawns, driveways or in wooded areas of many products used by homeowners, including automotive chemicals, paints and thinners, degreasers, pesticides;
- unsecured landfills or dumpsites;
- improperly sealed abandoned wells, which provide a direct route to the aquifer;
- abandoned or active mines, oil and gas wells;
- surface impoundment and well injection disposal of hazardous liquids; land disposal of wastewater or sludges;
- above ground storage tanks;
- accidental spills, typically during transportation of hazardous materials (municipalities should have emergency management plans specific to local hydrogeology);
- saltwater contamination induced by excessive pumping from an aquifer. The saltwater can be pulled in from the ocean but also from deeper saltwater aquifers that underlie many non-coastal areas.

Several of these sources, including commercial or industrial facilities, household septs, and improper disposal by homeowners, produce heavy metals and volatile organics found in wells throughout the country. Volatile organic compounds or VOCs (carbon- and often chlorine-based chemicals that tend to evaporate) are commonly found in industrial and household solvents, such as paint thinners, degreasers and cleaners of various types. These include so-called septic system cleaners, which pollute groundwater and kill off many of the beneficial bacteria that keep septic systems working properly. The most common VOC is TCE or trichloroethylene.

to contamination and problems resulting from over-pumping:

- The *Pinelands Protection Act* of 1979 (N.J.S.A. 13:18A) imposed strict controls on development and groundwater usage in a 937,000-acre area that overlies an unconfined sand and gravel aquifer containing 17 trillion gallons of water.
- In the mid-1980s, the NJ DEP established two critical areas where groundwater withdrawals had to be cut by 35-50 percent because water tables had dropped about 90 feet and saltwater was intruding into the aquifer. Critical Area #1 includes southern Middlesex County, all of Monmouth, and northern Ocean County. Critical Area #2 includes parts of Burlington, Camden, Gloucester, Ocean and Atlantic counties.

Throughout the state, regional or watershed organizations monitor groundwater:

The Delaware River Basin Commission was established in 1961 to oversee water quantity and quality in that watershed. Its work includes extensive groundwater monitoring.

The Delaware and Raritan Canal Commission reviews development applications, especially stormwater management plans, in parts of five counties within the 400-square-mile canal watershed. The canal supplies water to about 1 million people.

Middlesex County draws about 80 percent of its water supply from groundwater and since the 1970s has known that excessive groundwater use was causing saltwater intrusion into its aquifers. The county planning board and health department now conduct a wellhead and aquifer-recharge protection program, funded by the county and NJ DEP. Middlesex is using GIS maps of primary recharge areas, major wellhead protection areas and all potential sources of contamination to plan protection for its water supply. The completed plan will incorporate an overlay zone that imposes tougher standards in recharge and wellhead areas; a land acquisition program to protect important groundwater

recharge areas; and special training for municipal health and land use officials to ensure that the management recommendations are imposed and enforced.

Several watershed associations also monitor groundwater. These groups do research, present seminars and publish brochures. Several are involved in aquifer mapping and wellhead protection projects.

For Further Information

Musconetcong Watershed Association,
908-537-7060 or www.musconetcong.homestead.com

Passaic River Coalition, 908-766-7550 or
www.passaicriver.org

Paulinskill-Pequest Watershed Association,
973-383-1406 or www.paulinskillpequest.homestead.com

South Branch Watershed Association,
908-782-0422 or www.eclipse.net/~sbwa/

Stony Brook Millstone Watershed Association,
609-737-3735 or www.thewatershed.org/

Upper Raritan Watershed Association,
908-234-1852 or www.urwa.org

Upper Rockaway River Watershed Association,
973-361-1359

LOCAL ACTION

Securing adequate potable water is primarily a local responsibility. The municipal power to plan and zone, which allows towns to control what is built on the land, is one of the best ways to prevent pollution and overuse of groundwater because what happens on the land ultimately affects groundwater quality and quantity. Therefore, groundwater protection should be a central principle of municipal planning.

An environmental commission can take the first positive steps towards groundwater protection by preparing a municipal Natural Resources Inventory (NRI) or Environmental Resources Inventory (ERI). The NRI should map and rank groundwater recharge areas and aquifers. The soils maps will provide important information for groundwater protection, such as permeability and septic suitability. Maps of the surficial and bedrock geology can help determine an aquifer's safe yield of water and susceptibility to contamination.

Groundwater Recharge Mapping

The NJ DEP's NJ Geologic Survey (NJGS) has produced a report to provide municipalities a means to assess groundwater recharge areas and rank their importance. The focus is on groundwater recharge (the volume of water transmitted to the subsurface through soils), rather than aquifer recharge (recharge to geologic formations that can yield economically significant quantities of water to wells or springs).

Awareness of groundwater recharge areas is important because land use and land cover have a large effect on the recharge that is necessary for most water supplies, wetlands and surface water bodies. Municipalities can use the recharge maps to help decide where, how and to what extent to develop land. NJGS developed the method so that it will provide a reliable estimate of groundwater recharge without requiring an advanced knowledge of hydrology or mapping.

Byram Township (Sussex) was the first municipality to have created its own groundwater recharge map using the NJGS groundwater

recharge mapping method. Assisted by NJGS, the environmental commission produced the map for a 1994 update of its Natural Resource Inventory. The NRI also contains bedrock and surficial (glacial deposit) geology maps from NJGS and a special Water Resources chapter.

The NJGS is mapping groundwater recharge areas in the entire state. It has finished maps for the Upper Passaic, Rockaway and Whippany watersheds in northern New Jersey and the Rancocas and Cooper watersheds in southern New Jersey. Maps of recharge in Monmouth, Middlesex and Cape May Counties are also available. Areas under way are Morris and Bergen Counties and the North and South Branch Raritan River watersheds.

For Further Information

A Method For Evaluating Groundwater Recharge in Areas of New Jersey, Emmanuel G. Charles and others, NJ DEP, Report #GSR-32, NJ DEP Office of Maps and Publications, 609-777-1039 or <http://www.state.nj.us/dep/njgs/pricelst/index.htm>

NJ DEP GIS information, 609-984-2243 or <http://www.state.nj.us/dep/gis/>

Wellhead Protection

Federal law requires each state to establish wellhead programs that delineate areas of protection around public supply wells. NJ Geological Survey (NJGS) has delineated wellhead protection areas (WHPAs) for community wells in the state, based on geology, soils and aquifers. The protection areas are delineated in Tiers, determined by the time it takes a given particle of groundwater to flow to a pumping well, known as the "time of travel." The distance the water will travel over a set time period will vary depending on the rate of pumping and aquifer characteristics, such as transmissivity, porosity, hydraulic gradient, and aquifer thickness. NJGS has delineated three tiers for each WHPA indicating the relative risk of contamination to the

well. For example, the outer border of Tier 1 has a time of travel of two years, protecting against pathogens, which cannot survive in groundwater more than this time. Counties and municipalities are responsible for passing ordinances to regulate wellhead areas.

For Further Information

Wellhead Protection: A Guide for Small Communities, US EPA, 1993, 877-987-7433
www.epa.gov

New Jersey Wellhead Protection Program Plan, NJ DEP, Division of Watershed Management, 1991.
www.state.nj.us/dep/watershedmgt/index.html

NJ DEP Bureau of Safe Drinking Water,
 609-292-5550 or www.state.nj.us/dep/watersupply/safedrnk.htm

NJ DEP, NJGS, 609-984-6587 or
www.state.nj.us/dep/njgs

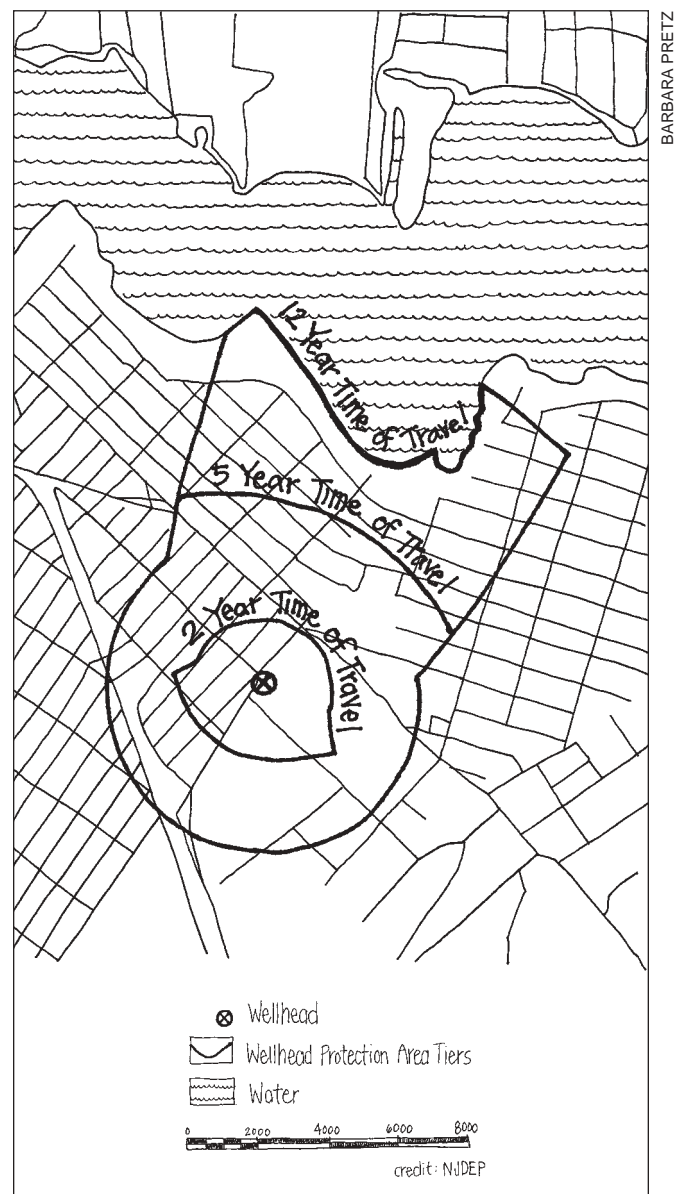
- Base zoning of residential densities, allowable industrial or commercial uses, and the location, size and density of sewered areas on available water supplies.
- Complete a build-out analysis, showing what a municipality would look like if all the development allowed by the zoning ordinance were to take place to help local planners evaluate whether full development will exceed the carrying capacity of the local natural features, including water supply.

Natural Resources Inventory

The NRI should encourage and emphasize watershed-based planning, explaining how the sum of all human activities affects surface- and groundwater resources. It should include the following information, central to groundwater protection:

- up-to-date information about private and public wells, including usage, wellhead protection areas and episodes of contamination;
- a list of potential sources of pollution — existing sites as well as those that could develop as allowed in the master plan or zoning ordinances.
- an open space inventory that explains how maintaining natural land conditions helps prevent water pollution.

This valuable information will enable other municipal bodies to act. The planning board and governing body can revise the master plan and ordinances to protect surface and groundwater and work with nearby municipalities on these issues. Among the strategies to consider:



Wellhead Protection Area Delineation

- Delineate zoning districts to prevent inappropriate or high-risk development over sensitive recharge and aquifer areas, to buffer streams, wetlands and lakes, and to coordinate lot size with soil and septic requirements.
- Small-lot subdivisions with wells and septic systems are prone to problems, especially in areas where the water table is susceptible to contamination. A municipality may decide to zone certain areas for larger lots, or provide public water systems as needed.
- Continue to rely on septic systems to allow groundwater recharge. Building sewer systems can deplete groundwater supplies by carrying away large quantities of water to be discharged elsewhere. In addition, because sewer lines can leak, they should not be run over or through important aquifers.

Groundwater Protection Ordinances

Local ordinances can protect groundwater by incorporating the following strategies:

- Require site plans and best management practices (BMP's) that protect groundwater from contamination by either point or non-point sources of pollution;
- Institute wellhead protection and septic management programs;
- Designate aquifer and limestone overlay zones;
- Establish stream corridor and lake buffer regulations;
- Promote clustering to preserve open space;
- Limit clearing and land disturbance. Clearing and changes in vegetation can increase erosion and reduce recharge; large lawns promote the use of fertilizers and pesticides.

Municipal boards of health, in conjunction with environmental commissions and other boards, can organize testing programs for individual household wells and small water companies that supply fewer than 15 connections and 25 people. State law does not require private well drillers to

test for bacteria or the growing list of chemicals that often contaminate private wells. New Jersey's *Private Well Testing Act*, effective September 14, 2002, requires home sellers of the 370,000 private wells in the state to test for bacteria, nitrates, iron, manganese, lead and volatile organic compounds for which maximum contaminant levels have been established. Regular testing between sales is not required.

Local boards of health and environmental commissions can also promote water conservation, educate residents about preventing groundwater pollution, organize hazardous waste disposal days for homeowners, and help the planning board and governing body develop master plans, ordinances and management practices that protect groundwater.

Municipalities in New Jersey's northern "snow belt" should also test wells for salt contamination and restrict the use of road salt, especially in important groundwater recharge zones, wellhead protection zones, over susceptible aquifers, and near waterways. Salt can leach into surface- and groundwaters, harm plant and animal life, damage cement and metal infrastructure, and make water unsuitable for certain manufacturing processes. Some studies show that road salting will eventually produce severe water quality degradation.

The zoning and construction officers, the sanitarian, and the board of health should obtain "Right to Know" information about hazardous substances used or released by local businesses, then make inspection visits. They can organize or oversee monitoring programs for suspected contaminated sites. These officials can also ensure that septic and well regulations are suitable for local geological conditions and are enforced.

Aquifer Overlay Zone Ordinances. In 1979, the Morris County towns of Boonton Township, Mountain Lakes and Denville hired a consultant to map the aquifer that supplies their public water system. Subsequently, Mountain Lakes, Denville and Montville adopted overlay ordi-

nances to protect the aquifer that supplies their public water systems. In the overlay area, special requirements are added to existing zoning, site planning and performance regulations to protect the aquifer from contamination and preserve the quantity and quality of recharge. The ordinance requires planning board approval for new wells, special groundwater and recharge studies for development applications; bans underground storage tanks in residential developments (or requires test wells for existing tanks); prohibits body shops, hazardous waste products and gas stations; and lays down special stormwater management provisions. The emergency management plan directs special attention to spills that occur on land over the aquifer.

Groundwater-based Carrying Capacity Studies

Municipalities can perform a carrying capacity study to determine the number of septic systems that can be installed and used before the underlying groundwater resource is threatened. Nitrate, a main constituent of domestic wastewater, is often monitored as a gauge of groundwater quality. It is highly mobile, moving quickly through an aquifer and does not degrade easily by biological or chemical processes. At concentrations in excess of 45 mg/l (milligrams of nitrate per liter of groundwater) nitrate can be fatally toxic to infants. The US EPA has set a standard of 10 mg/l for nitrate in its safe drinking water regulation, which the NJ DEP has also adopted as part of the groundwater quality standards.

West Windsor (Mercer) performed a study using estimated inputs of nitrate from major sources of nitrogen — lawn fertilizer, leachate from septic systems and precipitation. The resulting numerical output was compared to a standard to evaluate if the carrying capacity of the system failed or passed. West Windsor used the results of the nitrate dilution model to determine the minimum lot size to meet a target nitrate level of 8 mg/l in groundwater. The study concluded that current residential zoning on two parcels of undeveloped land might constrain the natural

carrying capacity of the underlying aquifer. The study recommended modifying the zoning on the two parcels to sustain the quality of the local groundwater.

The Mendham Township (Morris) Environmental Commission used a Rutgers University growth management program (*The Current Planning Capacity Model* and the *Nitrate Dilution Model*) to produce a “Critical Water Resources Study” for the Township. Mendham has no sewers and most drinking water comes from private wells. The study recommends 5.5 acre zoning in most of the township, to protect drinking water from nitrate contamination from septs. The acreage requirement is based on geologic formations so that nitrates in septic effluent can be diluted to safe levels in groundwater.

Other municipalities in Somerset, Hunterdon, Morris, Warren and Sussex counties have used the nitrate dilution model to assess potential groundwater contamination from septic systems and for rezoning purposes. *The Pinelands Comprehensive Management Plan* also used the nitrate dilution model as a basis for zoning for different densities in areas of the Pinelands. It can be an efficient tool for determining the appropriate level of development for an area. However, carrying capacity studies can be controversial.

Wastewater Management

The municipal wastewater management plan specifies how a municipality or regional sewer authority will meet its wastewater needs for the next 20-year period. Requirements include identification of sewer service areas, areas on septic systems, environmentally sensitive area mapping, zoning and projected population distribution.

Lafayette (Sussex), which depends entirely on groundwater wells and septic systems, did a municipal wastewater management plan that considered geological and environmentally sensitive features, including available underground water supplies and suitability for septic systems.

The plan led to recommendations on population limits and minimum lot size. Lot sizes range from 1 to 4.5 acres; average densities, based on nitrate dilution and other factors, range from one unit per 2.2 acres to one unit per 6.1 acres. Lafayette's plan also:

- recommends specific types of septic systems or alternative technologies;
- calls for special wastewater technologies, such as recycling of wastewater, pretreatment of wastes or waterless toilets, in non-residential buildings;
- requires an acceptable water supply and wastewater plan for any non-residential proposal;
- discourages large-scale projects that would require large amounts of water and produce large amounts of wastewater;
- calls for preserving Lafayette's rural, low-density zoning as recommended in the State Development and Redevelopment Plan for Planning Areas 4 and 5 (Agricultural and Environmentally Sensitive);
- explains that sewers would be undesirable in Lafayette because of limited groundwater supplies, the likelihood that a sewer system would reduce recharge to Lafayette's aquifers and decrease base flows to many streams, and the inability of Lafayette's streams to assimilate discharge from even small-scale sewage plants and the need to maintain low density zoning (which would make sewers very expensive per household);
- recommends designating the entire township as a septic management district, with permits and required pumpouts, tracking of system failures, and public education.

A 2001 amendment to the State Water Quality Management Planning regulations affects residential development proposals for six or more septic systems and non-residential projects discharging 2,000 gallons or more per day to groundwater. Previously, residential developments on septic systems needed NJ DEP review only for 50 or more homes.

The new amendment requires submission of wastewater management plan amendments for the development applications described above. The new rules also mandate environmental assessments, which must:

- address impacts to riparian buffers;
- conduct nitrate dilution modeling to determine groundwater impacts;
- determine that there will be no net increase in loadings and minimum hydrologic modification to surface and ground water;
- determine that future water supply needs can be met.

Rather than wait for scattered development applications, municipalities can amend their wastewater management plans to address these regulations. DEP will review such amendments to see if the town's ordinances address the required environmental assessments. To qualify, for example, a municipality would have to have ordinances that require adequate riparian buffers and stormwater management that mimics natural runoff conditions and promotes infiltration.

Septic Management Ordinance. In areas served by individual wells and septic systems, the board of health may adopt even more strict standards than those required by the *State Realty Improvement Sewerage and Facilities Act* (N.J.S.A. 58:11-23 et seq.) and its implementing regulations (N.J.A.C. 7:9A-1.1 et seq.), also known as Chapter 199. In such areas, subdivision and site plan approvals, as well as construction permits, should be contingent on board of health certification so that the planned development will not pollute local waters.

Byram and Sparta Townships (Sussex) passed septic management ordinances in the late 1980s, assisted by a \$400,000 NJ DEP grant to the Sussex County Planning Department. The Byram septic management district encompasses the 525-home Cranberry Lake community. Homeowners must obtain a \$15 permit and update it every three years, showing proof of pumping. Homeowners, who must also find and map their systems, receive

extensive educational information. The Byram Environmental Commission and the Cranberry Lake Community Club also help administer a Cranberry Lake management program. The Byram Natural Resources Inventory, updated in 1994 by the environmental commission, contains a septic suitability map with an explanation of soil limitations and the kind of system required in each case. A soil scientist working with the Sussex-Warren Soil Conservation office prepared the map and information.

Mendham, Chatham and Harding Townships (Morris) require residents to obtain a thorough septic inspection and make necessary repairs before selling their homes.

Bedminster (Somerset) passed a septic installation and operation ordinance shortly after the State amended its septic requirements in 1990. The Township's ordinance establishes more stringent requirements than the State code, including greater setbacks, groundwater monitoring in certain soils, the provision of a reserve septic site, and a nitrate analysis before septic construction in some areas.

The Mount Olive (Morris) Board of Health amended the Township's codes in 1990 stating that:

- septic pumpers must obtain a Township license and pay a \$100 fee;
- new property owners (residential, commercial or industrial) must obtain a certificate of health inspection before they occupy their buildings. The certificate requires if the septic fails to meet code the purchaser must fix it within 60 days;
- sellers of property must prove that they have pumped the septic within three years;
- all septic systems must be pumped every three years. The pumping permit application requires a thorough description of the septic system, its condition and the gallonage pumped.

Landfill or Dumpsite Investigation

Former landfills and dumps can contaminate groundwater supplies for years after they have been closed. The Eagleswood (Ocean) Environmental Commission mapped aquifer gradients (essentially an underground topographical map) beneath a closed landfill and gathered data from monitoring wells. The Harrison (Gloucester) Environmental Commission analyzed groundwater samples from the Henry Harris landfill. The Pitman Borough (Gloucester) Environmental Commission monitored NJ DEP's remediation of the Lipari landfill, ranked number one on the federal Superfund list.

Limestone Area Protection

Limestone deposits found in northwest New Jersey are geological formations whose unusual nature makes them both an asset and a liability. Limestone is an important source of well water. However the groundwater in limestone is extremely vulnerable to contamination because acidic conditions can dissolve the limestone. Municipalities underlain by limestone can require proper site design and planning with special procedures for stormwater and septic management. The North Jersey Resource Conservation & Development Council has a model limestone ordinance and will help municipalities tailor it to their needs. The freeholders and soil conservation offices in Hunterdon, Morris, Somerset, Sussex and Union counties sponsor the Council.

The Green Township (Sussex County) Environmental Heritage Commission did research and field work to map limestone formations under its municipality. The maps will help the Planning Board make development decisions that protect recharge areas and aquifers. As a part of an educational campaign, Commission members made presentations to schools with slides illustrating the hazards of building in areas where limestone is too close to the surface and how to protect aquifers in limestone formations. They created a "Groundwater Flow

Demonstration Model” that showed how aquifer recharge occurs in limestone areas.

The Commission created a brochure called “Pointless Pollution” to inform homeowners, businesses and educational groups about how to prevent non-point source pollution. One side of the brochure folds out to reveal the water cycle, showing how groundwater affects land use and land use affects groundwater. The brochure’s other side talks about the causes, effects and prevention of non-point source pollution. It includes discussion of household products, septic systems, farming activities and runoff and erosion.

For Further Information

The North Jersey Resource Conservation & Development Council, 908-735-0733

Road Salt Restrictions

Overuse of salt for de-icing roads can result in elevated sodium levels in drinking water. The NJ DEP pamphlet “Ground Water Protection Practices for Roadway Deicing” notes that road salt has been known to be a common groundwater contaminant and recommends that municipal and county road departments:

- provide proper storage facilities for road salt;
- dump plowed snow in areas away from surface waters, public wells, and high recharge areas;
- develop detailed application plans that mark off sensitive areas where salt is not used, is used minimally or is used in conjunction with safer products, such as calcium chloride and sand.

Massachusetts and Connecticut follow these recommendations and claim they save money by avoiding environmental costs. Although some New Jersey environmental commissions have convinced their road departments to follow these best management practices (BMPs), and several municipalities have improved their salt storage

facilities, very few use a detailed, environmentally-based application plan.

The Ocean County Well Head Protection Plan recommends BMPs that include:

- using salt only where required for safety such as on hills, curves and intersections, and using more sand and alternatives such as calcium magnesium acetate elsewhere;
- educating homeowners to reduce salt use on driveways and walkways.

Contamination from Organic Chemicals

Tests of drinking water often reveal the presence of manmade chemicals. Volatile organic compounds (VOC) are of particular concern because many are indicated as probable carcinogens. For example, trichloroethylene (TCE) from household and industrial degreasing and cleaning compounds, including many septic cleaners, are increasingly common contaminants in wells. In the early 1980s Rockaway Borough (Morris) discovered TCE contamination in two of three Borough wells and eventually had to spend \$600,000 for a treatment plant. The Borough has been lobbying for better standards and testing, especially for VOCs, and more federal and state cleanup programs. The mayor called VOC contamination “a potential time-bomb” because it is such a common groundwater contaminant.

Testing for Contaminants

As of September 2002 State law will require testing of private wells when the home is sold. Several municipalities already have enacted ordinances to require this testing. Chester and Mendham (Morris) call for extensive testing, especially for volatile organic compounds, when wells are installed or when houses are sold. VOC is not a part of standard well tests.

The Ocean County Health Department has a very progressive and unique private well water testing ordinance, under which the wells must meet 26 parameters before any title transfer can occur. This program has uncovered many pock-

ets of pollution and is helping the county Health Department trace pollution trends.

Water Conservation

Water conservation programs can reverse the need to pump a well beyond its capacity, which leads to serious draw-downs of the well water level and saltwater intrusion near the coast. The Cape May County Health Department in cooperation with the County Water Resources Coordinating Council conducted a water conservation campaign under an NJ DEP grant. The County awarded mini-grants to municipalities for conservation measures. Primary measures included retrofitting municipal and school toilets with water-conserving fixtures, and selling low-flow showerheads, faucets and other conserving hardware. Secondary measures included passing resolutions and ordinances, performing audits of water use, installing drought-resistant gardens, and educating residents with brochures, articles and public service announcements.

The County has purchased three weather stations to help large irrigators, such as farms and golf courses, plan water use. The goal is to reduce water use by 15 percent. Saltwater has contaminated Cape May's aquifers to such an extent that the County has built a desalinization plant to provide water to the expanding population.

For Further Information

Development of a Ground-Water Management Aquifer Protection Plan: A Guide to Citizen Participation, Wayne Pettyjohn, Oklahoma State University, 1989

Ordinances mentioned in this book, ANJEC, 973-539-7547 or www.anjec.org

Groundwater Bibliography, Fifth Edition, Frits van der Leeden Library, 1991. National Agriculture Library, 301-504-5755 or www.nal.usda.gov/wqic

CHAPTER 3

STREAMS AND RIVERS

Water is the life force of the land. A stream or brook carries water through the landscape and all surrounding life depends on it. In turn, the health of the stream depends upon the surrounding conditions on land.

THE STRUCTURE OF A STREAM

A stream's watershed is the area of land that drains water into the stream. The largest part of most watersheds is the upland, the higher land that surrounds the stream. Despite its name, the upland is not all steep, rocky terrain. Some uplands are gently rolling fields and even flat, low-lying and spongy areas.

The use and the shape of land in the upland area determine the quality of the water reaching the stream, whether the water arrives at the stream quickly or slowly, across the surface or underground. The more overgrown and flatter portions of a watershed absorb and retain water longer than steep or sparsely vegetated places.

Infiltration of rain or melting snow into the groundwater is greatest in woods and wetlands. Steep slopes, paved areas or those cleared of vegetation let water run off more easily.

The stream transports water from a higher to a lower elevation, eventually flowing into a larger "collector" - a pond, lake, river or the sea. The stream corridor encompasses the stream and the land along its banks. Its width and shape vary with the terrain. Because gravity forces streams to take the path of least resistance, in hilly areas,

the corridors are narrow, rocky, V-shaped. Where the land flattens, the streams meander back and forth across wide, level corridors.

A well-vegetated corridor protects the stream against sedimentation from erosion and against pollutants such as salt, oil, fertilizer and pesticides. The roots of trees, shrubs, grasses and plants along the stream help hold the soil in place when heavy rains or swirling floodwaters threaten to erode the banks. By capturing and holding runoff from storms and filtering it before it flows into the stream, these plants remove many of the pollutants picked up by rainwater or melting snow in its journey across construction sites, driveways, lawns and farm fields.

On the other hand, organic debris from stream-side trees and plants — leaves, bark, fruit, nuts, branches — that falls into the stream provides the basic energy for the aquatic food chain. The bottom-dwelling (benthic) organisms that feed on this natural litter are eaten by larger creatures, and these in turn by fish and predatory birds.

The stream channel is the area outlined by the banks and the bottom, or bed, of the stream. Trees and shrubs that overhang a stream channel help cool the water and make it hospitable for fish. If trees do not shade a stream, the increased water temperature and sunlight encourage algae growth on the streambed. The algae, food for a whole different category of benthic organisms, becomes the basis of a restructured food chain that supports fish that can tolerate warmer, oxygen-depleted water.

Water Sources

Precipitation falling on a watershed's uplands reaches the stream either as groundwater or surface water. The headwaters, or starting point, of a stream often are areas where water trapped underground finds an opening and flows out as springs or seeps. The stream picks up additional water through underground flow from other springs or seeps. Underground flow from springs and the slow release of rainwater that has been absorbed and stored in spongy woods and wetlands along a stream provides a steady, continuing supply that forms the baseflow of a stream. This water normally keeps a stream flowing even when rain is scarce.

The stream also receives water as runoff from rain or melting snow. This surface water flows across the land, sometimes collecting in ponds or wetlands on its way to the stream. Surface runoff from rainstorms or melting snow provides periodic and sometimes dramatic infusions of water that can cause a stream to overflow its banks and cause flooding. Streams that dry up in periods of drought are called intermittent streams. Many headwater streams may be intermittent.

After a heavy rain or sudden snow-melting thaw, the stream overflows its banks onto nearby land — an area called the floodplain. Flooding often deposits soil eroded from higher parts of the stream corridor. Plants growing in the floodplain adapt to this periodic flooding; they can bend without breaking when flood waters wash over them, survive half-drowning and thrive in poorly drained floodplain soils.

The water in a stream is called the flow. Minimum, or base flow, is the dry-weather flow of the stream from springs and other sources of groundwater. Flood flow is the wet-weather flow of the stream, in which surface runoff from rain or melting snow adds to the base flow.

The velocity or speed of the flow of water in the stream is expressed as feet per second. (You can estimate velocity by timing how long it takes to float an object a known distance, and dividing that distance by the number of elapsed seconds.)

The total volume of water flowing through the stream is called the discharge and is expressed as cubic feet per second. Discharge is determined by multiplying water's velocity by the cross sectional area it occupies.

Along with the steepness of the terrain, the roughness of the stream channel affects the velocity of the stream flow. Water fighting the friction of a rocky channel between banks gnarled with tree roots will flow more slowly than water slipping through a smooth, clay-lined channel.

Water continually modifies the channel's shape by eroding the banks or bed of the stream and depositing sediments downstream. Local geology and weather determines how this erosion will occur. A stream that winds through a wide, flat floodplain will widen its channel in times of flood flow by cutting or eroding the banks. Fast-moving water erodes the outside bends of the curve, or meander. Slower waters inside the curve deposit sediments, creating sand and gravel bars. In steeper terrain, a fast-falling stream cannot meander, but tends to scour out and erode its bed during flood flows, cutting a deeper channel and creating an alternating pattern of small waterfalls, little rapids, or riffles (shallows causing broken water) and pools.

Benefits of a Healthy Stream

Few people in New Jersey live far from a stream. From the fast-moving trout brooks of the Highlands to the slow, meandering Pinelands rivers, the state has two dozen major rivers and countless smaller streams, brooks and tributaries. A healthy stream can benefit its neighbors by providing drinking water, scenic beauty, recreational possibilities and wildlife habitat. The surrounding stream corridor protects the stream and its human neighbors by storing water in times of drought, accommodating flooding during heavy rainstorms and filtering sediments and other pollutants from stormwater before it enters the stream.

Wildlife Habitat. Trout can live and reproduce only in the highest quality water: clean, cool,

oxygen-rich, and abounding in the macroinvertebrates on which the trout feed. New Jersey classifies water quality, classifying streams as trout-production, trout-maintenance or non-trout. Healthy non-trout streams throughout the state, slightly warmer and moving more slowly, can support a diversity of fish, including bass, bluegills, carp, pickerel and sunfish.

In addition to fish and other aquatic creatures, a stream provides basic life support to all life in its vicinity. From soaring hawks to slithering salamanders, 90 percent of the wildlife in the area visits a stream every day.

Recreation. Streamside pleasures such as fishing, bird watching, hiking, photography or painting depend on a healthy stream. These pleasures will diminish if the quality of a stream deteriorates through unplanned, uncontrolled development in the stream's watershed, increased pollution of the water or degradation of the stream corridor.

Human Influences

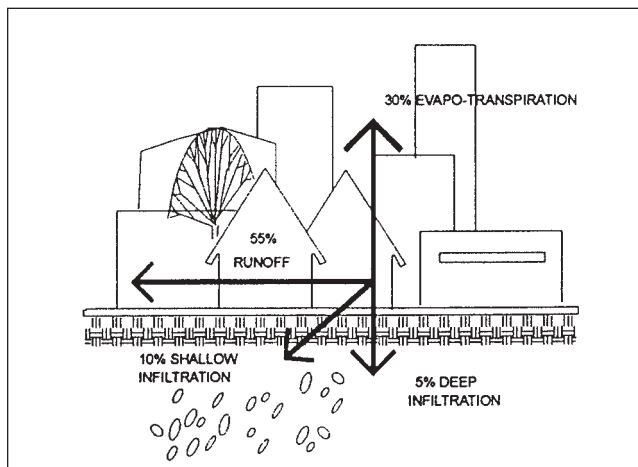
As humans occupy more space in a watershed, other species that live in or along the streams may be forced out. Streambanks cleared of vegetation cease to provide shelter or food. Sunlight unfiltered by vegetation increases water temperature and growth of oxygen-depleting algae. With more water reaching the stream as runoff, alternating periods of flood and low water, and increased sedimentation and pollution can

degrade a stream to the point where it supports few life forms.

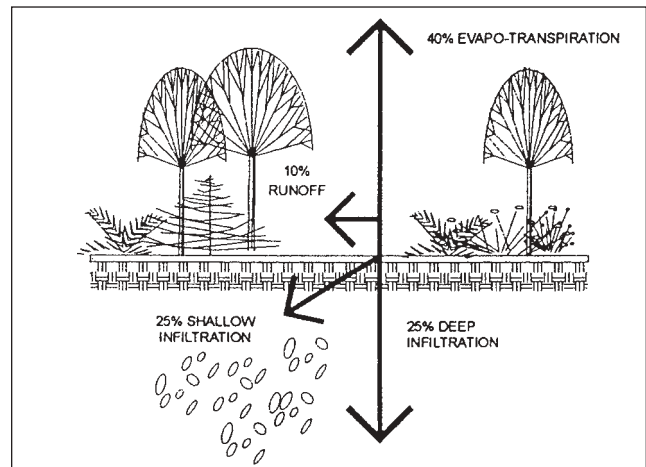
In this densely populated state, few communities can boast of healthy streams or undisturbed stream corridors. Intensive human use of the land threatens both the quantity and the quality of water in a stream. Further human intervention is necessary to protect, preserve or restore the benefits a healthy stream brings to the quality of life, health, safety and economy of the surrounding community.

Water Quantity. More intensive land use almost always means an increase in the land area covered by pavement or buildings, a decrease in the amount of rainwater that the ground can absorb and a commensurate increase in the volume of stormwater running into local streams. Grading natural detention areas and filling wetlands that had detained stormwater further exacerbates the problem. The result is increased flooding followed by water shortages after the water has rushed away. This increased stormwater carries more pollutants. The greater volume of water also erodes stream banks, washing sediment downstream and further degrading the stream's ability to support the plants and animals that live in or near it.

Water Quality. Two major categories of pollution affect water quality — point source pollution and nonpoint source pollution.



Water Infiltration with 75-100% Impervious Surface



Water Infiltration with Natural Groundcover

Point source pollution is waste discharged through a pipe from an industrial site or sewage treatment plant — that is, a specific source, or point. The NJ DEP regulates discharge of pollutants from point sources into surface water through the New Jersey Pollution Discharge Elimination System (NJPDES), which ensures these discharges comply with the State water quality standards. The NJ DEP sends municipalities a notice when a facility applies for a NJPDES permit to discharge to surface water.

Nonpoint source pollution flows into streams in stormwater runoff. Nonpoint source pollutants include sediment, toxins, bacterial contaminants from human and animal wastes, fertilizers, pesticides, litter, agricultural and industrial chemicals, oil and grease, and road salt. They are any pollutant that rain or melting snow can wash from the farmland, city streets, suburban lawns or industrial parks. Nonpoint source pollution can also occur from malfunctioning septic systems and air deposition. Control of nonpoint source pollution is a complex issue, given its diffuse sources.

Sediment from eroded soil causes nearly half the nonpoint pollution in New Jersey streams. Sedimentation blankets gravel in streambeds, smothering fish eggs and insects, reducing oxygen in the water and clogging the gills of fish. In addition, the sediment carries other pollutants with it and causes a general deterioration of the entire stream environment.

Soil erosion from land being graded for development accounts for most of the sediment in runoff. The rate of erosion from such areas of land disturbance is 10 times greater than from woodlands.

Excess nutrients cause excessive growth of algae and weeds, and are the second most prevalent type of nonpoint source pollution. They include nitrogen and phosphorous from fertilizers used in farming and lawn care, and, to a lesser extent, substances leaked from malfunctioning septic systems near streams. The resulting algal blooms and weedy overgrowth use up the oxygen in the water, to the detriment of fish and other aquatic creatures.

Bacteria, including disease-causing microorganisms (pathogens) found in human and animal waste, can leak into streams from substandard or malfunctioning septic systems or from defective sanitary sewers, or wash off the land or city streets into storm drains. Contaminated streams cannot be used for drinking water, fishing or recreation.

Pesticides and herbicides, salts, petroleum products leaking from vehicles, and metals from urban runoff are other ingredients often found in the nonpoint-source pollution washing into our streams.

STATE PROGRAMS

Several New Jersey laws regulate streams, including:

- The *Freshwater Wetlands Protection Act*, N.J.S.A. 13:9B-1 et seq. and *Regulations*, N.J.A.C. 7:7A-1.1 et seq. regulate activities in wetlands and transition areas. (See Chapter 4 on Wetlands for more detail.)
- The *Flood Hazard Area Control Act*, N.J.S.A. 58:16A-50 et seq. and *Regulations*, N.J.A.C. 7:13-1.1 et seq. regulate activities in the 100-year floodplain of a stream and mandate stream encroachment permits for construction, installation or alteration of any structure or placing of permanent fill along, in, or across the channel or floodplain of any stream; or any alteration of the stream itself. The intent is to minimize flood damage and degradation of water quality from nonpoint pollution sources and to protect wildlife and fisheries. In 1995, the *Flood Hazard Area Regulations* were amended to provide guidelines for protecting streams in addition to existing requirements for engineering structures to protect them from flood damages.

- The Water Quality Management Plan regulations address point source water pollution and nonpoint source pollution prevention.
- *New Jersey Pollutant Discharge Elimination System Regulations* (NJPDES) N.J.A.C. 7:14A-1.1 et seq. and N.J.A.C. 7:9-1 et seq. regulate point discharges to surface and ground water, to prevent degradation of water quality.
- Surface Water Quality Standards N.J.A.C. 7:9-1 et seq. These regulations set the limits for allowable concentrations of bacteria, dissolved oxygen and various chemicals. The limits are based on the water quality classification (trout production, non-trout, estuarine, etc.) of the stream. The standards also list all New Jersey streams and their classifications.
- The *Coastal Area Facilities Review Act* (CAFRA) N.J.A.C. 7:7E-3.26 regulates coastal wetlands. The NJ DEP determines the need for a wetlands buffer for all land within 300 feet of wetlands and within the drainage of those wetlands.

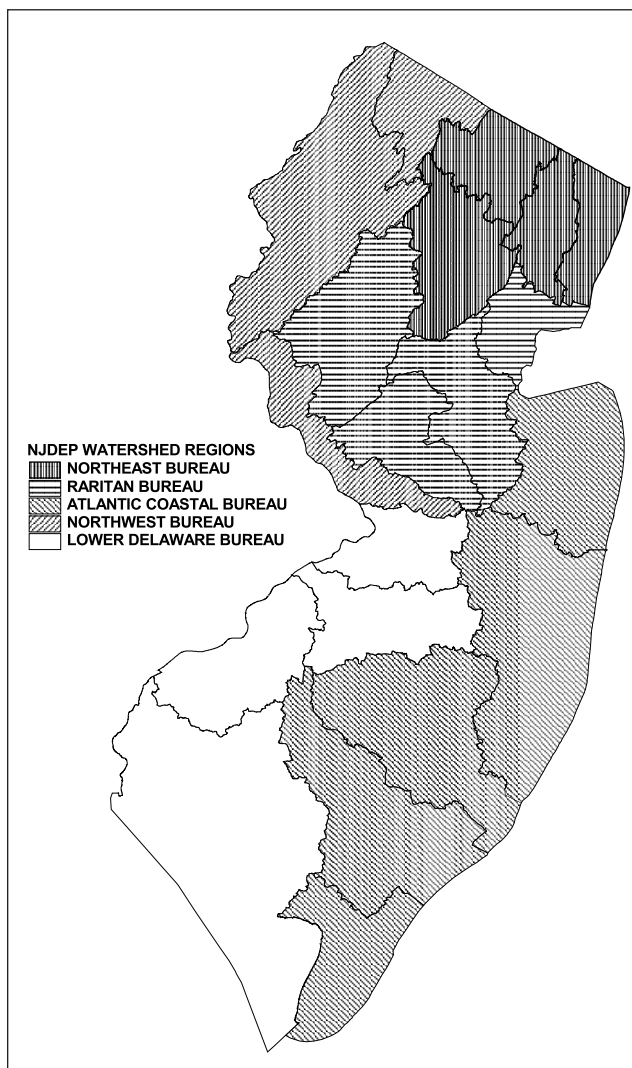
The municipal wastewater management plan specifies how a municipality or regional sewer authority will meet its wastewater needs for the next 20-year period. Requirements include identification of sewer service areas, areas on septic systems, environmentally sensitive area mapping, zoning, projected population distribution.

The planning board, environmental commission, health department and town engineer should review notices of applications for NJPDES permits, stream encroachment permits, and wetlands permits for potential threats to local streams. Environmental commissions should identify and map NJPDES-permitted discharges as part of a stream corridor protection program

Watershed Management

Watersheds are the areas of land over which precipitation drains to surface water bodies. To tackle nonpoint source pollution, destruction of headwaters, air deposition of pollutants to waterways and habitat degradation, the NJ DEP has initiated watershed management planning.

NJ DEP's watershed management process delineates 20 watershed management planning areas (WMAs), which are in turn grouped into five water regions. In each of the 20 WMAs, NJ DEP set up advisory groups that include representatives from all levels of government, environmental and civic groups, business and industry, academic institutions and area residents. With a goal of continuous improvement of the water resources in each area, these groups are working with NJ DEP to characterize their watersheds, identifying and prioritizing problems and solutions through targeted, intensive monitoring.



NJ Watershed Management Areas

For Further Information

NJ DEP Watershed Management Bureaus:

Northwest, 609-633-3812

Raritan, 609-633-7020

Northeast, 609-633-1179

Lower Delaware, 609-633-1441

Atlantic Coastal, 609-984-6888

FEDERAL PROGRAMS

The *Wild and Scenic Rivers Act* (16 U.S.C. 1274(a)) aims to protect and enhance rivers with outstanding scenic, natural, cultural or recreational resources. The *Wild and Scenic Rivers Act* was signed into law in 1968 in order to preserve forever the free-flowing condition of some of our country's most precious rivers. To qualify, a river must be in a free-flowing condition and must be deemed to have one or more "outstandingly remarkable" scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values. Currently, 159 rivers have received this designation, under which they receive certain federal protection measures.

It classifies rivers as follows:

- wild rivers are inaccessible and basically primitive and unpolluted;
- scenic rivers have largely undeveloped banks but are more accessible;
- recreational rivers are easily accessible, but may have diversions or impoundments and may be in or near urban areas. Local governments and landowners develop river management plans for these areas in cooperation with the National Park Service.

The Parks Service has given Wild and Scenic designation to three rivers in New Jersey: the Maurice, Great Egg Harbor River, and sections

of the Delaware. Designation covers about 42 miles of the Maurice River and its three major tributaries, the Menantico, Manumuskin and Muskee Creeks. A joint municipal-county project is developing a greenway plan for the Maurice River to establish a river conservation zone in the cities of Millville and Vineland and the townships of Commercial and Maurice River (Cumberland County) and Beuna Vista (Atlantic County). Each municipality adopted a river corridor management plan and downzoned to five-acre residential-recreational-institutional use from prior zoning that was often one-acre residential. The Maurice was the first example of local land use regulations accompanying a Wild and Scenic designation.

Great Egg Harbor River has also received Wild and Scenic designation. Its 129 miles and its tributaries drain 304 square miles of wetlands located in the Pinelands. It is the longest river in the Pinelands.

Congress has designated the section of the Delaware from Washington Crossing to the Delaware Water Gap, the Upper Delaware between Pennsylvania and New York from Port Jervis to Hancock and the Lower Delaware as National Wild and Scenic rivers.

The Musconetcong River is applying for designation. Thirty-three of its 45 miles are eligible. The designation process will take about two years.

The nonprofit organization American Rivers has a directory of local river groups and a toolkit on how to get a river designated as Wild and Scenic.

For Further Information

US Wild and Scenic River Program,
National Park Service, 215-597-7013 or
www.nps.gov/rivers

American Rivers, 202-347-7550 or
www.americanrivers.org

LOCAL ACTION

Effective stream corridor protection begins with research and planning at the local level. Steps include:

- mapping the stream and its corridor;
- incorporating stream corridor protection in municipal plans, ordinances and enforcement procedures;
- monitoring water quality;
- making sure federal and state standards and programs are upheld.

Gathering and distributing information about the local streams is the basis of their protection. Begin with a good map that identifies the watershed, the whole stream system — the stream and its tributaries, ponds, adjacent wetlands, steep slopes along the stream corridor, and land use patterns. A local streams map can be prepared as part of the environmental resources inventory (ERI) or natural resources inventory (NRI), as an overlay to the municipal base map.

If this overlay map is adopted as an official part of the master plan, town planners and officials can use it to support a stream corridor protection ordinance. The map can serve as a basis for evaluating land use decisions in the watershed. Less formally, the stream corridor map and protection plan can be used to teach streamside landowners and other residents about their local streams and how to care for them.

Stream Corridors

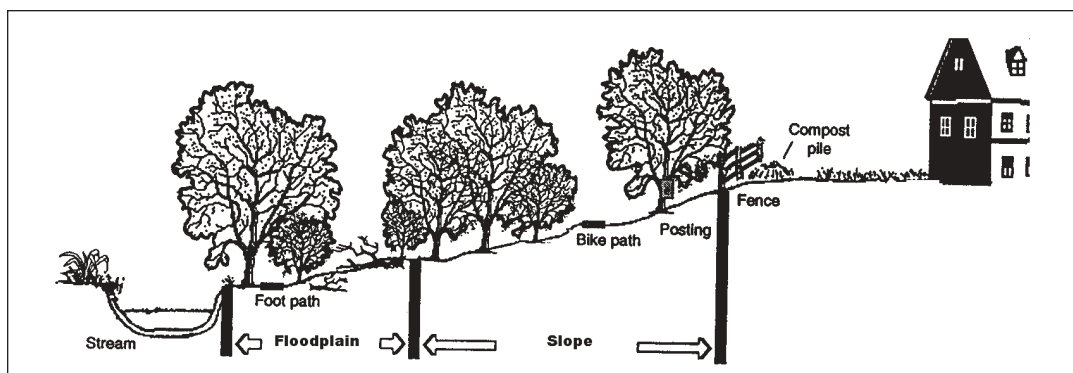
Stream buffers — vegetated corridors along a stream — help filter pollutants from runoff, curtail erosion, shade the water, and provide habitat for wildlife. They are vital to a stream protection plan. Towns can build a system of streamside buffers by:

- adopting a stream-corridor overlay zone as part of the zoning ordinance;
- acquiring land and/or conservation easements along streams as part of a greenway plan or a natural or recreational park system;
- requiring a conservation easement along streams at the time of any subdivision.

Some municipalities adopt buffers of a fixed width. Others use a more flexible system of “floating” buffers, where the width varies according to the natural values and constraints of the particular section of the stream. Floating buffers provide pollution control and protect the quality of a stream. Their widths vary according to the type of pollutant and the nature of the resource being protected.

A 1989 study published by Cook College, *Watershed Management Strategies for New Jersey*, presents the following recommendations:

- 50-200 feet for sediment control;
- 25-213 feet for streambank erosion control;
- 150-200 feet for nutrient pollutant removal;



Stream Buffer

ADAPTED FROM SCHUELER

- 75-300 feet for reservoir protection;
- 25-200 feet for stream temperature control;
- 25-50 feet for aquatic species;
- 200-300 feet for wildlife habitat.

Two planning and zoning tools — a stream corridor protection overlay zone and a streamside greenway — can be valuable both in protecting a stream from inappropriate development and in making residents more aware of the need to protect this commonly held natural resource.

Stream Corridor Overlay Zone

An overlay zone is an area that has been mapped to cover a particular cultural or natural feature of a community — such as a historic district, steep slopes or a stream corridor. This special zone overlays the town's existing zoning, establishing additional performance standards and criteria for development in the specified area. Property in an overlay zone is in two zones at once. Conditions and requirements of both zones apply to any proposed development.

Development of the stream corridor protection and management overlay zone begins with a map of the areas to be contained in the zone. The zone should consist of the stream and its banks, the 100-year floodplain and adjacent slopes greater than 12 percent.

The environmental commission can take the initiative in mapping the proposed stream protection area. Town and county planning offices have many sources of data to help with this mapping process: soils maps, topographical maps, the Federal Emergency Management Agency (FEMA) maps that delineate flood elevation levels, and NJ DEP wetland maps.

For the health of the stream, the stream corridor protection plan should steer development away from three sensitive areas:

- Steep slopes, once cleared of vegetation, are particularly vulnerable to erosion.
- Wetlands, once filled, can no longer hold and filter water. More water — and sediment — reaches the stream as runoff, leaving downstream areas vulnerable to sedimentation and flooding.
- Sensitive soils, which erode easily or drain poorly, if disturbed, can contribute sediment or pollutants to a stream.

The planning board, often working with research and data provided by the environmental commission, must define the goals and objectives of the stream preservation and management zone. It can set the standards and criteria for development in the zone, including requirements for buffers, conservation easements, and public access, liability and maintenance within the stream corridor area. The planning board should incorporate its rationale for stream corridor protection into the master plan — usually as part of the conservation element. The planning board may draft an ordinance for passage by the municipal governing body. Once the ordinance is adopted, the overlay zone is added to the municipal zoning map.

Streamside Greenway Plan

Greenways — linear parks of conserved land — are increasingly popular features in urban, suburban and even rural communities. Greenways serve many purposes: scenic and environmental protection, open space preservation and recreation. In urban areas where the greenway may include paved playgrounds and pathways, a vegetated buffer area between the paving and the stream will help curb pollution and improve water quality. Where streams pass through environmentally sensitive areas, a greenway may afford no public access, acting instead as a wildlife corridor, providing habitat for threatened and endangered species and staging areas for migrating birds.

Greenway design may involve the recreation, parks, shade tree, historic preservation and environmental commissions. The Planning Board can incorporate a streamside greenway plan into the conservation or recreation element of the master plan or the municipal open space plan. The local governing body can then implement the plan through zoning, land use ordinances

and purchases of easements or property. See Chapter 8 on Open Space.

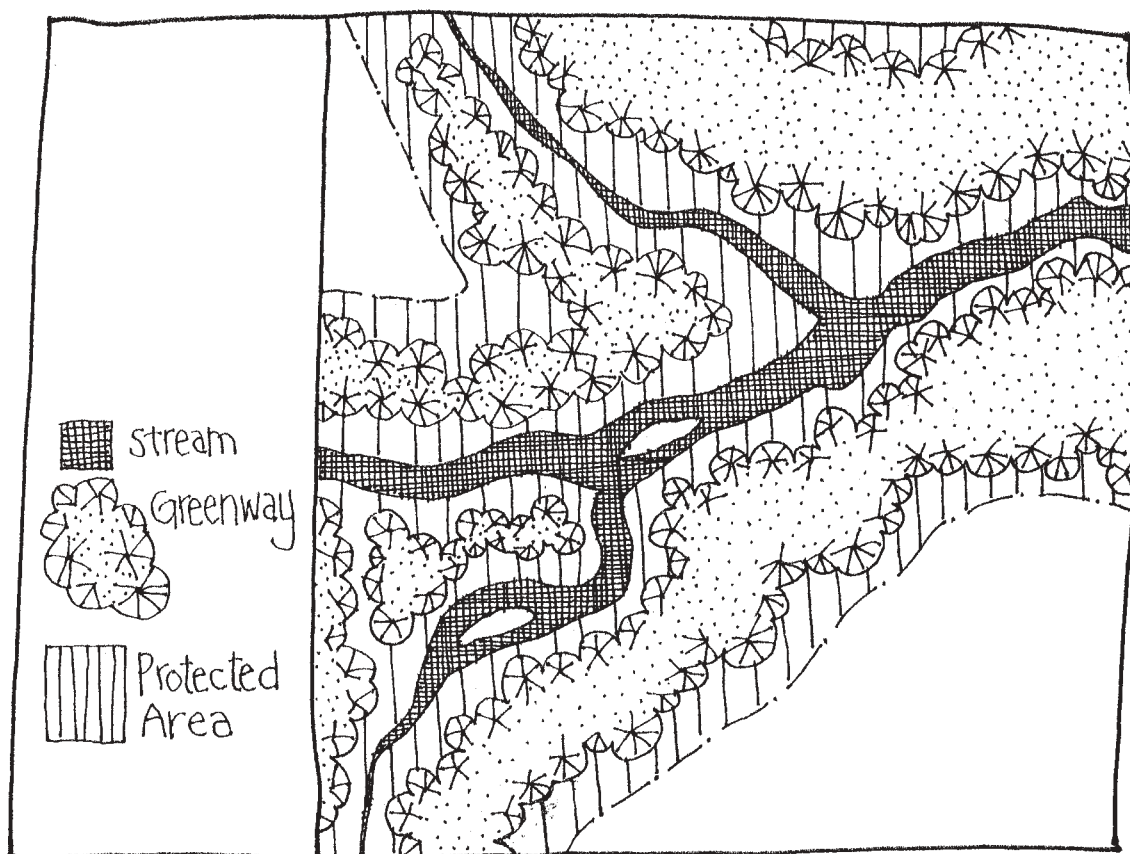
The Holmdel Township (Monmouth) Environmental Commission completed greenway studies along three of its stream corridors. Commission members and other community volunteers walked the streams and gathered data for the studies, which contain detailed descriptions of environmental features and wildlife, historic sites and land uses. Volunteers also built a nature trail along one stream, including entrance signs, interpretive maps and brochures, a footbridge over one tributary (built by Eagle Scouts), and interpretive signs along the trail. Using the studies, the Township passed a stream corridor ordinance to protect the streams, their woodlands, steep slopes and other features. The ordinance requires stream buffers of 50-150 feet, measured from the stream channel, the 100-year floodplain, or steep slopes along the stream, whichever produces the greatest buffer.

Applicants for development must provide conservation easements to protect the buffer, which must be marked in the field and protected from all disturbance.

Managing Stormwater

Increased development in a watershed brings an increase in impervious surface. This means that the ground can absorb less rainfall and higher volumes of water run off buildings, parking lots, driveways and lawns, picking up non-point source pollutants. Unchecked by natural vegetation, the runoff flows more quickly than before development. As a result, after each storm more runoff will carry more pollutants to the stream, faster. The challenge in managing stormwater runoff is threefold: reduce the volume, clean it up, and slow it down, so that it more closely mimics natural conditions.

The best stormwater control methods are those that closely emulate natural systems. For exam-



BARBARA PRETZ

Streamside Greenway

ple, runoff can be dispersed, rather than channeled, by directing it across a vegetated swale (a grassed depression). This slows the flow, increases infiltration into the groundwater, and filters out some sediment and pollutants.

Some purely structural stormwater management methods — detention basins, infiltration pits, trenches and artificial wetlands — can threaten aquatic ecosystems. The stormwater they discharge may raise the water temperature of the receiving stream to the point where it can no longer support trout and other sensitive species.

Nonpoint Source Pollution. Many of the basic strategies and powers that local governing bodies, boards and commissions might use to protect streams are the same as those used to protect wetlands. (See Chapter 4, wetlands.) To protect streams from nonpoint sources of pollution, the municipal governing body can control the location and density of development through

zoning ordinances. It can also require new development to meet standards that will:

- remove pollutants from stormwater by detention and filtration;
- provide vegetated stream corridor buffers;
- restrict clearing of vegetation on steep slopes;
- use best management practices (BMPs), such as oil and grit separators on all drainage inlets and inlet maintenance plans for all major projects;
- restrict fertilizer and pesticide use in suburban areas.

The town government can also require that the department of public works use best management practices. It should minimize use of and properly store road chemicals, sweep the streets, avoid using pesticides and herbicides, and properly dispose of leftover materials.

NEMO: Nonpoint Source Pollution Education

The University of Connecticut Cooperative Extension System developed the Nonpoint Education for Municipal Officials (NEMO) program as part of the US Department of Agriculture's Water Quality Initiative. NEMO provides municipal planning and zoning boards with information to help them reduce and minimize nonpoint source pollution. The program demonstrates the relationship between municipal decisions on land use and water quality. NEMO advocates a three-point strategy for protecting water quality:

- planning based on natural resources,
- innovative site design, and
- use of best management practices.

The NEMO program emphasizes that the amount of impervious (paved) surfaces will predict the potential for water pollution. According to the Center for Watershed Protection (Silver Spring, MD), "Imperviousness represents a common currency that can be measured and managed by

planners, engineers, and landscape architects alike." Stream degradation occurs at relatively low levels of impervious coverage (10-20 percent) in a watershed, according to Center Director Thomas Schueler. "Imperviousness represents the imprint of land development on the landscape. It is composed of two primary components: the rooftops under which we live, work, and shop, and the transport system (roads, driveways, and parking lots) that we use to get from one roof to another."

The Connecticut Cooperative Extension System developed geographic information system maps and slides depicting current land use/land cover (imperviousness) and the projected land use/land cover at buildout. Based on levels of impervious cover, the GIS maps indicate where municipalities are experiencing — or can anticipate — stream degradation, and can be used to establish preventive and remedial planning strategies.

Contact ANJEC at 973-539-7547 for information and assistance on applying NEMO to your community.

Stormwater restrictions. The *Municipal Land Use Law* (N.J.S.A. 40:55D-93) says that every municipality “shall prepare a storm water management plan and a storm water control ordinance or ordinances to implement said plan” once State funding is available. Although there has never been such an appropriation, the *State Stormwater Management Regulations*, N.J.A.C. 7:8-1.1 et seq., enacted to enforce law, are a useful guide.

For Further Information

Stormwater and Nonpoint Source Pollution Control Best Management Practices Manual, NJ DEP Watershed Management, 609-633-1441 or www.state.nj.us/dep/watershedmgt

Options for Municipal Stormwater Management, ANJEC Resource Paper, 973-539-7547 or www.anjec.org

Center for Watershed Protection,
410-461-8323 or www.stormwatercenter.net

Some communities in the Great Swamp watershed, located in Morris and Somerset Counties, are making an aggressive effort to control stormwater. As a condition of its permit to expand its sewer plant, the NJ DEP required Chatham Township to adopt an ordinance requiring no net increase in the rate, volume or pollutant loading of stormwater from new development. This ordinance is based on a model developed by the Great Swamp Watershed Association in partnership with consulting municipal engineers and environmentalists.

The NJ DEP’s Statewide Stormwater Permitting Program regulates stormwater runoff from industrial sites through general permits requiring periodic inspection. Businesses must keep chemicals and other industrial pollutants from coming into contact with rainwater, by covering materials with a roof or tarpaulin or moving them indoors.

The *Residential Site Improvement Standards* (N.J.A.C. 5:21 et seq.) govern streets and parking water supply, sanitary sewers and stormwater management. The State Standards take prece-

Nonpoint Source Pollution — NJ DEP Best Management Practices

The *Stormwater and Nonpoint Source Pollution Control Best Management Practices Manual* published by the NJ DEP and NJ Department of Agriculture provides guidelines for maintaining water quality in areas of development. These BMP’s can also be applied to upgrading and retrofitting existing stormwater control facilities. The emphasis of these BMP’s is on prevention, planning and preservation of natural systems. This philosophy is a radical departure from the traditional approaches of building either a system of drains to shunt stormwater away quickly from a development or a detention basin on a developed site, with little or no attention paid to maintenance.

The manual opens with a detailed explanation of the effects of development on water resources. Subsequent chapters deal first with planning and land use strategies to prevent nonpoint source

pollution, then with non-structural BMPs, and finally with methods of reducing the quantity and improving the quality of stormwater through structural means — detention ponds, infiltration trenches and artificial wetlands.

The chapter on land use and site design can help municipalities upgrade their master plans, zoning and land use regulations to incorporate improved nonpoint source pollution strategies. BMPs to improve water quality and to control the volume of stormwater will assist municipal engineers in reviewing new development projects and in retrofitting existing stormwater facilities. The manual is a valuable resource to use in developing educational materials about nonpoint source pollution and in improving town policies on procedures like roadway deicing, street sweeping and pesticide and fertilizer management on municipal property.

dence over local ordinances for any development that requires a major subdivision application. An applicant may exceed the Standards, since these Standards are the maximum that the planning board or zoning board may *require* but not the maximum that may be built. The parties can enter into an agreement to exceed standards, and file the agreement with the NJ DEP.

The regulations establish uniform standards and methodologies for calculating stormwater runoff and management design. They require stormwater facilities to control the volume and rate of runoff so that peak flows are the same after development as they were before. To maintain water quality, the Standards require that stormwater facilities prevent an increase in nonpoint pollution “to the greatest extent possible.” The Standards emphasize natural, as opposed to engineered, drainage strategies and the use of the “best available technology” to accommodate stormwater management. Design engineers are required to coordinate “structural detention requirements” — detention and retention basins, dikes, channels, impoundments, berms, and other manmade stormwater control structures — with land use and planning practices such as cluster development, open space acquisition, stream encroachment and flood-hazard controls.

Major elements of the stormwater standards revolve around the control of runoff quality and volume through regulation of the peak rate of runoff in the most damaging storms. These are the high intensity, short duration storms that happen fairly frequently — the once-a-year storm with 1.25 inches of rainfall within two hours.

Getting the Dirt Out. The *State Soil Erosion and Sediment Control Act* (N.J.S.A. 4:24-1 et seq.) regulates projects that disturb more than 5,000 square feet of land surface, involve more than one single-family dwelling, and require a building permit. Such projects require soil erosion and sediment control plans, to be certified by the county or regional Soil Conservation District. Although smaller disturbances are not regulated, they can also cause erosion and sedimentation, to the detriment of local streams.

In reviewing development plans, local boards can use several principles to control erosion on smaller projects. They can be written into resolutions of approval or local ordinances dealing with lot grading. They should:

- discourage development in areas of highly erodible or otherwise constrained soils;
- make sure stockpiled soil is protected or stabilized and located outside the stream buffer area;
- reduce the velocity and control the volume of runoff from the site;
- make sure as little as possible of the site is disturbed at one time;
- get sediment/erosion controls in place before construction begins;
- decide who will be responsible for monitoring sites to assure contractor and subcontractor’s compliance with agreed-on management practices;
- require stone “tracking pads” to collect mud from the tires of trucks entering and exiting the site;
- retain as much vegetation as possible;
- prohibit disturbance of steep slopes.

Smaller but potentially damaging sources of erosion and sedimentation may result from the roadside clearing, maintenance and repaving activities of municipal road and public works departments. Environmental Commissions can work with these departments to develop strategies for controlling erosion and sedimentation and should educate and train employees so they know when and how to install erosion controls and to stabilize disturbed soil.

Septic Systems. State law and regulations provide minimum standards for individual private underground sewage disposal systems through the *New Jersey Realty Improvement and Sewerage Act* of 1954, N.J.S.A. 58:11-23 et seq. and *Standards for Individual Subsurface Sewage Disposal Systems*, N.J.A.C. 7:9A-1.1 et seq. Local ordinances may set stricter standards.

For instance, current NJ DEP regulations require only a 25-foot buffer between septic tanks and open water (50 feet for effluent dispersal fields), and do not require inspection or maintenance of existing systems. A number of New Jersey municipalities have enacted more restrictive ordinances, mandating buffers of more than 100 feet and requiring both licensing and inspection of septic systems. Byram Township (Sussex) has an ordinance that requires that septic systems in the Township's Cranberry Lake community must be pumped every three years. See Chapter 2, Groundwater for additional information.

Stream Monitoring

Environmental commissions, watershed associations or school groups may undertake water quality monitoring programs, establishing a database against which to measure the impacts of proposed development within the watershed. Several commissions and watershed groups have supervised students or scout groups collecting water samples, doing chemical testing and preparing water quality reports from the findings. Monitoring includes visual inspection of sites to evaluate water temperature, clarity, turbidity and presence of wildlife habitat. Lab testing of samples collected will show levels of dissolved oxygen, pH, phosphates, nitrogen, hardness and chlorides.

The Washington Township (Gloucester) Environmental Commission planned and carried out an ambitious surface water quality assessment project between 1992 and 1995. The project included water quality monitoring of the Mantua Creek and preparation of a comprehensive report on the Township's surface water.

The report contained detailed information on local hydrology and the surface water testing program. It recommended that the process of sampling and testing should include more students and citizens, and should be expanded to include other water bodies in the Township. It also recommended that the Township should institute regular stream cleanups and street sweeping, and should install new catch basin

Rockaway River Case Study

Volunteers have worked to improve the Rockaway River in Morris County through public education, hands-on community projects and developing long-range plans for river protection.

The restoration effort has focussed on positive projects that enlist participation by a broad coalition of people interested in the river's future.

As a first step to connect people with the river and its watershed, the Friends of the Rockaway (FoRR) used signs to build recognition and a sense of responsibility for the river. FoRR installed over 100 river protection signs on riverbanks and at bridges. The signs show a blue heron and a frog and a message reading, "Rockaway River Sensitive Area: Help protect and care for this area." Usually the signs were put in the public right of way with permission of the governing body. If the location was on private land, the group received permission from the landowner.

To build a constituency, FoRR involved sportsmen, environmentalists, business owners, local officials, property owners, civic groups, students and others in river restoration activities. They started with positive, non-threatening actions to help the watershed — river cleanups, canoe trips, storm drain stenciling and a photo contest. By literally "getting their feet wet" in river restoration projects, the volunteers developed became river stewards.

FoRR selected a riverside park in Denville for its first restoration project. Canada geese and mallard ducks had denuded the park, making it an unsightly, eroded area. Through small grants, in-kind services from Denville Township and Morris County Soil Conservation District, and design assistance from the US Natural Resource Conservation Service, volunteers restored the area. Improvements included importing topsoil, planting native trees, shrubs and herbaceous plants, and creating wood chip trails.

gratings whenever streets are resurfaced or constructed in order to reduce the problem of sediments and litter in surface water.

Education

Community education is a vital part of stream corridor protection. A municipality might host a stream walk, sponsor cleanup days, encourage a local newspaper to run articles about the community streams, or initiate a specific stream stewardship program for local landowners.

Efforts to reduce the use of fertilizers and pesticides often hinge on educating residents. Residents and lawn care companies often apply more fertilizers and pesticides than a lawn needs or can use. Stormwater carries off the excess into streams and other water bodies.

The Middletown Environmental Commission (Monmouth) has sponsored organic lawn care workshops for citizens and professionals. As a result, 33 local lawn care companies now offer organic services.

Point Pleasant Borough (Ocean) introduced a “Lazy Landscaping” program to promote the use of native species, reduced fertilizer and pesticide use, and less watering. The Environmental Commission set up three demonstration gardens planted with indigenous flowers and plants to show residents how easy it is to do organic gardening.

To reduce nonpoint source pollution, Mendham Township Environmental Commission (Morris) prepared an educational brochure for residents on environmentally friendly lawn care techniques. The brochure includes information on low maintenance plants, and pest resistant flowers and shrubs. It explains the connection between lawn care and surface water quality.

For Further Information

NJ DEP, Division of Water Quality, 609-292-4543 or www.state.nj.us/dep/dwq For stream classification and water quality standards

NJ DEP Division of Watershed Management, 609-984-0058 or www.state.nj.us/dep/watershedmgt

Delaware and Raritan Canal Commission, 609-397-2000 or www.dandrcanal.com

Stormwater Control Ordinance for Lands within the Great Swamp Watershed Overlay Zone, 1996, and *Infiltration in the Great Swamp Watershed*, 1996. Great Swamp Watershed Association, 973-966-1900 or www.greatswamp.org

The Izaak Walton League of America — Save Our Streams, 800-453-5463 or www.iwla.org

Protecting Our Streams, ANJEC Resource Paper, 973-539-7547 or www.anjec.org,

Chatham Township’s stormwater ordinance, available from ANJEC, 973-539-7547 or Great Swamp Watershed Association, 908-966-1900 or www.greatswamp.org

CHAPTER 4

WETLANDS

“We need the tonic of wildness, to wade sometimes in marshes where the bittern and the meadow-hen lurk, and hear the booming of the snipe; to smell the whispering sedge where only some wilder and more solitary fowl builds her nest, and the mink crawls with its belly close to the ground.”

— Henry David Thoreau, *Walden*, “Spring”

WHAT ARE WETLANDS?

Traditionally, people thought of bogs and swamps as unnecessary by-products of oceans, rivers and streams—at worst, symbols of death and decay, sources of methane, breeding grounds for noxious odors and mosquitoes; at best, they were considered a nuisance. If unusable by humans, people commonly assumed wetlands to be worthless to nature. Leonardo da Vinci, in his career as a military engineer, worked to reclaim swamp-land for the Borgia family’s development projects. Centuries later, in New Jersey and throughout the United States, laws and regulations still encouraged developers to fill in wetlands and make them “useful.”

Now we have learned how important wetlands are:

- By filtering sediment and pollutants from the water flowing through them, wetlands protect water quality.
- During periods of heavy rainfall, wetlands act as a natural flood-control device.
- Wetlands provide habitat for many species of birds, mammals, reptiles, amphibians and fish

and a rich diversity of plant life. Nearly half New Jersey’s threatened or endangered species live in freshwater or coastal area wetlands.

- Wetlands help regulate the water level in streams and rivers by retaining water during wet periods and releasing it during dry periods. They help stabilize the water table by holding surface water and letting it seep into the groundwater supply.
- Wetlands along a shoreline or streambank help stabilize the land, buffering it from erosion.
- Draining wetlands for urban development results in greater runoff and probability of flooding as well as the destruction of wildlife habitat.

Wetlands are not wastelands. They are useful, both to nature and to people. Especially since we have destroyed about half our natural wetlands, we must preserve what remains if we want to maintain a healthy environment.

Defining Wetlands

Aside from the poetic words used to define types of wetlands — fen, quagmire, morass, sump, bog, slough — there is a common definition for all these types.

Neither dry land nor water bodies, wetlands are the transition from one to the other. Wetlands are saturated with water or covered by shallow water at least part of each year, or part of most years. Wetlands tend to evolve through natural or human activity, emerging as dry land or submerging under rising water levels.

The 1987 *New Jersey Freshwater Wetlands Protection Act* (N.J.S.A. 13:9B-1 et seq.) officially defines a wetland as:

“An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation....”

Wetlands Characteristics. New Jersey law uses three characteristics to identify wetlands — water, soil and vegetation.

Water must be present in a wetland long enough to support wetland vegetation. The surface may not always be flooded, but more subtle signals — sediment deposits, water marks on tree trunks, moss lines on trees, elevated roots — called hydrologic indicators, document wetlands hydrology.

Wetlands soils, called hydric soils, are saturated or covered with water for so long that oxygen is driven out. They are dark or gray in color, often mottled below the surface, and may smell like rotten eggs, due to the presence of hydrogen sulfide.

Plants that grow in wetlands, called hydrophytes, are able to thrive in oxygen-lacking hydric soils. Presence of these plants is often the first step in establishing whether or not an area should be classified as a wetland.

Wetlands Plants fall into four categories.

- *Obligate plants* almost always grow in wetlands and are an excellent indicator of presence of wetlands. Examples are cattails, royal ferns, skunk cabbage, swamp azalea, white cedar.
- *Facultative wetland plants* are found growing in wetlands more than two-thirds the time. Good wetlands indicators. Examples, cinnamon fern, pin oak, highbush blueberry, elderberry.
- *Facultative plants* are found in wetlands one- to two-thirds of the time, but also occur in uplands. Examples, red maple, foxtail grass, witch hazel, rosebay rhododendron.

- *Facultative upland plants* are typical upland plants that occasionally (less than a third of the time) grow in wetlands. Examples, American holly, beech, bracken fern.

How can the lay person recognize a wetland? In general, if there is a place where almost any time of year you walk through and get mud on your shoes, that's a wetland. It may be just a damp spot but if it stays damp except in drought, it's a wetland.

As classified by NJ DEP, four basic types of wetlands predominate in New Jersey: salt and fresh water marshes, wooded swamps, and bogs.

The US Fish and Wildlife Service classifies wetlands in five major categories depending on the type of aquatic environment. (See illustration on page 36.) This classification system further divides wetlands by soil type, vegetation, persistence of wet conditions, and other characteristics. There are hundreds of specific wetland types. The five major categories are:

Marine: coastal wetlands along an ocean, saturated with salt water undiluted by fresh water.

Estuarine: tidal wetlands in estuaries—areas where saltwater and freshwater mix (salt and brackish marshes along coastal rivers and bays).

Riverine: freshwater wetlands along rivers or streams.

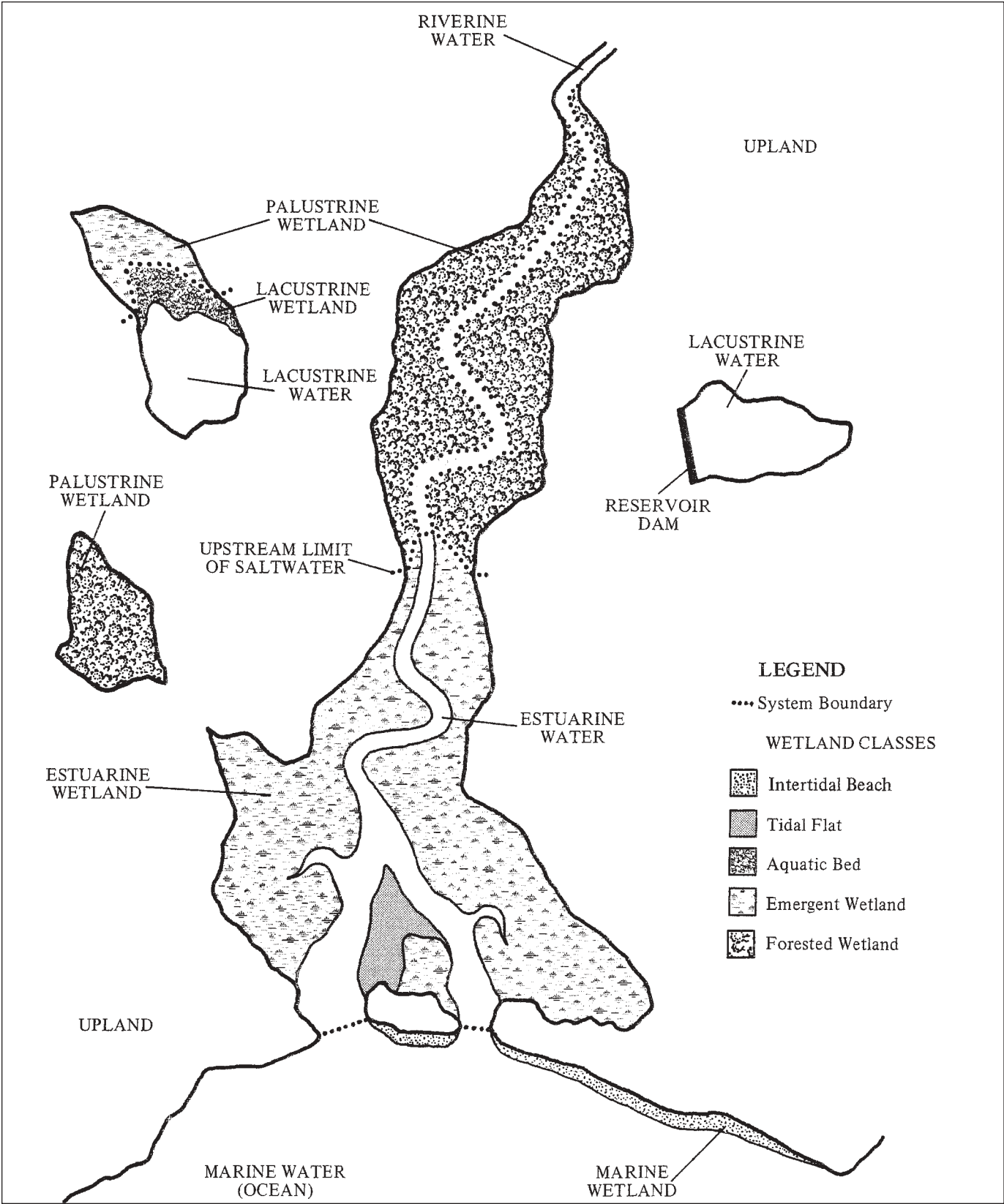
Lacustrine: freshwater wetlands associated with lakes, reservoirs and large ponds.

Palustrine: forested freshwater wetlands (swamps, marshes, bogs and small shallow ponds)

Where Are the Wetlands?

More than 600,000 acres (19 percent of the state's land area) of freshwater wetlands remain in New Jersey. Wetlands occur to greater or lesser extents in all counties, although in some counties more than half the wetlands have been converted to dry land or used as dumps.

Three sets of maps provide general information about New Jersey wetlands.



Major Types of Wetland and Deepwater Habitat Systems

US DEPT. OF INTERIOR

- The National Wetlands Inventory (NWI) maps are based on aerial photography by the US Fish and Wildlife Service. Copies of appropriate maps have been distributed to each municipality and should be on file at town hall.
- County soil survey maps, which map hydric soils and poorly drained areas, also provide general information about wetland locations.
- NJ DEP's New Jersey Wetlands maps, also based on aerial photography, are more detailed than either the NWI and/or county soil survey maps.

These three sets of maps are useful for general municipal planning purposes but are not detailed enough to provide specific information about a particular site. Local governments typically use the NWI, NJ DEP, and soil survey maps as a starting point for their inventories and make additional field surveys of wetlands for the basis of municipal wetlands maps. State law requires still more detailed, site-specific wetland identification and boundary delineation maps when land that may include wetland areas is to be developed.

For communities that use computer-based Geographic Information System (GIS) programs, the NJ DEP has digitized wetlands maps available in ARC Info on CD-ROMs. The wetlands information has been integrated with land use/land cover data.

For Further Information

National Wetlands Inventory maps and NJ DEP's aerial and digitized wetlands maps, NJ DEP Maps and Publications, 609-777-1039 or www.state.nj.us/dep/njgs/pricelst/orderform.pdf

County soil survey maps, County Soil Conservation District offices, listed in the telephone book blue pages under "County Government."

THREATS TO WETLANDS

Perhaps the biggest threat to wetlands is ignorance of their true value. This ignorance leads to land filling and drainage "improvements" that dry out wetlands, as well as to less obvious but no less deadly long-term degradation caused by pollution from surrounding areas.

As land values continue to increase, so does the pressure to develop marginal land, which frequently contains or abuts wetlands. Increased development, whether or not it entails filling of wetlands, brings increased stormwater runoff, which poses massive problems for wetlands.

Pollution carried in runoff from developed areas is known as nonpoint source pollution because it does not come from one specific point, such as the end of a pipe. (Effluent piped into a wetland from a sewage treatment plant would be considered a point source of pollution.) Nonpoint source pollutants include:

- sediment from agriculture, streambank erosion, construction activities and other land disturbance;
- salts from roadway and urban runoff and agricultural activity;
- pesticides and herbicides from rural/agricultural lands, suburban and urban developments, waste disposal areas;
- nutrients (nitrogen and phosphorus) from erosion of fertilized areas, septic systems, and agricultural activities;
- heavy metals from urban runoff and mining operations;
- bacteria from animal feces, manure spread on cropland, septic systems, urban runoff.

Increases in any of these pollutants decreases specific wetland values:

- Sedimentation results in a gradual filling of wetlands, decreasing the wetlands' ability to trap sediments, filter out chemical and biological pollutants, and absorb excess water.
- High levels of salts can destroy wetland plants and wildlife, reducing the wetlands' values as wildlife habitat or recreational areas.
- Pesticides and herbicides in increased concentrations can weaken or destroy aquatic plants and wildlife; worse, they can accumulate in tissues of plants and animals, posing hazards for species (including humans) higher in the food chain.
- High levels of nutrients can result in overgrowth of some wetland plant species, smothering others through lack of oxygen and killing the wetland as a functioning biological system.
- Wetlands trap metals and toxic chemicals carried in sediment, and filter these out of water percolating down to groundwater; an overabundance of metals and toxics in wetland soils threatens wetlands' values as wildlife habitat and recreational areas.
- Increased levels of bacteria overload the wetlands' absorbing, bio-processing and filtering abilities, and introduce disease organisms.

STATE WETLANDS LAW

Two state laws give broad protection to New Jersey's wetlands. The *Wetlands Act* of 1970 (N.J.S.A. 13-9A.1 et seq.) regulates activity in and around coastal wetlands, and the *Freshwater Wetlands Protection Act* of 1987 (N.J.S.A. 13-9B.1 et seq.) protects freshwater wetlands. Local initiatives to protect wetlands operate under the umbrella of these State laws. The Army Corps of Engineers regulates waters used in interstate commerce and those washed by tidal waters.

Cleaning Up Runoff — Artificial Wetlands

Wetlands are remarkably adept at cleaning up the pollutants carried in stormwater. This nonpoint source pollution is washed from every surface with every rain. It includes hydrocarbons, lawn chemicals, fertilizers, herbicides, animal wastes, sediment, heavy metals, organic and inorganic debris.

Some of these substances can be neutralized or used by wetland plants, some are filtered or settle out as stormwater passes through wetlands. Wetlands trap toxic chemicals.

Areas of created, or artificial wetlands can be effective components of stormwater management plans. Even a small, created wetland area of several hundred square feet can serve to capture and filter the runoff from a single residential or commercial property. Large artificial wetlands, several acres in size, are usually constructed around pools of standing water that serve as retention basins in commercial office parks or residential areas or along highways.

Coastal Wetlands

The *Wetlands Act* of 1970, administered by NJ DEP's Land Use Regulation Program, regulates activities in coastal area wetlands — salt marshes, salt meadows and tidal freshwater wetlands. Any construction requires one of two Tidal Wetlands Permits: Type A for minor projects, such as construction of docks, mooring slips, and repair of bridges; Type B for projects that dredge, fill, excavate or alter the wetland contour. Type B permit applications require that an environmental impact statement (EIS) be prepared.

Freshwater Wetlands

The 1987 *Freshwater Wetlands Protection Act*, also under the NJ DEP Land Use Regulation Program, provides protection for freshwater wetlands, including bogs, swamps and freshwater marshes. The State Act also regulates the upland transition areas, or buffer areas, that surround wetlands.

Activities in freshwater wetlands and transition areas require either a Statewide General Permit or an Individual Permit. Statewide General Permits allow limited activity in freshwater wetlands, provided permit conditions are met. Individual Permits are stricter; they are required when a proposed activity exceeds the requirements of a Statewide General Permit.

Before applying for either permit, the property owner must delineate the boundaries of the wetland and transition areas (buffers), and establish their classification. NJ DEP will verify this information and issue a Letter of Interpretation (LOI) authenticating the wetland delineation and classification.

The law classifies freshwater wetlands according to “resource values” and the wetland’s resource value determines the width of the transition area required:

- *Exceptional* resource value wetlands contain waters that support breeding populations of trout that originate and are contained within public land, or that provide habitat for endangered plant or animal species. A 150-foot transition area is required.
- *Ordinary* resource value wetlands (the “lowest” category) include drainage ditches, small isolated wetlands, swales, detention and retention basins. No transition area is needed for ordinary resource value wetlands.
- *Intermediate* resource value wetlands are those not defined as exceptional or ordinary. Transition areas of 50 feet are required for intermediate resource value wetlands.

For Further Information

NJ *Freshwater Wetlands Regulations*, N.J.A.C. 7:7A or www.state.nj.us/dep/legal/fwwrule/fwwrule.htm/

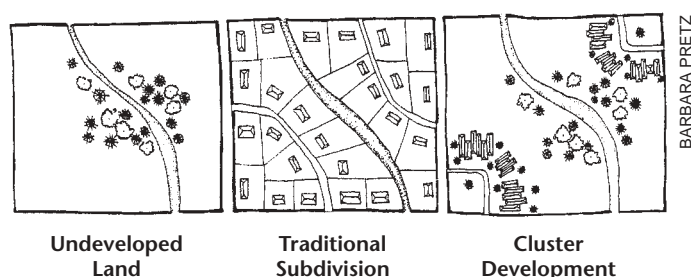
NJ DEP Land Use Regulation Program, 609-292-0060 or www.state.nj.us/dep/landuse

LOCAL ACTION

Master Planning and Zoning

Even though New Jersey law preempts local regulation of wetlands, municipal governments can promote wetlands protection through their land use planning. The municipal master plan provides a logical and legally defensible basis for zoning and zoning ordinances. The master plan’s land use element identifies the physical characteristics of the municipality — including wetlands. In preparing the land use element, planning boards often use the town’s environmental resource inventory (ERI), also called a natural resource inventory. Maps of local wetlands, based on information drawn from the National Wetlands Inventory, county soil survey and New Jersey Wetlands maps, can be part of the ERI and master plan. Planning boards should consider wetland areas when planning conservation areas, greenways, stream corridor protection or open space preservation. For additional information, see Chapter 3 on Streams and Rivers and Chapter 8 on Open Space.

Zoning and land use regulations can protect wetlands and other sensitive features like steep slopes, floodplains, high water table soils, poorly drained soils, shallow depth to bedrock, streams and aquifer recharge areas. Ordinances can require large lot zoning, usable land calculations, buffers, performance standards and overlay zoning.



A *minimum usable or buildable lot* ordinance requires that each lot have a minimum area that may not impede environmentally sensitive areas, such as wetlands, steep slopes or floodplains. The area must be within the building envelope defined by front, side and back yard setbacks. Site disturbance must be confined to this portion of the lot. Municipalities using this strategy will have to analyze existing zoning maps to see if the zones reflect natural conditions. Small lots in environmentally sensitive areas often cannot accommodate constraints-free building areas. (See Chapter 7 on Steep Slopes for a full discussion of this type of ordinance.)

Lot-size averaging ordinances enable a planning board to protect natural resources by approving some lots in a subdivision at less than the standard minimum lot size, if other lots are larger than the minimum and the subdivision as a whole conforms to the overall intent of the zoning regulations.

Open space/cluster ordinances or zoning standards empower municipalities to require that a certain percentage of a developable site be preserved as open space for aesthetic purposes and to protect natural resources such as wetlands. Clustering allows development on smaller lots than conventional zoning allows, in exchange for an area in the subdivision to be preserved as open space. Open space in clustered developments may be categorized either as active open space, to provide for recreation and other amenities, or passive open space that protects sensitive natural resources such as wetlands.

Transfer of Development Rights (TDR), or *Transfer of Development Credits (TDC)* applies the cluster concept to development in an entire community.

The owner of agricultural or environmentally constrained land may sell the right to develop that land to the owner of unconstrained land elsewhere in town (or to a governmental agency). The seller gains compensation for land that remains undeveloped and the buyer has purchased the right to develop a suitable area more intensively. A municipality using TDR must designate areas to be protected (sending areas) and areas of concentrated development (receiving areas). The result is the same overall amount of development, distributed to protect agricultural or environmentally constrained land. Although New Jersey law currently allows municipalities only in Burlington County to use TDR in their zoning, an amendment to the *Municipal Land Use Law* permits “non-contiguous cluster,” in effect transfer of development rights by a developer owning two properties in the same municipality. The Pinelands Commission has transfer of development rights within the Pinelands area using Pinelands Development Credits.

Conservation Easements

Some municipalities, wanting to reinforce State wetlands protection with local oversight, have a policy of protecting wetlands with locally held conservation easements where ever possible. Towns can hold conservation easements on wetland areas. These easements should be inventoried and monitored.

In Harding Township (Morris), the 1991 Greenway and Open Space Plan encourages municipal acquisition of conservation easements on local wetlands, particularly along stream corridors, as properties undergo subdivision. In 1998, the environmental commission and zoning officer inventoried conservation easements and developed a plan for annual monitoring. The information is part of the environmental commission’s land use database and GIS project. The project will track progress in acquiring easements to extend this local layer of wetlands/stream protection and will provide an ongoing record of easement monitoring.

The Old Bridge (Middlesex) environmental commission actively promotes conservation easements to protect wetlands and other environmentally sensitive areas through a brochure that explains easements and their environmental benefits. A conservation easement notice form informs new property owners about easements on their property.

Site Plan Review

Municipalities also can protect wetlands by adopting ordinances requiring identification of wetlands in applications for subdivision and site plan review. The Ten Towns Committee of the Great Swamp Watershed in Morris and Somerset counties has proposed a model ordinance for adoption by member communities. This model stipulates that a wetlands Letter of Interpretation (LOI) from NJ DEP be submitted as part of the application for any major subdivision or major site plan. Minor subdivision applications are not required to include an LOI but a qualified consultant must prepare an on-site wetland delineation. If this delineation shows the presence of wetlands that could be impacted by the proposed site improvements, an LOI will be required. Whenever an LOI or wetlands delineation is required, the developer must protect the wetlands and transition areas with a conservation easement dedicated to the municipality.

The model ordinance stipulates that all wetland and transition areas be clearly shown on plats and site plans. It also presents specific guidelines for protecting delineated wetlands during construction:

- snow fencing must be installed in the area of disturbance outside of the wetland transition area boundary line prior to the beginning of construction, to prevent encroachment into those areas;
- silt fencing and/or hay bales must be installed downstream from the disturbed areas, to prevent silt from entering wetland areas;
- existing vegetation within or adjacent to wetland areas must be preserved;
- final plans and site plans must include the NJ DEP-assigned wetland line(s) identification number;
- prior to signing of the final plat or site plan, the applicant must provide evidence of having filed any deed restriction required by NJ DEP to permit modification of the transition area.

Even without an ordinance like that of the Ten Towns, the planning board can still adopt several practices to protect wetlands during the site plan review process. The pre-application checklist furnished to development applicants can require identification of wetlands on the site. If the property is likely to include wetlands, the applicant should obtain from NJ DEP either a copy of a Letter of Interpretation that documents, delineates and classifies the wetlands and transition areas on the property or a Letter of Exemption documenting the property's exemption from State regulation. On projects that would require an individual wetlands permit, the planning board should suggest that applicants schedule a pre-application conference with the NJ DEP.

A site walk of the proposed development can help determine if the wetlands have been delineated correctly on the site plan. The planning board and environmental commission should bring the plan and meet with the applicant on site to see where the wetland flagging has been placed. The board and commission can compare wetlands identified on the site plan maps with what they see in the field.

On the site, various characteristics can indicate the presence of wetlands:

- hydrophilic plants, such as cattails or skunk cabbage (See page 35 for a list.);
- very black or mottled soil;
- presence of standing water or very wet soil.

If there are questions, the planning board should use its escrow account to hire a consultant or wetlands expert to review the plan to determine if the delineation was done accurately.

Performance criteria can minimize or prohibit the disturbance of environmentally sensitive

features and prevent damage on and off the site. Strict design and performance standards for subdivisions and site plans are crucial to municipal protection of natural features.

Other local initiatives include species surveys in wetlands. In 1992, Green Township undertook a “Threatened and Endangered Species Survey” of animal species in local wetlands, to inform and facilitate land use decision-making. The presence of endangered species habitat increases the required width of wetlands transition areas from 50 to 150 feet.

Permit Monitoring

Status reports on local wetlands permit applications appear in the biweekly *NJ DEP Bulletin*. Having an environmental commission member scan the *Bulletin* can help track local projects. The *Bulletin* is available by subscription for \$50, and also on the DEP website www.state.nj.us/dep. It also may be in the county or local library.

The planning board and environmental commission receive notices of applications to NJ DEP for permits, transition area waivers or Letters of Interpretation. Response time is limited — 15 days from receipt of notice of applications for LOI’s, General Permits and Transition Area Waivers, 30 days for Individual Permits. Boards and commissions should set up a system for responding quickly to the notices. Their local knowledge of an area may provide the State with information it would otherwise lack.

The planning board or board of adjustment should refrain from signing final subdivision or site plans until the application has received all State permits, certification of septic systems from the board of health and other governmental agency requirements.

During site plan and subdivision review, planning and zoning boards can include other wetlands protection measures. They can encourage conservation easements on wetlands, require official approval of each phase of construction, secure agreements for future maintenance activities, encourage minimal use of pesticides and

herbicides, and require use of native, pest-resistant plant species.

Other Ordinances

- Stormwater management ordinances can protect wetlands from pollutants and excessive flooding by requiring stormwater controls. For more information see Chapter 3 on Streams and Rivers and also the *Stormwater and Nonpoint Source Pollution Control Best Management Practices Manual*, NJ DEP, Office of Land and Water Planning CN 423, Trenton, NJ 08625. 609-633-1179 or www.state.nj.us/dep/watershedmgt
- Stream corridor protection ordinances usually require preservation of generous buffer areas — ranging from 25 feet to 150 feet wide along stream corridors and thus effectively protect wetlands adjacent to the stream. (See Chapter 3 on Streams and Rivers.)
- Tree protection ordinances protect trees and vegetation, usually limiting the amount of clearing that can be done on a site and protecting larger shade trees. Because tree roots and vegetation filter runoff and hold soil, these ordinances help protect wetlands. (See Chapter 6 on Preserving Forests and Trees.)

Wetlands Education

Education about the value of and threats to wetlands is a valuable municipal strategy to protect local wetlands. Educating the public on the value of wetlands can include:

- printing a fact sheet or publishing articles in the community newspaper or newsletter;
- involving school children in wetlands education;
- staging an early spring cleanup day in a local wetland area;
- inviting a naturalist to talk on wetland values;
- co-sponsoring public information sessions with the board of health on septic system maintenance or ways of minimizing pesticide and herbicide use;

- raising public awareness of nonpoint source pollution.

Several towns have printed brochures on wetlands. A brochure developed by the Cherry Hill Township Environmental Advisory Committee (Camden) provides basic information about wetlands. It suggests ways in which residents can protect wetlands. These include preserving native landscapes in wetland areas, properly disposing of grass clippings or yard waste, and reducing the use of pesticides and lawn chemicals. Hillsborough Township (Somerset) required a developer to pay for a brochure given to all homeowners containing a map and “dos and don’ts” near wetlands. The new development included permanently protected areas of wetlands, streams and floodplains.

Wetlands Restoration

A growing number of programs are working to return degraded ecosystems to close to their natural potential. The US EPA has done extensive study of wetlands restoration and has developed a list of restoration principles. These include using natural systems, addressing the causes of degradation, anticipating future changes and designing for self-sustainability.

Many restoration projects have combined restoration with education, so that residents will help maintain the restored wetland. The Bristol Marsh is a fresh water tidal marsh located on the Delaware River, 20 miles north of Philadelphia. Dumping, regrading and infestation of invasive

plant species have disturbed land abutting the marsh. The Pennsylvania Chapter of the Nature Conservancy launched a comprehensive effort to restore the Bristol Marsh and establish an ongoing marsh education program. The entire effort cost over \$200,000, and involves the US Fish & Wildlife Service, the Pennsylvania Heritage Parks Program, the Pennsylvania Game Commission and the Pennsylvania Delaware Canal Commission.

The Bristol Marsh Project was divided into three phases. Phase I included clearing sites of dumped debris, grading and reconditioning of the soil and installation of native grasses and wildflowers. Phase II included development of an interpretative path and boardwalk around Bristol Marsh with educational signage. The path connects with Bristol Borough’s historic riverfront walk. Phase III involves installation of woody plant material. Volunteers will be taught to do this once the site has been properly restored.

For Further Information

US EPA Wetlands Information Hotline,
800-832-7828 or www.epa.gov/owow/wetlands

Building Near Wetlands, *The Dry Facts*, NJ DEP
Land Use Regulation Program pamphlet,
609-777-1038 or www.state.nj.us/dep/landuse

Ordinances mentioned in book, ANJEC,
973-539-7547 or www.anjec.org

CHAPTER 5

LAKES

New Jersey has more than 1,000 lakes, each with its own characteristics and needs. The lakes provide habitat for a wide range of water-dependent wildlife, offer year-round recreation to residents and tourists, and supply drinking water to millions of people. Weeds, sediment and algae, increasingly common in New Jersey lakes, signal deteriorating lake water quality. Lake management and restoration programs have become essential to protect these valuable natural resources. Management and restoration plans must be custom-designed to suit each lake's conditions.

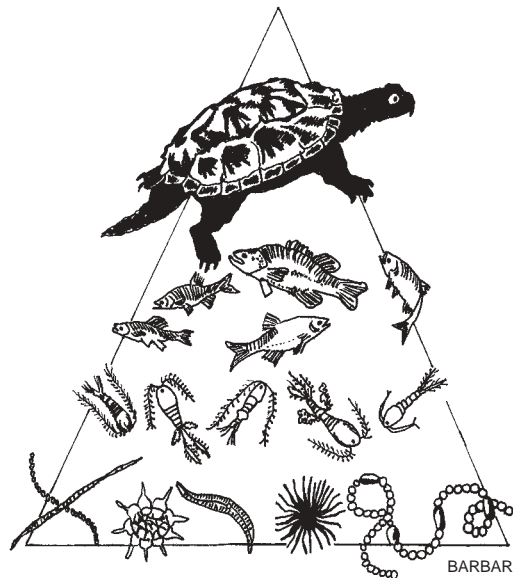
LAKE ECOSYSTEMS

Despite their individuality, lakes share many characteristics, including how they function as ecosystems. A lake ecosystem contains a number of habitats for water-dependent plant and animal life. These habitats include the wetlands, the shoreline (littoral zone), open water (pelagic zone) and lake bottom (benthic zone). The animals, plants and bacteria of each habitat interact and depend on each other and their surroundings to survive. Each habitat has its own physical, biological and chemical characteristics. An imbalance in any of these components can have an adverse effect on the specific habitat. Changes in nutrients, oxygen or sunlight infiltration can result in an imbalance throughout the ecosystem.

Properties of Water

The basic component of a lake's ecosystem is water. Water has physical and chemical characteristics that determine how plants and animals function in it. Two of the most important — the ability to hold matter in suspension and the ability to transmit light — are interrelated. Turbidity — murkiness caused by suspended particulate matter, often in the form of sediment — decreases the clarity or transparency of the water. This may reduce the depth to which sunlight can penetrate, thus inhibiting plant growth in a lake.

Two other characteristics of water are its ability to retain heat and its ability to absorb gases. In lakes of sufficient depth, the water will retain heat in layers — called thermal stratification — with a warm layer at the top, a cold layer on the bottom and a temperate one in the middle. The



BARBARA PRETZ

layers exist because warm water is less dense than cold and so is lighter. As the sun heats the surface the warmer water remains in a layer at the top. Shallow lakes heat all the way through so thermal stratification usually does not occur.

Stratification can prohibit the exchange of oxygen between layers. In the summer, oxygen depletion can occur on a lake bottom, which is sealed off from the air on the surface by a layer of warm water. In the fall and spring, as the surface water temperature becomes equal to the layers below, a natural process called “turnover” occurs, which mixes the water and reoxygenates the lake bottom.

Another characteristic of water is its ability to dissolve solids. A lake’s nutrients and minerals occur as dissolved solids. These include phosphorus, nitrogen, potassium, sodium, carbon, iron, calcium and trace amounts of about 25 others.

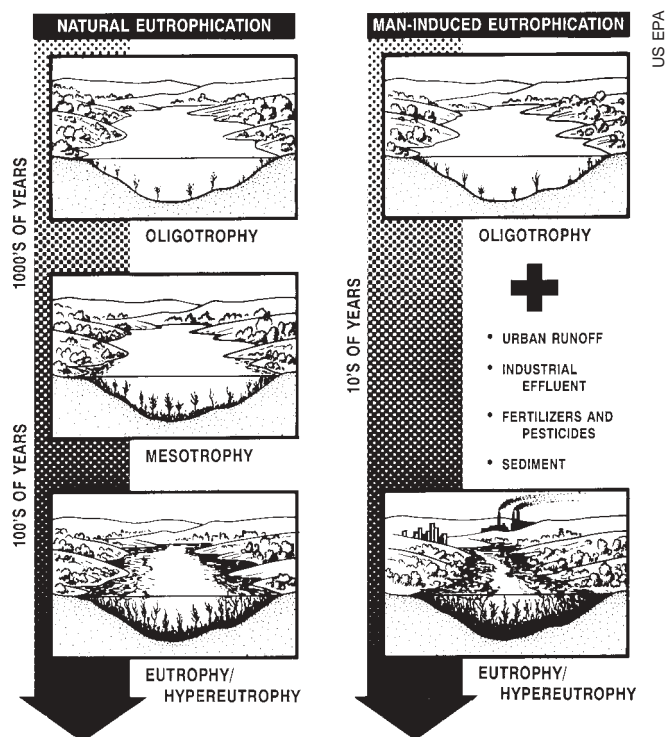
Sunlight is the major source of energy in a lake’s ecosystem. Solar energy fuels the growth of all plant life — algae, aquatic weeds, water plants — which in turn provides food for all life forms in the lake, from phytoplankton at the bottom of the food chain to carnivores at the top.

Lifespan of a Lake

A lake has a distinct life span. As it ages, it accumulates nutrients and sediments washed down from its watershed. Sediments fill in the lake, supplying shallow, sunlit waters with rich soils to nurture weeds and algae. Nutrients also promote this weed and algae growth. As these sediments, weeds and algae alter the ecology of the lake, its natural health declines and it is said to “age.” The aging process is called eutrophication.

The four stages in a lake’s aging are called trophic states. They are:

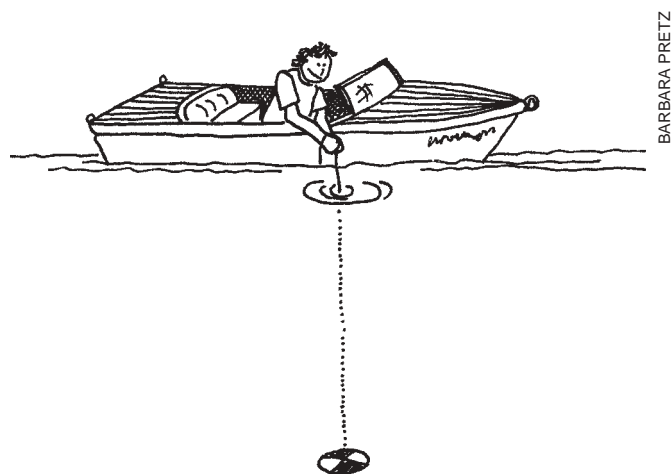
- *Oligotrophic* — young, nutrient-poor lakes with a low level of organic activity. Such lakes have clear, highly transparent water, little algae and few aquatic plants.
- *Mesotrophic* — a middle-aged lake with a moderate level of nutrients and increased algae and weeds.



- *Eutrophic* — mature lakes with a high level of nutrients and significant plant and algae growth that can cause decreased water clarity and oxygen depletion. These lakes are usually shallow with higher water temperatures and elevated levels of chlorophyll.
- *Hypereutrophic* — lakes with “pea soup” water conditions and extreme nutrient levels are at the end of the eutrophic stage. These lakes are very shallow, with higher water temperatures, poor water clarity, and oxygen depletion that can cause fish kills in the summer.

Natural eutrophication occurs over hundreds or thousands of years but cultural eutrophication, caused by human activities, can occur in as few as ten years without proper lake management.

One method to determine the trophic state of a lake is to measure water clarity, transparency and turbidity with a Secchi disk. A Secchi disk is an eight-inch black and white disk on a rope that is lowered into the water until it just disappears. The disk is raised until it can be seen again. The midway point between these two depths is the Secchi reading.



Taking a Secchi Reading

Nutrient Load

Stormwater from rain or snow flows over the land into rivers, lakes, streams and oceans. In a man-altered landscape, stormwater picks up nutrients in the form of nitrates and phosphorous from fertilizers on suburban lawns and gardens, farm fields and barnyards and contributes them to a lake's nutrient load. In addition, improperly functioning septic systems can leak into the lake, resulting in excessive nutrients from human waste. This overabundance of nutrients promotes overgrowth of algae and rooted aquatic plants, which has a number of impacts on lake ecology. The overabundant plant life can cut off sunlight, thus altering what kinds of plant and animal life can survive in the lake. Plants can grow only near the surface; in deeper waters the plants die and deplete the oxygen as they decay. Oxygen depletion further alters the plant and animal habitat. In severe cases, oxygen depletion can cause fish kills.

The amount and rate of water entering and leaving the lake is called the flushing rate or detention time. Low flushing rates can contribute to nutrient buildup and eutrophication.

LAKE MANAGEMENT

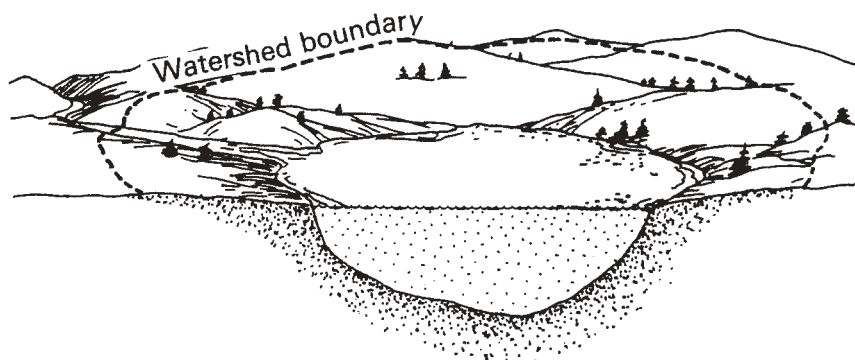
The Watershed

A lake's watershed consists of all the land that supplies water to the lake. Water flows into the lake and tributary streams and percolates through the ground to replenish the groundwater that also feeds the lake. A lake's drainage system can cover many square miles. Effective lake protection must consider the impacts of the entire watershed — the source of its water, its nutrients and its pollutants.

Although the geology and soils of a watershed play a role in the health of a lake, the land use in the watershed determines the lake's pollutant levels. In general, the level of watershed development correlates with the annual pollutant load. Stormwater runoff in developed watersheds might contain contaminants like motor oil and gasoline, fertilizer from lawns or farm fields, cow manure or eroded soil from new development. All this ends up in the lake.

Ideally the objective of lake management should be to reduce the pollution problem at its source. All lake management and restoration techniques, both watershed and in-lake, should be part of a comprehensive management system. Managing land use in the watershed is preferable to cleaning a lake after it has become loaded with nutrients or pollutants.

In designing a comprehensive management plan, it is important to define the study area and locate the source of the problems associated with the lake and the watershed.



The Watershed of a Lake

The plan needs to be based on complete information about the watershed and lake. This should include:

- Defining the watershed boundaries of the drainage basin. A topographic map that shows the land elevations can be used to delineate watershed boundaries. (US Geological Survey quadrangle maps)
- Identifying and mapping the watershed's geological formations, soil types and erosion rates, slopes, and groundwater flow. (Information available from US NRCS and County Soil Conservation Districts).
- Locating all streams and rivers to determine the pattern of surface drainage into the lake.
- Plotting existing land uses in the watershed and transferring this information to the topographic map.
- Identifying all municipal and industrial discharge permits.
- Listing all sources that contribute to the lake's nutrient supply. Some of the most common are:
 - Natural Sources: rainfall, forest runoff, erosion, groundwater, animal wastes, nitrogen fixation, sediment recycling, plant and animal decomposition, meadowland runoff, swamp runoff.
 - Cultural Sources (Human Sources): agricultural waste, managed forest areas, cropland, domestic/industrial waste, urban runoff, septic systems, landfill seepage, wastewater treatment plants.
- Listing known or possible sources of pollution.

In addition to information about the watershed, a comprehensive management plan will require specific information about the lake itself. The data include surface area, shoreline length, shoreline characteristics (steep, eroding, vegetated, sand), an inventory of inlets and outlets; maximum depth, mean depth and volume; a contour map of the lake bottom; basic water quality; an inventory of the lake communities —

plant, animal and human; and an inventory of existing lake management strategies.

This information will allow management planners to prepare further data, such as calculating the lake's detention time (lake volume divided by lake flow), or developing a lake nutrient budget (the amount of nutrients in a lake) and phosphorus load, the phosphorus concentration in lake water.

Hydrologic and nutrient/sediment budgets enable lake managers to assess the condition of the lake and create a baseline of information against which to measure future readings. The hydrologic budget is the lake's water balance: the difference between water deposited by rain, runoff and streams and water withdrawn by evaporation and discharge. The lake's nutrient/sediment budgets estimate the amount of phosphorus, nitrogen and sediment that enters the lake yearly. Figured into these budgets are calculations of nutrient and sediment loading from stormwater runoff, based on land use in the watershed and the results of water sampling from contributory water sources in wet and dry weather conditions. Sources of pollution including septic systems also factor into these calculations, as do any amounts of phosphorus and nitrogen that are recycled internally in the lake.

An analysis of the watershed and lake baseline data should make areas of concern readily apparent and help to clarify and define the goals of a lake management and restoration plan.

Generally a plan should:

- provide for long-term and short-term water quality improvements;
- use complementary watershed and in-lake management techniques;
- take into account the lake's use, natural surrounding condition and aesthetic attributes;
- be based on proven, scientifically sound methods;
- provide for community outreach and input;

- provide for personnel management;
- be cost effective;
- include a budget with sources of funds;
- include a schedule and timetable.

Environmental commissions, volunteers or community groups can gather much of this watershed and lake information. Beyond this point, it may be necessary to hire a consultant to develop or assess data.

CONTROLLING LAKE PROBLEMS

Source controls reduce the amount of pollution loading at the point of origin. Common source control techniques include use of non-phosphorus fertilizers and detergents; septic system inspection, maintenance and pumping; homeowners' management of pet waste and environmental landscaping.

Best management practices use structural and non-structural measures to intercept and pre-treat stormwater runoff to remove pollutants before the water reaches the lake. Some non-structural measures are vegetated swales and riparian buffers. Structural measures include detention basins, retention basins and created wetlands.

Source control and best management practices should be used throughout the watershed.

In-lake restoration measures are techniques designed to improve water quality or aesthetic characteristics to mitigate or decrease the impact of pollutants. Aeration, dredging, nutrient inactivation, weed control, algae control, bank stabilization and drawdown are the most common of these techniques. These techniques address four problems associated with lake quality — aquatic weeds, algae, fish and sediment. Permits are required for many of these activities. Before beginning work, check with your local municipality and the NJ DEP Lakes Management Program.

Aquatic Weeds

Generally aquatic plants are good for lakes. There are more than 1,100 varieties in the eastern United States; most lakes contain 20 to 30 species. An inventory of plant varieties in a lake should be part of the information database. Aquatic plants stabilize banks, create oxygen in the water, provide habitat and serve as a food source for animals, large and small. However if plants begin to take over, or one species begins to dominate, they become “weeds” in the eye of the lake user and unbalance the lake’s ecosystem.

To control aquatic plants, lake managers use several methods. They can cut, rake, pull or gather the plants in nets, depending largely on the root systems. Some plants have virtually no roots while others are strongly rooted. The selection of weed removal methods should take into account the ecological impacts, the time involved, the effectiveness and the cost.

When low-tech, manual methods are insufficient, aquascaping — landscaping with native wetlands and aquatic vegetation — is worth consideration. Aquascaping reestablishes native plants, stabilizes shorelines and improves fish habitat while controlling long-term plant growth. The goal is to displace unwanted species — the weeds — with more desirable native plants. A regional wildlife nursery that grows its own stock can provide plants.

Liquid dyes are sometimes used to inhibit aquatic weed growth on a lake bottom. When applied properly, the dye will tint the water blue and absorb the sunlight, preventing photosynthesis. This method works on small lakes or ponds that have little in- or out-flow but it lasts only six to ten weeks.

Herbicides and algacides are also used to control weeds. They come in two varieties — contact or systemic. Contact herbicides kill only the part of the plant they touch. Systemic herbicides will spread through the entire plant and kill it. Effective use of these chemicals is contingent upon the knowledge and expertise of the person applying them.

The use of chemical weed-killers poses several problems. The long-term effect on a lake's ecosystem is not known. They can affect non-targeted plants, and even when the chosen weed is killed, the remaining detritus can sink to the lake bottom and cover desirable plant life and make the lake shallower, thus permitting an even greater crop of weeds. Moreover, the decaying weeds use up oxygen, causing fish kills, and they provide nutrients for excessive algae growth.

Any dye, herbicide or algicide must be applied by an NJ DEP-approved aquatic pesticide applicator with a valid permit from the NJ DEP Bureau of Pesticides. The exceptions for the permit requirement are:

- 1) When the lake is not used for potable water, does not have an outlet structure or stream, and one person or entity owns the entire lake and shoreline.
- 2) When the application is made to control mosquitoes or flies under the NJ DEP Pesticide Control Mosquito/Fly Permit Program.

The permit requires that area residents be notified before a lake is treated with pesticides, and informed about restricted uses of the lake during and after application. The pesticide applicator is responsible for posting notices at access points around the shoreline. When a lake of three acres or larger is to be treated, NJ DEP regulations require publication of advance notices in two or more newspapers having the greatest likelihood of informing the public within the area of application.

Grass carp, a fish native to Asia, offer an alternative to chemicals. Grass carp can eat two or three times their body weight in vegetation daily. However, because their intestinal tracts are very short, the fish digest very little of what they eat, and deposit considerable amounts of waste, which may create a turbidity problem and add nutrients to promote algae growth.

The New Jersey Division of Fish and Wildlife (F&W) issues permits for stocking grass carp to control weeds, with the following requirements:

- The grass carp must be purchased from an NJ DEP approved hatchery and certified by the US Fish and Wildlife Service as triploid (sterile).
- A permit will be issued only for lakes of ten acres or less and from which the carp cannot escape.
- NJ DEP F&W personnel must inspect the lake.
- The vegetation to be controlled must be a type the carp will eat and must cover at least 40 percent of the lake basin.
- Grass carp cannot be stocked if the lake basin contains threatened or endangered species, exceptional resource value wetlands, or is adjacent to State-registered "Natural Areas" (unless allowed in the management plan of that area).
- The approved stock rate varies from 5 to 15 fish (8 to 11 inches) per surface acre, depending on the type and quantity of vegetation.

Another in-lake technique used to control weeds is drawdown—lowering the water level.

Normally done in the winter, the lowered water level exposes the lake's shallower areas and allows freezing temperatures to kill aquatic weeds. The drawbacks to this method of weed control are: It only works in cold winters; it may cause downstream erosion; or the lake's outlet structure can get stuck in the open position so the lake will not refill to its previous level. A lake lowering permit must be obtained from the NJ DEP prior to any drawdown.

A combination of techniques — aquascaping, mechanical or chemical control and drawdown — may be needed to solve an aquatic weed problem.

For Further Information

NJ DEP Division of Fish and Wildlife,
609-292-2965 or www.njfishandwildlife.com

Algae

Unlike aquatic weeds, algae float freely in lakes, making some methods used in shoreline aquatic weed control ineffective. A whole-lake approach is needed.

Ancient and primitive, blue-green algae were among the first plants on earth. Their appearance in a lake indicates high nutrient loads. The most common nuisance algae are *Anabaena*, nicknamed “Anny,” *Aphanizomenon* or “Fanny,” and *Microcystis* or “Mike.” Some types of stringy algae form a mat on the water’s surface and can be treated like floating weeds.

The best way to control excessive algae is to control the nutrients going into the lake. Phosphorus and nitrates are nutrients that promote algal growth. Phosphorus usually occurs in sediment carried to the lake in stormwater runoff from lawns, streets and farms. Nitrates frequently originate in groundwater from improperly sited, designed or maintained septic systems. Pollutants in stormwater from nonpoint sources cannot be traced back to or corrected at one single offending point. Some ways of controlling nonpoint pollution sources are properly maintaining septic systems, planting buffer strips of grasses or plants between fertilized yards and the lake, reducing the use of fertilizers on lawns, and leaving driveways and lake roads unpaved to prevent oil and grease from running into the lake. Nonpoint source control should be a major element of a lake management plan, with emphasis on specific local conditions.

After establishing local fertilizer needs, a town may develop a fertilizer management program that uses soil testing to set a minimum level of application rates, which may be specified in a fertilizer ordinance. The Borough of Mountain Lakes, a suburban lake community in Morris County, chose to focus on its most egregious nonpoint source of pollution, lawn fertilizers. It conducted a soil-testing program to determine how much fertilizer local lawns actually needed, testing for phosphorus, potassium, pH and organic matter. It turned out that 70 percent of the lawns tested did not need phosphorus. (Soil

testing programs are available through the Rutgers Cooperative Extension Service in each county.)

In 1992, Mountain Lakes enacted an ordinance regulating the use of lawn fertilizers by private and commercial applicators. The ordinance acknowledges “that the use of fertilizers containing phosphorus and their eventual presence in stormwater runoff constitutes a threat to the water quality of the Borough’s lakes,” and limits the amount of phosphorus in fertilizer to no more than 0.5 percent, P205 on a dry basis.

Fertilizer restrictions will help reduce algal blooms but may not cure them. Nipping algal blooms through control of nonpoint source pollutants is the ideal, but sometimes chemicals may be needed to quell an algal overgrowth. A common chemical used frequently is buffered alum, a combination of aluminum sulfate and calcium compounds. Buffered alum works best in a lake that flushes infrequently and where conventional stormwater quality enhancement measures are not possible. Alum should be applied only by an experienced applicator because there is a possibility of aluminum toxicity if the pH is not correct. Alum is applied on the lake surface and combines with phosphorus in the water to form a precipitate called “floc.” The floc captures the phosphorus as it falls through the water, binding it up in the sediment on the lake bottom. Deprived of the phosphorus as a nutrient, blue-green algae and filamentous algae will grow less vigorously. However, the phosphorous in the sediment encourages growth of aquatic weeds.

Some algaecides contain copper-based compounds, such as copper sulfate. These control floating algae by inhibiting photosynthesis. Copper buildup in the lake’s sediment is a concern and an NJ DEP permit is needed. The list of regulated chemicals changes from year to year, so check with NJ DEP Lakes Management before applying any chemical, to find out if you need a permit.

Sometimes aeration or artificial circulation is used to control algae. Air bubbles are introduced to the bottom of an oxygen-poor lake. Usually

aeration will control blue-green algae, but there are drawbacks. Aeration raises the overall temperature of a lake and can affect the lake's entire ecosystem. And if an aeration system is incorrectly installed, it may bring nutrient-rich water to the surface without re-oxygenating it and create an even greater nuisance.

Biofilters can also be used to eliminate or lessen the level of nutrients in runoff before they reach the lake. Biofilters — such as wetlands, shallow detention ponds, and aquascaped gardens — use plants to remove nutrients, primarily phosphorus, from runoff. This strategy channels phosphorus into growing more desirable plants than the blue-green algae. However, determining a wetland's suitability as a biological filter requires expert advice. Rare and endangered plant and animal habitats may be inappropriate as areas for additional nutrients, and some soil types are better suited as filters than others.

Aquascaping establishes a competition between submerged “good” plants and blue-green algae for phosphorus in the water. These “good” plants actually have algae called “epiphyton” attached to them that remove phosphorus. If 40 percent or more of the lake bottom is aquascaped with these plants, they will be dominant over blue-green algae. Wildlife nurseries grow suitable plants and bulbs for these purposes.

Protecting Fish

Fish have a low survival rate in lakes. Even without manmade problems few eggs become adult fish. Starting with about 100,000 eggs:

- 40,000 will hatch and make it to fry;
- 1,000 make it to fingerling;
- 200 make it to one year;
- 5 to 50 survive to adulthood.

To improve spawning habitat for fish in lakes, identify existing spawning areas and then protect them by limiting fertilizer use, maintaining vegetation, and restricting boat traffic in the area. Habitat protection strategies can be successfully

combined with a stocking program. State fishery agents are the experts when it comes to stocking.

Sedimentation

Sediment continually runs into lakes and ponds and can cause serious damage before it becomes obvious. Sediment causes turbidity and lake shallowing, and may carry algae-causing nutrients, toxic heavy metals and other pollutants. Sedimentation also can increase the incidence of fish diseases, reduce fish hatching areas, reduce the food supply for bottom-dwelling organisms, and decrease lake surface area and volume due to shoaling.

Prevention is the best solution to potential sedimentation problems. Steep slope protection is paramount in preventing erosion and sedimentation in the watershed. Steep slopes (with a gradient of 15 percent or more) and even more moderate slopes can be highly erodable. Many New Jersey municipalities have enacted steep slope and ridge protection ordinances that forbid or limit building and soil disturbance in these areas. Other ordinances control tree removal, so that the trees hold soils in place in the watershed. (See in Chapter 7 on Steep Slopes.)

Other methods for eliminating or reducing sedimentation are:

- to enforce soil erosion and sediment control measures;
- to establish construction site controls for soil disturbance and runoff prevention;
- to ensure use of agricultural controls such as crop rotation and proper tillage methods in farming areas;
- to establish street sweeping programs that will reduce the amount of highway salt, sand and inorganic debris in runoff and to set up composting programs to remove organic matter like leaves and brush from streets and parking areas in urban areas.

Individual homeowners can use similar techniques to clean up and reduce sediment in runoff. They can reduce fertilizer use on lawns and gardens, compost leaves and grass, reduce runoff by seeding bare areas or planting native species, direct downspouts from roofs to grassy areas or a rain barrel, or use a vegetative buffer between waterfront property and the lake.

One way to remove sediment from runoff is detention — holding back and slowing down stormwater runoff so that the soil particles can settle out before the water enters the lake. This is particularly necessary in areas where new construction is creating more impervious surfaces — roofs, roads, parking lots and sidewalks — and decreasing the amount of undisturbed land available to absorb the water. Some detention techniques are:

- check dams, which are placed in waterways to slow the velocity of the water, particularly following heavy rain or snow melt;
- catch basins, which capture coarse sediments and slow runoff velocity;
- dry and wet detention basins, which capture and hold back stormwater runoff, releasing it slowly and allowing sediment to settle out.

Vegetation — grass, ground covers, shrubs and trees — has an important role in reducing sedimentation and erosion, especially from banks and bluffs above the lake's waterline. Banks and bluffs can erode through river/lake movement at the waterline and from the passage of runoff on the way to the lake. Plants and trees provide a low-maintenance, long-term solution to bank and bluff protection. However, growing anything on a steep slope is difficult.

Planting aquatic vegetation can be helpful in stabilizing shorelines below the waterline, particularly in lakes with low wave action.

Steep slope or high-energy wave areas may need structural methods to capture sediment before it enters the lake. These include temporary measures, such as fastening blankets made from straw or plastic mesh to the ground to hold soil in place until vegetation takes root.

Where streams bend, more permanent structures may be needed to route water away from eroding banks. These include cribbing, revetments or deflectors on bends in streams that feed the lake. Deflectors and cribbing create slow moving water areas that allow sediment to drop out before reaching the lake. Revetments act like shock absorbers to dissipate water velocity and prevent erosion. Riprap and interlocking blocks are often used as revetments to “armor” vulnerable areas of stream bank.

When sediment accumulates over time, dredging can become necessary. Although not a control for sediment, dredging can remove sediment buildup and increase lake depth, but the cost is often prohibitive. In addition, disposing of dredged materials is often a problem, especially if toxins have built up in the sediment. Acquiring permits for dredging is a major undertaking.

NJ DEP permits that may be required:

- Freshwater Wetlands Permit for lake and pond dredging;
- Stream Encroachment Permit;
- Bureau of Solid Waste approval;
- Water Quality Certificate;
- Fish & Wildlife Lake Lowering Permit;
- NJPDES Permit if part of a hydraulic dredging project.

Also, a Sedimentation and Erosion (S & E) permit from the county Soil Conservation District permit may be needed and possibly an approval for hauling dredge material over county roads.

For Further Information

List of NJPDES permits from NJ DEP Permit Application Support, 609-777-0456 or www.state.nj.us/dep/landuse/

NJ DEP Lakes Management Program, 609-292-0427 or www.state.nj.us/dep/watershedmgt/bfbm/lakes.html

LOCAL ACTION

Municipal/Volunteer Monitoring Programs

Municipal employees or volunteers can undertake an environmental monitoring program to collect information on lake conditions. To assure that this baseline information is reliable, the volunteers must be organized and must collect and record the data systematically according to scientific parameters. Then the data must be analyzed and applied. Such specific data can predict general trends, or identify a single pollution problem such as a failing septic. As a further benefit, the people involved become knowledgeable and more competent to make management decisions regarding the lake. This volunteer work can help reduce the costs of hiring an outside consultant.

Several portable kits for chemical analysis of surface water are available to measure alkalinity, chloride (a component of raw sewage), hardness (the presence of calcium carbonate), dissolved oxygen, nitrogen, phosphorus, and pH.

Other information that should be recorded includes air and water temperature and water clarity (measured with a Secchi disk). In addition, aquatic plants (macrophytes) should be mapped and samples collected.

The selection of water sampling sites should include:

- all inlets that feed the lake, as they will determine watershed nutrient loading rates;
- all lake outlets;
- midlake, one sample per meter of depth;
- stormwater drains;
- physically distinct features like coves, very shallow, deep or narrow areas;
- shoreline areas (littoral area) that are typical of the lake.

Watershed Plan

Several citizen volunteer committees worked together to develop a watershed-based plan for the 1000-acres around Lake Topanemus in Freehold Township and Borough (Monmouth). The work included establishing best management practices, mapping all parcels in the watershed, prioritizing open space purchases and finding open space funding, educating the public, and producing a report, "The Lake Topanemus Watershed Management Action Plan." On the basis of a build-out analysis and this plan, the township rezoned 650 acres from one-acre to three-acre residential and made 400 acres of that top priority for open space purchase. The Monmouth County Planning Board provided technical assistance, including GIS mapping, groundwater recharge estimates, and data on how land use and development affect runoff.

For Further Information

Monmouth County Planning Board,
732-431-7460

Lake Study

Mount Olive Township (Morris) has completed a Phase I Diagnostic Study of Budd Lake under a \$56,000 grant from the USEPA Clean Lakes Program. The study examined a variety of lake and watershed characteristics and resulted in the development of a management plan for the lake. The Township has used the report's recommendations to restore water quality through sewer construction, dredging, drainage work and resident education.

The study evaluated a number of potential lake and watershed management alternatives to determine their ability to improve water quality and control pollutant inputs from the watershed. The alternatives with the highest ratings were a public education program focusing on nonstructural best management practices, fishery

management and nutrient interception, followed closely by the upgrade of existing catch basins and road de-icing management.

Following the Phase I study, the Township received a \$207,000 lake restoration grant from NJ DEP for selective dredging near the southern end of Budd Lake. Although selective dredging of the beach and outlet area of the lake was a low ranking alternative for water quality, the Township decided to move ahead with this option to improve boating and public access in that portion of the lake.

Based on the study's water quality and watershed data, a hydrologic and pollutant budget was developed for the lake. In the study, "pollutant" refers to the nutrients nitrogen and phosphorus and suspended sediments. Septic systems, the third largest source of phosphorus, accounted for approximately 15 percent of the total annual phosphorus load. The Township eliminated this problem by putting the area on the local sanitary sewer system.

Surface runoff from the watershed was the largest source of pollutants for the lake, accounting for approximately 63 percent of the total phosphorous load. Land use practices in the lake's watershed are causing extensive sedimentation and heavy nutrient loading that leads to algae blooms in the lake. Mount Olive planned a public education program on alternative landscaping and lawn fertilizer management to reduce the amount of phosphorous from this source.

The Township is working with the NJDOT to improve the storm drains on the state highway that runs along the edge of the lake. The storm drains currently go directly into the lake, bringing a large quantity of road salts and sediment.

By addressing several sources of pollution in Budd Lake, the Township is optimistic that it will be seeing continual improvement in the lake water quality. A pollutant budget can help by quantifying all the pollutant sources for a lake to assess a lake's trophic state.

Budd Lake decided to install sewers to solve problems caused by failing septic systems. However, sewers can promote intensive development that then has major negative nonpoint pollution effects on a lake. Towns and lakes should examine the "build-out" implications of sewers before deciding to give up septs.

Septic management may be the better idea. More towns on lakes are passing septic system management ordinances that typically require pumping every three years and require homeowners to find and map their systems. (See Chapter 2 on Groundwater.) A sensitive land use plan as part of the lake management plan will recommend development that is appropriate for the watershed. The land use plan should analyze land use in the lake watershed, including future build-out under existing zoning. It can then recommend changes in the master plan and land use regulations to preserve water quality.

For Further Information

Lake Smarts: The First Lake Maintenance Handbook, Steve McComas, Terrene Institute, Washington, DC, 1993. 202-833-8317

Pond and Brook: A Guide to Nature in Freshwater Environments, Michael J Caduto, University Press of New England, Hanover, NH

US EPA, www.epa.gov/owow/lakes

NJ DEP Lakes Management, 609-292-0427 or www.state.nj.us/dep/watershedmgmt/bfbm/lakes.html

North American Lakes Management Society, 608-233-2836 or www.nalms.org

NJ Coalition of Lake Associations (COLA), 973-729-6165 or www.njcola.org

Septic management ordinances available from ANJEC, 973-539-7547 or www.anjec.org

CHAPTER 6

PRESERVING FORESTS AND TREES

“The poplars are felled, farewell to the shade,
and the whispering sound of the cool colonnade!”

— *The Poplar Field*, William Cowper, 1732-1800

A few flowering ornamentals on a lawn, vast acres of wooded wilderness in a national forest, or a row of shade trees lining a residential street — whatever the setting, trees define a place. Trees provide beauty, shade, clean air and food and shelter for birds and animals. They also provide more subtle benefits, like the sound of wind whispering through poplars or the rattling of winter beech leaves.

Recent studies suggest that the value of trees and other natural features can be quantified in lower medical costs, improved job performance and better social behavior. In two 1980s studies, a view of trees was found to help hospital patients recuperate faster and prisoners keep healthier. In a 1986 study, participants’ stress levels, measured in blood pressure and other responses, fell markedly after just minutes of viewing ordinary natural scenes. By comparison, even attractive urban scenes had little positive effect. (See sidebar: “Studies Suggest Our Love of Trees May Be Genetic” on page 68.)

TREES: OUR PROTECTORS

Trees are silent workhorses in our environment. They protect our soil, water and air from the injurious effects of precipitation, erosion and pollution. They moderate local climate by blocking sunlight and wind thus conserving energy.

They buffer excessive light and noise, and provide sustaining habitats for wild flora and fauna.

Runoff and Erosion Reduction. The tree canopy, litter (fallen leaves and twigs), and the network of roots protect soils and stream banks against erosion by:

- moderating the force of rainfall and wind (a forested area can reduce wind velocity by 60 percent);
- slowing the velocity of runoff;
- holding soils in place;
- promoting groundwater recharge through naturally porous soils.

Trees also reduce runoff by taking up substantial amounts of water to support growth, and later releasing this water to the air as vapor (evapotranspiration). Heavily forested areas produce almost no runoff except during exceptionally heavy rainfall. When land is cleared for development, runoff increases as much as 60 percent. The rise in runoff also causes additional municipal stormwater management costs.

The ways trees protect soil and water become apparent when they are no longer there. Conventional clear-cutting and grading result in increased stormwater runoff that can increase erosion and cause siltation in lakes and streams. These effects can be severe, particularly if the completed development is not properly replanted with adequate shrubs and other vegetation, and if the soil’s ability to accept water has been damaged. Tree litter makes excellent habitat for

earthworms and other organisms that keep soil porous, while clearcutting, grading and using heavy machinery compacts the soil.

Fewer trees mean more sedimentation in surface waters. Yearly runoff from forested areas carries about 50 tons of sediment per square mile, but increased runoff from land stripped for development can produce up to 100 times as much. Fertilizers, pesticides and other contaminants in the sediment can impact nearby wetlands, streams, lakes or bays. Ridgelines and steep slopes are especially vulnerable to erosion. If they are cleared of vegetation, they can quickly lose their thin layer of soil and never recover their fertility.

Increases in runoff also have economic impacts. Costs rise for dredging, flood control and increased service, repair or expansion of municipal stormwater management systems.

Flood Control. By helping to reduce runoff, trees also reduce flooding. When trees are removed, the volume and speed of runoff increases, and streams and other water bodies tend to flood more often, more rapidly, and to higher levels. The damage caused by clearing and development may not be noticed in the area where it occurs, because the resultant flooding is often miles away from the source of the increased runoff. Increased flooding is a particular concern when several large development projects are within the same watershed. In wintertime, the shade provided by evergreens and by the trunks and branches of deciduous trees also helps prevent excessive runoff and flooding by slowing the melting of snow.

Groundwater Recharge. By slowing the speed of runoff and keeping soils permeable, trees promote groundwater and aquifer recharge. They also provide layers of organic matter that filter and purify precipitation as it percolates into the soil. Forests purify water so efficiently that some engineers recommend using them as living filters for partially treated municipal wastewater. At Whittier Narrows, near Los Angeles, 10-15 million gallons of wastewater are sprayed across the forest floor each day. Studies show that this

process does not contaminate groundwater and returns 90 percent of the water to the aquifer. Forest filtration of wastewater is cost effective, benefits aquifers and groundwater, and helps assure a steady supply of groundwater to maintain the baseflow of local streams.

Building Soils and Unlocking Nutrients. Trees help build soils as their leaves, twigs and limbs decay to form a layer of humus. Trees also make certain nutrients more accessible to other plants and animals. Trees draw up minerals and other nutrients from the soil through their roots and store them in their leaves. When the leaves fall and decay, these nutrients become available to other plants and animals.

Purifying the Air. Trees absorb or collect air pollutants, so the loss of trees in cities and towns is profoundly detrimental to air quality. According to American Forests, during the past decade, only one tree was planted in America's cities and towns for every four that were lost.

A vigorous tree-planting program could cut atmospheric carbon dioxide pollution significantly. Carbon dioxide (CO₂), the waste product of human respiration and the internal combustion engine, is the most significant of the "greenhouse gases." Trees consume CO₂ in the process of photosynthesis, and then give off oxygen. Every ton of living wood consumes 1.8 tons of CO₂ and produces 1.3 tons of oxygen. One acre of trees provides oxygen for 18 people and absorbs the amount of CO₂ produced by 26,000 miles of driving.

Trees also reduce CO₂ indirectly, by shading buildings and their surroundings in the summer, reducing the need for air conditioning and thus the CO₂ emitted by power plants. They also reduce CO₂ and, by shielding buildings from winter winds, reduce the CO₂ emitted by home and business furnaces. By some estimates, the CO₂ "savings" that result from lower cooling and heating needs (most pronounced in urban areas), could be 15 times greater than the reduction of CO₂ through photosynthesis.

Trees remove and use nitrogen from nitrogen oxides and airborne ammonia. They also remove as much as 13 percent of particulates (small bits of pollution) and 42 percent of the dust in the air, and reduce the amounts of several other air pollutants including ozone and peroxyacetylnitrate (constituents of smog), sulfur dioxide, chlorine and fluorine.

Air pollutants that the tree cannot use for its growth collect on the leaves until they are washed to the ground, where, ironically, they may contaminate soil or water. Some species of trees are extremely sensitive to pollution. For example, tulip trees are sensitive to ozone and birch trees are sensitive to sulfur dioxide. Like the miner's canary, they are sentinels that indicate problems early.

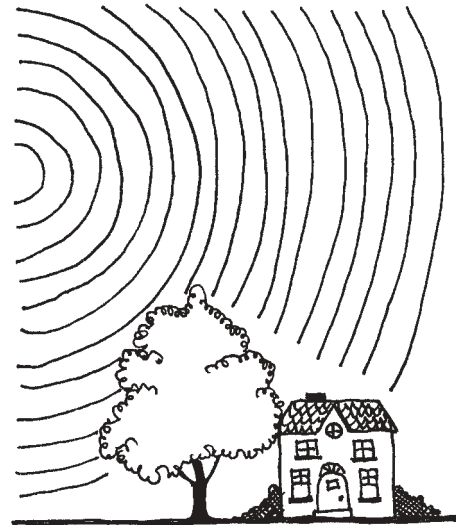
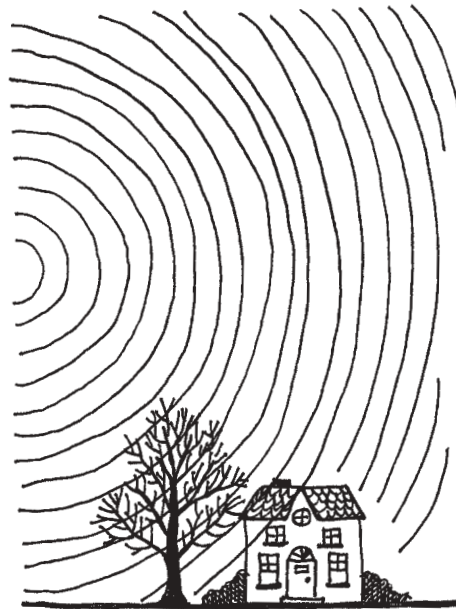
Moderating the Local Climate, Saving Energy.

Urban areas become "heat islands" where temperatures are 5 to 9 degrees higher than surrounding suburban or rural areas. Trees reduce local temperatures by:

- Shading buildings and pavement, which prevents heat absorption and the subsequent radiation of heat back into the environment. This cooling effect can extend a considerable distance from the wooded area. On cool nights, the process is reversed, as trees help hold the warmth radiating from the earth, pavements and buildings;
- Using solar energy, which would otherwise heat the air, to drive photosynthesis and evapotranspiration. Trees may take up hundreds of gallons of water on a hot day; evaporation of this water from foliage reduces the surrounding air temperature.

According to the National Association of Home Builders (NAHB), careful planting of trees around a building can cut air conditioning costs by as much as 50 percent, and heating costs by 20 percent or more in windy areas. Deciduous trees on the east and west sides will provide shade in the summer, blocking 70 to 95 percent of the sun's radiation, but will allow the winter sun's warmth to penetrate when the leaves are gone. Evergreens on the northern side will block

BARBARA PRETZ

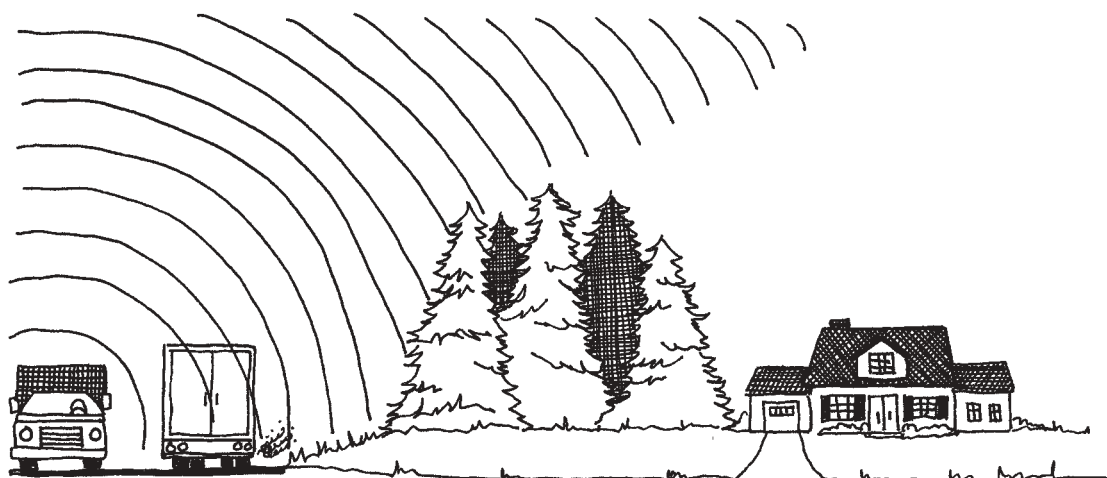


A tree allows solar warming in winter and gives shade in summer.

winter winds, and can be placed to help direct cooling breezes to open windows in the summer.

Noise abatement. Trees are sponges for noise, especially the higher pitched sounds that bother humans and other animals. A buffer of trees 100 feet wide and 50 feet high can cut traffic noise by about 50 percent.

Property Values. Statistics show that trees increase property values and the municipal tax base. The tax base may also be more stable,



Noise Control

because trees help a community attract and keep residents and businesses. Surveys show that trees account for 10-23 percent of the value of a house. In a 1993 survey by the NAHB, home-buyers were asked what would make new neighborhoods more attractive; 77 percent said “more trees.” In Athens, Georgia, trees were found to add \$1.79 million to the tax base.

Tree appraisals for insurance or other purposes often value trees around homes and businesses at many thousands of dollars. Appraisals are based either on replacement cost or on a more complex method that assigns a dollar value based on a tree’s size, species, condition and its practical, aesthetic and historical functions. A tree professional can give advice on determining these factors.

An Urban Forestry Project in East Orange (Essex) showed how trees affect the community,

for instance by making it more attractive for shopping. In Camden, planting pear trees along seven blocks almost immediately drew businesses to the empty storefronts there.

Habitat. Development that leaves only isolated patches of forest or meadow can devastate wildlife. Isolated open space tracts may look nice and provide some recreation for human residents, but they can support only meager wildlife populations. Larger wooded areas and “edge” habitats, where open areas meet forests, are needed to provide food, breeding areas and protection for many wild birds and animals. Wide natural corridors should connect these areas so that animals can travel to find food and breeding sites, escape predators, or take shelter from the elements. Wildlife specialists should review open space and greenway plans to make sure they include adequate wildlife habitats that are not disturbed by human activity.

Destroying or manicuring one open space parcel will reduce local wildlife at that site; cumulatively, many such small losses of habitat can add up to a situation where certain species will not continue to survive at all. Fragmentation of large tracts of forest and the cumulative decrease of “edge” habitat have reduced the number and variety of songbirds. Small wooded areas and suburban lawns (and their predator pets) do not offer suitable food or protection for these birds.

ILLUSTRATIONS BY BARBARA PRETZ



Wind Protection

Woodland destruction also harms aquatic life. Even small amounts of pollution or siltation can make streams unsuitable for trout. Fertilizer entering streams through runoff from farms and lawns can spur algae growth, which in turn reduces the light and oxygen needed for healthy stream ecology. When riparian tree cover is thinned or destroyed, increased sun exposure raises water temperatures, promoting algae growth, and harming sensitive fish and other stream life.

Recreation. Saving trees and forests will serve the many walkers, bicyclists and birders who enjoy the pleasures of the outdoors. The popularity and benefits of these areas will underscore the need to make nature a focal point of municipal planning and not treat undeveloped land as unused, waiting for the bulldozer.

The vast majority of Americans live in urban, exurban or “urbanizing” areas. As the population in those areas increases, preservation of woodlands and other natural resources will become an ever more pressing need.

NEW JERSEY’S TREES

Before European settlement, the area east of the Mississippi, from Canada to the Gulf of Mexico, was forest. Less than six percent of New Jersey was without trees. Three centuries of clearing for settlement, timbering and farming have erased most of that huge original forest. When farming proved to be unprofitable, New Jersey returned to woods as second- or third-growth forests grew on abandoned farmland.

Over the past fifty years the amount and location of wooded land in New Jersey have remained fairly constant, at about 42 percent of forest cover. Most of the forests are still found in the Pinelands in the south, and in the Highlands and Ridge and Valley provinces in the north.

In 1970, eight counties — Warren, Sussex, Hunterdon, Mercer, Monmouth, Somerset, Morris and Salem — had more forested land than in 1900, although the building boom of the

1980s hit hardest in many of the state’s least developed areas. Prior to that rush of suburbanization, most development occurred in the six counties nearest New York City — Bergen, Passaic, Hudson, Essex, Union and Middlesex — and in Camden and Trenton-Mercer County areas.

Sylvan Diversity

New Jersey is a small but ecologically diverse state, with at least 85 native and naturalized species of trees and a great variety of woodlands. Throughout the state are bogs, swamps and floodplains, which support distinctive forests depending on their location. In addition to these scattered forests, New Jersey has two major forested areas. The largest is the Pinelands, occupying 2,000 square miles or about a quarter of the state’s area. In spite of the Pinelands’ name, oaks predominate in about half of the upland areas and would be the dominant tree throughout the area were it not for timbering and fire. Pines are mixed in with the oaks and predominate in the rest of the Pinelands.

New Jersey’s second largest forested area is in the north, mostly in the geophysical provinces known as the Ridge and Valley and the Highlands, with some also in the Piedmont. These areas include many landforms — slopes and hilltops, valleys and ravines and flat land; but all are characterized by well-drained but moist soils. As in the Pinelands, human activity has had an immense impact on these forests. Fire, timbering, settlement and agriculture have conspired to promote three basic forest types where only two would grow naturally, and to establish forests of varying ages that contain different vegetation depending on their successional stage of growth.

The most common forest type is the mixed oak forest, having mostly red, white and black oaks, as well as other oaks and broadleaves. A second type of broadleaf forest, the sugar maple-mixed hardwoods forest, is found mostly in the limestone valleys of the Ridge and Valley region. The third forest type is the hemlock-mixed hard-

woods forest, having mostly hemlocks and a few broadleaves, similar to those found in the sugar maple-mixed hardwoods forest. New Jersey's hemlock forests have been devastated by an infestation of an exotic insect, the wooly adelgid.

Modern Threats

Since the 17th century, people have cut down or altered New Jersey's forests, but the forests have managed to survive and regrow in all but the most urbanized counties. Today, typical suburban development again threatens many of our woodlands. Immediate and obvious effects include:

- clearcutting and flattening the land in preparation for construction;
- roads and driveways to serve single family residential subdivisions;
- vast parking lots for shopping centers and strip malls.

Less visible effects of suburban sprawl may also damage and destroy forested lands over the long term.

- Road salt applications and unskilled pruning contribute to additional tree losses along roadways.
- Grading and construction methods can injure branches, trunks, roots or microscopic root hairs, either directly, through contact wounds, or as a result of compacted soils or changes in drainage.
- Filling around trunks and over roots, or paving too close to trees can cause a tree's death a few years after construction is finished, which obscures the cause. Root systems extend to a diameter one or two times the height of a tree, with most feeder and structural roots lying in the top foot of soil.
- Contact wounds to trunks and branches allow plant and animal pests to get beneath the bark and damage the critical thin inner bark, which carries nutrients from the leaves to the growing parts of the tree.

The State of the State's Trees

A study of New Jersey's municipal trees by the NJ Department of Environmental Protection's Bureau of Forest Management reveals that:

- Only one tree is planted for every five or six that die (the national average is one for four).
- One-third of the trees are dying or in bad condition and thus more susceptible to disease, drought, pests and pollution. Urban trees are especially vulnerable, because they often grow in small areas and poor soils, are subjected to pollution, vandalism, damage and aggressive pruning, and must compete with sidewalks, buildings, roads, wires or pipes.
- Almost half the sites where trees once stood are now empty. Two million trees would be needed to replant these sites.
- Disease is decimating Norway maples, like the chestnuts and elms before them. The deaths of these popular and invasive street trees will leave barren neighborhoods in many New Jersey towns.
- More than 30 municipal Shade Tree Commissions were disbanded in the 1970s and 80s, in part because of threats of liability suits from damage caused by trees. State statute now exempts commissioners from liability for death or injury if the town meets certain community forest planning and training criteria.
- Only about half of New Jersey's 566 municipalities have tree management programs of any sort, and municipal tree budgets are declining or disappearing.
- Only 100 municipalities have tree harvesting ordinances.

Developers and homeowners usually replant former woodlands with lawns and exotic ornamental vegetation that often do not survive because they are not well suited to natural conditions. Because the remaining woodlands are smaller and suffer changes in their growing conditions and their wildlife, they become less vigorous and more easily affected by drought, disease, pests and pollution.

Trees that formerly grew in forests but now grow in thinned-out wooded areas or near cleared spaces, pavements and buildings often cannot survive the change. They may die back at the top; suffer “sunscauld” or “scorching,” develop “feathered” trunks with new branches growing on the once-smooth lower trunk; suffer root damage or death because of temperature changes (a two degree change can kill shallow-rooted trees); lose branches or be uprooted by winds; develop longitudinal trunk and branch cracks from the combination of winter cold and sun exposure; or be damaged by road salt. Some trees might have to be removed because the damage to their roots, trunks and branches has made them a hazard, and some may be removed because they don’t look as full or attractive as trees grown in more open settings.

FEDERAL AND STATE PROGRAMS

Several federal and State programs support municipal efforts on tree protection. The NJ DEP State Forestry Service Community Forestry Program offers grants and technical assistance. The Green Communities Challenge Grants help municipalities manage vegetation on public lands and develop forest management plans. These grants have helped:

- Trenton maintain its trees;
- the Verona Shade Tree Commission inventory trees;
- the Teaneck Environmental Commission develop a community forestry plan;
- the Cranford Parks and Recreation Commission train tree volunteers;
- the Ocean County Soil Conservation District develop a county tree program that grants money to smaller organizations.

In 2001, the NJ DEP offered Green Communities Challenge Grants of up to \$2000, with a 33 percent municipal match required. When funds are available, the Program also offers Tree Planting Grants, and Community Stewardship Incentive Grants for tree maintenance in municipalities with approved management plans. The program can also help with model ordinances, a list of certified tree experts and a variety of educational activities including the NJ Big Tree program, which identifies the state’s largest trees by species and Project Learning Tree, an award-winning environmental education program.

The NJ Community Forestry Program also helps municipalities achieve Tree City USA designation from the National Arbor Day Foundation. To qualify as a Tree City municipalities must:

- 1) celebrate Arbor Day;
- 2) have a tree ordinance;
- 3) have a tree board or department, paid or volunteer;
- 4) spend at least \$2 per capita (in cash or kind) on a municipal tree and forest program.



For Further Information

A Guide to the New Jersey Community Forestry Program explains this program's grants, awards, technical and educational assistance. NJ DEP State Forestry Service, Community Forestry, 609-292-2532 or www.state.nj.us/dep/forestry/community

Forest Resource Education Center (FREC) in Jackson at the State Tree Nursery, 732-833-9816

National Arbor Day Foundation, 402-474-5655 or www.arborday.org

Natural Resources Conservation Service, US Department of Agriculture, 732-246-1171 (or the 16 district offices in New Jersey); help on reforestation, forest stewardship, natural resources inventories, planning for development or conservation projects, and farmland property assessments

Public Lands and Environment Program, US Department of Agriculture Forest Service; helps conserve, restore and sustain natural habitats, 202-205-1523

the property owner, municipal commissions can treat or remove trees located on private property if the trees harbor insects or communicable diseases that threaten neighboring trees. Shade tree commissions can charge property owners for planting, protecting and removing trees on public rights of way in front of their property.

The 1996 *New Jersey Shade Tree and Community Forestry Assistance Act* (N.J.S.A.13:1L-17.1 et seq.) provides immunity to shade tree commission members from liability claims related to deaths or injuries caused by trees or shrubs under the control of the commission. Commission members must have completed an accreditation program, and the municipality must have a State-approved comprehensive community forestry plan in place.

The Community Forest Management Plan

The NJ Community Forestry Program encourages counties and municipalities to develop and implement comprehensive community forestry management plans. As an incentive, the Program awards Green Communities grants to municipalities and counties, to be used to hire a professional consultant to prepare a plan. An approved management plan is one of two criteria that a municipality must meet in order for its shade tree commission members to receive liability protection under the *New Jersey Shade Tree and Community Forestry Assistance Act*.

The Community Forestry Program anticipates that formal management plans will lead to more consistent stewardship of New Jersey's community forests and, over the long term, will result in more and healthier trees, decreased tree removal costs and a reduction in hazardous tree situations. The Community Forestry Program recommends that a management plan contain:

- goals and objectives, and an explanation of how the management plan will address or reduce liability associated with trees;
- an overview of the municipality's tree history;
- the roles and duties within the municipal or county organization pertaining to tree

LOCAL ACTION

Shade Tree Commissions

The State law enabling Shade Tree Commissions, (N.J.S.A. 40:64.1-14) permits municipalities to establish by ordinance shade tree commissions of five to seven members, to regulate, plant and maintain trees and shrubs on public land and along roadways, and to pass ordinances "necessary or proper" to carry out the job. The local shade tree commission must be consulted prior to any street and sidewalk work that might damage trees on public property or in public rights-of-way. A commission's authority extends to state and county roads only if the State Department of Transportation and the county shade tree commission or department of parks and recreation agree. With the consent of

planting, removal, maintenance and other functions;

- coordination procedures among citizen groups, volunteer boards, planning boards, construction officials and tree management officials;
- a training plan for shade tree commission members, municipal or county employees, homeowners and others involved in maintaining the community forest;
- strategies for increasing public awareness and community involvement;
- the short- and long-term plans to carry out tree maintenance, tree assessment/inventory, tree planting and tree hazard identification. Adoption of ordinances, such as tree harvesting, tree removal, tree protection during construction, site plan standards and the establishment of greenways;
- a budget that identifies all available resources, including volunteers, for the management plan.

The **Teaneck Township** (Bergen) Environmental Commission used Green Communities grants to conduct a street tree inventory and create a management plan. In a 1994 pilot project the Commission surveyed about 10 percent of the Township's trees to develop, test and refine the methodologies necessary for conducting a complete inventory of the estimated 15,000 trees on the Township's 120 miles of streets. The pilot program showed that volunteers were able to collect accurate data. The Commission decided to keep the data requirements simple — such as “oak,” rather than what species of oak, for ease of data gathering and usefulness of information.

A review of the pilot project yielded the following conclusions and recommendations:

- Vacancies were noted in about 25 percent of the locations surveyed, pointing to the need for a planting program.
- More than half of Teaneck's street trees were maples, but maples are suffering from disease. Therefore, more diverse species should be planted in the future. Providing an assortment of tree species in a neighborhood helps avoid

the spread of disease, enables species to use different nutrients in the soil and provides aesthetic variety.

- A tree maintenance program, including root feeding and periodic pruning, would benefit the 15 percent of the trees found to be in poor condition.
- Residents should be urged to water trees in front of their homes.
- Power line pruning and sidewalk lifting are major problems that the municipal government should address.

Once the pilot project was completed, the Commission recruited additional volunteers to complete data collection for the entire town. By June 1997 the inventory was complete with data entered for about 15,000 trees.

The Highland Park (Middlesex) Environmental Commission conducted a shade tree inventory using a software program developed by Rutgers University Agricultural Extension. Using the inventory the Commission completed a Master Plan for Shade Trees that sets goals and gives advice for caring for the trees in the town. The next step is a Community Forestry Management Plan, which will give practical steps for maintaining the town's trees. When the State approves Highland Park's Plan, the town becomes eligible for stewardship incentive grants.

For Further Information

Community Forest Reference Manual, Trees for New Jersey Streets, Planning and Care of Urban Trees, and Laws of New Jersey Pertaining to Shade Tree Commissions, NJ Shade Tree Federation, 732-246-3210

NJ DEP Community Forestry Program, 609-292-2532 or www.state.nj.us/dep/forestry/community

Street Tree Inventory CD, Rutgers University Publication #E231, 732-932-9762 or www.rce.rutgers.edu

Greenways

A greenway plan can be an excellent way to preserve trees and forests. The Open Space chapter of this manual contains more about greenways. Two municipalities whose plans specifically address woodland preservation are:

- Harding Township (Morris) proposes forested stream corridors connecting the Great Swamp National Wildlife Refuge (3,500 acres in Harding) and Jockey Hollow National Historical Park (1350 acres in Harding). Although 41 percent of the Township is already publicly held, the Township considers protecting these greenways critical for water quality, erosion and flood control and habitat, including old growth forests.
- Holmdel Township's Master Plan (Monmouth) calls for protection of wooded corridors along ridgelines and streams, and "ribbons of green" through developed areas. The Township's plan is part of a county greenway plan.

Ordinances

Before the 1980s, most municipal tree programs were modest, managing only street and parkland trees. Increasingly, municipalities have decided to protect more of the community forest by:

- requiring tree removal and replacement plan as part of a subdivision or site plan application;
- establishing standards to protect existing trees on or near construction sites;
- controlling the removal of certain kinds or quantities of trees in addition to street trees, such as historical, specimen or other large trees, or trees along stream corridors and scenic vistas (for instance, ridgelines);
- requiring new construction have specified types of landscaping, including trees;
- requiring cluster development or building envelope restrictions to preserve trees and sensitive natural features;

- regulating commercial timbering practices;
- establishing greenways for habitat and recreation.

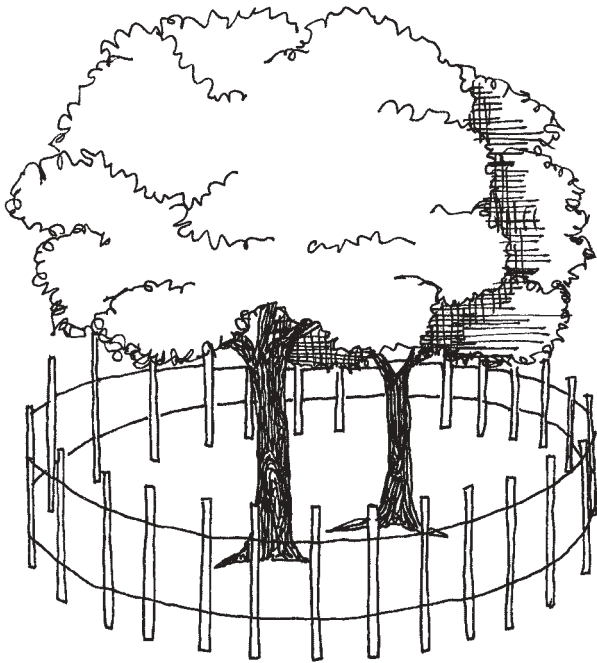
State forestry officials recommend that to avoid confusion, communities adopt separate tree protection and tree harvesting ordinances.

Tree Protection. Many towns require, as part of a subdivision or site plan application, that an applicant submit a tree removal and replacement plan that will preserve as many mature trees as possible. The plan should show compliance with set disturbance limits, tree replacement formulas and street tree planting.

Another common type of ordinance is designed to protect trees during construction. This ordinance requires that protective fencing be placed at a certain distance (usually at the drip line) around trees that are to be preserved on the site, to keep heavy machinery from compacting the soil and damaging the tree's roots. Soil compaction can kill trees a year or more after construction is finished. The ordinance also forbids storage of construction materials, soil or equipment within the protected area. An ordinance may contain a requirement for bonding to assure that any tree that is damaged will be replaced.

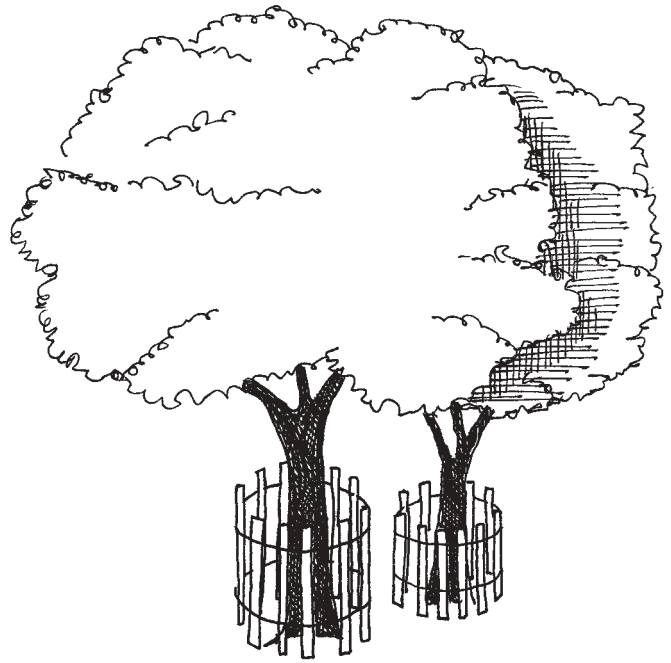
The NJ DEP State Forestry Service's guidelines for ordinances regulating construction, tree removal and planting recommend that:

- each municipality provide a list of preferred trees for certain climates, soils and topographies to guide property owners and developers with tree planting plans;
- no subdivision, site plan or other development, no building permit and no construction be approved until a detailed tree removal, replacement and planting plan and diagram is submitted;
- specific site plan criteria be adopted, including that:
 - driveways be aligned to save as many trees as possible;



Trees with Correct Fencing

- parking lots include islands of trees with no paving inside the dripline (the outer circumference of the tree's branches) and with grading designed to water but not drown the trees;
- construction activity not be allowed within the dripline;
- trees damaged during construction be replaced, including trees likely to die because of root disturbance or changes in drainage;
- a tree buffer be maintained around building sites and between streets and buildings;
- newly planted trees have a two-year guarantee and a bond to pay for replacements;
- trees not be removed from slopes or environmentally sensitive areas if this will mean extra runoff, erosion, or silting (unless the Soil Conservation District approves an alternative plan);
- healthy trees of historical or natural importance not be removed;



Trees with Incorrect Fencing

- when trees are removed for soil removal or fill, equivalent wooded areas be replanted on the site.

Mine Hill (Morris) based its ordinance on the NJ DEP Bureau of Forestry model. It requires detailed tree removal plans for all site plans and subdivisions, building and occupancy permits, soil removal operations, or any development requiring removal or planting. Residential lots smaller than a half acre are exempted, as are some other situations. The ordinance also requires:

- islands of trees every 100 feet in parking lots, with no paving within 10 feet of the trees, and good drainage required;
- no tree removal within 100 feet of streams or wetlands or from slopes if it will create runoff, erosion or siltation;
- wells with a radius of at least six feet all around the trunk for trees where fill has been added;
- minimum 20-foot tree and shrub buffers on three sides of commercial and industrial build-

ings and preservation of trees wherever possible on the street side;

- aesthetic tree buffers around multiple dwellings, billboards, utility towers or buildings, junk yards, landfills or vacant lands;
- replacement of any trees removed by landfill or mining operations.

South Brunswick (Middlesex) passed its ordinance in 1990, the result of 18 months' work by the Environmental Commission. "Trees," the Commission said, "represented the bucolic essence that originally attracted us to the township." The tree protection ordinance begins with a statement of purpose, which includes air pollution and loss of property values as reasons to avoid cutting trees.

For nearly all development applications, the ordinance requires a site plan showing developable wooded acres and the trees six inches in diameter or larger, identified by species and size. The plan must show which trees are to be cut and where trees will be replaced. Trees must be replaced according to a formula; the larger the tree removed, the more new trees must be planted. For instance, for trees less than 18 inches in diameter, three new trees of 2.5 inch diameter must be replanted, and for trees 41 inches across or larger, 15 trees of at least 2.5 inches must be planted.

In place of half the required replanting, developers may ask to contribute twice the value of the replanting to a tree and park fund, which may be used for projects recommended by the Environmental Commission. The Planning Board may reduce the replanting requirement if the developer can prove replanting costs more than 5 percent of total site improvements. Specific approvals are required to cut any tree 16 inches or greater in diameter, and site plans are to be adjusted if possible to save these trees. The ordinance also stipulates construction and grading methods to protect trees, and requires developers to replace any trees damaged during construction. Escrows, performance and maintenance guarantees are required. Permit holders

must notify the municipality in writing at least three days before they begin cutting. Penalties may reach \$1000 per day and 30 days in prison.

Middletown (Monmouth) has a detailed ordinance for preserving natural features, including trees. A Shade Tree Advisory Committee reviews development applications, and a Shade Tree Inspector must approve landscaping work. No final approvals are given until wooded areas within 200 feet of the site are mapped, and a detailed landscaping and screening plan is submitted. Certain trees within setbacks are to be protected and developers must submit performance guarantees to protect existing trees. Substantial vegetated buffers are required along roads, between lots, and between residential and other zones. If the buffer is waived (the Shade Tree Committee must be consulted), the developer must pay an amount equal to what the buffer would have cost to the municipality's Shade Tree Planting Fund.

Developers must provide a minimum of 10 trees per acre in residential developments, pollution-resistant trees at certain intervals in and around parking lots, and follow specific requirements on specimens and planting.

The Berkeley Heights (Union) Environmental Commission's "Tree Save" program compliments the township's tree ordinance. In 1995, the Commission convinced the Planning Board to add a condition to all its resolutions to protect trees on lands proposed for development. This condition requires representatives of the developer, the Planning Board, and the Environmental Commission to mark the trees that must be saved and to make minor site plan adjustments if necessary. The developer must protect designated trees from trunk or root damage.

Tree Removal. In addition to ordinances regulating tree removal during development or construction, some municipalities require property owners to obtain a permit before removing any healthy tree in excess of a certain size, or limit the number of large trees that can be removed in a given time period. However, many tree protection ordinances include broad exemptions for single-family half-acre or one-acre lots, or exempt clearing within public rights-of-way.

Harding Township's (Morris) ordinance lists nine factors for deciding whether to issue a tree removal permit. These include whether removal would impair the growth of remaining trees, would change existing drainage patterns or allow erosion or dust, would change the screening between buildings or lots, would have an aesthetic impact or damage the value of the property, and others.

Medford (Burlington) requires a permit for clearing more than 1500 square feet within the Pinelands areas of the town. Permits stipulate that specimen trees not be cut and that the project be finished within six months and replanted with native vegetation, except in turfed recreational areas. In cleared or unwooded developments, trees must be planted at 40-foot intervals along both sides of the street.

Old Bridge (Middlesex) defines tree removal as any act which causes a tree to die within two years, including damage to roots, soil compaction, grading or filling, excessive pruning, or paving too near the tree. The ordinance prohibits removing specimen trees, certain trees within 100 feet of a stream, trees in a buffer or greenbelt, and trees that screen certain unattractive structures such as transmission towers or junkyards. The Construction Official cannot approve an application until the Environmental Commission, engineer and planner have commented (within 30 days). The Construction Official can require reforestation if trees are removed illegally.

The West Milford (Passaic) ordinance covers both private and commercial tree removal, requiring permits for all minor and major subdivisions, site plans, building applications and certificates of occupancy. The town forester must inspect the site, must assess the impact on property values and aesthetics, and can "affix reasonable conditions." Removal in all situations is restricted to 30 percent (or five trees per acre per year for personal firewood) and cutting or damaging of historical or botanical specimens is prohibited.

Tree Harvesting. The State Forestry Service encourages the landowner and municipality to use professional foresters to help write and enforce tree-harvesting plans. The Service and the State Forester will prepare or approve such plans. The Service's model tree harvesting ordinance requires loggers to:

- Obtain a municipal timbering permit;
- Submit a detailed map showing wetlands, streams, soil types and slopes, proposed skid trails, roads, species and sizes of trees to be cut;
- Submit a management plan and a regeneration plan requiring that all trees be cut to ground level, that no wetlands be filled, that unharvested trees be protected from damage, that the site be regenerated to a safe and natural state, including reforestation, and leaving a 25-foot vegetated buffer along streams, ponds, and marshes (a 200-foot buffer is required for some activities).

Maurice River (Cumberland) has a detailed tree-harvesting ordinance. It exempts residential lots under an acre and certain agricultural activities. Commercial cutters can apply to cut only 10 acres at a time on each of two tracts. They can have no more than two permits at one time, three permits per year and only one permit on any given parcel. Cutting, skidding and trucking are strictly regulated, as are the cleaning, grading and replanting of the area. Cutters must put \$75 per acre in escrow and pay application fees of \$25 for the first acre and \$5 for each additional acre.

Studies Suggest Our Love of Trees May Be Genetic

In diverse civilizations from ancient to modern, the notion persists that trees and other natural scenes have a therapeutic effect on our thoughts, feelings and health. Recent research has shown that natural scenes physiologically affect human beings, even if the scenes are only pictures on a wall. Simply viewing natural scenes can affect blood pressure, muscle tension, alpha waves (produced in the brain during states of relaxed attention) and psychological characteristics such as sadness, anger, aggression, elation and interest. The effects occur quickly, often within four to six minutes.

Studies in several different parts of the world also show remarkably similar visual preferences for a certain type of landscape — a savanna — a park-like image with open grasslands, trees, but little underbrush. Although researchers expected to find very different landscape preferences among different cultural, educational or occupational groups, the savanna image was chosen by people from Asia, Europe and North America. The image is even more attractive if it contains water.

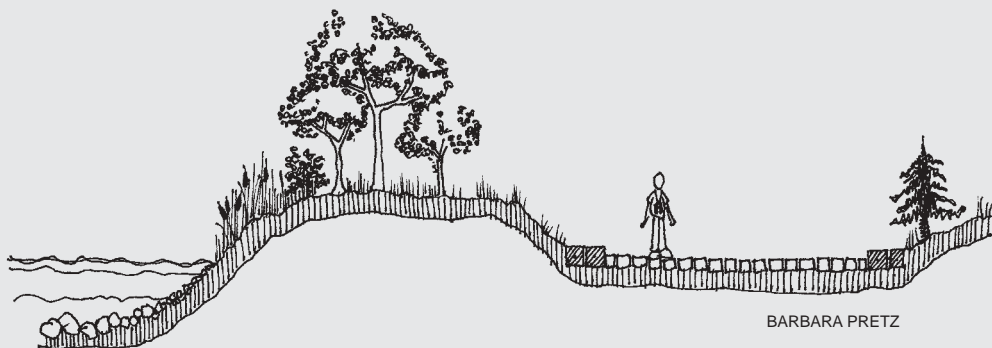
Plants and trees, especially larger trees, consistently produce strong positive reactions, even in urban scenes. Natural scenes without trees typically receive moderate to low ratings. Some researchers suggest that this landscape preference may be genetically based, because evolution favored those who were drawn to and nurtured by a setting that provided the best access to food, water and safety.

The studies also show biophobic reactions to other kinds of landscapes. Most people expressed an aversion to densely forested images with heavy underbrush and little openness. In such areas, predators would be able to hide, and early humans would have had a harder time finding food and water. Air pollution (which cuts visibility), urban noise, and man-made elements such as power lines and towers, billboards, roads, cars and rectilinear forms produced strong negative reactions.

One expert, Roger Ulrich, professor at Texas A&M University, believes that community planners and conservationists can use these studies to preserve trees and other natural features. In addition, the studies can assist medical practitioners, sociologists and psychologists to understand how the environment affects human behavior.

Natural scenes prompt more than aesthetic pleasure, stress reduction and a happier mood. They also enhance thinking processes, including creative problem solving, because positive emotional states markedly affect the ability to think. Proof of nature's efficacy for human well-being will help substantiate nature's value, including its economic value, since mood affects job productivity and natural scenes attract tourists.

In urban environments, natural elements of any size can have a positive effect, Ulrich observes. A few street trees, small parks, plantings in and outside buildings, bits of grass or shrubbery can help reduce stress and lift the mood of city dwellers. Trees directly combat three of the worst stressors in the urban environment: air pollution, noise, and crowding.



For Further Information

The Municipal Tree Manual, International Society of Arboriculture, NJ Chapter of ISA, c/o Monmouth County Shade Tree Commission, 732-431-7903 or www.isa-arbor.com

Trees NJ, a non-profit organization working to preserve, enhance and expand urban and community forests, 609-298-2999 or www.treesnj.com

Rutgers Cooperative Extension, county offices in all but Union (in blue pages of phone book); information on the care, protection and value of trees and woodlands, and help diagnosing tree diseases

Rutgers University Office of Continuing Professional Education; short courses in forestry and landscaping, 732-932-9271 or www.aesop.rutgers.edu.

Building Greener Neighborhoods: Trees as Part of the Plan, American Forests, 202-955-4500 or www.amfor.org, and the National Association of Home Builders, 1995; how to write more tree-friendly site plan ordinances

NJ DEP State Forestry Service, Community Forestry, model ordinances for tree protection, tree harvesting and establishing a shade tree commission, 609-292-2532 or www.state.nj.us/dep/forestry/community

How to Conduct a Street Tree Inventory and How to Write a Municipal Tree Ordinance, Tree City Bulletins, National Arbor Day Foundation, 402-474-5655 or www.arborday.org

Guidelines for Developing and Evaluating Tree Ordinances, California Department of Forestry and Fire Protection, Urban Forestry Program, PO Box 944246, Sacramento, CA 94244-2460

Tree preservation and forestry sample ordinances, ANJEC, 973-539-7547 or www.anjec.org

CHAPTER 7

PROTECTING STEEP SLOPES

Hills, mountains, and ridgelines have provided visual inspiration for humankind since time immemorial. Symbols of strength, aspiration and beauty, these chunks of geology often lend a special character to a landscape — the qualities that make an expatriate long for “the hills of home.”

Slopes serve important natural, aesthetic and planning functions, such as abating noise, light or air pollution; buffering wind, rain and snow; providing a pleasing, distinctive setting; and acting as visual barriers between different development zones. Vegetated hillsides can serve as buffer areas that absorb the force of wind-driven rain and snow. They provide harmonious settings for human communities. And they can help offset some noxious effects of human activity — diminishing air, light and noise pollution.

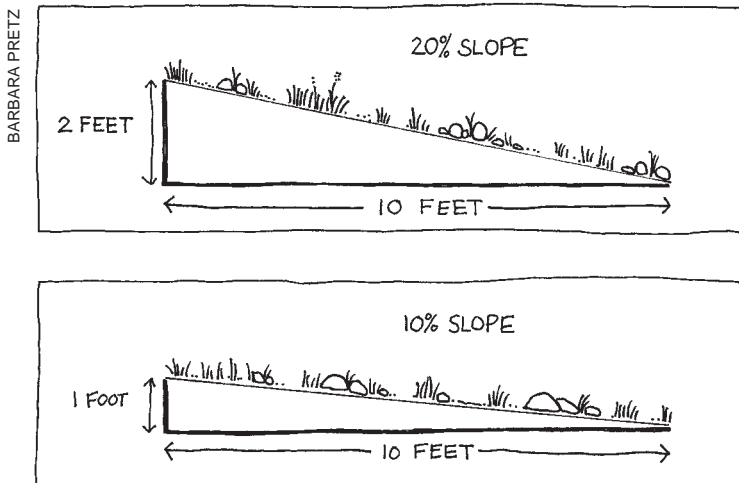
The natural stability of slopes is determined by:

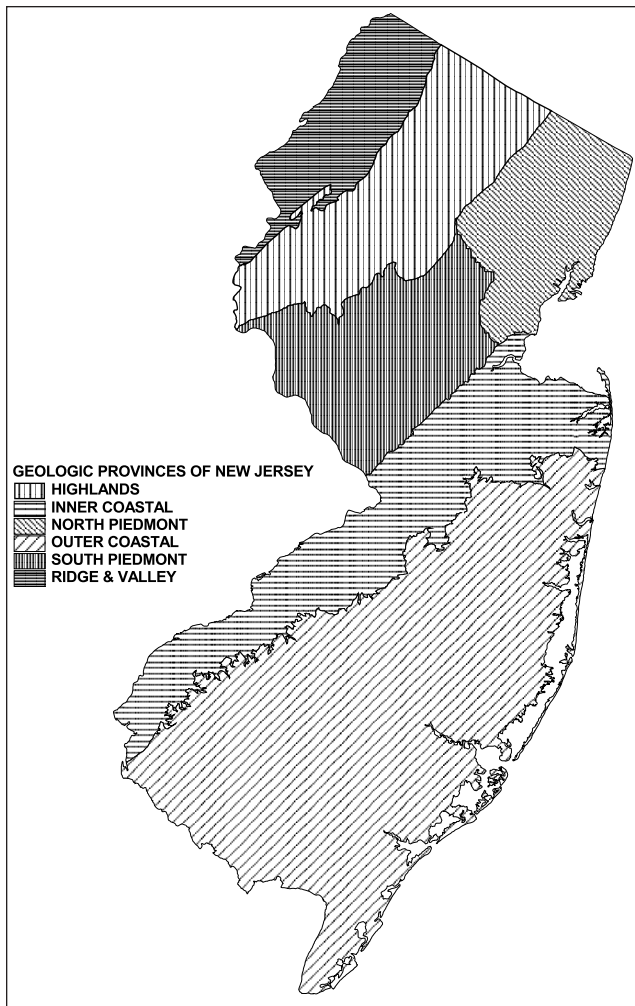
- steepness (described as a percentage based on the amount of rise over a certain distance—a 10 percent slope rises one foot over a 10 foot distance);
- length;
- subsurface geology;
- soil characteristics, such as erodibility, compactibility, percolation rate, water retention capacity, fertility;
- amount and type of vegetative cover;
- climate (precipitation, wind, freezing and thawing).

SLOPES IN NEW JERSEY

New Jersey is divided into four physiographic provinces, characterized by different geology and landforms. The southern half of the state is much flatter than the northern half, but all four provinces have slopes to protect. (See Chapter 2 on Groundwater.)

The fall line, dividing the steeper and flatter parts of the state, runs through the center of Mercer and Middlesex counties. South of the fall line lies the Coastal Plain province. Here, steep slopes occur mostly as streambanks, isolated hills and coastal bluffs. Examples are the coastal bluffs in Atlantic Highlands, Telegraph Hill, Mount Holly and Arneys Mount. The bluffs are very susceptible to slumping and erosion and pose significant engineering and safety problems. Streambanks typically are soil or clay and also can be unstable.





New Jersey Geophysical Provinces

Just above the Coastal Plain lies the Piedmont region, which has extensive flat land but also many ridges and uplands, such as the Palisades, Rocky Hill, Sourland Mountain, Cushetunk Mountain, the Watchung Mountains, Long Hill and Hook Mountain. The Piedmont is separated from the Highlands province by an escarpment 200-800 feet high running through Mahwah, Boonton, Morristown, Gladstone, and then in an irregular line to the Delaware River near Milford, Pennsylvania. The Highlands contain New Jersey's greatest concentration of steeply sloping terrain, with large areas of greater than 15 percent slope.

The northwestern corner of the state is in the Valley and Ridge province, which is marked by long parallel ridges and valleys trending north-east to southwest. Among these ridges and valleys are Kittatinny Mountain, Walpack Ridge, the Flat Brook valley, the Delaware valley above the Delaware Water Gap, and the broad valley between Kittatinny Mountain and the Highlands.

The Piedmont, Highlands, and Valley and Ridge provinces all have slopes ranging from 10-35 percent but vary in the proportion of steeply sloped terrain, with the Highlands having the most and the Piedmont the least. The Highlands and Valley and Ridge provinces also tend to have greater "relief," or differences in elevation, and thus more steep slopes of greater length.

The Results of Disturbing Slopes

Disturbing the plant life, drainage patterns, topography or soils of slopes often increases the amount and speed of runoff and can cause erosion, soil creep, slumping (sections of soil shifting down and outward on the slope), and landslides. When a hillside is cleared, the usual result is more and faster runoff, especially when grading has smoothed a slope's natural roughness. Leaves and branches no longer shield the soil from wind and rain; roots no longer hold the soil in place; and the smoother slope allows the runoff to travel faster, thus increasing erosion and decreasing groundwater recharge. These problems become progressively worse on steeper slopes.

Runoff carries eroded sediments to lowland areas, to wetlands, ponds and streams, where the resulting turbidity and siltation can damage or destroy aquatic life and disrupt the ability of wetlands to filter and purify water. This combination of increased runoff and stream siltation affects the ability of streams and wetlands to retain water, changing the pattern and rate of the water's rise and fall and causing increased flooding.

Changing topography by excavating or grading the foot of a slope or cutting into the face of a hillside often promotes instability and erosion. Erosion, slippage or excessive runoff may also

result when existing soils are replaced with soils more suited for septic systems or lawns. Soils on ridgelines and steep slopes often are thin and susceptible to wind and water erosion. Only specialized vegetation thrives in these conditions; conventional landscaping usually does not and may require excessive upkeep. In any case, even a brief denuding of ridgelines and steep slopes can cause soil losses that will discourage any regrowth of plant life and habitat.

Dramatic runoff problems often result when slopes are covered with impervious surfaces, such as buildings, roads, driveways and parking lots. Since water can't percolate into the soil, it runs off the site, picking up speed as it travels across these smoother surfaces. Eroding surrounding soils, this high velocity runoff carries increased amounts of silt into nearby surface waters. Excessive runoff sometimes also results in flooded or icy conditions in parking lots and roads.

In addition to the obvious problems of runoff, erosion and landslides, altering the soils or vegetation on slopes may also reduce the percolation of water into the soil and disrupt the recharge of groundwater and aquifers. Aquifers in areas of steep bedrock, like parts of northern New Jersey, do not contain much water. Poorly designed or excessive development that disrupts aquifer recharge while increasing the demand for water for human consumption can result in periodic or permanent water shortages.

Aquifers can also be damaged by the heavy road salting typical in hilly areas and from septic installation on slopes, where soils are thin or otherwise unsuitable for leach fields. In such areas, septic effluent may seep out on the face of the hillside.

Grading hillsides and ridgelines sometimes alters drainage divides, sending more runoff in one direction and less in another. Clearing and grading may even alter the local climate, changing the path and severity of wind, precipitation, noise and pollution.

Local regulations can address some of these problems, but designing, building and maintaining development on steep slopes will inevitably mean higher costs for the developer and for the municipality. Problems often come to light after construction is finished and the developer is gone. Then the municipality may be stuck with burdensome costs for stormwater management, septic failures, sewerage, winter storm maintenance, construction of public water systems, or fire and emergency services. (See Chapter 4 on Streams and Rivers.)

How Steep Is Steep?

Problems on Slopes of Only 2-5 Percent. Many municipalities prohibit development or disturbance on slopes 25 percent or steeper, but whether less-steep slopes are developable depends on the proposed use and on existing natural conditions. If municipalities permit development on slopes, they must be aware that the cost of public services, especially for road maintenance and plowing, will rise in such areas. Developers must be willing to bear the extra cost to develop slopes correctly.

The US Natural Resources Conservation Service (NRCS) (formerly the US Soil Conservation Service) and the State Development and Redevelopment Plan (SDRP) provide some guidelines:

Minor Slopes — Less than 10 Percent.

- minor slopes are best suited for development, and are less costly to develop;
- ponding, runoff, and erosion may be a problem on nearly level slopes from 0-2 percent, unless the soils are well drained;
- erosion can occur on slopes as slight as 2-3 percent, depending on soils. Soils that percolate readily tend to be less erodible than less pervious soils, such as clays;
- slopes of 5-10 percent present moderate septic problems because of possible seepage.

Steeper Slopes — Greater Than 10 Percent.

- steeper slopes are more erodible, need special stormwater management and roadway specifications, and raise costs for utilities, sewers, and other infrastructure;
- slopes greater than 15 percent have soils that tend to be thin and less fertile;
- slopes from 10-25 percent should be left in a natural condition, carefully maintained in grass or tree cover, or used as pastureland; construction on such areas can increase the sediment load of streams 100-fold;
- slopes greater than 25 percent should be left alone but can provide good sites for recreation or wildlife.

Soil Classifications Indicate the Degree of Slope.

The US Natural Resources Conservation Service maps and classifies soils by slope and other characteristics. These include erodibility, permeability and general stability; suitability for agriculture, pasture, woodland, windbreaks and different kinds of recreation and habitats; and limitations for all kinds of site work and construction, including septic systems.

The soil classifications, signified by two or three letters, can be used to determine slope:

Classifications ending with

- A or having only two letters have slopes of 0-3 percent;
- B have slopes of 3-8 percent;
- C have slopes of 8-15 percent;
- D have slopes of 15-25 percent;
- E have slopes of 25-35 percent;
- F have slopes of more than 35 percent.

Specific sites often have a range of slopes.

Parcels with steep slopes sometimes have small, flatter areas that are suitable for construction.

Environmental commissions, open space committees and planning boards can use the NRCS soil classifications to map slopes and other environmental features and to help design

conservation areas and greenways, and locate suitable types and densities of development.

PROTECTING SLOPES

The 1992 Manalapan Decision. Prior to 1992, many communities protected steep slopes and other environmental features (see Chapter 4, Wetlands) through land use ordinances that excluded these and other environmentally sensitive features from the calculations of the allowable density of development on any given parcel. The town determined the number of units that could be built on a parcel after first subtracting from the total acreage that was constrained by environmentally critical features. The amount subtracted depended on the environmental constraint and how completely it would inhibit development or disturbance. For instance, this type of ordinance would allow no wetlands acreage in density calculations. As for slopes, typically only 33 percent of acreage with slopes of 15-25 percent and only 20 percent of acreage with slopes of 25 percent or more would be used for density calculations. Some ordinances also qualified slopes by depth of soil.

Manalapan (Monmouth) relied on such density adjustment factors in its land use ordinance to protect wetlands and floodplains. However, in a 1992 suit brought by a developer, the Appellate Division ruled that the ordinance was void because it was inconsistent with the Municipal Land Use Law (MLUL) (N.J.S.A. 40:55D-4 & 6), which states that densities are to be based on gross, not net, acreage. Although some municipalities still retain density adjustment ordinances, many planners consider this risky, warning that municipalities that don't revise their ordinances may open themselves to challenges or to claims that their land development ordinances are defective in other areas.

The MLUL does provide other options for alternative slope protection. Two sections of the law, Article 1, General Provisions, and Article 6, Subdivision and Site Plan Review and Approval, pertain to steep slope regulation. The general

purposes of the MLUL (N.J.S.A. 44:55D-2) give municipalities broad powers to plan development in ways that will preserve natural resources and protect the common good. This section of the law provides a basis on which communities can plan to protect steep slopes and other environmentally critical natural features.

The MLUL encourages municipalities to:

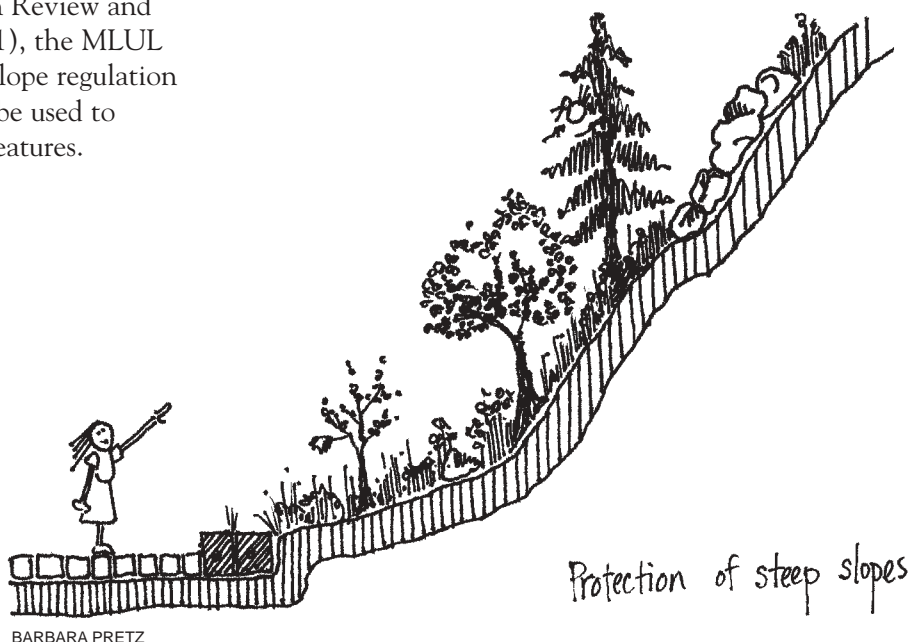
- “secure safety from fire, flood, panic and other natural and man-made disasters”;
- “provide adequate...open space”;
- “promote...population densities and concentrations that will contribute to the...preservation of the environment”;
- “encourage the appropriate and efficient expenditure of public funds by the coordination of public development with land use policies”;
- “provide a desirable visual environment through creative development techniques and good civic design and arrangements”;
- “promote the conservation of...open space, ... and valuable natural resources in the State and to prevent urban sprawl and degradation of the environment through improper use of land.”

Under “Subdivision and Site Plan Review and Approval” (40:55D-38 through 51), the MLUL more specifically addresses steep slope regulation and planning strategies that may be used to protect slopes and other natural features.

Subdivision and site plan ordinances must provide:

- streets of suitable grade that can provide access for firefighting and emergency equipment and are “consistent with the reasonable utilization of the land”;
- adequate water supply, drainage and utilities;
- protection of soils from erosion by wind or water or from excavation or grading;
- protection of potable water supplies from pollution or other degradation caused by development or other land uses;
- necessary standards for grading, improvement and construction of streets, drives, drainage, sewerage and other facilities and provisions for ensuring the standards are met.

In addition, ordinances may provide for residential clustering, which can be used to avoid sensitive areas and may set standards for “economy and environmental soundness in layout and design,” including varying the sizes and shapes of lots and of yards and setbacks, another useful method for avoiding sensitive areas.



The MLUL requires site plan ordinances to address preservation of existing natural resources on the site; safe and efficient vehicular circulation; screening, landscaping and location of structures; and conservation of energy. Other sections of the law describe planned developments and general development plans for large tracts having a mix of different kinds of development. In such cases, a municipality may require an open space plan aimed at conservation and recreation, an environmental inventory listing sensitive features and how they would be affected by development, and a fiscal report describing the development's impact on municipal services and taxes.

Ways to Protect Slopes

The Manalapan decision came about because municipalities were trying to adjust lot sizes after the fact, rather than zone for large enough lots to begin with. The MLUL calls upon municipalities to base planning on natural features and to establish adequate lot sizes to compensate for the need to protect those features. The State Development and Redevelopment Plan also recommends municipalities plan and zone in ways that protect sensitive resources. Consequently, many planners are advising municipalities to establish and implement more aggressive, environmentally based zoning and subdivision ordinances.

Working with the provisions of the MLUL, many municipalities and planners have developed ordinances that regulate steep slope development more logically and thoroughly than the ordinances that relied on density adjustment factors. Some zoning ordinances are based on carrying capacity studies that use such factors as water supply and septic suitability to establish appropriate densities. Since steep slopes are typically poor sites for septic systems and for adequate water supply, these areas are generally zoned for larger lots.

A similar approach is to base the zoning map on maps of natural resource or environmental constraints to insure that future development is suited to the natural carrying capacity of the land. When Ian McHarg introduced this

approach in *Design with Nature*, in 1971, it was a turning point in planning. However many municipalities ignore the natural constraints of the land and still zone according to existing infrastructure, current development patterns, a need for variety in residential lot sizes, or the preferences of property owners.

Municipalities also can help protect steep slopes through open space and greenway plans and through tree removal ordinances. (See Chapter 8 on Open Space and Chapter 6 on Trees.) To designate greenways, some municipalities or preservation groups apply scenery classification systems to quantify aesthetic qualities.

Ordinances. The Manalapan ruling specifically cited Article 8, Zoning, of the MLUL (N.J.S.A. 40:55D-65b), which allows municipalities to “regulate the bulk, height, orientation and size of buildings and other structures; the percentage of lot or development area that may be occupied by structures; lot sizes and dimensions; and for those purposes may specify floor area ratios and other ratios and regulatory techniques governing the intensity of land use.”

By linking these strategies with master plan recommendations for limitations on development, municipalities have a good basis for ordinances that will protect sensitive natural features. Some MLUL terms, such as “intensity” and “orientation,” are not defined in the act and are open for interpretation. “Orientation” originally may have been intended to encourage southern exposures for energy conservation, but it could also be interpreted as encompassing all factors, including slopes, that affect the placement of buildings and other site improvements on a lot.

“Intensity” can include:

- the number of units per acre in different zones;
- “FAR,” or floor area ratio, (total floor area as a percentage of lot size). The MLUL definitions of floor area ratio (“the sum of the area of all floors of buildings or structures compared to the total area of the site”) and of structure (“a combination of materials to form a construc-

tion for occupancy, use, or ornamentation whether installed on, above, or below the surface”) may mean that the areas of all structures, including septs, detention basins, driveways and parking lots can be factored into the FAR;

- total impervious coverage restrictions, also usually stated as a ratio of coverage to lot size;
- minimum open space ratios.

The most common new strategy for protecting sensitive areas, including slopes, is to require that all new building lots contain a building envelope that is free of environmental constraints, including steep slopes. Each lot must have a minimum improvable area — an environmentally suitable area within the building envelope defined by side, front, and back setbacks — and site disturbance must be confined to this portion of the lot.

Municipalities using this strategy will have to analyze existing zoning maps to see if the zones reflect natural conditions. Small lots in environmentally sensitive areas often cannot accommodate constraints-free building areas.

The requirement for a constraints-free building area or zoning increased lot size for sloped land affects only new lots, and so does not protect slopes on existing tracts. Performance criteria can require builders to minimize the disturbance of environmentally sensitive features and prevent damage on and off the site. Strict design and performance standards for subdivisions and site plans are crucial to municipal protection of steep slopes and other natural features.

Design and performance standards for steep slopes should govern:

- road, driveway and parking lot location and design;
- septic location and design;
- stormwater management;
- grading, erosion and stormwater management on the slopes but also on flat areas or water bodies affected by drainage from the slopes;
- footings for buildings;
- landscaping and tree or vegetation removal;
- scenic protection, especially to control or prohibit clearing on hillsides that are within important viewsheds;
- noise control and light pollution;
- groundwater and aquifer protection, including well testing to insure adequate sustained yields (See Chapter 2 on Groundwater Protection.);
- open space requirements for active and passive recreation;
- sufficiently large and connected greenways for habitat protection.

The best steep slope ordinances begin with a detailed statement of purpose, citing other legal and regulatory documents, such as the MLUL and the State Plan, or recommendations from organizations such as the Natural Resources Conservation Service (NRCS). The ordinances impose strict development regulations on moderate slopes, ban disturbance on very steep slopes (commonly 25 percent or more), and mandate maximum preservation of the topography and natural conditions of the land, including views and scenic character.

Sample Ordinances. Examples follow of some strict and demanding ordinances and some sections not found in other municipal ordinances.

Randolph’s (Morris) ordinance thoroughly explains the need to regulate development on steep slopes in order to protect public health and safety and water resources. The ordinance cites the MLUL, the NRCS, and Randolph’s location at the headwaters of several major watersheds to support the need for the regulations.

Developers must obtain a special “steep slope disturbance permit” before undertaking any site work. The ordinance prohibits disturbance of slopes 25 percent or greater; limits disturbance to 10 percent on 20-25 percent slopes, 15 percent on 15-20 percent slopes, and 40 percent on 10-15 percent slopes that are within 100 feet of fresh water or of a wetlands transition area. The

town requires that “to the greatest extent possible” slopes of 10 percent or greater remain undisturbed, including disturbance from activities on nearby flatter areas.

Applicants for permits must prove that:

- the soil disturbance will not cause excessive erosion, instability, or runoff;
- steep slopes have been avoided where possible;
- there is proper sewage disposal and safe water supply and drainage;
- finished grades don’t exceed 3:1, or 33 percent;
- water resources have been evaluated to avoid degradation;
- the township’s tree removal ordinance has been complied with.

In subdivisions containing steep slopes, lots must be designed to “avoid excessive erosion, vegetation clearance, and degradation of water resources while ensuring proper placement of housing and associated uses.”

Wayne’s (Passaic) Environmental Protection Ordinance, which covers all natural features, is thorough and exacting. It includes clear statements of purpose, referring to the MLUL, its own master plan, and the Manalapan decision. Its purposes include to “encourage the most appropriate use of land considering its character and peculiar suitability for certain uses,” to “prevent degradation of the environment through improper use of the land,” and to “promote a desirable visual environment and conservation of natural resources.”

Sections on each natural feature are again preceded by clear statements of steep slope protection, including protecting the view of and from ridgelines and hillsides. The ordinance applies to all subdivisions, site plans, grading permits, and building permits that involve 250 or more square feet of disturbance.

The Township’s Environmental Protection Overlay District governs lots or parcels contain-

ing 250 contiguous square feet of one or more “critical environmental features” — including slopes of 15 percent or more, and other features typically associated with steep slopes such as woodlands, shallow depth to bedrock, and various water features. These overlay regulations pertain to the entire lot or parcel, require an environmental assessment, restrict impervious cover to 10-30 percent depending on lot size, encourage clustering, and require permanent open space dedication to help protect natural features. The ordinance sets strict requirements on grading and on tree protection, planting and removal. (Fees are based on the number of trees to be removed and tree removal from “any slope” is prohibited if the township tree officer judges that it will create additional runoff, erosion, and siltation).

Where there are steep slopes, Wayne’s ordinance sets disturbance limits ranging from 85 percent on half-acre lots to approximately 25 percent for single-family and 65 percent for multi-family on five-acre lots. Slopes of 30 percent or more cannot be disturbed. Permitted disturbance depends on the degree of slope and also on proximity to surface waters. If a proposed disturbance exceeds what the ordinance permits, the developer must increase the lot size or revise the plans.

West Milford’s (Passaic) zoning is based on carrying capacity, using a method developed by Rutgers’ Cook College to determine “current planning capacity.” This method calculates the land’s capacity to accommodate development from an analysis of natural resources and man-made infrastructure. The emphasis in West Milford is on water supply and quality, including septic dilution. Steep slopes are a factor in carrying capacity, in part because they tie into water supply and septic suitability. At 80 square miles, West Milford is the second largest township in New Jersey. The steep slopes typical of the Highlands region characterize much of its land. The Township has zoned this land, marked by slopes or other sensitive features, for larger lots. Site disturbance (including all grading and clearing) is restricted to a percentage of the lot: on four-acre lots, only 20 percent can be disturbed;

on three-acre, only 25 percent; on one-acre, 35 percent; on 20,000 square feet (just under a half-acre), 45 percent.

Lambertville (Hunterdon) spent several years designing its 1993 steep slope ordinance. Members of the Environmental Commission and the Planning Board, landowners and developers looked at developable parcels to see how different methods of regulation might affect them. The ordinance's statement of purpose includes the protection of "unique and predominant views," and emphasizes performance standards and design guidelines. Unlike steep slope ordinances in other municipalities, this one applies to all lots in all zones, all subdivisions, site plans, building permits, zoning permits, conditional uses, variances, and site disturbances.

If at least 25 percent of a parcel has slopes of 15 percent or greater and if there is public water and sewer, housing may be clustered but the number of permitted units remains the same. Open space must form a connected system within each project and with neighboring projects and must be maintained under a land management plan, typically by the developer or through a homeowners association.

On slopes 15 percent or greater, grading and terracing must be minimized and development should follow natural contours and should "retain natural topographic features such as drainage swales, stream beds and banks, ridgeline vistas, rock outcroppings and mature plant formations." Development should not "impair the visual integrity of the slopes when viewed from publicly accessible vantage points" and should provide for maximum steep slope vegetation. Mature trees must be retained and trees at least 10 inches in diameter must be shown on the site survey and cannot be removed without specific planning board permission.

For Further Information

Environmental ordinances, ANJEC,
973-539-7547 or www.anjec.org

Natural Resources Conservation Service,
Soil Survey and Resource Assessment,
202-690-4616 or www.nrcs.usda.gov

NJ Geological Survey, 609-292-1185 or
www.state.nj.us/njgs

CHAPTER 8

OPEN SPACE

In 1997, the Governor's Council on New Jersey Outdoors estimated that New Jersey had approximately 835,000 acres of public preserved open space. The Council saw a need to preserve one million additional acres. In response, the voters passed the open space referendum in 1998. The following year, the Legislature enacted the *Garden State Preservation Trust Act*, which authorizes the State to raise almost \$1 billion over the next 10 years for open space, farmland and historic preservation.

What Is Open Space?

Open space is land free of most development or structures other than those that support recreation, environmental and cultural education or agricultural activities. New Jersey's open space ranges from natural areas where the only human presence is an occasional research scientist, to fully developed recreational complexes with parking areas, sports fields, swimming pools, ice skating rinks, boat docks and recreational buildings that serve thousands of residents each year. Farmland is another important kind of open space, which has the additional benefit of providing a nearby source of food, with significant savings in transportation costs.

Open space can be a thousand-acre rural wildlife preserve, a hundred-acre farm, a suburban park or a community garden on a vacant city lot. All these kinds of open space benefit the state's inhabitants — both human and others. Open space is crucial for providing habitat for wildlife and plant species. Open space protects water resources and provides recreational opportunities, including tourism, generating income and

jobs throughout the state. It helps preserve local character and diversity and increases the value of adjoining property. It saves a town the cost of supplying services for residences or businesses that might otherwise be built on the land.

Frederick Law Olmsted, the 19th century designer of New York's Central Park and many other urban preserves, believed that these natural areas provide an essential escape from urban tensions, promote feelings of freedom and mental rejuvenation, and "...generate aesthetic feeling, good morals and a democratic society."

The two sections that follow discuss the types of open space most typically present and available for preservation in rural/suburban and in urban areas, but the classifications are not exclusive. Enclaves of natural open space can occur in urban as well as non-urban settings, and community gardens, typically found in cities, also can be effective in rural and suburban communities.

RURAL AND SUBURBAN OPEN SPACE

Open space in rural or non-urban areas can be categorized as passive, active or agricultural, according to the human use to which it is put.

Passive Open Space

Land held as passive open space remains in a relatively natural state as woods or meadows, mountains or streams. It may include environmentally sensitive areas — beach or dunes, estuaries or other wetlands, floodplains or stream corridors, greenway linkages or steep slopes. Human recreation, if permitted, is generally

restricted to hiking, hunting and fishing, biking, sledding or boating.

Wildlife Habitat. Preserving a diversity of natural open spaces is important for the ecosystem. New Jersey is home to a great variety of wildlife; it is one of only four states in which observers have sighted more than 200 different bird species in a 24-hour period. Generally, preserving land in large blocks or in long, linear corridors, called “greenways,” provides the most benefits for wildlife, although even small enclaves of open space can have wildlife value. Greenways can be crucial links that allow movement between habitat areas. Their use determines the widths required:

- 300 to 600-foot-wide forested greenways to provide room for larger or more mobile animals and to provide interior spaces for wintering areas;
- much wider forested corridors and woodlands to support species that cannot tolerate the light, wind, noise and visual disturbances, or the different plants, predators, and diseases that characterize the “edge” habitat, which can intrude 1000-2000 feet into a forest;
- one-and-a-half to ten-foot-wide recreational trails for people should be routed to avoid sensitive deep-woods habitats or other areas;

While nearly all natural open space helps purify water and air, each type of landscape functions differently and supports different plants and animals. Some species require not only a specific type of habitat but also protection from human contact. Other plants and animals thrive in close proximity to homes and other human facilities. An evaluation of existing and potential wildlife habitat is important in determining how much human use to permit in an area of preserved open space.

Relationships between species and habitat types are complex and not always apparent to the casual observer. Destruction of open space, or a shift toward too much of one type — suburban lawns, for instance — causes ripples through the entire ecosystem, including our own species.

Statewide, the conversion of open farmland and forests to landscaped suburban subdivisions has facilitated a problematic growth in the deer and goose populations. The overabundance of deer destroys the forest understory that previously supported a greater diversity of wildlife. In the Watchung Reservation, a 2,002-acre reserve in suburbanized Union County, for example, browsing deer have nearly wiped out many indigenous plant species, allowing non-native plants to invade and proliferate.

The shift from rural to suburban landscapes has helped encourage the spread of Lyme ticks, which flourish on the edges of civilization and nature. The quickly spreading plants and tall grasses that grow where suburban lawns and playing fields push against the edges of forests and fields are perfect tick habitat.

Although opportunistic animals like ticks, deer, geese, squirrels and cowbirds thrive at the suburban edges of woodlands, other species require large tracts of unbroken space to survive. As development for housing, roads, power lines and other human uses cuts into these areas, forests lose their ability to buffer these species. As the edges of the woods increase, opportunistic species enter, feeding on native species, competing with them for habitat and reducing the native populations.

Flood Protection. In some areas, preserving passive open space has the practical effect of avoiding “natural” disasters. For instance, building homes or businesses in a floodplain can result in loss of property and life during a flood. Destroying and filling wetlands can have similar effects, since one function of wetlands is to retain water during wet seasons and discharge it slowly during drier seasons. Without this delaying action of wetlands, rainwater simply rushes downhill, overfilling streams and rivers.

Buffers. Buffer areas around preserved open space protect the natural features so they can function normally. Buffers can reduce the effects of nonpoint source pollution from adjacent human uses. Added to protected wildlife habitat, they provide extra seclusion for species that most

need it. If the protected area contains steep slopes or a stream corridor, providing a buffer around these natural features can minimize erosion by distancing human activity from them.

Certain types of natural landscape serve to buffer other types. Wetlands, for example, prevent nearby lakes or streams from getting shock loadings of nutrients, pollution or sediment during a rainstorm. But wetlands also should be buffered, both to protect the wetlands ecosystem and to maintain the wetlands' natural pollution filtering capacity, which protects adjacent land.

Stewardship. Protecting passive open space serves many utilitarian purposes. As the most powerful of the thousands of species that share this most populous state, humans have put themselves in a position of stewardship for the natural world. Recognizing the impact of our actions on our entire natural environment, we can nurture and protect the land.

For any municipal body contemplating preserving passive open space, it is important to become familiar with the area's landscape and ecosystem and how they relate to and support other areas or habitats. A field trip to existing open space with a local nature expert can enhance open space planning.

Environmental Education. Passive open space provides an opportunity for environmental education. In many schools, nature is studied from a distance, an approach that can create the impression that humans are separate from the ecosystem and the environment, unaffected by what happens to other species. Open space adjacent to a school may allow for hands-on environmental education programs. A town that provides other outdoor environmental education opportunities for children and adults in parks and other appropriate sites will have greater community understanding of and support for open space preservation.

Active or Recreational Open Space

Humans also need open space for active recreation — open space in the form of playing fields, jogging trails, tennis courts, playgrounds, docks or other boating facilities. These sites should be relatively unconstrained by environmentally sensitive features. Wetlands or steep slopes, for example, would have limited suitability as active recreational sites.

Local demographics help determine active open space requirements. Existing recreational facilities — both public and private, such as country clubs or those associated with a private development — should be factored into the needs assessment for additional tennis courts or ball fields.

Agricultural Open Space

Farmland preservation should be included in open space planning. As open space, farms contribute to the diversity of New Jersey landscapes, often preserving or buffering vistas. Farmland provides many other economic and environmental benefits:

- Farms often extend wildlife habitat, or form links between other areas of open space, providing corridors for wildlife.
- Farms provide a local food source.
- The volume of stormwater runoff from farmland is four or five times less than from an urban or suburban area of comparable size. A well-managed farm can help protect aquifer recharge areas. Trained in applying nutrients and pesticides — and mindful of their costs — farmers are less likely than suburban homeowners to misuse or overuse chemicals.
- “Farmland is tax-paying open space,” states the “Common Ground,” the summary for the New Jersey Open Space and Outdoor Recreation Plan for 1994 to 1999. Although qualifying farms are taxed at a preferential rate, they do not create the demand for municipal services that equivalent acreage in residential development would generate, and they contribute more tax revenue than dedicated open space, which is usually tax exempt.

URBAN OPEN SPACE

Vacant city lots can be reclaimed as open space, replacing rundown buildings or garbage-strewn lots with places to play or learn or garden. Open space in urban areas is likely to be limited and particularly precious. Parks and other active recreation sites, such as ballfields or schoolyards, provide places for people to play, and even to encounter a few trees and flowers. For example, Trenton's Cadwalader Park is the site of an environmental education program that provides an opportunity for urban children to observe nature and to learn about their place in it.

Community gardens provide city dwellers with food, oxygen and the air-cleansing benefits of growing plants, as well as recreation. They provide an ecological use for empty lots that otherwise might collect garbage and pollution, or become sites for illegal activities.

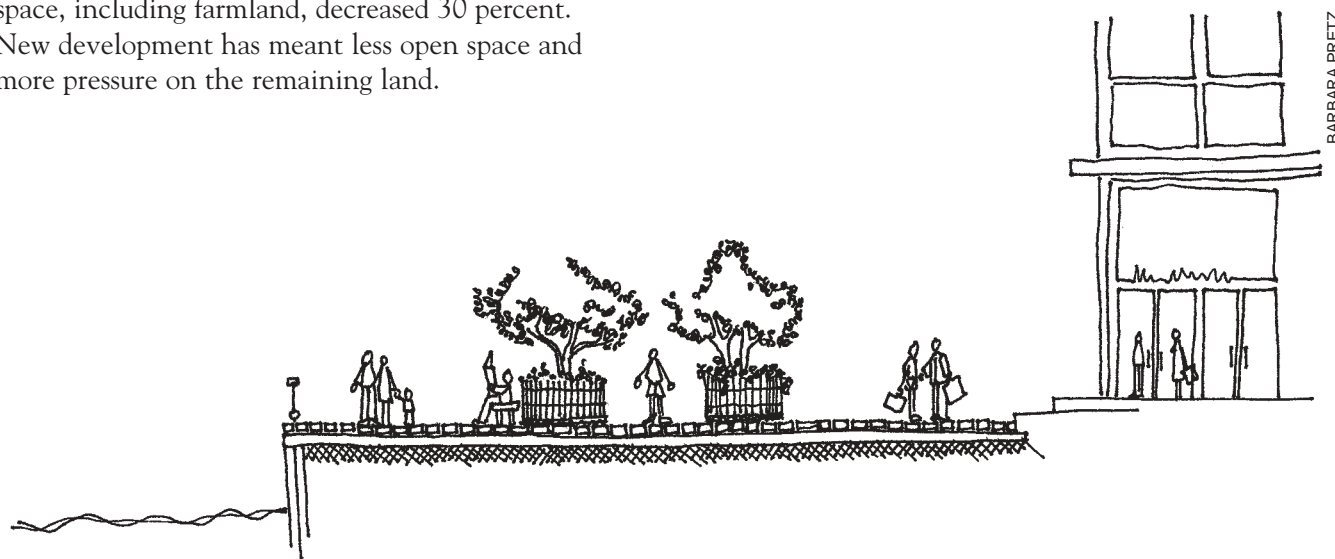
CONFLICTS IN PRESERVATION

The challenge to open space preservation in New Jersey is the demand for land for residential or commercial development. The demand stems from a movement out of the cities into the suburbs and open land. At the same time, we are using larger and larger areas of land for each residence. From 1980 to 1990, New Jersey's open space, including farmland, decreased 30 percent. New development has meant less open space and more pressure on the remaining land.

A factor favoring development is the fundamental and constitutionally protected private property rights in the United States. In a 1926 court case, the *Village of Euclid v. Ambler Realty Co.*, the US Supreme Court established municipal authority to limit, by zoning, the uses to which a given piece of property can be put. However, municipalities cannot regulate away all development rights to privately owned land without compensating the owners. Municipal refusal to extend existing infrastructure, such as sewer and water lines and roads, can influence how a particular piece of private open space will be developed.

As development reaches rural areas, conflicts can result between development and agriculture. Newcomers may be unhappy to find that the farm next door is not a picture-book homestead with a neat barnyard and a few chickens, but a farm that may create dust, noise and smells.

The process of preserving open space also can lead to conflict when scarce financial resources force tough choices about what can be preserved. Purchasing and maintaining open space for recreation may preclude the purchase of natural areas for protecting wildlife habitat. Once preserved, open space areas may need further protection from human mistreatment such as dumping, littering and vandalism.



BARBARA PRETZ

During redevelopment, waterfronts can be reserved for parks.

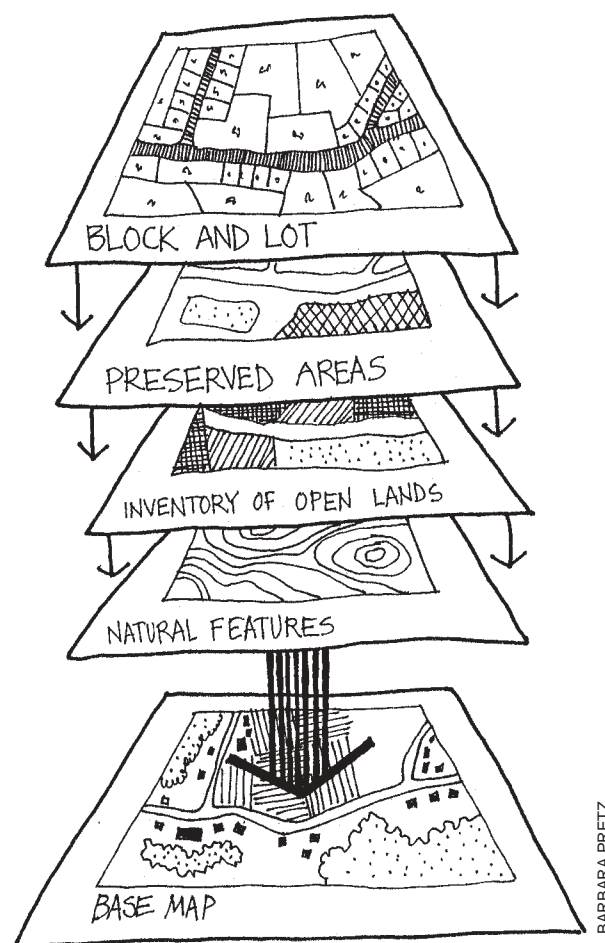
PRESERVATION TOOLS

The desire to preserve a specific tract of land often arises when public attention is suddenly focused on the parcel, usually when development is proposed there. Preservation opportunities also arise on a broader scale when the governing body or some other group perceives a lack of protected open space for either recreational or natural resource purposes, triggering a systematic review of the town's overall open space goals and policies. In either event, mapping and planning are critical.

Mapping/Data Collection

Open space preservation starts with knowing what you have. The town's environmental commission might play a lead role, since it is charged with maintaining an index of open areas, both public and private, for the purpose of determining the proper use of such areas (N.J.S.A. 40:56A-2). Many sources of written information, both mapped and documentary, can give a conceptual idea of what parcels may be open.

A municipal open space plan should be based on sound data about existing environmental conditions. It is important to gather information about the natural systems and various types and uses of local open space. In many towns, the master plan includes a conservation plan element that is based on an Environmental Resource Inventory ("ERI," also called a Natural Resource Inventory, or "NRI"). The ERI, typically prepared by the environmental commission, contains facts about local geology, geography, topography, soils, vegetation and hydrology, and may include an inventory of open space. State and county offices also have natural resources information.



Data layers of a map show existing land use and natural features.

Developers can be asked to supply data in their Environmental Impact Statements on portions of sites that might be appropriate or desirable for preservation as open space. The environmental commission can also alert the planning or zoning boards or the governing body about specific areas that must be maintained under State or federal law, such as wetlands and floodplains. On-site verification often shows conditions to be different from those recorded on paper. The NJ DEP can provide wetlands maps, aerial photographs, topographic maps and computer-generated Geographic Information System (GIS) maps and databases.

For Further Information

The Environmental Resource Inventory, ANJEC, 973-539-7547 or www.anjec.org

NJ DEP's Natural Heritage Program has information on known rare or endangered plant or animal species, 609-633-2765 or www.abi.org/nhp/us/nj

Association for Biodiversity, www.abi.org/nhp/us/nj

NJ DEP's Landscape Program has maps that identify critical habitat for endangered and threatened species, 609-292-2965 or www.state.nj.us/dep/fgw/ensphome.htm

NJ Office of State Planning, 609-292-7156 or www.state.nj.us/osp

County Soil Conservation District offices have reference copies of aerial photographs, soil survey maps and descriptions of soil characteristics, blue pages of phone book

County planning departments have information on geology, soils, topography, waterways and other water resources.

Municipalities have municipal tax maps and records on parks, other publicly owned land, and open agricultural land that has qualified for farmland tax assessment.

Regional planning associations, watershed associations and local and statewide land conservancies also may have maps and other information.

The local and county historic commissions have information about historic sites and possible archeological sites.

The next step is to create a detailed open space inventory, a baseline for all future planning. The environmental commission may have already compiled such an inventory. The State enabling legislation for environmental commissions requires them to inventory open space. An environmental commission can apply for a matching grant of up to \$2500 from the Environmental Services Program at NJ DEP to map and plan for open space preservation, or to hire professionals to do so.

Determine which areas will require actual site visits to verify information on development or open land and to check for scenic vistas or special environmental features. The open space map should show all open space, public or private, that has been preserved permanently or conditionally. Permanently preserved open space includes publicly owned parkland or recreational facilities and land preserved by a private or public land trust. Land that is deed restricted or protected by permanent agricultural, conservation or drainage easements should also be marked on the map. Land protected by wetlands and floodplain regulations may be mapped, although this protection might not be permanent if regulations change or a developer is able to build in the area by providing mitigation elsewhere.

Conditionally protected open space includes land belonging to schools or scout camps, property that may be sold if the facility the property supports is no longer needed or economically viable. Some land is conditionally protected by regulations that restrict development in specific areas — airport hazard zones, for example. As small airports cease to exist, the restrictions that favored low-intensity land uses, such as golf courses and trails, in surrounding areas, also cease to protect those areas. Conditionally protected land also includes farms enrolled in a municipally approved farmland retention program through the *Agriculture Retention and Development Act* (N.J.S.A. 4:1C-11 et seq.) since, after continuing to farm for a specific period, generally eight years, the farmer has the option to continue in the program or not, and may choose to develop the land.

Open Space Plan

After information about natural resources and open lands has been collected and organized, the next step is to evaluate the town's open space goals and needs, and then determine the degree to which they will be met by existing preserved open space. This is a complex task because open space serves so many important and varied purposes: natural resource/environmental, recreational, agricultural, quality of life and economic.

The ultimate goal of the comprehensive planning process is a recommendation on the amount, types and areas of additional open space that need to be preserved, and a methodology and/or priority list for land acquisition that corresponds to that projection. Taking the preserved lands as a starting point, an environmental commission, an open space commission or other municipal body can create an open space plan, using some basic principles.

- Create greenways to link areas of passive open space to permit wildlife movement.
- Buffer all open space containing environmentally sensitive features, such as waterways, wetlands and steep slopes, with additional preserved land.
- Evaluate and prioritize privately owned vacant land according to its ecological, scenic, recreational or other benefits.

Use the town master plan, current zoning designations, and information on extensions of sewer and water lines to determine where development is most likely to occur. Since development pressure and land values may be higher in those areas, municipal open space preservation dollars will probably stretch further in parts of town not served by infrastructure. However, planners should give special consideration to privately owned open space in the more developed or development-prone areas. Preservation of open space may be particularly crucial to maintain quality of life and a sense of community identity in these areas. If the town has a separate recre-

ation plan, the open space plan must reflect it and vice versa.

What kind of open space do we need? Various formulas can help in estimating community needs for recreational open space. (See box "Calculating Recreational Open Space Needs" on page 86.) Calculating the need for natural open space or farmland requires different considerations, including the importance of farmland preservation to the town, and the need for wildlife and aquifer protection.

Greenway Planning

Many environmental commissions have compiled inventories of their towns' existing open space. Using the inventory, the commission can identify potential links between existing, preserved open space parcels that will form a linear open space network, sometimes called a "greenway."

Greenways are often planned along a waterway or other linear natural features. As mentioned earlier, a greenway is generally much more beneficial for wildlife than many small, non-contiguous areas of open space would be. Recreational greenways are desirable for people, as well, because they provide long stretches of open space for walking, biking and observing nature.

For Further Information

Greenways: A Guide to Planning, Design, and Development, Loring LaB. Schwarz, editor, The Conservation Fund, Island Press, Washington, DC, 1993.

How Greenways Work: A Handbook on Ecology, Jonathan M. Labaree, National Park Service and Atlantic Center for the Environment, 1992. 202-343-3780

Keeping Our Garden State Green, ANJEC, 1989. 973-539-7547 or www.anjec.org

Calculating Recreational Open Space Needs

The two common ways of calculating the amount of recreational open space needed in a given area are the *Acres per Population* method and the *Balanced Land Use* method.

The Acres per Population method is based on either the present population or some projected future population. Many land use planners use the National Recreation and Park Association (NRPA) guidelines, which set a “core system standard” of 6.25 to 10.50 acres of recreational open space per 1,000 residents. The NRPA suggests more specific land use ratios as follows:

Miniparks: 0.25 to 0.50 acres per 1,000

Neighborhood parks/playgrounds: 1.0 to 2.0 acres per 1,000

Community parks: 5.0 to 8.0 acres per 1,000

The NRPA offers even more specific guidelines, suggesting the number of facilities needed per 1000 residents for various recreational activities such as basketball courts, tennis courts and soccer fields.

The formulas used to calculate recreational open space needs for the NJ DEP’s *New Jersey Open Space and Outdoor Recreation Plan for 1994 to 1999* are not based on population figures. These formulas recommend using total land area to calculate how much land the State and federal governments should acquire for recreation.

The New Jersey plan recommends that municipalities or counties calculate recreational land needs as a percentage of the total of developed and developable land. This method recognizes that the need for municipal or county recreational land is generated by development. It excludes undevelopable land, including land set aside by conservation easements or regulation where public use is not permitted.

The guidelines call for a municipality to acquire for recreational use 3 percent of the developed and developable land within its boundaries, and for a county to acquire 7 percent. At the state and federal level, the plan projects acquisition of 10 and 4 percent, respectively (applied to total land area, not just developed and developable).

These are meant to be long-range guidelines that recognize other legitimate competing interests for finite land resources. The Acres per Population method and the Balanced Land Use method are both useful tools for estimating minimum needs for active open space.

Implementing an Open Space Plan

A municipality has various options for protecting open space. These include outright acquisition, acquisition of conservation easements or development rights, restrictive covenants, farmland preservation options and zoning initiatives. The method used may depend on the purpose for protecting each site, whether for recreational, farmland or passive open space use, as well as its long-term management. In addition, planners need to consider funding options for acquiring the property, including potential partnerships with private, county, state or federal organizations.

Options for Protecting Land. Land ownership is often described as owning a bundle of rights on a property. “Fee simple” ownership means that a landowner owns all these rights. It is possible to sell or give away some rights while retaining title to the property. Conservation and other easements represent rights that have been given up by the landowner. Deed restrictions, neighborhood covenants, leases and management agreements are other methods a landowner can use to restrict use of a property without relinquishing ownership.

Property Ownership. Buying land is the most expensive preservation option. Towns often try to pass such opportunities on to a county, state or federal agency. However, if a larger governmental entity does purchase open space in a community — for use as a recreational area, for instance — that property and any facilities built on it will have to be shared with a larger population. Private conservation organizations, such as land trusts or watershed associations, also may be able to assist a town in acquiring land.

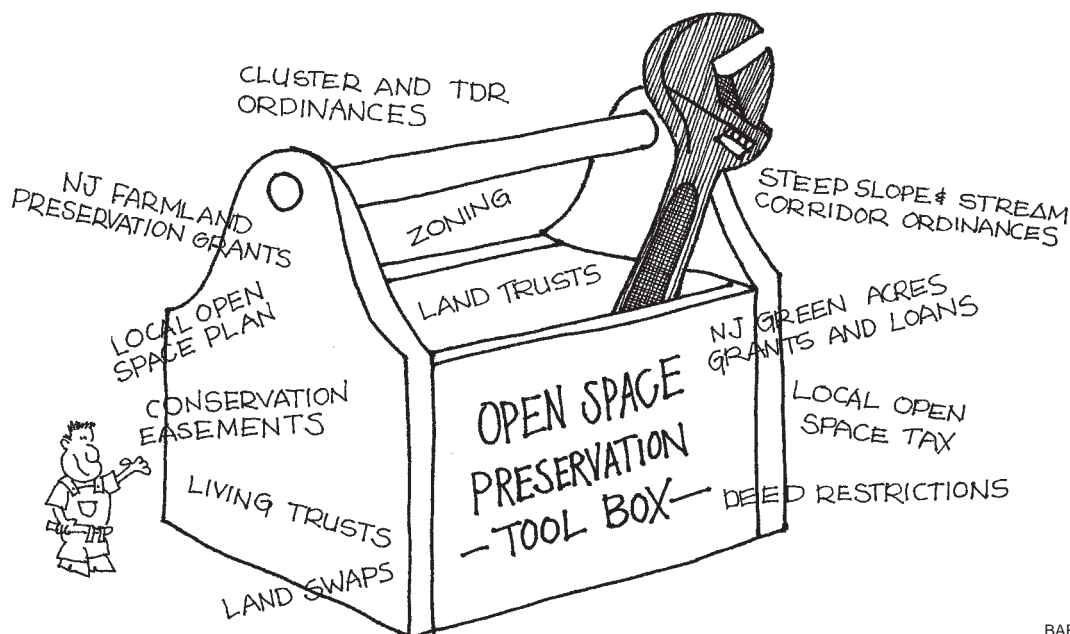
Several options are available to a town seeking to purchase a property. The most costly, sale at fair market value, means the town will pay the going rate for the property. In a bargain sale, the landowner agrees to sell the property at less than market value. This option enables the landowner to take an income tax deduction for the difference between the bargain sale and fair market prices and to reduce the capital gains tax on the sale.

An installment sale allows the town to spread the payment over a period of years and the landowner to spread the income and capital gains over the same period. Negotiations of an installment sale include deciding which party will be responsible for paying property taxes and which will have the right to use the land until

the sale is complete. Installment sales may be at either fair market or bargain sale prices.

Town-owned open space often comes as a donation of land by property owners seeking to conserve their land and/or save on taxes. Donations may be made during the owner's lifetime or by will. A reserved life estate enables landowners or their family members to continue to live for the rest of their lives on the property they intend to preserve through a sale or gift to a town or nonprofit organization. This arrangement allows the recipient organization to defer assuming responsibility for taxes on and maintenance of the property. Similarly, a leaseback arrangement, in which a seller or donor of property arranges to continue to use the property, provides the municipality or nonprofit with income to offset the cost of acquiring or managing the land.

Preserving Land without Owning It. A municipality can preserve land as open space without acquiring full title to the property. The most common method is to purchase or accept donation of a conservation easement, which permanently restricts the use of the land. The terms of a conservation easement can be tailored to a specific situation. The landowner sells or



BARBARA PRETZ

gives away certain rights — for example, the right to subdivide the property, to build on it, or to cut down trees — but retains ownership. Conservation easements may even permit public access to the protected property, although they usually do not. Granting an easement can provide substantial tax benefits to the landowner.

A landowner may also limit the use of a property through a deed restriction. A deed restriction does not carry the tax benefits of a conservation easement, unless land is donated or sold at less than market value to a conservation agency that agrees to impose the deed restriction after sale.

Another strategy that allows a landowner to retain title to property while restricting development is the transfer of development rights (TDR). Under the *Municipal Land Use Law* (MLUL) (N.J.S.A. 40:55D-113) towns in Burlington County may designate certain areas as developable at a density higher than the normal zoning would allow, provided that the developer purchases development rights from a landowner in another part of town. A landowner who wants to keep property undeveloped may sell the land's development rights to a developer. The developer can apply the additional development rights to build more intensively on another piece of property. This system helps a municipality concentrate development in areas where infrastructure already exists and protect other areas as conservation or agricultural open space. (See Chapter 4 on Wetlands.)

A similar program is in effect in the Pinelands, where the Pinelands Development Credit Program allows the transfer of development credits from preservation areas to regional growth areas.

The MLUL allows for non-contiguous cluster, a form of transfer of development rights. With non-contiguous cluster, a developer can transfer density from one property to another, gaining higher density on one parcel and deed-restricting the other as permanently preserved open space.

Other provisions of the MLUL (N.J.S.A. 40:55D-39c) allow towns to maintain open space

through site plan and subdivision review ordinances that encourage cluster development. This enables a developer to build either multifamily units or housing on smaller lots than the zoning permits by permanently protecting open space with conservation easements on another part of the site. A well-designed conservation easement will require that deeds of future homeowners include provisions for managing and maintaining the conservation area, financed by annual fees, and generally under the direction of a homeowners' association. (ANJEC maintains a database of sample ordinances and easements.)

Funding Sources for Land Acquisition. To provide funds for acquiring open space, a municipality may appropriate money from general funds, issue bonds, or create a dedicated open space tax. A growing number of towns are opting for a local open space tax, generally anywhere from 1/2 to 2 cents per \$100 of assessed value.

Most counties also have enacted a dedicated open space tax. Local open space funds may be used to match these county funds and the New Jersey Green Acres funds. The State and counties often act more favorably on grant requests from communities that have both an open space plan and a local funding source in place.

The 1999 *Garden State Preservation Trust Act* allows the State to raise \$98 million a year in revenue bonds for open space, farmland and historic preservation. Under the Act, the Green Acres Program is to draw up a proposed project funding list for approval by the State Legislature. Towns and nonprofit organizations may apply for Green Acres matching grants and low-interest loans (2 percent for 20 years) for open space acquisition and park development.

Green Acres has a Planning Incentive Grant program, which allows a municipality that has an open space plan and a local open space tax to file the plan with Green Acres to qualify for a streamlined application process. Once Green Acres has approved the plan, the program provides non-project-specific "block grants" of funding which the town can allocate to implement any of the projects within the scope of its

plan. The local government can acquire the sites without having to file separate applications. This program encourages towns to plan their open space needs, enables them to react quickly to acquisition opportunities, eliminates the need to reapply for funding for each project and reduces bureaucratic paperwork and delay.

In addition, community fundraising can help preserve land. In Mount Olive Township (Morris), for instance, a number of local organizations joined with the Morris County Park Commission and the New Jersey Conservation Foundation to sponsor a “Turkey Mountain Square Yard Sale.” For their contributions, donors received honorary deeds to a square yard of this area.

Federal dollars are available for land conservation through the National Park Service, Forest Service, Fish & Wildlife Service, or the Bureau of Land Management. These acquisitions are governed by the goals of each agency, and funding requires an act of Congress. This is a good option for privately held open space adjacent to existing federal holdings.

Nonprofit conservation organizations are another source of funding, either for acquiring land or easements permanently, or for holding the property until a public agency or local nonprofit group obtains financing to buy it.

- The Nature Conservancy, New Jersey Field Office, buys only critical habitat and operates sites as nature preserves.
- The New Jersey Conservation Foundation and the Trust for Public Land, New Jersey Field

Office, use revolving funds to buy land that they expect to sell quickly to another conservation organization or governmental body.

- The New Jersey Natural Lands Trust, an independent body within NJ DEP, accepts and manages donated open space. As a quasi-governmental agency, its land holdings cannot be condemned or removed from conservation.

A community may create a local land trust to acquire and manage open space. Land trusts work cooperatively with landowners and governmental agencies. They may hire staff, or rely on volunteers. As a private, nonprofit, tax-exempt organization, the land trust may raise money through membership dues and grants, loans or donations from individuals, businesses or foundations. A land trust may buy and sell land, generally protecting the land after sale through deed restrictions and covenants, or retaining conservation easements on it. Some local land trusts have revolving funds they use to acquire and hold land or easements until public funds become available. Private nonprofit organizations with revolving funds can react quickly to real estate opportunities, whereas raising public funding can be a slow process.

Acquiring Farmland Open Space. Farmland preservation presents special challenges, stemming partly from the fact that farmland can survive as open space only if farming as a business is successful. Farming success often depends on preserving large contiguous areas of farmland or separate tracts that are close enough to allow use of the same farm equipment and services. A 100-acre farm site may not support needed capi-



BARBARA PRETZ

tal investments in equipment, irrigation systems or deer fencing.

As with passive open space, farmland suffers from the urban/suburban population's lack of familiarity with its realities. A homeowner may not appreciate farmers running noisy equipment at odd hours and applying pesticides and fertilizers to the soil. If a farm is made up of non-contiguous parcels, the farmer's need to move slow-moving farm equipment back and forth on public roads will not be popular with suburban commuters. If a farm is losing its economic viability, being surrounded by homeowners who consider its activities to be nuisances may increase the farmer's desire to sell to a developer. Preservation of local farmland needs to be supported by a municipal right-to-farm ordinance that includes a requirement to notify homebuyers in farming areas that normal farming practices do not constitute actionable nuisances.

Other measures that may help a municipality preserve farmland are down-zoning areas of town to minimum lot sizes of five or ten acres, and limiting the reach of development-inducing infrastructure such as sewers. Farmers often have mixed feelings about such measures, which affect land values and may lessen a farmer's ability to borrow against the land, and lower the price that a retiring farmer may get from sale of the land.

More permanent protection comes through acquisition, either in fee simple or through a development easement. A town may also create a local farmland preservation program under which farms enrolled for a minimum of eight years receive incentives and special protection. The *Agricultural Retention and Development Act* (N.J.S.A. 4:1C-11 et seq.) establishes the basis for both of these municipal programs as well as for the purchase of development rights by the State or by County Agriculture Development Boards (CADBs). State funding has come from dedicated bond acts. The latest of these, the 1999 *Garden State Preservation Trust Act*, makes available funds for the acquisition of farmland development easements or fee simple titles to farmland.

The State Agricultural Development Committee (SADC) has designed the Planning Incentive Grant Program, commonly called "PIG" to help counties and municipalities focus on multiple farms within an agricultural development area. To be eligible to apply, a municipality must have a dedicated funding source for farmland preservation and an Agricultural Advisory Committee, which reports to the planning board. The planning board must have adopted a "Farmland Preservation Plan Element" as part of the master plan. This must include an inventory of farm properties and a map, a statement showing that municipal ordinances support agriculture, and a plan for preserving as much land as possible by leveraging funding through a variety of mechanisms.

The criteria for evaluating applications includes ability to leverage monies, local commitment to preservation and agricultural retention, a plan to maintain agricultural viability, soil productivity, project area size and density, tillable acreage and imminence of change. The SADC will give priority to plans that most effectively leverage funds over the longest period of time (up to 10 years), include some donations of value and already have option agreements. Towns with high quality soils, great densities of tillable farmland, and a demonstrated commitment to funding preservation, promoting agricultural viability and minimizing residential incursion and infrastructure will also receive priority. Since the soils and sizes of all the farms in an application will be averaged, it is possible that small farms with lower quality soils could become eligible when included in a project with larger farms with high quality soils.

Once a town has received preliminary approval, it must obtain two appraisals, which are submitted to the State for certification of value. All parties (seller, State, county and town) must sign a final agreement regarding value. Then surveys and title searches can be ordered, at the town's expense for eventual 50 percent reimbursement. It is hoped that this program will be faster than the traditional easement program.

The SADC also has a non-profit program, modeled after Green Acres non-profit matching grant program. This program will provide up to 50 percent matching grants to non-profit conservation organizations to purchase development easements or farmland in fee. The non-profit organization has to provide the remaining half of the appraised value. This could be funds from municipalities or counties, as well as bargain sales.

Sometimes saving a farm takes creative financing, using partnerships between non-profits, landowners and municipal boards. Towns have purchased land parcels by combining funds from state or county grants, Green Acres loans, and local open space taxes. The town will then look for ways to produce some income from the property consistent with its preservation as open space.

Sometimes saving the farm takes creative partnerships. For example, the New Jersey Conservation Foundation and Salem County worked with farmers David and Nellie Fogg in Lower Alloways Creek Township. The Fogs sold the development rights on their 200-acre farm to the County, then swapped the proceeds of that sale for additional farmland in a nearby town. The swap, known as a tax-free like-kind Section 1031 exchange, allows a property owner to exchange one income-producing property for another without triggering a concurrent capital gains tax liability. (The “basis” in the original property is transferred to the second, and tax payments are deferred, much as homeowners selling a primary residence can defer taxes if they purchase another residence within a certain time limit.)

New Jersey’s Forest Stewardship Program assists landowners who own five or more acres of woodland. The owner pays a fee to have a forester complete a woodland management plan, which is updated annually for a smaller fee. The forester marks trees appropriate for removal to maintain the woodland’s health and the owner agrees to comply with the program’s stewardship management guidelines. If the owner produces at least \$500 of income on the five acres (plus an additional amount per acre over five), the land may qualify for tax relief through the farmland

assessment program. NJ DEP’s Division of Parks and Forestry, county agricultural extension and soil conservation service offices can provide information on the Stewardship Program and how to contact the regional forester. The municipal tax assessor can provide information and application forms for farmland assessment. A landowner must file for two years before receiving farmland tax status in the third year.

The greatly reduced property tax resulting from farmland assessment can be a considerable inducement to preserve any type of farmland, including pasture, so long as the land continues to produce the required farm income. (Once a property ceases functioning as a farm, the owner must pay “roll back” taxes at the going rate for the previous two years.)

Acquiring Urban Open Space. Community gardens are a productive form of urban open space. Successful examples include a program in Trenton, one in Camden and two in Newark — one run by the Greater Newark Conservancy and one associated with the Essex County Agricultural Extension Service’s Master Gardener program.

City gardening groups can sometimes lease vacant lots for nominal amounts from landowners who are happy to have someone willing to clean up and garden on their property. There is always the possibility that the landowner may find another use for the spruced up lot, but many community gardens have flourished on the same spot for more than a decade.

One method of acquiring open space in a city is for the local government to take over a property for nonpayment of taxes. Such sites could become pocket parks or community gardens, perhaps acquired, created and maintained by neighborhood groups.

Former industrial sites in urban areas may contain contaminated soil or groundwater. In fact the soil in any abandoned city lot may be contaminated with lead. The county health department, NJ DEP and NJ Department of Health can provide information on cleanup requirements and procedures.

Cultivating Open Space in the City

Isles, Inc., a non-profit community organization in Trenton, has shown not only how to preserve open space in a city, but how to use it to grow a community and food. Isles' successful community garden and beautification program sponsors sites throughout the city.

Transforming vacant lots into gardens, particularly for food production, has special problems, but at least one special benefit. City lots often contain dilapidated structures and piles of litter, and removal of this debris is the first step in the transformation process. Sometimes, a less visible but more dangerous problem also lurks in city soils—lead. Lead-contaminated soils must either be cleaned or removed and replaced. If the site was once industrial, other pollutants also may need to be removed. On the positive side, once this work is done, city gardeners get a slightly longer gardening season, courtesy of the thermal energy retained by the closely spaced buildings.

Isles has been lucky to find many allies for its gardening program. Neighboring Hamilton Township has provided free compost and wood mulch from the Township's Ecological Facility. Local merchants have donated supplies, seeds and plants, or agreed to give discounts to enrolled gardeners. Volunteer organizations in neighboring communities have helped in gardens and other beautification sites. Even the Howell Living Farm, a county facility that demonstrates farming methods used at the turn of the century, sends two of its giant plow horses, a plow and a farmer to plow one of the larger community gardens each spring.

Each community garden is the work of the community, not of Isles, which remains in a support role. Groups must organize interested people to attend planning meetings with Isles, and identify potential sites. Isles will then help choose the most appropriate site, negotiate with the owner for a lease, test the soil and help plan the garden, including recommending plant selection and pest control. Isles also provides mulch and compost, seeds, fencing, a sign, and will lend tools. The group must clear the site, put up the fence, design and construct raised beds, and plant and maintain the garden. Each group also pays a small membership fee and has a representative on Isles' garden committees.

The benefits of the community gardens go beyond just producing pockets of open space in an urban environment. The gardens also produce nutritious food for hundreds of people in a city where hunger is ever present. Only three supermarkets serve Trenton's population of nearly 89,000, so affordable, nutritious food is hard to find.

Isles also uses urban open space, some of which it owns, to provide environmental education programs to over 5000 children. These programs help urban kids to understand that the city, and they themselves, are part of nature. If urban environmental education is based only on trips outside the city, children could easily be left with the impression that the environment only exists beyond city limits.



Educating the Community

Both landowners and the general public should be made aware of the economic and environmental benefits of preserving open space. Individual landowners can reap tax benefits from land or easement donations, but should also know that if part of a site is preserved as open space, the value of the other parts of that site may increase substantially. It is also important for the public to understand that although the property tax revenue, if any, from open space is lower than it would be if the site were developed, the long-term cost to the taxpayers for municipal services on open land is far less. Even if a community has to bond to purchase land as open space, the avoided costs for roads, schools and other municipal services will usually cover the purchase price within 20 years.

Educating the community about the environmental benefits of open space is equally important. Open space is critical for protecting ground and surface water supplies, for purifying the air, for minimizing flood damage to property by preventing development in floodplains, and for maintaining biodiversity by protecting habitats. Nature trails, guided walks and outdoor education programs for all age groups foster an understanding of natural systems and promote stewardship.

The Alexandria Township (Hunterdon) Environmental Commission published a booklet about the Township's open space plan. The booklet explains the need for greenways, greenbelts, and stream corridors. It explains the effects of development and why the municipality should protect its open space and farmland. All 1500 residents received a copy of the guide. The open space plan produced a positive response and also raised the visibility of the Commission.

Maintaining Open Space

Provisions for the perpetual maintenance of an open space tract are usually established at the time of acquisition. If the land is preserved through an agricultural or conservation easement, the terms of the easement deed usually charge the owner of the land with maintaining it.

A number of towns have asked their environmental commissions to develop a management plan for municipally owned open space parcels. Some commissions have involved the community in developing and carrying out the management plans, which include cleanups, Adopt-a-Park programs, and replanting of areas that have been disturbed.

The Princeton (Mercer) Joint Environmental Commission put together a program to build support for open space and increase stewardship for existing parklands in Township. They developed a packet of eight maps and narratives for each of their town's open space tracts. Commission members did the research and photography, wrote the text, and handled publicity and distribution of the packets. The Commission also proposed an "Adopt-A-Park" program, and proposed guidelines for maintenance of the open space tracts. The Township Committee subsequently adopted the Commission's guidelines.

For Further Information

Public Financing of Open Space in New Jersey, a manual on creating an open space tax, ANJEC, 2001. 973-539-7547 or www.anjec.org

"Open Space is a Good Investment" ANJEC Resource Paper, 973-539-7547 or www.anjec.org

Isles, 609-393-5656 or www.isles.org

Land Trust Alliance, 202-638-4725 or www.lta.org

Morris Land Conservancy, 973-541-1010 or www.morrislandconservancy.org

New Jersey Conservation Foundation, 908-234-1225 or www.njconservation.org

Nature Conservancy, New Jersey Field Office, 908-879-7262 or www.tnc.org

Trust for Public Land, New Jersey Field Office, 973-292-1100 or www.tpl.org

NJ DEP's Green Acres Program, 609-984-0500 or www.state.nj.us/dep/greenacres

County Agricultural Development Boards, www.state.nj.us/agriculture/sadc.countyboards.htm

NJ Department of Agriculture, 609-292-3976 or www.state.nj.us/agriculture

Rutgers Cooperative Extension Office, www.rce.rutgers.edu/county/index.html

LOCAL ACTION

Open space preservation requires the participation of all municipal bodies. The town's environmental commission can play a lead role, since it is charged with maintaining an index of open areas, both public and private, for the purpose of determining the proper use of such areas (N.J.S.A. 40:56A-2). The environmental resource inventory (ERI), maintained by the environmental commission, contains valuable information that is vital for determining which open lands are most important to preserve for natural resource considerations and for agriculture. The environmental commission can alert and educate the planning or zoning boards and the governing body about specific areas that must be maintained under State or federal law, such as wetlands and floodplains.

In some municipalities, the environmental commission or a consultant working closely with the environmental commission creates the comprehensive open space plan. In other municipalities, the open space committee, which may be an offshoot of the commission or a separate group, takes the lead in creating an open space plan. In any case, the environmental commission should have representation on the open space committee, and should have input throughout the open space planning process.



Once a municipality has a comprehensive open space plan, the planning board can give its stamp of approval by adopting the plan as an official element of the town's master plan. Without this step, any open space plan will be of limited value. It is essential that planning board members have input into the plan as it is being created, so that the board will support its adoption when that time comes. If the town has a separate recreation plan, the open space plan must reflect it, and vice versa.

Using the open space plan and a supporting master plan as a base, the governing body and the planning and zoning boards have roles in carrying out open space preservation. The governing body establishes an open space trust fund funded by a dedicated property tax approved by the voters. Under the *Municipal Land Use Law* (N.J.S.A. 40:55D-43), the municipal governing body may also adopt a clustering ordinance. The planning and zoning boards can encourage developers to utilize it.

Other appropriate actions of the governing body might be downzoning (that is, increasing significantly the number of acres required for each building lot in an agricultural zone), or adopting other ordinances supporting open space, including a right-to-farm ordinance. The municipality can further the goals of the open space plan by not approving development proposals that require sewer extensions into land identified as environmentally sensitive. Sewers allow more concentrated development.

In acquiring open space with public funds, cooperation is crucial in order to stretch funds as far as possible and preserve more than one category of open space. Prioritize within each category — recreation, farmland and specific passive categories appropriate to your local situation, such as woodlands. Remember that even legally “protected” categories (absent changes in the protective legislation) such as wetlands and floodplains require adequate buffers and any other possible protections, particularly if still in private ownership.

In rural towns, creation of a municipally-approved farmland preservation program pursuant to the *Agricultural Retention and Development Act* (N.J.S.A. 4:1C-11 et seq.) is also advisable, and is essential to farms seeking to sell their development rights to a County Agricultural Development Board.

Open Space Case Studies

One of the fastest growing areas in the state is the area around Princeton, which has been experiencing both a business and residential boom for at least a decade. Two municipalities that have experienced the most growth are Plainsboro (Middlesex) and West Windsor Townships (Mercer), where hundreds of acres of farmland and other open space have been developed.

Plainsboro has used the demand for developable land as a basis for what it calls the “least cost approach” to acquiring open space. It offered a developer a cluster zoning option in return for 80 acres for a new community park and a sizable contribution toward construction of park facilities. Likewise, approval of a 148-home development was conditioned on permanent preservation of 462 acres of farmland and related open space.

The neighboring township of West Windsor has a highly regarded school system, which can be a negative when it comes to open space preservation. Good schools attract more people wanting homes to be built. The Township has been able to hold on to 38 percent of its land area as preserved open space, but is faced with intense development pressure. A close look at what development would cost the Township in added services has helped it look at open space preservation in a new light.

In 1993, the master plan projected that continued development would ultimately result in a population of 48,000. The Township then had 18,000 residents. Downzoning has reduced the projection to 33,000, with a target of 28,000. The Township convinced at least one developer to switch to a clustered layout for a retirement facility. This allows the developer to build more,

smaller units and set aside large amounts of the development site as contiguous open space, some natural, some with walking trails and some with recreational facilities for the residents of the complex. And developers can save money with smaller lots because they require fewer linear feet of infrastructure, including roads, sidewalks, sewer and water lines.

The Township's plan to preserve open space includes this type of negotiation in addition to a voter-approved 2-cent open space tax for land acquisition. The Township also adopted a "Timed Growth Ordinance," which paced development over 50 years. Unfortunately, the Court found the timed growth ordinance to be invalid.

West Windsor recently performed a study on three undeveloped parcels of land in the community to determine a sensible limit for development as measured by the "carrying capacity" of the groundwater aquifer. The study utilized a nitrate dilution model, endorsed by the National Association of Home Builders, that calculates the amount of leachate from septic systems that the soils and subsoils can assimilate without threatening the quality of groundwater. Nitrates, a main constituent of domestic wastewater, are often monitored as a gauge of groundwater quality.

The West Windsor study estimated the inputs of nitrates from major sources of nitrogen — lawn fertilizer, leachate from septic systems, and precipitation. The results of the nitrate dilution study were used to determine the minimum lot

size to meet a target nitrate level of 8 mg/l in groundwater. The study concluded that current residential zoning on two of the three undeveloped parcels of land included in the study might exceed the natural carrying capacity of the underlying aquifer. On the remaining parcel, the current zoning could sustain future development as allowed by existing zoning. The study recommended modifying the zoning on the other two parcels of land to protect the quality of the local groundwater.

For Further Information

Getting It All Together, The Application of Environmental Information to Land Use Planning, ANJEC, 1980. Available on loan from ANJEC, 973-539-7547

The Conservation Easement Handbook, Trust for Public Land and the Land Trust Exchange, 1988. 202-543-7552

Open Space Is a Good Investment and Open Space Plan, ANJEC Resource Papers, 973-539-7547 or www.anjec.org

The Benefits of Open Space, Leonard W. Hamilton, ed., Great Swamp Watershed Association, 1997. 973-966-1900 or www.greatswamp.org

Recreational Needs Formulas, National Recreation and Park Association, 703-858-0784 or nrpa.org

CHAPTER 9

COASTAL PROTECTION

Wildwood, Surf City, Atlantic City, Ocean City. Originally these names evoked images of the natural wonders of the Jersey shore, but now they remind us of crowds, cars, casinos, boardwalks, motels, and expensive beachfront property.

Today almost the entire 125-mile shoreline of New Jersey is densely developed, with urban and suburban settlements fronting the ocean and more building to come. The natural shoreline has been virtually erased, except for Little Beach Island in the Brigantine National Wildlife Refuge and the 9.5 miles of Island Beach State Park, which has been modified only slightly by structures and use.

THE NATURAL SYSTEM

New Jersey's coastline is naturally shy of sand, because no major rivers empty directly on the coast to dump their loads of sediment. Left alone, beaches, dunes, and offshore sandbars function as a sand-sharing system. Sand is moved along the shore by the surf, which typically strikes different parts of the coastline in a slightly northerly or southerly direction, and is moved either landward or seaward by winds and waves, building dunefields, beaches and bars by taking sand from one to give to the other.

During a storm, sand from the beach and frontal dune is usually pulled offshore, absorbing the force of the waves, leaving a broad, flat beach where waves can dissipate, and creating a large offshore bar. Sand from beaches and dunes is also blown inland, often just beyond the dune crest, or carried inland when the sea washes over the land,

or at breaches where the ocean breaks through barrier islands or other narrow landforms.

In fair weather, the system reshapes itself as longer, milder ocean waves lift sand from the bars back onto the beach and offshore winds redistribute dune sand to the beaches and help reconstruct the dunefields. Onshore winds also carry beach sand into the dunes. Natural vegetation deflects winds and anchors the dunes with a network of roots. The rebuilt beaches and dunes are rarely in the same place or in the same shape as before the storm.

New Jersey Shoreforms

New Jersey has two basic oceanfront landforms — coastal barriers (islands and spits) and headlands, where the mainland meets the sea directly. The state's bay shores, on the inland margin of the barrier islands and along the bays where the state's rivers empty out, are covered in Chapter 10 on Estuaries.

Most of the oceanfront shoreline is barrier islands or spits, consisting of the peninsula that extends north from Monmouth Beach to the tip of Sandy Hook and the 10 islands that extend 102 miles south from Bay Head (just south of Manasquan Inlet) to Cape May. There have been more islands in the past and in different configurations, due to the movement, creation or closing of inlets. The barrier islands form two complexes, north and south of Little Egg Inlet, which lies between Beach Haven and Brigantine. Islands range in width from a few hundred yards at Island Beach to one mile at Wildwood.

The headlands consist of 19 miles of northern coastline from Long Branch to Bay Head and three miles at the Borough of Cape May Point. Unlike the low elevations of the barrier islands and spits, the northern headlands reach up to 25 feet above mean sea level. Although headlands are less vulnerable to flooding or storm surge, they are subject to erosion at the bluff face and from the beach. Like the barrier islands, these shorelines are gradually migrating inland.

SEASHORE CONFRONTATIONS

New Jersey's coastal problems result not from the assault of waves and wind on the oceanfront but from two other classic confrontations — man versus nature and private property rights versus the public good.

The Line in the Sand

Mobility is the basis of a dynamic natural coastal system. Manmade construction literally draws a line in the sand and then tries to force nature to respect the line. As development disturbs or eliminates critical parts of the natural system — sandbar, beach or dune — storms or daily erosional forces produce erratic or extreme changes in the shoreline.

When the natural system breaks down, the result is often catastrophic and expensive. Critics of coastal development point out that these costs are not really for “shoreline protection” since the shoreline functions very well if left alone, but for “real estate protection” to maintain buildings and infrastructure in areas that cannot support them.

Very few places on the Jersey shore are free of engineered attempts to stabilize a naturally nomadic landform. Since the turn of the century, engineering has been a central strategy and now 80 percent of the shoreline, in 41 out of 45 shore towns, has permanent structures trying to secure the sand.

New Jersey is famous for its shoreline “armor” — jetties, bulkheads, seawalls, groins, breakwaters,

rip-rap, artificial dune cores and artificial reefs. Armoring typically leads to more and larger armoring and so on. The ultimate armor is the seawalls that exist in Long Branch, Sea Bright, Monmouth Beach, and much of the shoreline between Sandy Hook and Asbury Park, as well as at Cape May and North Wildwood to the south. Sea walls typically result in the loss of the beach itself.

State and federal taxpayers, not shore residents, bear most of the costs of real estate protection and the costs for repairing property damage after storms. Storm damage has not deterred development or even shifted it out of areas of proven hazard. Seventy percent of the building on Long Beach Island has been constructed since the devastating March 1962 nor'easter, which all but erased the state's dunes, caused 14 deaths and \$100 million in damage, much of it on Long Beach Island.

The 1962 storm, however, was not as severe as the hurricanes of 1938 and 1944. Statistics on rising sea levels suggest that by 2050, the surge from a storm like the hurricane of 1944 could be one to two feet higher. The numbers of people, homes and businesses at the shore have escalated tremendously since 1944 or even since the 1962 nor'easter. Emergency evacuation from the state's many barrier islands would be very difficult. Accordingly, experts warn that the price tag for future major storms could top \$1 billion.

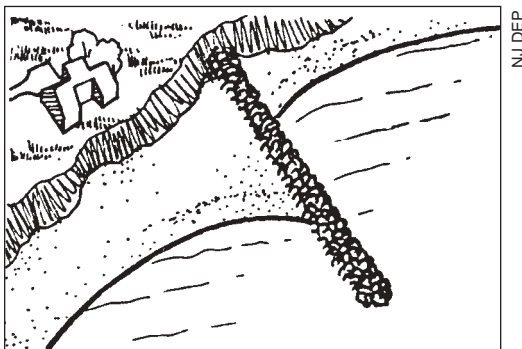
These expenses result from the intensive development and use of the shore, not from natural processes. Most shoreline lots are developed, whether with tiny bungalows in Seaside Park, the homes on large lots in Mantoloking, the boardwalks and amusements in Point Pleasant Beach, or the high-rise hotels and casinos in Atlantic City. Few undeveloped lots remain, and they command extremely high prices. In many communities, two- to three-story condominiums are replacing single-family homes. Development in most towns has not reached maximum densities allowed by local zoning, so building will continue in most coastal communities.

Coastal Development and Disturbance

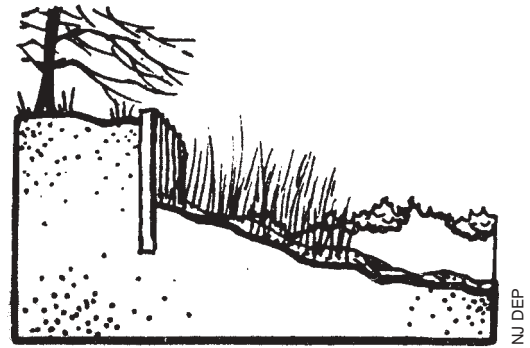
In typical New Jersey shore development, dunes have been the first to go — bulldozed to make way for buildings, boardwalks and views, or damaged by trespassers. Dune grass, whose roots help hold dunes in place, cannot survive even light foot traffic. Eliminating or damaging the dunes makes the coast more vulnerable to floods and storms and encourages greater beach erosion. Without the dunes, beaches are more vulnerable to wave and wind action and also are deprived of the dunes' reserves of sand. The long-term result of beach erosion is a gradual shift of the coast's barrier islands toward the mainland.

Development also alters the ability of offshore winds to rebuild dunes, because winds channeled by buildings erode the dunes rather than rebuild them. In developed areas, sand reserves carried inland by overwash are bulldozed away, and the wind is unable to carry them back onto the dunes.

New Jersey coastal communities' first response to worsening beach erosion has been engineering. (See box "Remaking the Beaches" on page 100.) Groins were built into the surf to catch sand being transported along the shore by the waves. Bulkheads were built along the beaches to stop waves from carrying the sand away. Jetties were built along inlets, which are highly erodable, shifting areas particularly unsuited for development. In fact, engineering remedies usually end up damaging the natural beach-dune-bar system further and introduce additional problems.



Jetties trap sand drifting along the shoreline and erode sand from the other side.



A vegetated strip between the ocean and the bulkhead will limit further erosion.

Groins trap sand on one side but leave the downdrift side without this source of sand, causing greater erosion there. The same thing happens at some inlets, where jetties on one side trap large amounts of sand, but leave the other side of the inlet "sand starved." Groins and jetties also force sediment offshore into deeper water and out of reach of the beach-dune system. Groins in one municipality often sand-starve a neighboring municipality's beaches.

Bulkheads also interfere with the beach/dune sand-sharing system and generally do poorly in storms. Waves crashing against or breaking over bulkheads cannot dissipate naturally and the ensuing turbulence carries away sand from in front of or behind the bulkhead.

Failed bulkheads are often replaced by seawalls, which fatally interrupt the beach/dune system and its response to storms. With increased turbulent wave action and no reservoir of dune sand, beaches are more readily dragged out to sea, offshore slopes become steeper, and fair-weather waves replenish less and less sand. This sets the stage for more damaging wave action, which further erodes the beach and offshore slope. The beach disappears, and bigger and bigger seawalls are needed to keep the ocean off the land.

The newest and most grandiose answer to erosion is beach replenishment. New beaches are made at very high public costs. In calm weather, they provide recreation and natural beauty; during storms, they help protect the shoreline by being sacrificed to the force of the waves.

Remaking the Beaches after the Sand Is Gone

Armoring the beaches and dunes is no longer considered the best approach to saving shoreline property since this often leads to more erosion, greater storm damage and the loss of beaches and dunes. Attention has turned to dune maintenance and beach replenishment, two strategies that aim to preserve or re-establish natural protections.

Many municipalities have dune ordinances and some fund small sand replenishment or “beach nourishment” projects. State and federal taxes usually fund large beach or dune projects.

All four oceanfront counties in New Jersey conducted large beachfill projects following the 1962 storm that left 14 dead and \$100 million in damages along the state’s coast. These projects continued in the 1980s and 1990s. In 1995, 5.5 million cubic yards of sand were dredged, trucked, pumped onto beaches and bulldozed into dunes.

The costs are high:

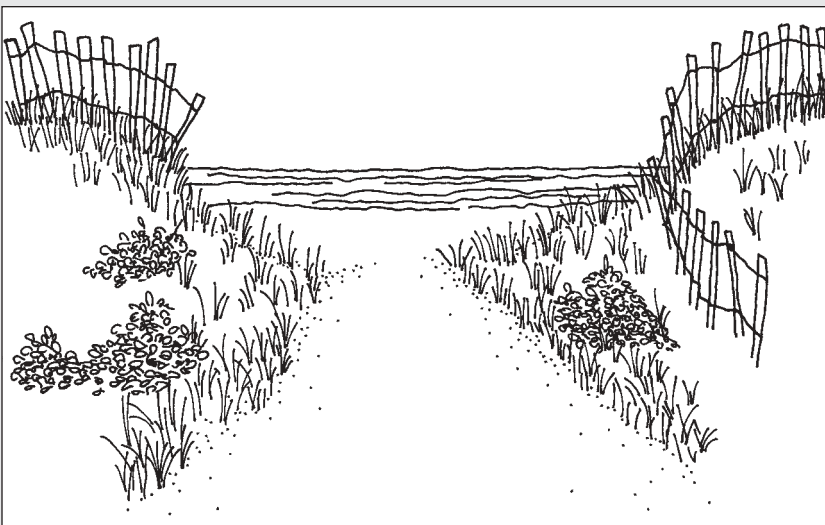
From 1980 to 1995, beachfill projects along the New Jersey shore — in about half the state’s shore communities — cost \$135 million. Federal funds usually pay 65 percent; the State usually pays the state, county and/or local share. Since 1992, the New Jersey’s Shore Protection Fund has provided \$15 million per year for beach protection, most of which will probably go to only four ongoing nourishment projects, from Seabright to Ocean Township, from Asbury Park to Manasquan Inlet, in Cape May City and in Ocean City.

Beachfill projects may last for 50 years — if nature cooperates — but need interim replenishing every three to five years or after storms. Cumulative total cost for this interim work usually is several times greater than the cost of the initial beachfill.

Over the next 50 years, from Sea Bright to Manasquan where seawalls and armoring have led to severe beach erosion, the U. S. Army Corps of Engineers will conduct a \$1.6 billion replenishment project. New Jersey taxpayers will fund \$561 million of the 50-year cost. Beginning in 1994 at Monmouth Beach, the Corps pumped enough sand onshore to create 100-foot-wide beaches along this 20-mile stretch. Some critics question whether this is a good solution and, at an average \$80 million per mile, a proper use of taxpayers’ money. In July 1996, a tropical storm carried away half of Monmouth Beach’s newly restored beach; the same thing happened in 1995.

From 1980-95, Ocean City received \$53 million in beachfill projects and from 1991 to 1995 Cape May City received \$10.8 million. In both cases some of it was for emergency replenishment after storms.

There are often related costs for storm damage to sea walls, since, after promoting the erosion of the beach, sea walls become subject to the direct assault of ocean waves. In 1984, the sea walls at Sea Bright and Monmouth Beach sustained almost \$160 million in damage.



BARBARA PRETZ

Beachfill often erodes more quickly than natural beaches, partly because beach structures, especially seawalls, have created shorelines with steeper offshore slopes and more damaging wave action.

Rising Temperatures, Rising Sea Levels

The costly and hazardous problems of erosion, flooding and storm damage are gradually worsening as sea levels rise. Because of global warming, sea levels are rising faster than at any time in the past 7,500 years. Since 1930, ocean levels have risen about nine inches; and, although estimates vary, the US EPA predicts levels could rise more than a foot within the next 40 years.

Rising sea levels will:

- move shorelines inland by hundreds or thousands of feet, gradually overtaking developed areas;
- increase shoreline erosion and the landward movement of barrier islands;
- cause greater overwash;
- increase flooding and extend floodplains and flood zones;
- increase storm damage, storm surges and breaching especially on lower-elevation coastlines, such as New Jersey's barrier islands.

Higher sea levels could also release toxins from hazardous waste facilities located within the 100-year floodplain, increase salinity in rivers and estuaries as well as in coastal wells and aquifers, erode and inundate coastal marshes and wetlands, and wreak havoc on species within those ecosystems.

The rise is being caused by the global greenhouse effect where gases, especially carbon dioxide generated by human activity, blanket the earth, trapping more heat. This is causing the melting of glaciers and the West Antarctic ice sheet and the physical expansion of warmer ocean waters. In the last 125 years, carbon dioxide in the atmosphere has increased 30 percent and the sea has risen a foot on the Atlantic coast. Scientists

expect greenhouse gases to double by 2050 and global temperatures to rise by 1.5 to 4.5 degrees centigrade. (A 5-degree decline caused the last Ice Age.) At the same time, many coastal areas are slowly sinking.

For Further Information

And Two if by Sea, by Beth Millemann, Coast Alliance, Washington, DC, 1986.
202-546-9554 or www.coastalliance.org

Coastal Dunes: A Primer for Dune Management, by Norbert Psuty and Erica Rohr, Institute of Marine and Coastal Sciences, Rutgers, 2001.
www.marine.rutgers.edu/geomorph

Living with the New Jersey Shore, by Karl F. Nordstrom, et al., Duke University Press, 1986.
919-687-3600 or www.dukeupress.edu

STATE AND FEDERAL ACTIONS

Several state and federal studies and regulations reflect the dynamic and vulnerable nature of coastal areas, the need to address shore problems on a broad basis and the public's vested interest in effective shore management. These initiatives emphasize dune maintenance, beach replenishment, and better land use controls as the preferred approaches to shoreline management. State or federal attempts to regulate land use to protect coastal areas have usually met with stiff opposition from shore residents, officials and business people.

Federal provisions:

- The 1972 *Coastal Zone Management Act* (CZMA) requires states to produce Coastal Management Plans to qualify for coastal management grants and to exercise maximum authority in "decisions of more than local significance" for the "effective management, beneficial use, protection, and development of the coastal zone."

- The *National Flood Insurance Act* of 1968, amended 1973, established the National Flood Insurance Program (NFIP). NFIP provides federally subsidized insurance to property owners in municipalities with building code ordinances that lessen flood-risk. NFIP requires new structures to be built on stilts above possible flood levels and to incorporate some waterproofing. The NFIP does not regulate land use or building on dunes, although it does require some dune and vegetation protection within areas likely to experience damaging wave action. The goal was to minimize property damage through effective planning and land use. However, by providing otherwise expensive or hard-to-get insurance the program may have actually boosted the value of shoreline property and accelerated building. In the 10 years prior to NFIP, flood losses in the US totaled \$2.2 billion and 186 deaths, while in the 10 years following NFIP, losses were \$4.7 billion and 411 dead.
- The 1974 *Disaster Relief Act* directed the Federal Emergency Management Agency (FEMA) to cooperate with states and municipalities to draw up disaster and evacuation plans and provide emergency assistance after hurricanes.
- The 1982 *Coastal Barrier Resources Act* restricts federal funding that encourages development on coastal barriers. Only two locations in New Jersey have been designated under the Act — Island Beach State Park and Sandy Hook (which are already protected as public parks).
- The 1995 FEMA National Mitigation Strategy Program calls for removing people from hazardous areas, reducing public costs for natural catastrophes, and reducing NFIP payouts by half by 2010. Both NFIP and FEMA are beginning to consider the relationship of wind and erosion to property damage, and FEMA now requires some municipal dune protection for towns to qualify for federal disaster funding.

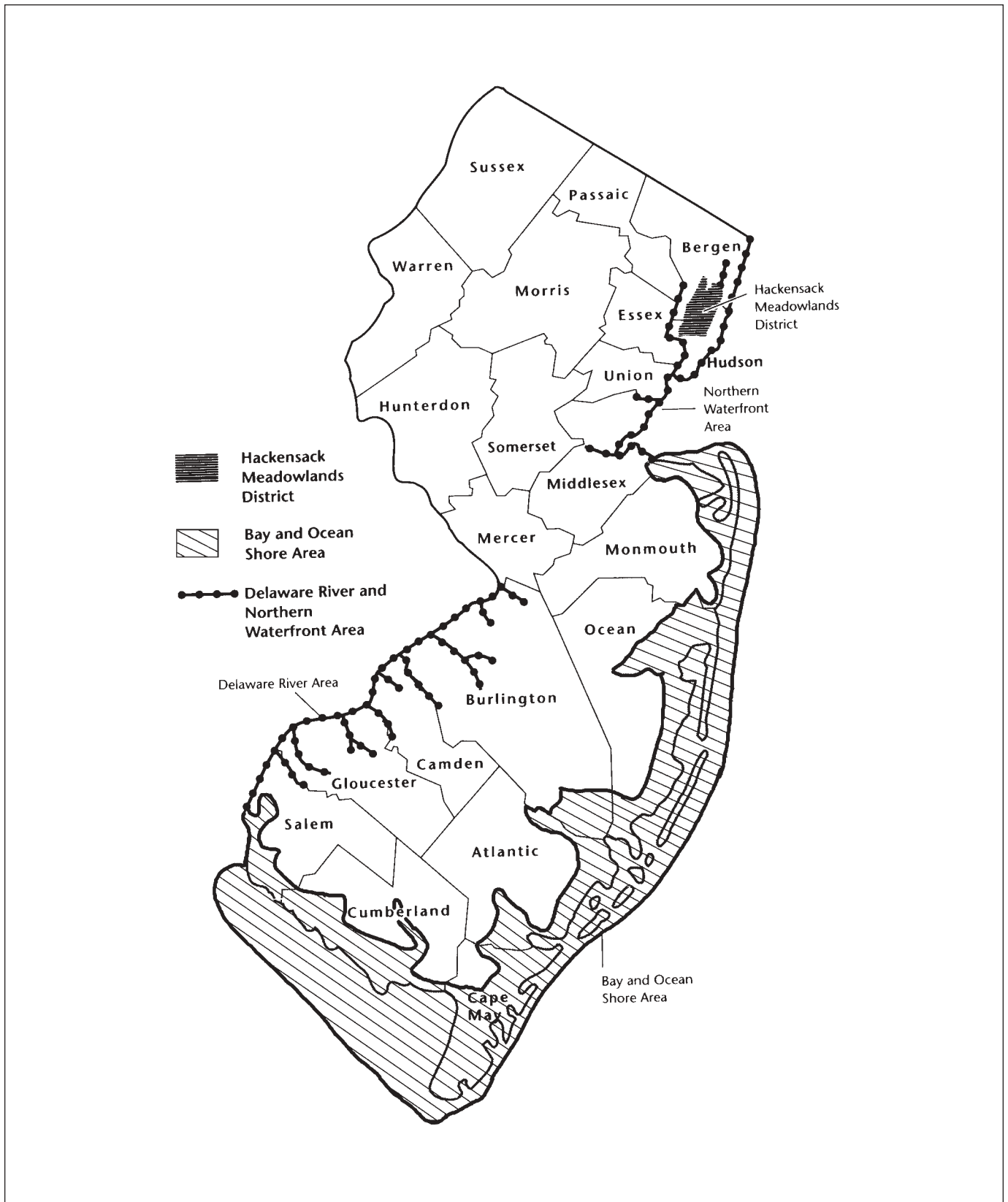
New Jersey's Coastal Management Program, under the federal CZMA, includes the *Coastal*

Area Facilities Review Act (CAFRA) passed in 1973 and amended in 1994 and Blue Acres funds to buy coastal lands. The CAFRA regulations directly address land use, requiring state review and permits for:

- any building on beaches or dunes;
- any development within 150 feet of the beach, dune or high water line on previously undeveloped land;
- any commercial development with five or more parking spaces or housing projects with three or more units within 150 feet of the beach, dune or high water line;
- commercial development with 50 or more parking spaces, housing projects with 25 or more units and all industrial or public projects beyond 150 feet. In urban areas, housing projects with 75 or more units and commercial developments with 150 or more parking spaces within 500 feet of the beach, dune or high water mark are included in the review process.

The 1994 amendments to CAFRA, known as CAFRA II, attempt to establish a regional planning system in line with the State Plan along the coast. Under CAFRA II, all construction on or within a certain distance of dunes or beaches now requires State review. Municipalities can no longer allow the once-common practice of bulldozing the dunes nearest the beach for construction or to enhance views of the ocean.

The regulations implementing the CAFRA II legislation direct growth into centers consistent with the State Plan. The DEP has identified over 100 centers in the CAFRA area. The regulations allow sector permits to provide an abbreviated permitting process for those communities who have completed advanced planning and received DEP approval. Sector permits apply to CAFRA centers for which NJ DEP has certified that the land use ordinances are consistent with State Coastal Zone Management rules. Once the NJ DEP has approved the sector, the municipality can issue development permits inside the sector without NJ DEP involvement.



New Jersey Coastal Zone

The NJ DEP commissioned the Rutgers' Institute of Marine and Coastal Sciences to produce the 1996 *Coastal Hazard Management Report*. The Report is a reference for understanding the shore and protection strategies. It details current information about the shoreline, includes a broad range of recommendations, and reports on beach engineering, dune management, sea level rise, coastal storms and coastal economics.

The Report aims to reduce risks to life and property in hazardous areas. It classifies the currently popular management activities — hard structures, beach replenishment, dune maintenance — as short-term strategies, adequate for minor storms. To plan for major storms and the long-term future of the shore, the report recommends regional strategies and a better understanding of coastal dynamics.

Among the suggested regional and long-term strategies are:

- designating high hazard zones in which development would be prohibited or restricted;
- prohibiting construction of high-rise or multi-family structures in high-hazard areas, to limit the number of people at risk;
- using setback lines to prohibit development too close to the ocean;
- taking high-hazard lands out of the private domain through purchase with public funds.

To implement these strategies, the Rutgers report recommends that New Jersey establish a single state entity responsible for managing the coast under a comprehensive coastal planning statute. Many of the Report's recommendations — especially those on land use and strategic retreat from high-hazard areas — have met with stiff opposition and been criticized as unrealistic.

At best, the shoreline protection programs of most municipalities meet only short-term management goals. Few, if any, have begun to consider mitigation or retreat from high hazard areas.

For Further Information

Coastal Hazard Management Report: New Jersey's Shoreline Future—Preparing for Tomorrow, Norbert Psuty et al., Institute of Marine and Coastal Sciences, Rutgers, 1996.
www.marine.rutgers.edu/geomorph

Coastal Dunes: A Primer for Dune Management, Norbert Psuty and Erica Rohr, Institute of Marine and Coastal Sciences, Rutgers, 2001.
www.marine.rutgers.edu/geomorph. Available at county public libraries in shore areas.

Federal Emergency Management Agency,
202-646-4600 or www.fema.gov

NJ DEP Land Use Regulation,
Coastal Regulation, 609-633-2289 or
www.state.nj.us/dep/landuse

LOCAL ACTION

Municipal shore protection measures often include building codes, dune ordinances, dune maintenance work and volunteer dune planting programs directed by the environmental commission, garden club, school or scout groups.

Most municipalities have been slow to react to new information about coastal lands and managing the human impact there. It is not easy to recognize the constantly changing and often hazardous nature of coastal land. It is even more difficult to take steps needed to decrease damage to the environment, risks to life and property and costs for beach protection and storm damage.

Catastrophes like the storms of 1962 and 1984 helped change the mindset of some coastal residents and officials, who now understand that dunes are a critical line of defense against the forces of winds, waves and tides. However many municipalities have clung to heavily engineered approaches that aim to hold the line against the sea. They have continued "armoring" the shore and allowed development in the very areas that

storm damage has proven most hazardous.

A few towns are realizing how armoring the beach with hard structures and other practices creates adverse conditions:

- After the 1992 storm destroyed their boardwalks, Bradley Beach and Belmar (Monmouth) moved them further inland and did not rebuild certain sections.
- Many municipalities have stopped the practice of using rows of fencing along the backbeach to trap sand, which they then bulldozed to make smooth beaches and clear the view for oceanfront homes and boardwalk visitors. This practice prevented the formation of protective dunes and resulted in great quantities of loose sand being blown and washed into the streets during storms.
- Some municipalities, such as Lavallette (Ocean), have initiated dune building and maintenance programs to establish dunefields just seaward of their boardwalks.

Several municipalities have sought federal or State assistance for shore protection programs and contribute a local cash share to costly sand replenishment projects. With much of the state's beach funding already dedicated, coastal towns will probably have to finance an increasing share of their beach work.

Protection Programs

Avalon (Cape May) is frequently cited for its shore protection programs. With the support of its residents and cooperation among its officials, Avalon has implemented a multi-faceted shore-front management program. It includes dune protection, federal and local beachfill projects, homeowner education, maps of flood- and storm-prone areas, quarterly beach profiles by a beach specialist and many other initiatives to enlist federal and State aid and the cooperation of neighboring towns.

Avalon is located at the northeastern end of a barrier island, next to Townsends Inlet, an area of severe erosion and mobility. The municipality

has one of the most extensive dunefields in the state and a wide, stable beachfront. Since 1987, Avalon has had nearly a dozen beachfill projects to replenish the sand on its beaches. The cost is more than \$10 million, coming from federal funds supplemented by several million-dollar municipal bond issues.

The funds also paid for:

- two big earth movers purchased from federal surplus to move sand from the south beach, where it builds up, to the north beach, where there is erosion;
- Operation Green Dike, construction of a 3,000-foot dune-levy along the inlet area;
- 4,000 feet of Geotextile tubes to protect the inlet from erosion.

A 30-year-old seawall and revetments (stone-faced embankments) and a newer 500-foot aluminum bulkhead also fortify the inlet. On the beachfront, about 3,000 feet of dunes have been built upon an artificial core of gravel wrapped in Geotextile fabric.

However, most of Avalon's beach is protected only by dunes and maintained by plants and dune fencing. Since 1963, after the Army Corps of Engineers repaired the dunes, the Environmental Commission and public works department have held semi-annual dune-grass planting parties. In the spring the dune grass is fertilized from the air with slow-dissolving pellets.

Elevated wooden walkways protect many of the paths to Avalon beaches. They are angled to the southeast to avoid creating channels for flooding or storm-surge from the northeast.

Avalon advises residents to retrofit older buildings against wind and flood damage, including lifting them on stilts. The town has spent \$4.4 million to elevate public buildings and private owners have elevated about 50-75 older homes. FEMA and NFIP require that new construction be elevated above flood level, but few coastal towns recommend this for existing buildings. Avalon is trying to get grants or low-interest

loans to help residents with these expenses and has petitioned the State to let coastal municipalities require wind strapping and bracing and other protective measures in home construction.

Avalon officials also seek expert help and outside funding. For instance, the town has hired a beach specialist, or “Sand Doctor,” Stockton College Professor Stuart Farrell, to take quarterly profiles of the beaches to study erosion.

Avalon also works with the US Department of Agriculture in testing various grasses and shrubs for dune maintenance. The town sends representatives to Washington or invites state and federal politicians and administrators to Avalon to get the help the town needs. Avalon shares its knowledge with neighboring shore towns.

Dune Ordinances

Many municipalities have dune protection ordinances, although several readily grant variances to allow construction in the dunes. Some ordinances define the dune area as static rather than constantly migrating, and fail to protect inland areas that may become dunes. Many towns still allow building on dunes, especially on the landward ridges and slopes of the dunefield.

Construction in dunes is subject to State regulation in accordance with CAFRA.

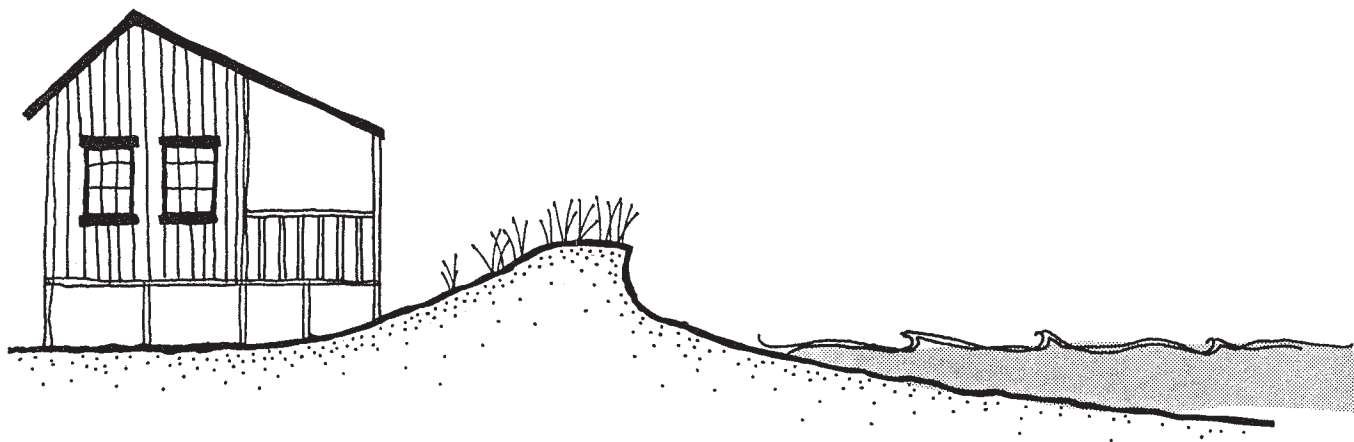
Defining “dunes.” Barnegat Light’s dune ordinance uses the definition of “dunes” from the CAFRA and the Shore Protection programs. It

states: “Wind or wave-deposited or man-made formations, vegetated or drifting windblown sand, that lie generally parallel to, and landward of the beach, and between the upland limit of the beach and the foot of the most inland dune slope. Formations of sand retaining structures and/or snow fences, planted vegetation, or other measures, are considered to be dunes regardless of the degree of modification of the dune by wind or wave action or disturbance by development.”

Mantoloking’s ordinance defines its “dune area” as “that area between the Seaward Edge of the Dune and the Landward Edge of the Dune” — generally the most easterly and westerly lines where the dune forms or dune vegetation meets the elevation of the beach and of inland property. The landward edge may also be defined by a minimum 60-foot dune width, measured from the seaward edge.

The Bay Head ordinance combines the mapping of a specific dune area with a general definition that includes land subject to future dune migration and “other areas along the beachfront which either may be constructed or planted for the purpose of preserving and protecting the shoreline.”

The Beach Haven ordinance defines the beach-dune area as lying eastward of the “building line” mapped by the Borough engineers and as “the dunes, beaches, strand, backshore and foreshore and the areas where, according to a normal beach profile, the same would or should exist.”



Shoreline Erosion

The map is to be corrected when necessary to reflect changes in the terrain. Similarly, “dune area” is defined as the area “actually or normally occupied by dunes.”

Ordinance Provisions Avalon revised its dune ordinance in 1970 to include a detailed survey of the dune area — the area in which dunes are likely to form, even though dunes might not be present there, due to their shape-changing nature. A 1988 ordinance prohibits depositing any rubbish against the backs of the dunefields. Although placing brush and Christmas trees behind the dunes was thought to help hold the sand, the practice was found counterproductive and even dangerous, since the rubbish can become missiles in a storm.

The dune ordinance gives the Avalon engineer and officials the right to review and revise the restrictions and conditions on use of the beaches and dunes, recognizing that these landforms can alter over time, as can the best ways to protect them. The ordinance prohibits the removal or redistribution of sand from beaches or dunes and requires homeowners to obtain a permit before removing sand that has been blown or washed onto private property, in case the removal might open that property or others to hazards.

Trespassing on dunes and removing any snow fencing or vegetation are prohibited. Bulkheads, engineer-designed so that they are not “detrimental to the maintenance of an adequate dune line,” and sand fences are permitted to “supplement dunes.”

Like Avalon, Mantoloking sits on a narrow barrier island, but its well-maintained dunes help protect the town. Large lots allow houses to be built back from the beach. However, the 1962 storm eroded some dunes back to the houses. Some shore scientists expect that Mantoloking will seek beach nourishment and structural engineering because of the narrowness of its location.

Mantoloking’s beach-and-dune ordinance acknowledges that “there may be no long term defense for fixed oceanfront structures against a constantly rising ocean level,” but that the best interim protection is “sufficient elevation and

breadth in the beach and dune areas.” Dunes “should provide an uninterrupted barrier and a source of sand to mitigate the effect of storm waves” for the benefit of oceanfront and inland portions of the town. Because this is “the only viable option” to protect against erosion and flooding, the town will not grant any waivers or variances.

The Mantoloking’s dune inspector is directed to “liberally construe” the ordinance’s many detailed provisions for dune use and maintenance to provide the greatest benefit to the beach and dune system. In addition to a dune inspector, the town employs a consultant to visit the dunes twice a year to advise on needed maintenance, and an in-house dune program director to supervise planting and fencing and make recommendations to the dune inspector.

Mantoloking’s ordinance, which includes an appendix with detailed instructions to homeowners for dune maintenance work:

- bans all construction in the dune and beach area, except if allowed under the ordinance (residential walkways and dune platforms) or permitted by the CAFRA review process;
- warns property owners that failing to follow the principles of the ordinance may make them liable for damage to other properties;
- prohibits trespassing on the dunes except for municipal dune work or for entry on approved pathways, walkways or dune platforms constructed as specified in the ordinance appendix;
- prohibits the destruction of dune vegetation or sand fencing;
- prohibits the removal of sand blown or washed onto a property, although it may be moved eastward on the site;
- prohibits the lowering of a dune “by the action or inaction” of property owners and requires property owners to install dune fencing and plantings as specified in the appendix;
- requires permits for dune replenishment and for activities covered by the ordinance. If site

conditions change, the dune inspector may revoke or modify these permits on the advice of the dune consultant and dune program director;

- requires the dune program director to make periodic inspections and provide written reports and advice to property owners;
- establishes specific parameters for location of the dune edge, its foreslope and height, and allows the dune inspector and the dune consultant to require property owners to take action to achieve those parameters, including bringing in off-site sand, if the dune consultant believes natural forces would take too long or allow hazardous conditions.

Beach Haven's ordinance allows certain structures — walkways or steps, platforms, bulkheads, cantilever decks — that do not disturb or damage the dunes and have been reviewed by the town engineer, but does not include specific requirements like those in the Mantoloking ordinance. Beach Haven requires permits to move sand within the beach-dune area or to remove sand washed or blown onto lands west of the dune line. The ordinance specifically notes the town's rights of eminent domain to buy up parcels if necessary for public safety or welfare.

For Further Information

The ANJEC Resource Center has samples of municipal ordinances for dune and shoreline protection.

Sample Ordinances for Protecting Significant Coastal Habitats, ANJEC, 1998. 973-539-7547 or www.anjec.org

SHIFTING SANDS: *New Jersey's Wandering Shoreline*

In Cape May Point, the sandpipers think the shoreline is right where it should be—where the water meets the sand. A few hundred yards in either direction makes no difference to them. But the property owners in Cape May Point Borough and other New Jersey shore communities want the shoreline to stay put, since their lot lines are fixed and their buildings are threatened by wind and waves.

It's an elusive goal. Since 1879, the ocean has removed 1500 feet of Cape May Point, carrying away or stranding many structures. Visitors can see how much this area has changed by looking out from the light-house. The sites of two prior lighthouses are now in the ocean, the 1847 site just in the breakers and the 1823 site farther out.

To the east, the small village of South Cape May once stood between Cape May Point Borough and Cape May City. The last of its 50-60 small cottages was lost to shoreline erosion in the 1950s. Erosion was made more severe by the groin at Cape May City, which steals sand from this area by trapping it on the City side.

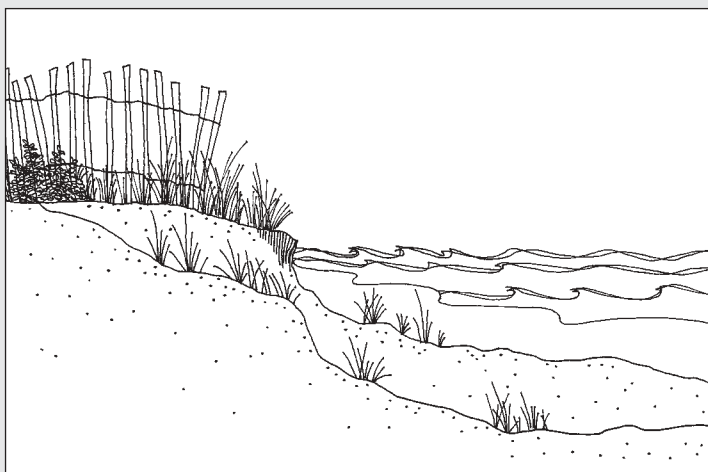
Just west of the South Cape May site is a huge World War II concrete bunker. It perches in the waves on wooden stilts, with a few massive concrete blocks jostled atilt to either side by the ocean. The stilts were never meant to support its weight but only to help stabilize it where it was built in 1942, 900 feet inland.

The sea has claimed other things at Cape May Point. Turn-of-the-century trolley tracks are now under water; two lifesaving stations were lost to shoreline erosion in the 1950s; former oceanfront homes have been moved inland to new sites among the many more modern homes in the town.

To try to stave off the wind and waves and keep the shoreline from moving farther inland, the beaches and dunes here are heavily engineered. The dunes themselves are manmade, as they are in many other areas of the shore. Nine walls — or groins — jut into the surf. They create a serrated shoreline with small pocket beaches that widen on the northeast side of the groins, where sand drifting along the shoreline is caught, and erode on the northwest side of the groins, from which waves carry away sand.

At the landward end of some of the groins are bulkheads, but the waves have reached in to cause erosion behind some of these walls and have scooped out a small cliff or scarp along the dune face just below the parking lot and pavilion for Cape May State Park. To stop this scouring or scarping and to try to trap some sand, long flat plastic nets filled with rocks have been laid up against the dune face. These plastic nets are nothing to look at, but neither are the groins, the slabs of concrete laid against the dune face, or the extensive snow fences criss-crossing the dunes to keep people off and sand in. To help prevent erosion, the paths to the beaches are wooden walkways, and the backs of some of the dunes have been planted with dune-grass.

Out under the surf is a 1000-foot-long artificial reef, one of three that Stevens Institute of Technology installed here, in Avalon and in Belmar/Spring Lake in 1993-4. The purpose of the reef is to break the force of the waves and to provide fish habitat.



BARBARA PRETZ

CHAPTER 10

ESTUARIES: COASTAL CORNUCOPIA

Estuaries are the unique, transitional coastal areas where freshwater from rivers and streams meets and mixes with saltwater from the oceans. Estuaries are affected by tides, but are sheltered from the full effect of waves and other forces of the sea by reefs, barrier islands, mudflats, or other shoreline features. An estuary's brackish (mixed salt and fresh) waters filter slowly and gradually out to sea over a period of weeks.

Estuaries are a gathering place for wildlife. The convergence of many habitats — fresh and salt water, river currents and ocean tides, deep channels and shallow bays, mud and sand tidal flats, salt and brackish wetlands, woodlands and fields — make estuaries nature's most prolific nurseries. According to some estimates, estuaries produce, area for area, 12 times more plant and animal life than the ocean, four times more than lakes and streams, and more than twice as much as cultivated land. More than 80 percent of all fish and shellfish depend on estuaries for primary habitat, spawning areas or nurseries.

Estuaries also serve other important natural functions. Marsh plants filter out excess nutrients and other pollutants that have been swept off the land in stormwater runoff. Coastal wetlands also absorb floodwaters, dissipate storm surges, and prevent shoreline erosion.

Since prehistoric time, estuaries have also been great gathering places for people. Native Americans came to harvest fish, wildlife and estuarine plants. America's earliest cities were located on rivers and bays — the waterways were nature's highways and a source of water for towns and industries. Most of the world's great shipping

terminals are in estuaries. More recently, people have flocked to estuaries to vacation and to buy or build homes, often paying a premium to live in new shoreline subdivisions. In a recent rating of natural systems by economists and ecologists, estuaries were ranked highest for both their dollar value and their value as habitats.

NEW JERSEY'S MAJOR ESTUARIES

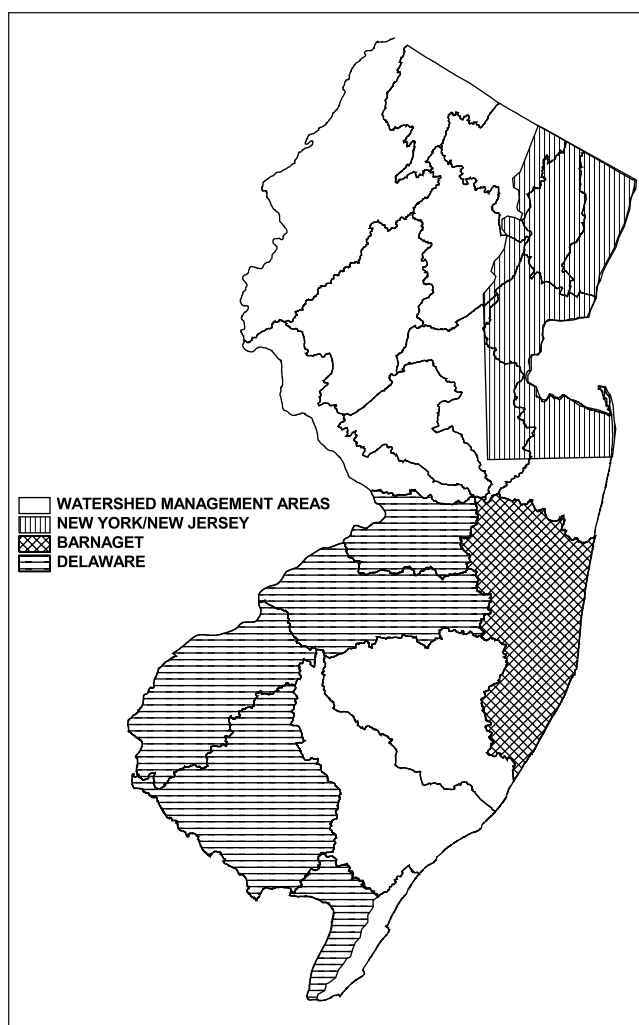
New Jersey has three major estuaries, the Delaware Estuary, the New York/New Jersey Harbor Estuary, and the Barnegat Bay Estuary. The Delaware Estuary includes the Delaware Bay, the lower portion (tidal waters, beginning at the "falls" at Trenton) of the Delaware River and the tributaries leading into those waters. The New York/New Jersey Harbor Estuary includes Hudson River tidal waters from a line just north of the New Jersey border, to the ocean between Sandy Hook, NJ, and Rockaway Point, Long Island. The Barnegat Bay Estuary extends 40 miles from Metedeconk (near Point Pleasant) to the southern tip of Long Beach Island, including Manahawkin Bay, Barnegat Bay, Little Egg Harbor and the tidal portions of the Toms River and many smaller creeks.

Competing Interests

Centuries of human use of estuarine resources have taken their toll. The clash between economic and environmental needs is especially keen in estuaries because they are such rich sources of natural and recreational bounty.

Our state's rivers and bays have long functioned as sewers for human and industrial waste. Associated wetlands and mudflats were often diked or filled, and used as dumps. Dredging for shipping also has damaged estuarine ecology. Shipping spills have polluted the estuaries, often with the oil and chemical products produced in vast quantities in New Jersey.

The federal *Clean Water Act* did much to reduce the amount of pollution flowing into our rivers and estuaries through “point sources” (that is, discharges through pipes from industrial and residential uses). Today, the biggest threats come from “nonpoint sources” such as runoff from development within the estuarine watershed and from recreational water activities.



National Estuary Program Study Areas in New Jersey

Each estuary is a hub of competing human and natural activities. The New York/New Jersey Estuary is the country's most densely populated area, with 20 million people and the country's largest seaport, bringing in \$55 billion in cargo annually. The Estuary, with its spaghetti bowl of roads, its industrial wastelands and landfill landscapes, may appear to be in a terminal ecological state. Yet more than 100 species of fish inhabit it, and one-quarter of all the nests for wading birds between Connecticut and New Jersey are there. Plant life is similarly diverse — Staten Island alone has 178 rare plant sites.

The Delaware Estuary, extending 135 miles from Trenton to the sea, is home to five million people, with 750,000 more expected by 2020. Like the NY/NJ Estuary, the Delaware is heavily industrialized and requires regular dredging to maintain deep shipping channels. The Delaware Estuary hosts more chemical industries than any place in the world, ranking second in the United States for petrochemical plants. As the nation's largest freshwater port, the Delaware Estuary receives 70 percent of the oil imported to the East Coast. Yet the Estuary has the second largest population of migratory shorebirds in North America. The Nature Conservancy has designated the Delaware Bay's shoreline ecosystem as one of the world's 75 “Last Great Places.” It is a major stopover for migrating raptors, a hatchery for a half-dozen species of commercial fish, a spawning route for fish such as shad, and a habitat for shellfish. Sports fishermen spend \$25 million a year in the bay; and birdwatchers in Cape May alone spend \$5.5 million. The Delaware River also supplies water to 20 million people outside its watershed — one tenth of the nation's population.

The Barnegat/Little Egg Harbor Estuary is shallow — mostly less than six feet deep and never more than 13. Its shoreline and bottom ecologies are susceptible to overdoses of nutrients from lawn fertilizers, septic systems and boat toilets; to pollution washed off of roads by stormwater; and to the action of boat traffic. Approximately 53,000 boats use the Barnegat Bay each year. New challenges are rising from the increasing

popularity of personal watercraft — jet skis — that go even in very shallow waters of the Bay.

Dredging is needed to maintain navigable channels through the Barnegat Bay. This disturbs underwater habitats directly and also indirectly, altering the flow and mix of waters. Because an almost unbroken chain of barrier islands separates the Bay from the ocean, it retains pollutants for a long time. It takes 50 days for the Bay to flush itself.

The Barnegat Estuary's 660 square mile watershed is home to 435,000 residents in 37 municipalities. In summer, the population doubles and sometimes triples. Extensive road building and residential and recreational development have altered the movement of the water in the bays and changed the mix of salt and fresh waters. Overuse of aquifers under and near the bays is changing the estuary's salinity by pulling ocean waters toward the aquifers.

Still, the Barnegat Bay Estuary provides habitat for an impressive array of wildlife. This includes otters and seals, the state's largest osprey population, major populations of Atlantic brant, black ducks, and peregrine falcons, one-quarter of the state's commercial catch of hard clams, blue crabs, and more than 300 species of plants. Many of the plants are on Island Beach State Park, which the US Fish and Wildlife Service has designated a Critical and Unique Habitat.

Estuarine Recovery

By the 1940s and 1950s, pollution in the Delaware River and Bay, heavy use of water by industries, and the dams on several tributaries had almost destroyed commercial and sport fishing in the Estuary. The 60 miles from Trenton to Wilmington was one of the most polluted riverways in the world. In warm months, the oxygen content of the water near Philadelphia was zero, choking off most riverine life and preventing shad and herring from traveling upstream to spawn. Four decades later, the Delaware Estuary is cleaner than it has been since 1900. Ninety percent of it is swimmable and fishable, thanks

to changes brought about by the federal *Clean Water Act*.

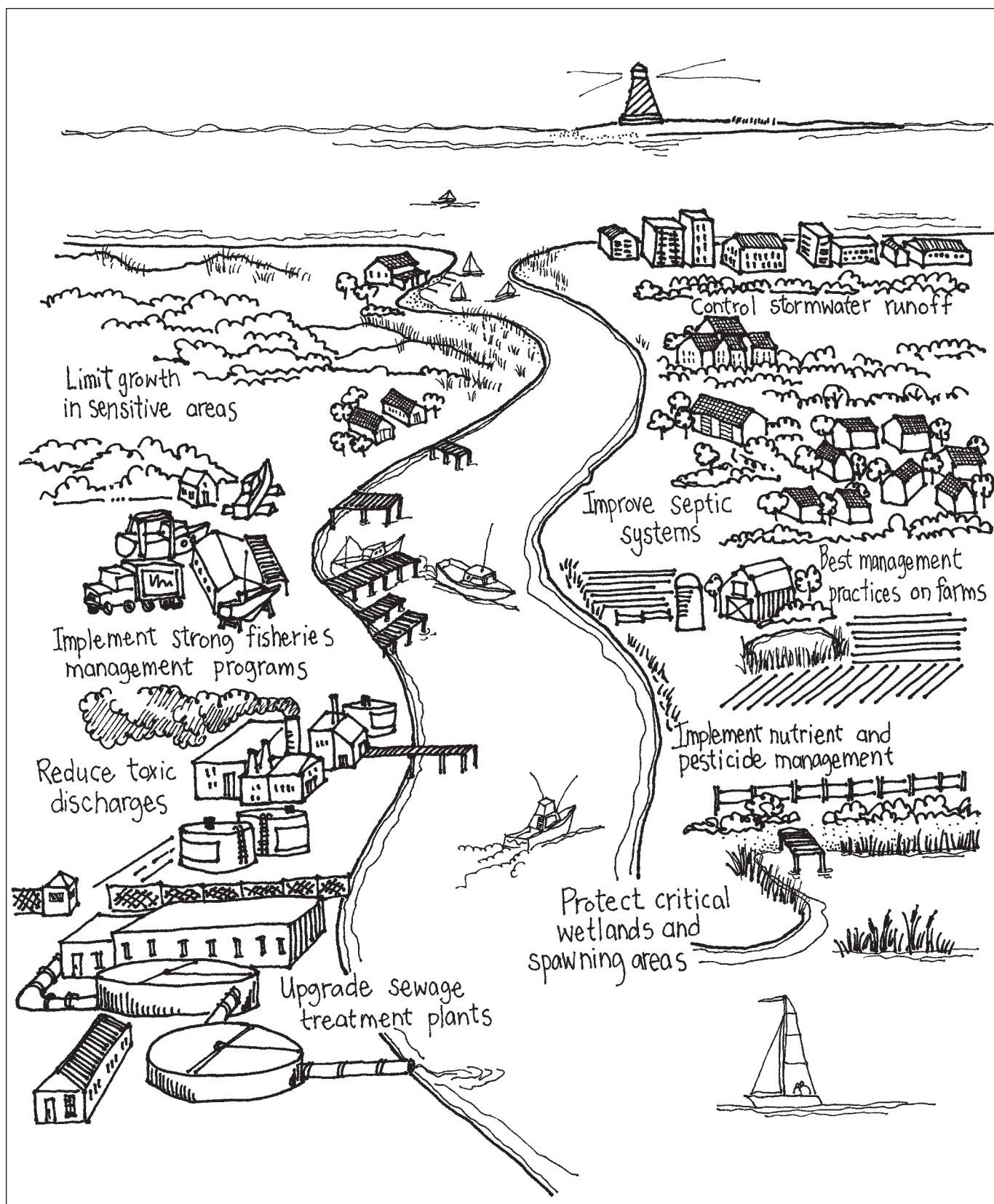
However, environmental and economic problems remain. Overuse of the water in the Delaware by industries, farms, homes and power plants threatens wildlife habitat and human drinking water because it draws saline water farther into the Estuary and into wells on its shores. The trend toward coastal suburbanization and tourism continues to threaten the health of estuaries. Nonpoint source pollution in stormwater runoff is also a major and growing threat. By 2020, a 16 percent increase in suburban and urban sprawl could deliver an estimated 45 percent more nonpoint source pollution to the Delaware Estuary.

As point source pollution from industries, power plants and sewer facilities has decreased in the last 40 years, water quality has improved in the New York/New Jersey Harbor Estuary. Yet the water, sediments, plants and animals of the Estuary contain a toxic legacy of heavy metals, pathogens and PCBs, and many areas are still too polluted for fish and shellfish. The New York/New Jersey shipping industry suffers because channels silt up and there is no safe way to dispose of PCB-contaminated spoils that are excavated during dredging.

The huge New York metropolitan watershed sends immense quantities of degraded runoff water into the Estuary. Half the nonpoint contaminants are nutrients (phosphorous and nitrogen) and pathogens (bacteria and viruses).

FEDERAL AND STATE PROGRAMS

The federal Environmental Protection Agency has accepted New Jersey's three major estuaries and their watersheds into its National Estuary Program (NEP). The NEP, established in the 1987 reauthorization of the *Clean Water Act*, identifies environmental problems and sources of pollution in estuaries. The program encourages state and local governments and public and private groups to take action and generate inno-



Strategies for Protecting Estuaries

vative solutions, and directs public and private money and assistance to those projects. The culmination of the work of each individual estuary program is the creation of a comprehensive, long-term management plan that is designed to conserve estuarine resources.

The Delaware Estuary was accepted into the NEP in 1989. A 25-year Comprehensive Conservation and Management Plan (CCMP) was approved in 1995. Key issues in the Delaware Estuary Program (DELEP) are habitat conservation, point and nonpoint source pollution, public access and education, and sustainable development. EPA's Region II oversees the CCMP. The Partnership for the Delaware Estuary, a non-profit education and outreach organization established in 1996, implements it.

The New York/New Jersey Harbor Estuary was accepted in 1988, and its CCMP was finalized in 1995. By Congressional order, the NY/NJ Harbor Estuary Program (HEP) also includes a restoration plan for the New York Bight — the ocean's continental shelf from Cape May to Montauk Point, Long Island, including New Jersey's entire Atlantic coastline. The HEP focuses on habitats and wildlife, toxic and pathogenic contamination, disposal of dredging spoils, floatable debris, nutrients, stormwater runoff and sewer overflows caused by stormwater. EPA's Region II office administers the implementation of the NY-NJ Harbor Estuary CCMP.

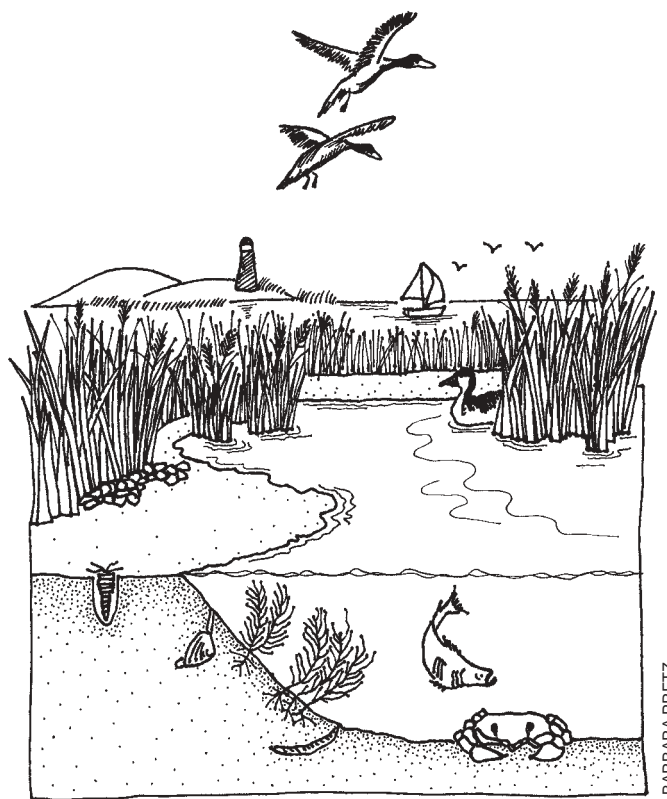
The *Barnegat Bay Study Act*, passed by the State Legislature in 1987, established the Barnegat Bay Estuary program. In 1990, the NJ DEP and the Barnegat Bay Study Group began a three-part study, culminating in the 1993 Barnegat Bay/Little Egg Harbor Watershed Management Plan and the 1997 Action Now Agenda.

The EPA accepted the Barnegat Bay Estuary into the NEP in 1995 and funded the creation of a CCMP. Because the Barnegat Bay Estuary is located almost entirely within Ocean County, its Freeholder Board agreed to be the lead agency along with the NJ DEP in the implementation of the CCMP. The non-profit Barnegat Bay Water-

shed and Estuary Foundation is also a partner in the project.

The Barnegat Bay Estuary Program (BBEP) centers on watershed-based planning, fisheries, water use, nonpoint source pollution, and purchasing or protecting sensitive areas. The management plan characterizes estuary problems as the "cumulative results of seemingly innocuous everyday activities in and around the Bay that are slowly degrading [its] environmental quality."

The Barnegat estuary management plan stresses public education and local action. It calls for all 37 watershed municipalities to establish active environmental commissions, to lobby for amendments to the State's *Municipal Land Use Law* that would mandate open space along the estuary's bays and tidal rivers, and that would convene special municipal committees (representing the planning and zoning boards, the environmental commission, and the health department) to review all site plan and subdivision proposals



National Estuary Program Study Areas in New Jersey

before formal applications are made or formal hearings are held.

The plan urges municipalities to “make full use of their planning and zoning powers under the *Municipal Land Use Law* to ensure the protection of the Barnegat Bay.” A Technical Committee has drafted a municipal guide for planning boards, with examples of local programs and ordinances aimed at estuary protection.

The Management Plan also establishes the Barnegat Bay Watershed and Estuary Foundation. This citizen watchdog group monitors the activities of municipal, county and state governments and of private interests, and promotes public education, including a training course for local schoolteachers.

The three estuary programs have carried out extensive research and monitoring to provide a scientific basis for the individual management plans. They established avenues for local participation and built a constituency for estuarine management by having residents, the business sector and municipalities participate on citizen advisory committees and local government committees. Municipalities were, and are, key players, because most estuary management plans concentrate on issues that local activities and decision-making control or impact. They often center on land use issues, especially open space preservation, nonpoint source pollution, watershed-based planning and sustainable development.

For Further Information

NATIONAL ESTUARY PROGRAM:

Environmental Protection Agency,
www.epa.gov/owow/estuaries/

DELAWARE ESTUARY

Delaware Estuary Program, c/o Delaware River Basin Commission, 609-883-9500 or
www.delep.org

Partnership for the Delaware Estuary,
800-445-4935 or www.udel.edu/PDE/

Delaware River Greenway Partnership, c/o
Heritage Conservancy, 215-345-7020

Delaware Riverkeeper, 215-369-1181 or
www.delawariverkeeper.org

The Delaware Bay Schooner Project,
856-785-2060 or www.ajmeerwald.org

NEW YORK-NEW JERSEY HARBOR ESTUARY/BIGHT

US EPA, NY/NJ HEP Coordinator, Marine
and Wetlands Protection Branch,
212-637-3816 or www.harborestuary.org

NY-NJ Baykeeper, 732-291-0176 or
www.nynjbakeeper.org

Hackensack Riverkeeper, 201-692-8440 or
www.hackensackriverkeeper.org

BARNEGAT BAY ESTUARY

Barnegat Bay Estuary Program, 732-286-7877
or www.bbep.org.

NJ DEP Office of Coastal Planning,
609-777-3251

Barnegat Bay Watershed and Estuary
Foundation, Rutgers Cooperative Extension,
732-505-3671 or www.bbweef.org

Rutgers Cooperative Extension of Ocean
County, 732-505-3671

Alliance for a Living Ocean, Barnegat Bay
Watch Program, 609-492-0222 or
www.livingocean.org

Ocean County Soil Conservation
District/NRCS, 609-971-7002

LOCAL ACTION

Municipalities working to improve the quality of estuaries use a variety of strategies. These include watershed-based planning, open space preservation, carrying capacity zoning (based on the natural ability of the land to support development), control of nonpoint source pollution, streambank restoration and habitat preservation. Protecting streams, the coast, groundwater and slopes also protects estuaries. The preceding chapters on these subjects give other information on municipal actions that will help estuaries.

Watershed-based Planning

Many estuary protection efforts center on watershed-based planning that crosses municipal boundaries, involving different town governments, county planners, environmental agencies and private groups. The NJ DEP's watershed planning initiative is covered in Chapter 3 on Streams and Rivers.

Since 1992 the Monmouth County Planning Board has been a leader in watershed planning. The Planning Board helped organize municipalities in the County as Regional Environmental Planning Councils to discuss watershed issues and mutual concerns. The Councils have met regularly, published newsletters and collected environmental data, which the Monmouth County Planning Board publishes and makes available on GIS in public libraries. Through the experience they have gained, the Councils were ready to participate when NJ DEP launched its watershed initiative. As subwatershed groups, they will help develop plans for regional stormwater management in Watershed Management Area 12.

The Navesink River Municipalities Committee, composed of Fair Haven, Rumson, Red Bank, Tinton Falls, Colts Neck and Middletown, meets monthly "to reach a common ground in the care and preservation" of the river. Formed in 1989, the Committee is part of a long-standing watershed management program to restore the Navesink River and its shellfishing beds. The

committee has held seminars on environmental and safety issues including one on controlling the Canada goose population and discouraging geese from coming onshore. The committee has started an oyster farm production program encouraging area residents to cultivate oysters. The committee is participating in Watershed Management Area 12 meetings.

More than a dozen other agencies (including the US EPA, the State and federal Departments of Agriculture, county planning boards and health departments), private groups (including the American Littoral Society, the Navesink River Environmental League, and the New Jersey American Water Company), municipalities and Rutgers University have been involved in the effort. In January 1997, for the first time in 26 years, the lower third of the Navesink was opened for unrestricted shellfishing. The federal government selected the Navesink as one of 25 "national symbols of progress" to celebrate the 25th anniversary of the *Clean Water Act*.

The Gloucester County Environmental Planning Section has mapped watersheds and sub-watersheds, identified sources of point and nonpoint source pollution, and helped municipal planning boards and environmental commissions to initiate watershed-based planning. The county used a \$200,000 federal grant for streambank stabilization work, nutrient studies and stream gauging, a water resources video and curriculum for county schools, and seminars for local officials.

Open Space

Vegetated buffers on stream banks and shorelines remove nonpoint source pollutants and shade the waters to help keep them cooler. To help the estuaries, municipalities can develop open space plans with greenways and buffers along streams and shores. Examples of these open space programs are detailed in Chapter 3 on Streams and Rivers and Chapter 7 on Open Space.

Some municipalities have developed programs for open space preservation on the estuary's shores. Greenwich Township (Cumberland)

revised its master plan with the intent to preserve marshlands near a heavily industrialized area. The municipality has 2,000 acres of marshland next to the Dupont Corporation facilities and another 1,000 in farmland or open space. The master plan recognizes the crucial importance of preserving these areas in their natural state as estuarian habitat, parks and bird observatories, and for quiet recreation.

Under the Route 130/Delaware River Corridor Project (Burlington), 12 heavily developed municipalities are working to establish open space preservation plans along the Delaware River and Rancocas Creek. The citizen steering committee will identify key open space parcels, plan waterfront access and recreation, and help plan the Delaware River Heritage Trail. The National Park Service is coordinating the trail plan. The Rancocas Conservancy, the Burlington County Bridge Commission, and many other organizations are involved in the project, which will link the Rancocas Greenway Project, the Delaware River Greenway Program, and the Lower Delaware Wild and Scenic Rivers Study. To pay for open space purchases, municipalities and nonprofit groups may apply for loans of up to 75 percent of the purchase price funded by Burlington County's open space tax.

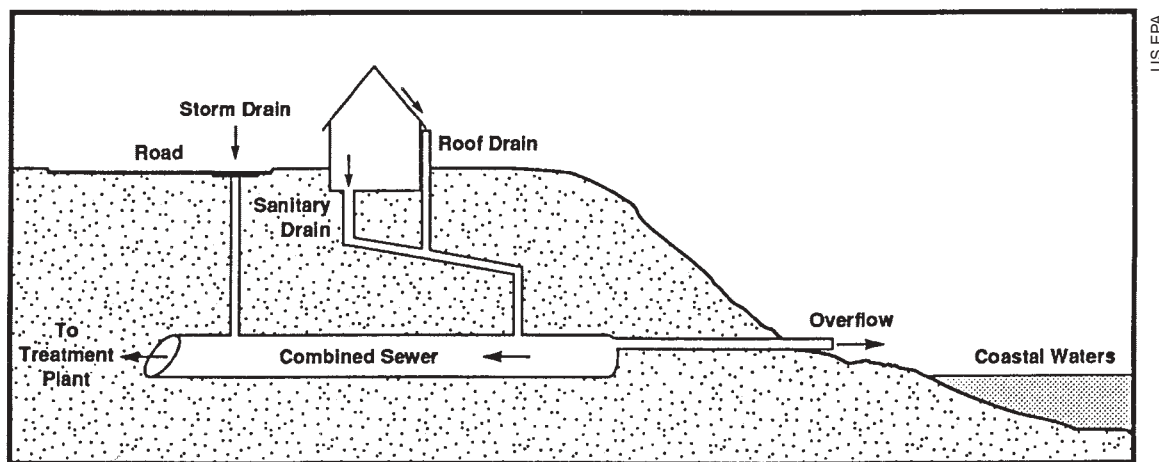
In the Barnegat Bay estuary, the Trust for Public Land's Barnegat Bay Initiative has been actively preserving habitat and recreational land in the watershed since 1989. TPL's "The Century Plan:

A Study of One Hundred Conservation Sites in the Barnegat Bay Watershed" is a guide for conservation of 50,000 acres of sensitive environmental areas. A number of these sites, in municipalities such as Berkeley, Brick, Lacey, Ocean and Stafford, are already publicly owned by various entities including NJ DEP, the US Fish and Wildlife Service, or the Ocean County Department of Parks and Recreation. By 2001 TPL had acquired about 6,500 acres in the area.

Ecotourism

Cumberland County, on the Delaware Bay, is an area rich in wetlands, rivers, farmlands and natural habitats. However, the rural county also suffers from economic problems and a high rate of unemployment. Traditional economic development efforts have often been at cross-purposes with efforts to protect and preserve wetlands and open space. For this reason, the South Jersey Land Trust and the Cumberland County Planning and Development Department joined to investigate opportunities for ecotourism in the county. Ecotourism provides a way for local residents and landowners to derive income from natural resource-related activities such as bird-watching, photography and canoeing, giving them an economic reason to protect those natural resources.

The South Jersey Land Trust conducted a series of activities related to the development of ecotourism in Cumberland County, including a



Combined Sewer Overflow

day-long ecotourism workshop for municipal officials, chambers of commerce, and conservation organizations. It featured a keynote address by a national ecotourism expert and seven breakout sessions on topics such as making ecotourism a part of a regional tourism program and assistance from conservation agencies. These sessions were followed by a slide show on the economics of birding in New Jersey.

Water Pollution

Several initiatives deal directly with specific sources of pollution of estuary waters.

New Jersey Harbor Dischargers Group is an organization of the ten New Jersey wastewater treatment agencies that discharge into the NY-NJ Harbor Estuary. These ten utilities generate 600 million gallons of wastewater daily and serve about half the state's population. The organization tests for the source and extent of contamination from sewer plants and holds workshops on strategies for removing "floatables" from stormwater and regulating combined sewer overflows (the spilling of untreated wastes when stormwaters push treatment plants beyond capacity).

Under the *Clean Vessel Act* (33U.S.C. 1322,106), certain estuaries and bays may be designated as "No Discharge Zones," where boats may not flush effluent into the water. The Shark, Shrewsbury, Navesink and Manasquan Rivers have this designation. Part of the Hudson River and the Barnegat Bay Estuary Programs also have applied to US EPA for designation. These programs establish pumpout stations at marinas or town parks. A pumpout boat began traveling Barnegat Bay in the summer of 1999. This initiative is funded through the *Clean Vessel Act*. The lead agency is the Marine Sciences Consortium at Sandy Hook (732-872-1300), a non-profit group associated with Rutgers that works closely with counties and municipalities.

US EPA's Near Coastal Waters Program is funding a pump-out program as a joint effort with the Ocean County Planning and Health Boards, the New Jersey Marine Sciences Consortium, and the Marine Trades Association. Under the

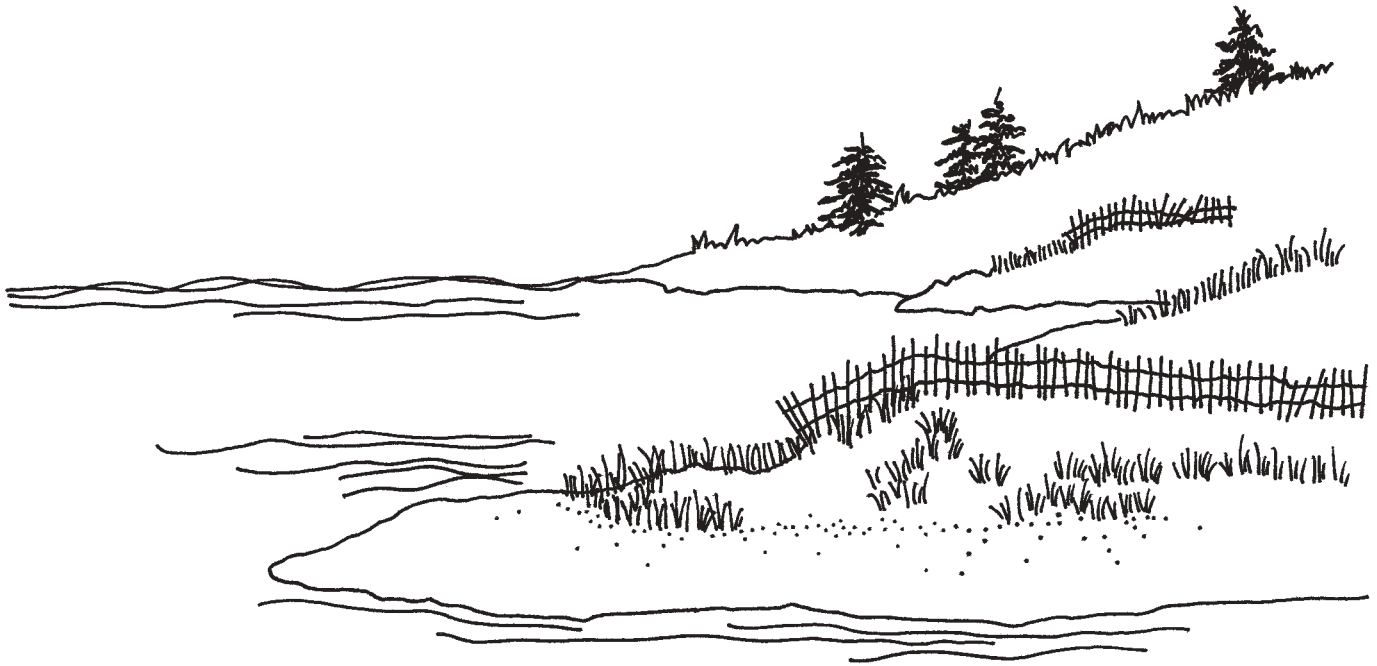
Sewage Infrastructure Improvement Act (N.J.S.A. 58:25-23 et seq.), 20 or more Ocean County municipalities will map their stormwater systems, monitor discharges, and develop stormwater management and nonpoint source pollution control programs.

Nonpoint Source Pollution

Nonpoint source pollution is the largest source of contamination in estuaries, as it is in lakes and rivers. For a full discussion of controlling nonpoint source pollution see Chapter 3, Streams and Rivers, and Chapter 4, Wetlands. The Mercer County Soil Conservation District sponsored a variety of stormwater management projects in several municipalities, particularly in the watershed of Assunpink Creek, which flows to the Delaware through Trenton. Projects include nonpoint source pollution education in schools county-wide. Volunteers stenciled storm drains with pictures of fish to remind people not to dump down the drains because they carry stormwater directly to the fish habitat. To reduce the need for maintenance and pesticides in detention basins and to provide habitat, they planted wildflowers and trees and placed bird, bat and butterfly houses in the basins.

Red Bank (Monmouth) was the first municipality on the Navesink River to enact a "pooper scooper" law to clean up stormwater by requiring pet feces to be removed from lawns and roadways and put in the garbage. The 18,000 registered dogs in the ten municipalities of the Navesink's 95 square mile watershed produce roughly nine tons of feces daily. Red Bank also cooperates with the NJ DEP in sampling and testing water from stormwater outfall pipes before and after the drains are cleaned to determine if cleaning lowers bacteria counts.

Stafford Township (Ocean) has developed numerous strategies aimed at proper land use and estuarine protection. In 1994, Stafford received the US EPA's First Place National Storm Water Control Program Excellence Award for its work in protecting groundwater, lakes, streams, and the estuary. Among the stormwater strategies are



BARBARA PRETZ

special catch basins connected to underground filtration systems. A joint NJ DEP/Stafford educational publication explains the program.

Stream Restoration

The Cooper River, a tributary of the Delaware, runs through a densely populated area of Camden County. It suffers from the problems of an intensely used urban river. More than a million visitors come each year for the recreational activities at Cooper River Park. The Park shoreline was eroding due to wind, wave and ice action, heavy public foot traffic and output from several unprotected stormwater discharge pipes. The erosion caused loss of wildlife habitat, an accumulation of silt in the river, a reduction in park open space and elimination of shoreline vegetation to filter out pollutants from storm water runoff.

The Camden County Soil Conservation District stabilized a half-mile section of Cooper River using a variety of erosion control methods. The project was intended to serve as a model for streambank restoration. The SCD formed a partnership with US Department of Agriculture Natural Resources Conservation Service, Camden County Parks Department, Delaware

Riverkeeper Network, and over 60 volunteers. The first phase of the project stabilized the bank by grading eroded banks, installing coconut shell Bio-Logs for temporary stabilization, installing biodegradable soil stabilization blankets over newly seeded areas and seeding the exposed river bank with wildflower mix. Volunteers planted rooted cuttings of dogwood and willow, wetlands herbaceous plants; assorted rooted shrubs and blackberry bushes along the river banks.

Phase II combined further planting with structural stabilization methods needed for severely eroded banks. This included the installation of matting on a sloped area, gabions (rock-filled cages) along a steep, unstable bank, and riprap as a transition area between structurally stabilized and planted sections.

Habitat Enhancement

The Delaware Bay is the site of the largest number of spawning horseshoe crabs anywhere along the Atlantic coast. During the latter part of May, hundreds of thousands of horseshoe crabs lay and fertilize eggs on Delaware Bay shores. This spawning activity coincides with the stop-over of millions of migrating shorebirds who eat enough eggs to continue their northern migra-

tion. This plentiful food is the primary reason the Delaware Estuary is the largest staging site for migrating shorebirds in eastern North America.

Until 1991, an assessment of spawning horseshoe crab population trends in the Delaware Bay was unavailable. Considering the value of horseshoe crabs to humans and migrating shorebirds, it was important to establish whether the Delaware Estuary's spawning horseshoe crab population was increasing or decreasing. An annual census was initiated in 1990 with scientists and volunteers collecting information and compiling the data into a report, printed by the Delaware Estuary Program.

Annual counts have continued each year. The Limuli Laboratories in Cape May coordinates volunteer training and data compilation for Delaware Estuary beaches in New Jersey and Delaware. The public can participate in the program by calling the toll-free number 877-TAG-CRAB.

The census comparison data show a striking decrease in the spawning horseshoe crab population. Some environmental factors contributed to the decrease in numbers — stormy weather and turbulent wave action in 1993 and cool water temperatures in 1994 but the data strongly indicated over-fishing as a major cause. The need for a fishery management plan to regulate harvesting of horseshoe crabs was apparent. In 1998 NJ DEP adopted a management plan that limits the amount of crabs that fisherman can harvest and the days when fishing can occur. Harvesting requires a permit and reporting of the catch.

In addition, development along Delaware Bay shores is affecting the crab population, because construction of bulkheads and jetties eliminates the habitat necessary for horseshoe crab spawning. The use of manmade structures on the Delaware should be limited.

For Further Information

Managing Nonpoint Source Pollution in Your Community: A Municipal Guide, Natural Resource Conservation Service (NRCS), Somerset County, 732-246-1171, ext. 165

Nature Conservancy, 908-879-7262 or <http://nature.org>

NJ DEP, Division of Watershed Management, 609-683-3812

Monmouth County Planning Board, 732-431-7460

Trust for Public Land, 973-292-1100 or www.tpl.org

Stockton Alliance, 609-695-1211 or www.stocktonalliance.org

CHAPTER 11

REDUCING WASTE

Materials conservation involves the reuse or recycling of materials. In nature, materials conservation happens automatically. Nature reuses a dead tree as a home for large and small creatures. Dead leaves, grass, flowers, vegetables and trees are recycled as they decompose to humus, a component of soil.

Everything around us — both natural and manmade — is made of material that could be conserved. But by the time we buy most goods, they hardly seem related to a natural resource. Supermarkets distance us even from things like vegetables that may come directly from the soil.

SOLID WASTE PROBLEMS

A century and a half ago, not much was thrown out, and what we call source reduction occurred as a matter of course. No one would have thrown out an old shirt, no matter how worn. Old rags could be made into paper or rugs or “recycled” in many other ways. Garbage was mostly food scraps and ashes left over from cooking and heating. Plastic was unknown, and paper, which is a large share of what we now throw out, was scarce and saved carefully. Old tools and furniture would be discarded only if they could not be fixed, since they were not so easy to replace as now.

People threw out things we call “biodegradable.” Vegetable peelings, bones, old rags and ashes rotted away to humus, providing nutrients for crops and other plants, which in turn became the raw materials for producing new food and clothing.

Landfills

Letting garbage decay in nature’s cycle of materials conservation did not create an ideal method disposal of solid waste. People weren’t necessarily thinking about returning resources to the earth as they discarded things like bones and vegetable peels. Much of the time, they simply disposed of trash and castoffs out the front or back door or in the streets.

Even when garbage was removed promptly to dumps, there were problems. Dumps caused odors, attracted pests and allowed pollution to pass into streams and soils, or to scatter across the land. Landfills were invented to deal with many of the health and aesthetic problems of dumps. In modern landfills, an impermeable bottom liner keeps garbage from polluting water and soil. A daily covering of soil reduces odor and the escape of garbage.

But as garbage and most pollution are kept inside landfills, air and water are kept out. Without air and water, biodegradable items like paper, food scraps, wood, leaves and grass are entombed. Almost no decomposition occurs. Much of what does occur is anaerobic — without air — and produces pollutants such as methane gas. The organisms that work in anaerobic conditions die off after a short time and the remaining garbage rests unchanging. The University of Arizona’s Garbage Project has done archaeological-style excavation of American landfills and found hot dogs and lettuce leaves 10 and 20 years old that look much as they did when they were dumped into the landfill. In one sense, landfills are working too well, and they have been doing so for

decades, preventing decomposition of biodegradable things.

Lack of air and water are not the only reasons why little decomposition goes on in a landfill. Things like plastics will not break down in any reasonable amount of time, even in the presence of air and water.

Landfills tie up resources — the materials that make up a can or bottle or lawn chair or old toaster. Indirectly, they tie up energy. Making steel from recovered cans and scrap takes about one quarter of the energy required to turn iron ore into new steel cans. Making aluminum from used cans uses only five percent of the energy of making aluminum from bauxite. Sending used materials to landfills rather than to a manufacturer for reprocessing forces us to go on using large amounts of new resources and energy to make new items.

The problem of landfills being a dead end is compounded by the fact that we are also using and discarding more and more all the time. On average, each American is responsible for approximately three and a half pounds of garbage per day. This has risen from about 2.65 pounds per person per day in 1960, and, with our increasing reliance on convenience, shown in packaging and multiple copies of every report, the situation can only get worse.

Recycling

Recycling is our mimicking of the natural process of materials conservation. Since we have invented things nature cannot easily break

down, like plastic and stainless steel, we have had to invent ways of recycling them without nature's help.

New Jersey made recycling mandatory in 1987 with the passage of the *Statewide Source Separation and Recycling Act* (N.J.S.A. 13:1E-99.11 et seq.). Although we have come a long way, by 1999 the state was still below the 60 percent recycling level that an amendment to the Act required us to meet by December 31, 1995.

A look at plastic will illustrate both recycling's progress and its problems. Plastic has become a symbol of all that is not environmental, since everyone knows that the plastic items in our homes will long outlast us. But plastic's advantage is that it is a lighter and often more versatile packaging material than metal, glass or paper. It preserves freshness, whether of yogurt or a saw blade. Plastic provides a convenience we have come to depend upon.

The basic building blocks of plastic are monomers, small molecules isolated from petroleum or natural gas products. Monomers can be used to form different polymers, or plastic resins. The resulting plastic has different properties, depending on how the molecules are arranged.

Polyethylene terephthalate, more commonly known as PET or #1 plastic, can be made clear for liquids such as soda. High-density polyethylene (HDPE or #2 plastic) can be made cloudy to protect milk from light or can be made colored, for detergents, and can be formed into a handled container, unlike traditional PET. Polystyrene (PS or #6), can be made foamed (Styrofoam) or



BARBARA PRETZ

into clear but somewhat brittle containers. Low-density polyethylene (LDPE or #4) makes good plastic film, like plastic shopping bags or clear plastic food wrap.

If six or seven basic types of plastic were not enough to complicate things, the way any plastic resin is processed into an item can give it different properties. Milk and soda bottles are blow-molded: the resin is pushed out like a balloon and shaped. Cottage cheese or yogurt containers are injection molded: plastic resin is fitted around a mold. Two plastic containers bearing the same number but made by different processes will react differently upon being chipped up or melted.

Still another complication to plastic recycling is in the form of mixed materials. Plastic is used to coat the outside of paper milk cartons, and is used as one of the components of juice boxes (aseptic containers), along with paper and aluminum. Soda bottles made of PET have another type of plastic in their bottle caps. All these mixtures present problems of separating plastics one from the other, or from other materials.

A plastics reprocessor often handles only one kind of plastic, e.g. blow-molded PET, remelting it. Any plastic that is not of the same type constitutes a form of contamination. For instance, if a clear #3 bottle (polyvinyl chloride) is in a batch of PET, the #3 plastic will melt, turn into black fragments, and give off hydrochloric acid before the PET melts. Just one bottle in 20,000 ruins the batch of PET, and can damage the reprocessing machinery.

Technology has solved some of the problems. PET soda bottles have been redesigned to be a bit thicker and achieve stability with five rounded pressure points on the bottom, eliminating the need for a base cup of HDPE. New machinery for PET bottle reprocessors will detect "contamination" in the form of #3 plastic.

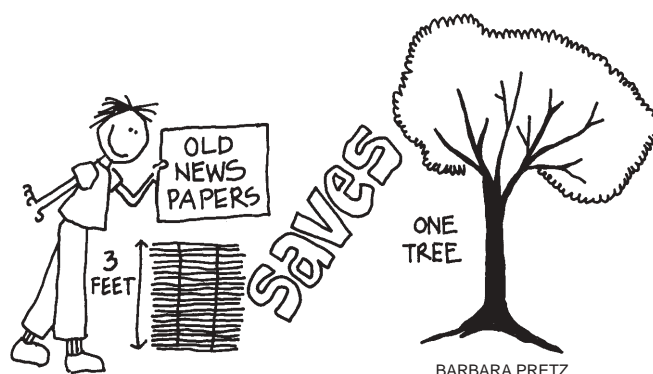
Indirect technological support for recycling has come from manufacturers switching to use of either #1 or #2 plastic from another number. This helps add to the volume of recyclable #1

and #2 items, assuring reprocessors a bigger supply. The demand for #1 and #2 plastics has grown over the past years. They can be refashioned both into new containers and many other articles, like rugs, shirts and plastic wood.

Technology will continue to solve more problems, both with plastics recycling and other recycling. But contamination from different materials is not the only problem with recycling. There are problems with individuals putting out the items for recycling. People may be too lazy to recycle, or to learn what new items they can recycle. Or they may assume that they should recycle everything, including things not accepted in their local program, things for which there are as yet no markets. Such items contaminate a whole batch of recycling. This is not an easy point to make. People feel virtuous about recycling and find it hard to resist recycling anything with a recycling symbol, even if the material is not locally accepted.

Some materials, like polystyrene, #6 plastic (most often seen as Styrofoam) may not be cost-effective to recycle, at least in the conventional way. To get a marketable load of Styrofoam would take a relatively long period of time, and a large volume equals a small weight, so transportation costs may exceed the return.

While recycling consumes fewer resources and less energy than the original manufacturing process, reprocessing still contributes to the build up of greenhouse gases and global warming. Recycling, while being a nice feel-good way of conserving materials, cannot be considered a full solution.



REDUCE/REUSE

Source reduction incorporates the best forms of materials conservation — the other two “R’s” — reduce and reuse. Reducing and reusing mean less garbage — and even, in some cases, fewer recyclable materials. You can reduce the number of plastic bags you throw out by packing lunch items in reusable containers. Using cloth towels instead of paper, you discard fewer paper towels.

The computer was supposed to create a paperless society, but, along with the photocopying machine, often produces more paper copies. Paper is still a major component of our landfills. Reducing paper consumption might involve changing the habit of printing out everything to edit or making multiple copies. It might also involve using both sides of paper, and finding uses for outdated stationery and rolls of printing paper too small for commercial use.

Buying things that will last, even if they cost more initially, is also a way to reduce what gets thrown away. Customers should demand that things be more durable. Getting things repaired is another form of source reduction. Electronics service personnel can advise whether to repair an older stereo component rather than discarding and replacing it.

Choosing products with as little packaging as possible and encouraging manufacturers to reduce or reuse packaging is also important.

Finding ways things can be reused at home or by neighborhood organizations and businesses keeps them out of the waste stream. Backyard composting removes pounds and pounds of banana peels and lettuce cores and provides free fertilizer for the garden, shrubs or lawn. A store that offers a packing and mailing service may welcome usable packing materials, such as Styrofoam peanuts. Schools might appreciate a variety of discards or old equipment. Local charities may want used clothing, toys or furniture. Newark decided that matching potential donors of used items with recipients was important enough to publish a whole guide.

Matching Discards To Those Who Can Use Them

In 1995, the City of Newark distributed a booklet called “Second Chances: The Planet Newark Guide to Donating Unwanted Goods.” The booklet was designed to help individuals and businesses to match goods that they did not need to organizations and schools that could use them. The booklet lists items in an index that goes from Appliances to Videocassettes. For each item, all the organizations that might accept them are listed, with details on whether pickup is possible, when items could be dropped off, and information for contacting the organization.

“Newark believes it can help reduce the amount of trash generated here by getting usable items that one person might throw away into the hands of those who would consider these items valuable resources,” said Mayor Sharpe James. “People are always disposing of clothing they outgrew, furniture that’s getting a little worn, and toys the kids don’t play with any more. As long as they’re still usable, the landfill is the last place we would want to put these items.”

The problems with source reduction are problems of making it happen. We have built reliance on convenience into our schedules and our living and work spaces.

One beauty of source reduction, from the municipal official’s standpoint, is that it relies on labor of the homeowner or business owner, which the town does not have to pay for. Convincing the homeowner or businessperson to recycle does require education. Changing people’s habits has been a challenge, but it can be done. To make source reduction work, a municipality must sell the advantages, especially the economic ones. Some municipalities have used unit pricing of garbage disposal — “pay as you throw” — to encourage people to find ways to reduce, reuse and recycle.

In some instances, it does not seem possible to source reduce, at least immediately. For example, all the various brands of over-the-counter medicines are overpackaged. The only way to avoid the excess packaging would be not to buy. The only other recourse may be consumer pressure on the manufacturer or industry. Most products list either the address or telephone of the manufacturer.

Any problems that arise from instituting “three R’s” pale beside the waste of continuing to use raw materials for manufacturing products and packaging and the continued discard of products and packaging. These practices are exhausting Earth’s resources.

Failing to conserve materials costs us money. While both recycling and trashing carry the cost of buying and maintaining trucks and the cost of labor to collect materials, trashing also involves high tipping fees at landfills or incinerators.

Data Gathering

For materials conservation, two different kinds of data gathering are important: the waste audit and a study of possible alternate waste dispositions for materials identified by the waste audit.

A waste audit determines what is actually being disposed of, in what quantity, and how. A waste audit tallies what is trashed and what is recycled. It can be done on an individual level at home or on an institutional or municipal level. Its primary aim is to identify materials that are still being trashed in amounts that would make their removal from the garbage stream cost-effective.

Preliminary statistics on the makeup of the municipal waste stream can be obtained from the county or municipal recycling coordinator, or perhaps local waste haulers. These figures will identify types and amounts of currently recycled materials, the amount of “contamination” — i.e., trash improperly included by individuals with their recycling, and the amount of trash picked up through normal garbage collection. Keep in mind that these figures may or may not include statistics for local businesses, at least some of which may have their own waste contracts and haulers.

A waste audit involves physically sorting trash and recyclables by material. People have many misconceptions about the composition of what we throw away, and only a real encounter with waste can dispel myths. On the municipal level, where you could not go through all the town’s garbage, a visual inspection is useful. You will be able to measure amounts accurately and get a better idea of what you are dealing with. You will also have to visit the area where your town’s recyclables are sorted, or paw through some curbside or other recycling containers to see what overzealous individuals are putting in that is not currently recyclable in your area.

The county recycling coordinator may have results of any waste audits done by local businesses. Otherwise, you may have to obtain this information directly from the businesses. A business that has not previously done waste audits should be reassured that it is not required to sort every bag of trash, merely a representative sample. If you discover that a business has not been providing information for the annual municipal tonnage report, find out whether this is because:

- its recycling hauler is providing this information;
- the business did not understand that it should be providing it;
- the business is not recycling properly.

Waste audits will identify materials to target for increased materials conservation. The results may show that a material like recyclable paper is still being trashed in quantity. Try to determine who is disposing of such materials. Small businesses, for instance, may still not be recycling paper, thinking it will cost them too much. Or perhaps the schools or the municipal complex are not extracting all recyclables from the garbage.

The waste audit will identify materials that show up in the garbage in quantities sufficient to make it practical to find ways of getting them out of the waste stream. Be creative about finding an alternate disposition for these materials. The county or municipal recycling coordinator may

Backyard Composting

Lauren Fischbach, the South Toms River recycling coordinator, had gotten her township recycling program to a point where she no longer felt that it would be cost effective to add new items. South Toms River is a small town of 1,074 homes and businesses. Ms. Fischbach felt certain she could convince people to do backyard composting, especially when she told them how much they would save the town — and ultimately themselves — by doing so. In a backyard composter, the homeowner could process yard waste and vegetative kitchen scraps without any cost to the town. Even chipboard (the gray cardboard in cereal boxes) and paper towels and napkins could be composted.

Ms. Fischbach bought compost bins to give away free to residents. She tested and encouraged commitment to composting by putting each bin owner through a one and a half-hour training program. In the first year, with 26 percent of households participating, Ms. Fischbach was able to document a 172.84-ton reduction at the landfill directly due to the composting. This translated into \$15,500 of savings on tipping fees. Even after subtracting the one-time cost of the bins, the program showed a net saving of about \$4,000. Over time, with expected savings of \$15,000 per year, it will add up. Moreover, distribution of more composters has brought participation up to 31 percent.

Ms. Fischbach sees her composting program as advantageous to residents since they can use the composter to avoid the greater “yuck factor” of saving waste for a week in a plastic bag versus composting, which can quickly take care of any odor problems that occur. Ms. Fischbach recognizes that part of her composting program’s rapid success was due to the size and housing stock of the municipality, but she feels that the program can work in any town. She recommends targeting a neighborhood or area at a time, to give better control and to make tabulating results easier.

have lists of recycling markets, or you can consult the Association of New Jersey Recyclers (ANJR), which has lists of all sorts of traditional and nontraditional materials for recycling.

Recycling markets are not the only solution to investigate. Collect information on source reduction of not-readily-recyclable materials. These opportunities may be harder to discover, except in the area of composting, where factual information is available. Choose options that will save or make money for the town, and sell your options to the community on that basis.

After doing a waste audit and a preliminary survey to determine which materials could be recycled or otherwise removed from the waste stream, conduct a cost analysis for recycling each material. Then you can get everyone focused on the fact that keeping something out of the trash will save money — or perhaps even make money — for the town.

When the waste audit turns up something that is recyclable but being trashed, find out who is not recycling properly and why. With paper as an example, perhaps your collection system requires more effort than people are willing to make. Or they do not dispose of paper in an amount they think makes recycling worthwhile, so they are trashing it.

Calculate how much the town would save in tipping fees if this paper were removed from the trash. Is there a market that would accept the paper without bundling or grade separation? Can containers be provided whose cost will be recouped through savings in tipping fees?

For materials not already being recycled, start with the same cost-savings analysis. Yard waste and organics take up a large portion of the space and weight of garbage. Some New Jersey towns have realized that getting of this material out of the garbage justifies the up-front cost of buying needed equipment. (See box on backyard

composting.) Towns can even choose to designate vegetative kitchen waste as recyclable, and ban it from the trash. If the town does so, it may then either provide a means to recycle that material, or require it to be composted at the point of generation. A municipal recycling program could be coupled with public education about the benefits of point-of-generation/home composting, which would reduce the amount of materials that need to be transported and composted by the municipality.

Are reusable items like children's toys or used clothing ending up in the trash? Find ways to encourage people to donate these to organizations for reuse, as Newark did.

Supermarkets, large industrial plants or the municipal government might follow the example of other large businesses that have reduced and recycled much of their trash. For example, it may be possible to shift the costs of recycling to your suppliers. Rutgers University, which constantly buys new office and dormitory furniture, found that the cost of recycling or disposing of packing materials was considerable. Rutgers' procurement officer rewrote contracts with suppliers, requiring them to recycle these materials. At least one supplier took the situation one better and switched to shipping its furniture in reusable blankets. For creative and already-tested ideas, ask large businesses near you how they are saving money recycling and source reducing.

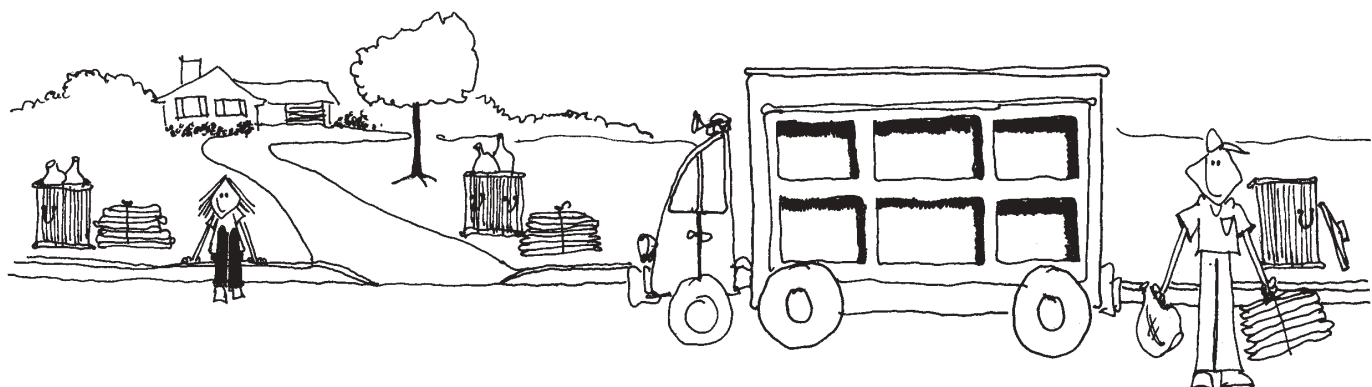
ANJR maintains a database of recycling markets. They can send you a list of the markets in your area for the materials you seek to recycle. Most

county coordinators also keep lists of markets. Almost everyone agrees that recycling and other forms of materials conservation are good for the environment, but at the municipal level and in the individual home or business, what sells materials conservation is the bottom line — money. Show that equipment and operating expenses are recouped quickly and consistently.

STATE LAW

The *New Jersey Statewide Mandatory Source Separation and Recycling Act* establishes several tiers of responsibility for recycling. Each county must formulate and adopt a district recycling plan requiring leaves and at least three other designated materials to be separated from the municipal solid waste stream and recycled. Each municipality, in turn, must adopt a recycling ordinance that incorporates and implements the county plan. The municipality may use its ordinance to require the recycling within its borders of more than just the materials designated by the county for recycling.

A district plan may establish a countywide system for collecting recyclables and transferring them to market, or it may make the individual municipality responsible for recycling the designated materials. In Mercer County, with only 13 municipalities and a mostly suburban character, the county and the towns agreed that a countywide curbside collection system would be most efficient and cost effective. In Bergen County, with its 70 municipalities and denser population centers, the



BARBARA PRETZ

towns are responsible for their own recycling programs. Likewise, Ocean County towns, which have large population fluctuations between winter and summer, have been glad to have the control over collection schedules that a municipal system affords. Some counties may have their own materials recycling facility, but contract individually with municipalities for its use.

Leaves are the one statutorily mandated material for recycling, but again, the law allows flexibility. The county or individual municipality may collect and compost leaves at an approved site, or the municipality may mandate that leaves be composted on site, i.e., at the point of generation—homes and businesses.

In fact, as the provisions for leaves demonstrate, the ultimate responsibility for recycling is on the generator of solid waste, whether that is the homeowner, school, business or municipal complex. The county or municipality does not itself have to provide the means to recycle any designated material, but it must ascertain that there is a way available to individuals or entities to do so, before requiring that recycling.

Other allies can be found everywhere. Recycling and materials conservation are popular environmental causes that individuals and businesses want to support. Peer pressure can influence the one household on the street that doesn't recycle, or the one grocery store that doesn't have a drop-off bin for recycling plastic shopping bags.

LOCAL ACTION

New Jersey's Recycling Act requires each municipality to designate a recycling coordinator. This person may be a full-time employee of the municipality, a part-time employee or a volunteer. The recycling coordinator carries out most of these functions for the town. The recycling coordinator should always be looking for more ways to save or, when the market is good, make money through materials conservation. Most recycling coordinators will be happy to receive help, especially in recycling education and increasing materials conservation in the municipi-

ality. The governing body must also see that its other recycling obligations under the Act are carried out. These include providing for collection (some counties do all or part of the collection), filing tonnage reports, and publicizing the recycling program at least twice yearly.

Ordinances

Under the Recycling Act, the municipal governing body must pass a recycling ordinance that conforms with an approved county plan and requires waste "generators" to source separate at home or work. Your county recycling coordinator can provide the appropriate model ordinance or guidance on what yours should contain. Make sure that other legal requirements are in place. For example, many multifamily housing developments or businesses are included in municipal curbside collection programs. Make sure planning and zoning ordinances require provision for space for centralized collection containers. NJ DEP or ANJEC can provide a model multifamily recycling ordinance.

Enforcement procedures for recycling under the municipal ordinance must be made clear and convincing to anyone who rejects the economic arguments and refuses to recycle. Use a tiered system of warnings and penalties, so that the first offense will get a warning and the penalties become more severe with each succeeding offense.

Site Plan Review

The *Municipal Land Use Law* (N.J.S.A. 40:55D-2.0 and N.J.S.A. 40:55D-38.b(9)) makes planning and zoning boards responsible "to promote the maximum practicable recovery and recycling of recyclable materials from municipal solid waste through the use of planning practices designed to incorporate the State Recycling Plan goals and to complement municipal recycling programs." They must also assure planning conformity with the municipal recycling ordinance. The planning and zoning boards, in concert with the town engineer, should make sure that all housing developments and businesses are designed with adequate space for recycling containers. Under the Municipal

Land Use Law or a “Clean Builder” ordinance if the municipality has one, planning and zoning boards can place specific recycling and reporting requirements on builders during permitting.

An environmental commission should request information on proposed recycling provisions in each Environmental Impact Statement it requires of a developer. The commission should establish and maintain a good working relationship with the recycling coordinator. The commission can help with community education concerning materials conservation and the economic benefits of recycling.

The municipal utilities authority (MUA) may, when necessary, enforce mandatory recycling requirements. The MUA and the board of health may be called on for professional expertise and help with educating the public about the benefits of materials conservation and the economic benefits of recycling.

“Clean Builders”

New Jersey always has ongoing construction. Building new homes, stores or plants or renovating old ones generates a constant stream of waste construction materials and debris. Construction waste ranges from old windows and hand-hewn oak timbers from the demolition of old buildings to odds and ends of two-by-fours and bits of drywall and concrete left over from new construction.

Technology and new markets have made much construction material recyclable, but that doesn’t guarantee that it will be recycled. A municipality can start a “Clean Builders” program by adopting an ordinance requiring recycling during construction and mandating maintenance of separate containers for various recyclables. When applying for permits, developers or other builders should be given a checklist of what they must recycle (based on what the town has discovered existing markets for) and a recitation of what documentation they must submit. In site plans, the planning board resolution or developer’s agreement should reiterate that the developer must meet the recycling and reporting requirements.

The primary reason for any builder to recycle should be economics. The cost of disposing of construction debris as trash is substantial. Given the potential cost savings, separating materials for recycling is well worth the effort. Builders who have recycled successfully have developed systems of movable bins to store recyclables temporarily while working on one or a few homes within a development. When one section or home is complete, the recycling can be shifted into a larger container for pickup when the container is full.

A developer in Mercer County found that renting a tub grinder to chip cleared trees and other untreated waste wood was hundreds of dollars cheaper than the dumpsters that would be needed for disposal of the same wood. Moreover, chipping provided a free source of mulch for use on the site.

Wood, metal and cardboard can be recycled for great savings compared to the cost of landfilling them. Convincing a builder to recycle is easier if the municipality provides cost savings analyses and names of potential markets. These buyers of recycled materials are also prime sources of information on ways to expand “Clean Builders” programs. Passaic County has a model ordinance and other materials a municipality can use to encourage recycling of construction debris.

Especially with renovation or demolition of a single building, creative ways of encouraging recycling may be needed, since the quantities of material generated may not realize cost savings. The recycling coordinator or environmental commission could team up with the construction code official to produce a list of materials from demolition that could be reused in construction elsewhere, under current construction code requirements. The list would be especially effective if coupled with a list of organizations or individuals willing to accept the used materials. Several historic preservation commissions have set up an antique parts exchange, which enables renovators to locate historically accurate materials for an old house.

For Further Information

Deconstruction: Salvaging Yesterday's Buildings for Tomorrow's Sustainable Communities, Institute for Local Self Reliance, 202-232-4108 or www.ilsr.org

Building Savings: Strategies for Waste Reduction of Debris from Buildings, US EPA, RCRA, 800-424-9346 or www.epa.gov

Economic Incentives

Although most people could tell you how much various residential services like gas and electric and cable television cost them, they are often unaware of what trash disposal costs. The costs, often hidden in the tax bill, include tipping fees, labor and equipment. The person who never recycles and sets out seven bags of garbage pays the same under most municipal schemes as the person who has recycled and reduced his or her trash output to one bag or less.

Some towns have instituted per-unit pricing, where residents pay according to the amount of garbage they throw out. If you dispose of more, you pay more. It's a quick lesson in the fact that garbage disposal costs money, and just how much. It also lets residents realize cost savings

when they reduce their garbage through recycling and conservation.

Unit pricing for garbage only works if a comprehensive recycling program is in effect — to offer legitimate ways to reduce garbage. Good education on source reduction and recycling must support the program. Towns with this system say that they have not had problems with illegal dumping, though they stress the importance of making it clear that illegal dumping laws will be enforced.

Buy Recycled

Wakefern Corporation provides most of the house brands for the Shop Rite Supermarkets in New Jersey and several other states, and does market development for the stores. It asked a number of individual stores to experiment with separating organics from the waste stream. Certified supermarket composters collected the organics, which include many papers. In just eight months, the 16 participating stores diverted more than 1200 tons of garbage from the waste stream to the compost pile.

Wakefern hopes to take one more step and buy the compost back for sale in the Shop Rite stores. Buying recycled is called “closing the loop.” Atlantic County, which accepts yard waste from Mercer and Atlantic Counties, is



BARBARA PRETZ

already selling its finished compost. “Closing the loop” assures that materials collected will always have a market, and that recycling will continue to be economically advantageous.

Some counties and many towns, like Newark, have adopted “Buy Recycled” ordinances for government purchases. For your town to do likewise, research recyclable products that are available for purchase. Both ANJR and NJ DEP provide guides to such products. These guides, along with follow-up calls to suppliers for actual price lists, will help you decide what is feasible for your town. Share this information with the businesses in your town and encourage them also to “buy recycled.”

Spreading the message to individual consumers could encourage local supermarkets and other stores to put up signs and labels highlighting products that have recycled content — from fleece jackets to toilet paper and carpeting.

Education

People need to be educated about what is actually recyclable in their area, but they generally will not read through an entire recycling hand-out or advertisement. Education for adults will be most effective if it includes the economic benefits of something that is also good for the earth. Education for children reaches the adults, too, since children do not hesitate to go home and tell their parents what they should do.

For Further Information

Pay as You Throw, US Environmental Protection Agency (EPA), 1-888-EPA-PAYT

Making Less Garbage: A Planning Guide for Communities, Inform Inc., 212-361-2400 or www.informinc.org

Association of New Jersey Recyclers (ANJR), 908-772-7575 or www.anjr.com

NJ DEP Bureau of Recycling and Planning, 609-984-3438 or www.state.nj.us/dep/dshw/recycle

CHAPTER 12

AIR QUALITY

Air is our most critical resource, and one largely taken for granted. We can live for weeks without food and days without water, but can live for less than five minutes without air. The average human breathes 15,000 quarts of air each day. The exchange of oxygen and carbon dioxide links the plant world and animal world; we are all breathing together, easily, unconsciously, continuously.

The Earth's air, or atmosphere, is a thin band of gas, composed primarily of nitrogen (78 percent) and oxygen (21 percent), that encircles the planet. Although other gases — argon, carbon dioxide, water vapor, ozone — make up only 1 percent of our atmosphere, they have vital functions. Carbon dioxide maintains the Earth's heat balance by absorbing infrared (thermal) radiation, and is critical for photosynthesis. Ozone in the upper atmosphere absorbs harmful ultraviolet radiation.

Water vapor also absorbs infrared radiation, and is the essential ingredient of the hydrologic cycle.

AIR QUALITY

Breathing in, breathing out, it seems so simple. But we feel helpless when a radio or TV announcer informs us that "An air quality alert is in effect today." When air is polluted, it becomes a threat to our health and well being. Air pollution also poses significant economic and environmental hazards.

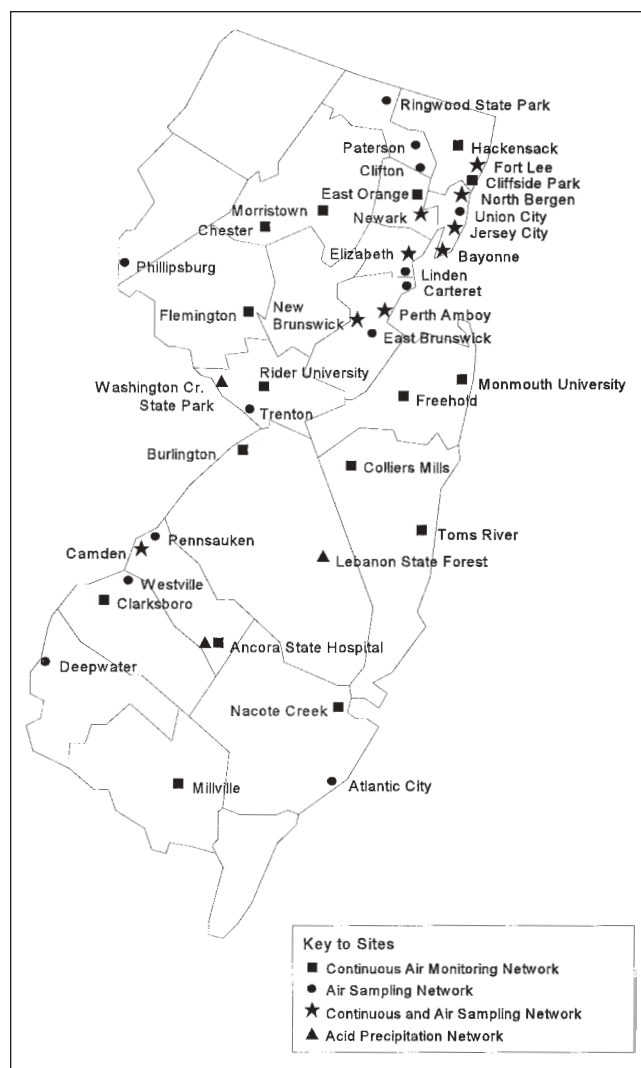
Natural occurrences such as forest fires and volcanic eruptions can produce air that is unsafe to breathe. Growing plants can produce hydro-

carbons, decaying vegetation can give air a foul odor, and in some parts of New Jersey naturally occurring radon gas is a serious indoor air quality concern.

However, most air pollution is manmade and therefore controllable by man. Motor vehicles cause a large proportion of air pollution. The burning of fossil fuels for power generation and for heating is another major source. Industrial processes, spills, leaks, evaporation from chemical or fuel storage tanks, and the use of sprays, solvents and pesticides add additional pollutants and toxics into the air.

Feel more secure indoors? According to one US EPA study, we may breathe up to three times as many carcinogens in our homes and offices as outside. Cigarette smoke and vapors from cleaning products, paints and solvents pollute our indoor air. The modern home, insulated and sealed to retain heat, acts as a trap for such substances. Modern construction materials and interior furnishings also contain many hazardous chemicals, and some emit fumes.

What's the answer? Humans can act to control or diminish some of the manmade threats to clean air. The federal *Clean Air Act* (42 U.S.C. 7401) establishes a system of air quality standards and emission standards. Under the *New Jersey Air Pollution Control Act* (N.J.S.A.26:2C-1), the State enforces the standards by monitoring, issuing permits for many sources of air pollution, prohibiting open burning, regulating the amounts of certain substances in fuels and other consumer products, and establishing motor vehicle emissions testing procedures.



New Jersey Air Monitoring Network

Municipalities have a role to play. Residents and employers can learn to reduce pollution in the home and workplace. Public education, economic incentives and land use planning can help reduce automobile emissions by reducing reliance on automobile transportation.

Health Effects

The US EPA rates “outdoor exposure to criteria air pollutants” as the number one environmental risk that Americans face. The “criteria” pollutants are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulates and lead.

Respiratory illnesses such as asthma, emphysema, chronic bronchitis, lung cancer, heart disease, and neurological and behavior disorders have been linked to air pollution. Clinical studies, animal studies, analysis of severe air pollution episodes, and studies of at-risk communities have documented the health effects of air pollution. Air pollution contributes to at least 14,000 premature deaths annually in the United States and costs the nation \$21.4 billion in medical bills and cleaning costs.

In summer months, New Jersey often exceeds the National Ambient Air Quality Standards for ozone, a pollutant generated by combustion engines. High levels of ozone cause shortness of breath, headaches, sore throat, nausea, increased respiratory rate, coughing, chest pains, increased allergic reactions and reddening of the eyes. Extensive medical evidence shows that ozone reduces pulmonary and immunological functions. Ozone also damages forests, reduces crop yields and even degrades manmade materials, including the rubber of the tires on the cars that caused it.

Ozone is a secondary pollutant that forms when nitrogen oxides from tailpipe emissions react with sunlight. Ozone is a regional problem, because the emissions have usually blown from the place where they were produced by the time they have been converted into ozone. Ozone concentrations are highest during long, hot, sunny summer days.

In the past New Jersey also exceeded the standards for carbon monoxide, although lately the state has seen an improvement, with no days exceeding the standards in recent years. Carbon monoxide is a problem in the winter and fall when weather conditions tend to limit the dispersion of pollutants. Carbon monoxide is a deadly, colorless, odorless gas that builds up near traffic trouble spots and in enclosed areas where cars are idling. Eighty-five percent of carbon monoxide pollution comes from cars. Carbon monoxide interferes with the ability of the blood to transport oxygen to the brain, heart and other tissues. In high concentrations it is fatal. In low concentrations it can impair brain functions and

threaten fetal development. People with heart disease, newborns and unborn children are especially vulnerable to carbon monoxide exposure.

Monitoring

The NJ DEP has an air quality monitoring network including 53 locations throughout the state. The Pollutant Standards Index, used to measure air quality, expresses the current level of pollution as a percentage of the federal health standard. A level of 100 or above means the air pollution is at or above the federal health standard. On days when the pollution levels are high, it is advisable not to exercise or engage in heavy work outdoors. Additionally, elders, children and people with respiratory illnesses are advised to remain indoors and avoid strenuous activities.

The Price of Congestion

Our over-reliance on the automobile brings ozone in the spring and summer, carbon monoxide in the fall and winter. These pollutants give new meaning to the seasons. Decades of planning for sprawl development have left most communities overly dependent on cars. Nationally, 50 percent of all personal and shopping trips and 22 percent of work trips are less than one mile; 87 percent of personal and shopping trips and 56 percent of work trips are less than four miles. These distances are easily covered by bicycle or on foot. Short trips are disproportionately polluting, because cars run much less efficiently (i.e., don't fully combust the pollutants) for the first three to five miles.

Traffic congestion robs us of quality of life. In small downtowns it also robs the merchants of business. A study of towns with increased facilities for pedestrians found that, in addition to reducing air pollution and accidents, the improvements also increased retail sales.

Congestion and traffic also contribute to a breakdown in the sense of community by reducing opportunities for people to interact. People passing on foot can stop and talk. These unplanned encounters contribute to a sense of belonging in a community.

Asthma Survey

The Belvidere (Warren) Environmental Commission (BEC) faced issues of an electric utility seeking a plant expansion, a manufacturing facility fined for violating air quality standards and a suspected higher than average asthma rate in the community. The BEC realized the value of establishing a baseline of respiratory health conditions in Belvidere and conducted a health survey. They recommended that future surveys also be a function of the commission. The survey requested information on each household member, including age, gender, number of years living in town, and whether a physician had diagnosed and treated any respiratory ailments, including asthma, chronic bronchitis, emphysema, lung cancer or any other cancer.

Survey results indicated that asthma cases of residents of all ages were 14.9 percent of the surveyed population, compared to projected asthma cases in the United States for all ages of 5.8 percent to 7.2 percent, and 5.3 percent to 6.75 percent in New Jersey. The survey revealed a 21 percent asthma rate for children under 18 years, compared to an estimated asthma rate in the United States for this age group of 6.6 percent to 7.3 percent.

The BEC recognized that this survey does not show a cause and effect relationship for the elevated levels of asthma. However, it is significant that the entire Town of Belvidere is within a NJ DEP Bureau of Air Monitoring non-attainment area for sulfur dioxide, a respiratory irritant.

Making our communities less dependent on cars will require changes in land use planning, zoning, transportation planning and allocations, and public perceptions. These changes can be made in small steps that will make communities safer, more prosperous and more enjoyable places to live, work and shop.

LOCAL ACTION

Municipalities can incorporate into their master plans and zoning ordinances techniques to reduce automobile air pollution:

- land use planning that incorporates mixed use zoning, increases zoning density in centers and clustering, and discourages sprawl development;
- increasing access to existing mass transit;
- preferential parking for carpools;
- linking employment centers to transit stations with dedicated shuttle buses;
- improving and increasing facilities for bicycling and walking.

Master Plan

The municipal master plan usually includes a circulation element that deals with current and projected traffic development. Incorporating local transportation planning into the master plan helps to minimize increases in air pollution from additional traffic generated by new development. Techniques include:

- creating a high-density mixed-use zone, especially around mass transit stations, allowing infill development and encouraging brown-fields redevelopment;
- designating outlying areas that are not desirable for new development;
- creating bicycle and pedestrian connections between new or existing land uses;
- encouraging the use of carpools and public transportation by limiting parking;
- allowing pedestrian crossings over and on major roads;
- reducing curb cuts;
- eliminating future strip malls unless they are in a center of some kind;
- eliminating free-standing office parks; offices should be a part of a cluster.

Zoning Ordinances

The governing body can pass zoning ordinances to implement the land use goals of the master plan. Mixed-use zoning, high-density cluster developments, and parking ordinances are tools that can help improve air quality and reduce traffic. Although municipalities have often used zoning to keep industrial and residential areas separate, zoning ordinances can help to integrate residential areas, shopping and business developments so fewer and shorter automobile trips are necessary. Mixed-use zoning that allows both housing and commercial uses helps prevent the car-dependent “condo in the cornfield” type of development.

Zoning ordinances can encourage increased density in centers designated in the master plan. In a center, development is concentrated to help make mass transit more cost-effective, reduce traffic and avoid the cost of extending sewer lines and other utilities. The State Development and Redevelopment Plan encourages this type of development. A town can pass special ordinances applying to only this designated core, such as



BARBARA PRETZ

allowing increased density and mixed use. It also can reduce automobile parking within this core area to give priority to alternative modes — walking, mass transit and bicycling.

Modern zoning usually requires adequate parking by setting a minimum number of parking spaces per square feet of commercial building space or anticipated residents. The parking ordinance can support clean air efforts by requiring a minimum number of parking spaces for bicycles and a maximum number of parking spaces for cars. The ordinance may also require priority parking locations for carpools. Measures to reduce trips by restricting parking need to be part of a comprehensive plan that provides convenient alternatives so that people don't simply park in other areas.

Other Ordinances

Idling ordinance. New Jersey has a statute (N.J.S.A. 39.3-70.2, N.J.A.C. 7:27-15.8) that prohibits motor vehicle idling for more than three consecutive minutes, with certain exceptions. A local idling ordinance cannot have standards more stringent than the State's, but an ordinance may make it easier for local police to enforce the State standard. A town should notify warehouses, convenience stores and other businesses of the idling ordinance, and post signs at these locations to alert drivers to the restrictions and the penalties involved.

Transportation impact study ordinance. A town may require a developer to complete a transportation impact study as part of the development application to evaluate the effect of a proposed development on local traffic. To be sure the study is not biased toward the developer, the town may furnish a list of firms from which the developer may choose, or may require the developer to contribute funds into an escrow account, which the town can use to hire its own traffic consultant.

Tree ordinance. As natural allies in the fight against air pollution, trees deserve special protection. Trees contribute to local air quality by releasing oxygen, filtering pollutants out of the

air, and creating shade in the summer to reduce the need for air conditioning. Ordinances can require developers to replace trees that the new development destroys, to maintain existing trees where possible, and to plant one tree for each specified number of parking spaces. For more information, see Chapter 6 on Tree Protection.

Bike Plan ordinance. Lumberton (Burlington) requires bicycle paths as a form of linkage between adjoining residential developments, between schools and residential neighborhoods, and between shopping areas and surrounding streets to expand the circulation opportunities for both pedestrians and bicyclists. The ordinance requires a contribution to a bikeway fund if a bike path is deemed inappropriate for a particular development. A copy of the Township Bike Circulation Map is included in the ordinance.

Site Plan Review

The planning board and zoning board can work with developers to make sure their proposals conform to the clean air objectives of the town. A town can enact ordinances to implement these objectives and allocate capital improvement funds for them if they are included in the master plan. Some specific objectives could include:

- developing incentives for increasing density in a designated core area;
- providing safe pedestrian and bicycle access to all public schools and transit stops;
- providing bicycle parking at all major shopping areas;
- creating parking lot linkages;
- linking existing facilities with sidewalks and bike routes;
- avoiding long cul de sacs, which force cars to double back in order to go to any destination;
- encouraging an on-site convenience store in large condominium developments that are beyond walking and bicycling distance of shopping areas, to reduce the trips made by residents.

Bicycle and Pedestrian Committee

A citizen advisory committee that works with municipal officials and boards, the traffic engineer and the police department can help a town become bicycle and pedestrian accessible. The committee may originate with the environmental commission or another interested group. It should involve a variety of citizens who will use the pedestrian and bicycle system, such as senior citizens, high school students and merchants. Bicycle and pedestrian facilities designed without advice from the users often remain unused.

The bicycle and pedestrian advisory committee should review proposed developments and transportation improvements to evaluate their impact on bicycling and walking. The committee may also sponsor educational and promotional events in the community, publish maps of bike-friendly roads, and encourage local employers to promote bicycling and walking.

A key task of the committee is to develop a municipal bicycle and pedestrian plan — a long-range plan (10-20 years) to make a town bicycle and pedestrian friendly. Ideally, it will be adopted as part of the municipal master plan. This official status helps assure that other planned transportation improvements will not adversely affect bicycle and pedestrian access.

The foundation of a municipal bicycle and pedestrian plan is the roadway and sidewalk inventory. The advisory committee then uses the inventory to identify areas that are bicycle and pedestrian friendly and to prioritize areas that need improvements. Important areas to provide access to include schools, transit stops, recreational facilities, public facilities such as the post office and library, and the downtown business center. A road inventory should record sidewalk conditions, gaps in the sidewalk system, and existing crosswalks. It should also make note of cuts-through and paths that are usable by bicyclists and pedestrians but not by cars. These paths are often found at the end of dead-end streets, near parks and in the vicinity of schools.

Bicycle and Pedestrian Safety

In Chatham Township and Madison, (Morris) a one-mile section of the Shunpike, previously four lanes, was restriped to two lanes, with a shared left turn lane, and wide shoulders. The improvement helped residents who previously complained that they could not safely open their mailboxes due to the proximity of high-speed traffic. The change also provided safer access to a large and popular playground and made it possible, for the first time, for residents of a condo development to walk and bicycle safely to the nearby shopping center. The backers of this project were able to overcome the initial resistance by agreeing to a trial period of one year. The improvement became permanent once the project showed it could work.

A Morris County group called B.I.K.E., Inc., created a road inventory of Southeast Morris County by bicycling every road in every town. Their system rated roads in three categories: “not recommended for riding,” “ride with caution” and “bicycle-friendly.” The bicycle-friendly roads generally had low speed limits, wide lane widths, good shoulder conditions, and simple traffic patterns. Roads not recommended for riding had high speeds, short sight distances, complex traffic patterns and bad surface conditions.

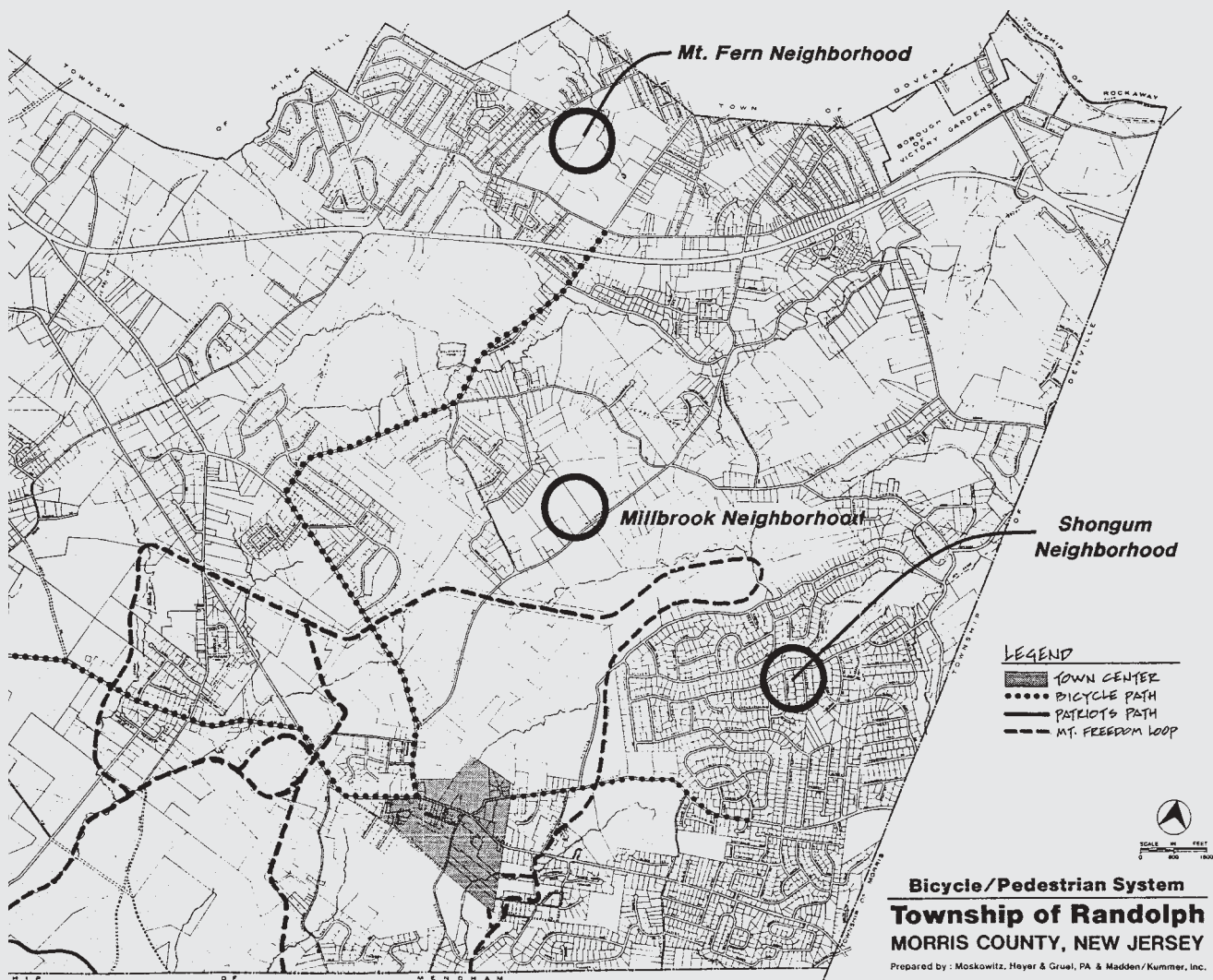
When a committee completes a road inventory, both routes and gaps become apparent. Road and sidewalk inventories are useful planning tools to designate certain areas as bicycle and pedestrian zones. In these areas, transportation planning can favor bicycling and walking and discourage the use of automobiles. The inventories will help the committee select the areas with the greatest potential for improvements.

Making simple, high-impact improvements early can help increase interest and support for the bicycle and pedestrian plan. A good strategy is to inaugurate the plan with a project that is a guaranteed success. Examples include linking existing bicycle facilities, closing gaps in the sidewalk system near popular facilities, and installing

Randolph Bikeway Plan

Like many New Jersey towns, Randolph (Morris) has suffered from an increase in traffic and congestion in the past 20 years. In response, Randolph developed the Randolph Bikeway Plan, which states, “For many years, the Randolph Town Council has been concerned about increasing congestion and traffic flow both in and through the Township. The solution to these problems appears to rest with an integrated approach to transportation planning.” Integrated transportation planning does not rely on a single strategy but combines zoning changes and increases in density with improvement of alternative facilities. When revising its comprehensive master plan, Randolph considered development of a new town center, designed to be a “pedestrian village” where residents will be able easily to shop on foot, and where increased density will allow for greater use of mass transit.

Since most residents will still live outside this center, another master plan goal was to develop a bikeway plan with its hub at the new town center. In 1999 the Township started revising its bikeway plan. The new goals of the plan are to provide off-road facilities through existing municipal and county parks and open space. The open space is becoming the backbone to a unique trail system that is connecting the largest parks in town, large neighborhoods, community facilities, the village center and the schools.



secure and convenient bicycle parking. Special one-time events can also help stimulate interest.

Parent-Teacher Associations are allies to work with on pedestrian and bicycle safety. PTAs can educate parents about air pollution and the direct connection between air pollution and short automobile trips. They can organize walk-to-school groups of children, escorted by parents if need be, and promote pedestrian safety and traffic calming measures such as striping or texturing crosswalks in the vicinity of schools.

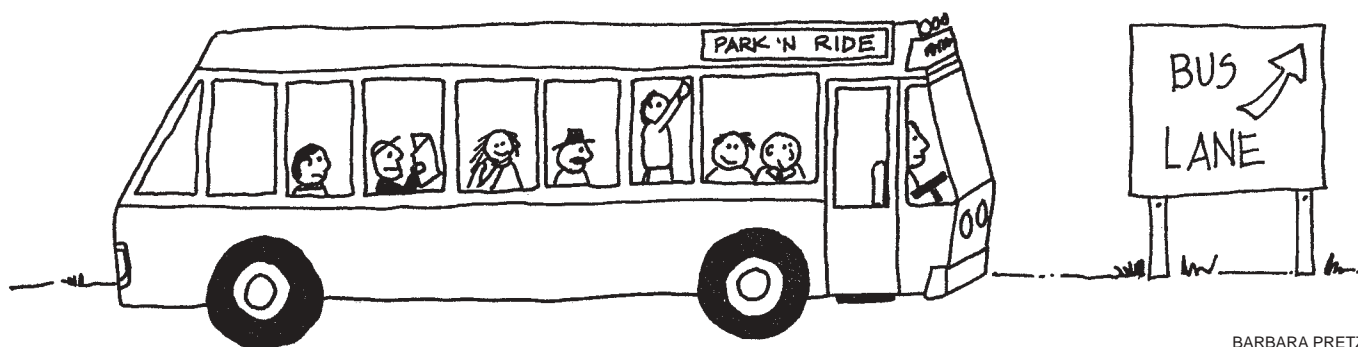
Traffic Calming

Traffic calming means intentionally reducing the speed and dominance of motor vehicles in order to put pedestrians and bicyclists on equal ground with vehicular traffic. European communities use a variety of engineering techniques to achieve this goal in selected areas. Traffic calming may provide the “fringe benefit” of improving the flow of traffic, thus reducing pollution caused by vehicles waiting in traffic. A study of the effects of traffic calming in a variety of German communities found a 16 percent decrease in traffic crash costs, accompanied by decreases in air pollution, noise levels and fuel use. At the same time, traffic flow actually improved.

Traffic calming is most effective when used in a specific zone or area. Applying traffic calming techniques to a single street tends simply to move the traffic, accidents and pollution to an adjacent street. Traffic calming may be appropriate in residential areas around schools, core areas, and central business districts. Traffic calming devices provide visual and physical

reinforcement of the rights of pedestrians and bicyclists to use the roadways safely. Some examples of traffic calming include:

- **Speed tables** — These are flat-topped speed bumps that may also function as raised crosswalks. This is a direct way of enforcing New Jersey’s “Yield to Pedestrians” law. Speed tables are effective near transit stations and pedestrian malls.
- **Textured surfaces** — Using different colored and textured pavers to denote sidewalks and crosswalks can help improve pedestrian safety, especially within parking lots and where sidewalks cross the driveways of shopping centers. Textured surfaces, sometimes called rumble strips, installed before busy intersections, alert drivers to slow down.
- **Road closures** — This technique involves creating a cul-de-sac or dead end, and is generally used in residential areas to eliminate through-traffic. These closures should provide a “cycle slip” so that bicyclists and pedestrians can pass through freely. Municipalities should be judicious in their use of cul-de-sacs because they may increase substantially the miles vehicles must travel.
- **Reduced road widths** — Narrower roads will lower motor vehicle speeds. Techniques to reduce road widths include extending curbs into the roadway, creating islands that also provide a refuge for bicyclists and pedestrians crossing major roads, and forcing the road to meander by installing physical objects such as planters.



BARBARA PRETZ

Some traffic calming can be achieved with temporary measures, such as placing traffic cones with flags in crosswalks to alert drivers to the rights of pedestrians, or installing temporary speed bumps. Temporary measures can help overcome resistance as people get used to the idea of traffic calming.

Access to Mass Transit

Improving access to mass transit stations is another way to help improve local air quality. Continuous sidewalks within a mile radius of the train station, well marked crosswalks, good lighting and restrooms are important to encourage walking to transit. Intersections in the immediate vicinity of transit stops should be evaluated for bicycle and pedestrian accessibility.

Secure bicycle parking is important at transit stations, as bicycles are left unattended for long periods of time. Bicycle lockers that protect bicycles from weather, vandals and theft are ideal for this location. In addition to regular bike racks, the railroad station in Princeton Junction (Mercer) has 60 bike lockers, the largest locker bank of its kind in the nation. The local parking authority leases out the lockers on a yearly basis for \$12 each, and there is a substantial waiting list.

Parking Space Equivalents. Shuttle buses, bike racks, reserved spaces at mass transit parking areas for car pool users, and transit passes are examples of parking space equivalents. They serve the function of a parking space — to bring people to the parking space location — but without the car.

When faced with the costs and impacts of increasing parking in the downtown area, the Chamber of Commerce of Boulder, Colorado used this approach. With the help of Go Boulder, the local transportation management association, the Chamber developed a multifaceted program to increase access to the downtown without increasing the number of parking spaces and cars. Deciding that the most important function of parking was to attract customers to the downtown, the Chamber worked with the local transit authority to

provide low-cost transit passes to employees of downtown businesses. They also arranged to provide free transit use to local university students as part of their tuition, and expanded bicycle parking. As a result, existing parking spaces became more available. This program costs less than building additional parking and helped to reduce traffic problems.

Ride sharing. We know that carpooling can reduce congestion and air pollution. It can also reduce the need to expand transit parking lots, many of which are near capacity. Building more parking is expensive, and because a disproportionate amount of pollutants are emitted during the first few moments after ignition — the typical length of a ride to the transit stop — commuters driving individual cars to the commuter lot may still contribute significantly to air pollution. Encourage residents to carpool to the train station or commuter lot, or lobby for local jitney service.

The NJ Department of Transportation, through the regional Transportation Management Associations (TMAs), encourages employers to participate in the voluntary “Smart Moves for Business Program” (formerly the mandatory “Employee Trip Reduction Program” based on requirements of the *Clean Air Act*). This program assists employers in finding ways to reduce the number of car trips its employees make to their facilities. Employers can utilize a variety of strategies including ridesharing, vanpooling, transit service promotion, employer-sponsored shuttles, telecommuting, preferential carpool parking, flextime, guaranteed ride home, and financial incentives. The TMAs have computer software that helps to pair drivers with riders and destinations.

Municipal Purchasing Power

Municipalities can make energy-efficient choices when purchasing vehicles or constructing municipal buildings. Across the county, cities are purchasing low emission vehicles or alternative fuel vehicles for their transit and paratransit systems. If low emission vehicles are not avail-

able, fuel efficiency still should be a priority in purchasing public works trucks and police cars.

“Green building” is a concept that municipalities can use in all their buildings. Structures can be designed and well insulated to reduce heat and cooling needs. Upgrading light fixtures to energy-efficient ones will pay for itself in reduced energy costs. Solar power can be explored for use on all municipal buildings.

With energy deregulation, energy consumers can choose their power source. The immediate objective of deregulation is to open up the market to competition and thus lower prices. Buying the cheapest electric power will, in most cases, mean buying the dirtiest power — from older coal plants.

New Jersey law requires each electricity supplier to disclose to retail customers the air emissions associated with the generation of the electricity they purchase. Additionally, the Act requires the supplier to disclose the types of fuels used to generate the electricity: dirty coal, clean coal, oil, natural gas, nuclear, solar, wind, geothermal or another source.

Municipalities can provide information to their residents on available cleaner or renewable (“green”) energy sources, and encourage residents and businesses, as well as the municipal government to select an energy supplier based on environmental efficiency, not just cost.

Public Education

Municipalities can educate their residents on local air quality problems and proposed solutions. Boards of health can gather and disseminate information on local trends in respiratory illness. Town newsletters can encourage walking, biking, carpooling and public transportation, and the use of solar panels, energy-efficient appliances, and electric or battery-powered yard equipment. The local government also can provide radon-testing units to residents and facilitate proper removal of asbestos from older homes through public education.

Environmental advocacy groups may be able to help you locate health and air quality information. They may also have volunteers willing to work locally on projects to improve air quality. The Tri-State Transportation Campaign is a regional alliance of public interest, transit advocacy, planning and environmental organizations dedicated to reforming transportation policy to promote environmental health and sustainability in the NJ/N/CT region.

For Further Information

Funding Bicycle and Pedestrian Projects in New Jersey; A Guide for Citizens, Cities and Towns, Tri-State Transportation Campaign, 1999. 609-396-2923 or www.tstc.org

American Lung Association, New Jersey Chapter, 908-687-9340 or www.lungusa.org/newjersey

NJDOT/Smart Moves for Business at 609-530-5947 or www.state.nj.us/njcommuter

NJDOT Ridesharing Assistance System, 800-245-POOL

NJ DEP Air Quality Hotline at 800-782-0160, or www.state.nj.us/dep/airmon

Benchmarking Air Emissions of Electric Utility Generators in the U.S., Natural Resources Defense Council, 212-727-2700 or www.nrdc.org

NJ DEP Bureau of Transportation Control, for idling ordinance, 609-530-5342 or www.state.nj.us/transportation

APPENDIX

CONTACT INFORMATION FOR ORGANIZATIONS MENTIONED IN THIS BOOK

Federal Government

EPA Region II
1290 Broadway
New York, NY 10007-1866
212-637-3000
www.epa.gov/region2/

National Wild and Scenic River Program
National Park Service
Mid-Atlantic Regional Office
Division of Park and Resource Planning
200 Chestnut Street, Room 260
Philadelphia, PA 19106
215-597-1582
www.nps.gov/rivers

Natural Resources Conservation Service
(or the 16 district offices in New Jersey)
US Department of Agriculture
1370 Hamilton St.
Somerset, NJ 08873
732-246-1171
www.nrcs.usda.gov

NJ State Government

Delaware and Raritan Canal Commission
PO Box 539
Stockton, NJ 08559
609-397-2000
www.dandrcanal.com

Delaware Estuary Program Coordinator
c/o Delaware River Basin Commission
PO Box 7360
West Trenton, NJ 08628
609-883-9500
www.delep.org

NJ Department of Agriculture
State Agricultural Development Committee
PO Box 330
Trenton, NJ 08625
609-984-2504
www.state.nj.us/agriculture

NJ Department of Environmental Protection
401 E. State Street
PO Box 402
Trenton, NJ 08625-0402
609-777-3373
www.state.nj.us/dep

New Jersey Office of State Planning
33 West State Street
PO Box 204
Trenton, NJ 08625-0204
609-292-7156
www.state.nj.us/osp

New Jersey Pinelands Commission
PO Box 7
New Lisbon, NJ 08064
609-894-7300
www.state.nj.us/pinelands

Rutgers Institute of Marine and Coastal Sciences
71 Dudley Road
New Brunswick, NJ 08901
732-932-6555
www.marine.rutgers.edu/geomorph

Rutgers University Office of Continuing
Professional Education
102 Ryders Lane
New Brunswick, NJ 08901-8591
732-932-9271
www.cook.rutgers.edu

Nonprofit Organizations

Alliance for a Living Ocean
 Barnegat Bay Watch Program
 PO Box 95
 Ship Bottom, NJ 08008
 609-492-0222
www.livingocean.org

American Rivers
 1025 Vermont Ave., NW, Suite 720
 Washington, DC 20005
 202-347-7550
www.americanrivers.org

Association of New Jersey Environmental
 Commissions
 PO Box 157
 Mendham, NJ 07945
 973-539-7547
www.anjec.org

Association of New Jersey Recyclers
 120 Finderne Avenue
 Bridgewater, NJ 08807
 908-772- 7575
www.anjr.com

Center for Watershed Protection
 8391 Main Street
 Ellicott City, MD 21043-4605
 410-461-8323
www.cwp.org

Coast Alliance
 600 Pennsylvania Avenue, SE, Suite 340
 Washington, DC 20003
 202-546-9554
www.coastalliance.org

Delaware Bay Schooner Project
 2800 High Street
 Bivalve, Port Norris, NJ 08349
 856-785-2060
www.ajmeerwald.org

Delaware River Greenway Partnership
 c/o Heritage Conservancy
 85 Old Dublin Pike
 Doylestown, Pa. 18901
 215-345-7020
www.livingplaces.com

Delaware Riverkeeper
 PO Box 326
 Washington Crossing, PA 18977
 215-369-1181
www.delawareriverkeeper.org

Inform, Inc.
 120 Wall Street
 New York, NY 10005
 212-361-2400
www.informinc.org

Isles
 10 Wood Street
 Trenton, NJ 08618
 609-393-5656
www.isles.org

Izaak Walton League of America
 707 Conservation Lane
 Gaithersburg, MD 20878
 800-453-5463
www.iwla.org

The Land Trust Alliance
 1331 H Street, NW
 Suite 400
 Washington, DC 20005
 202-638-4725
www.lta.org

National Arbor Day Foundation
 100 Arbor Avenue
 Nebraska City, NE 68410
 402-474-5655
www.arborday.org

National Recreation and Park Association
 22377 Belmont Ridge Road
 Ashburn, VA 20148-4501
 703-858-0784
www.nrpa.org

National Wildlife Federation
 Backyard Wildlife Habitat Program
 11100 Wildlife Center Drive
 Reston, VA 20190
 800-822-9919
www.nwf.org

Nature Conservancy
New Jersey Field Office
200 Pottersville Road
Chester, NJ 07930
908-879-7262
www.nature.org

New Jersey Conservation Foundation
Bamboo Brook
170 Longview Road
Far Hills, NJ 07931
908-234-1225
www.njconservation.org

NJ Shade Tree Federation
Blake Hall
93 Lipman Drive
New Brunswick, NJ 08901
732-246-3210 or 3219

North American Lakes Management Society
PO Box 5443
Madison, WI 53705
608-233-2836
www.nalms.org

Trust for Public Land
New Jersey Field Office
20 Community Place
Morristown, NJ 07960
973-292-1100
www.tpl.org

New Jersey Audubon Society
PO Box 125
Franklin Lakes, NJ 07417
201-891-2185

Trees NJ
PO Box 583
Bordentown, NJ 08505
609-298-2999
www.treesnj.com

Watershed Institute
31 Titus Mill Road
Pennington, NJ 08534
609-737-3735
www.watershedinstitute.org/addresses.html

Regional Organizations

Camden Urban Gardening Program
3 Riverside Drive
Camden, NJ 08103
856-365-8733

Delaware & Raritan Greenway
1327 Canal Road
Princeton, NJ 08540
609-924-4646
www.delrargreenway.org

Friends of Hopewell Valley Open Space
PO Box 395
Pennington, NJ 08534
609-466-3763
www.princetonol.com

Friends of Princeton Open Space
PO Box 374
Princeton, NJ 08542
609-921-2772
www.hansonhelpers.org

Great Swamp Watershed Association
PO Box 300
New Vernon, NJ 07976
973-966-1900
www.greatswamp.org

Greater Newark Conservancy
303-9 Washington Street
5th Floor-Room 3
Newark, NJ 07102
973-642-4646
www.aircurrents.org

Hackensack Riverkeeper
1000 River Road – TO9OC
Teaneck, NJ 07666
201-692-8440
www.hackensackriverkeeper.org

Hudson Riverkeeper
25 Wing and Wing
Garrison, NY 10524-0130
845-424-4149
www.riverkeeper.org

Monmouth Conservation Foundation
Box 191
Middletown, NJ 07748
732-671-7000
www.monmouthcountyparks.com

Morris Land Conservancy
19 Boonton Ave.
Boonton, NJ 07005
973-541-1010
www.morrislandconservancy.org

Musconetcong Watershed Association
PO Box 113
Asbury, NJ 08802
908-537-7060
www.njave.com/environment/musconetcong/

NY-NJ Baykeeper
Building 18, Sandy Hook
Highlands, NJ 07732
732-291-0176
www.nynjbaykeeper.org

Passaic River Coalition
246 Madisonville Road
Basking Ridge, NJ 07920
908-766-7550
www.passaicriver.org

Paulinskill-Pequest Watershed Association
PO Box 740
Blairstown, NJ 07825
973-383-1406
www.paulinskillpequest.homestead.com

Rancocas Watershed Conservation Foundation
PO Box 4109
Mount Holly, NJ 08060
800-267-6469

Raritan Riverkeeper
PO Box 244
Keasbey, NJ 08832
732-442-6313
www.nynjbaykeeper.org/riverkeeper

South Branch Watershed Association
41 Lilac Drive
Flemington, NJ 08822
908-782-0422
www.eclipse.net/~sbwa/

Stony Brook Millstone Watershed Association
31 Titus Mill Road
Pennington, NJ 08534
609-737-3735
www.thewatershed.org

Upper Raritan Watershed Association
PO Box 273
Gladstone, NJ 07934
908-234-1852
www.urwa.org

Upper Rockaway River Watershed Association,
PO Box 55
Denville, NJ 07834
973-366-0212

South Jersey Land Trust
229 Lake Avenue
Pitman, NJ 08071
609-589-2049
www.sjwatersheds.org

West Windsor Township Greenbelt
271 Clarksville Road
PO Box 38
Princeton Junction, NJ 08550
609-799-2400
www/westwindsornj.org

INDEX

A – B

Active open space	81
Acquisition of land	88-91
Agriculture	81
Algae	50
Air Quality	132-141
Air Pollution Control Act, NJ	132
Aquatic weeds	48-49
Aquifer	5-7
Barnegat Bay Estuary	110-115
Best Management Practices	14
Bicycle safety	137-139
Board of Health	3, 14

C – D

CAFRA, see Coastal Area Facilities Review Act	
Carrying capacity	15
Clean Air Act	132
Clean builders	129
Cluster	40
Coast	97-109
Coastal Area Facilities Review Act	24, 102
Coastal Barrier Resources Act	102
Coastal Zone Management Act	102
Community Forestry Program	61, 62
Composting	126
Delaware Basin Commission	11
Delaware and Raritan Canal Commission	11
Delaware Estuary	111-115
Disaster Relief Act	102

E – G

Easements, conservation	40
Ecotourism	117
Environmental commission	2, 12, 24 27, 28, 31, 95, 130
Environmental Resources	
Inventory	12, 13, 83-84, 94
Estuaries	110-120
Eutrophication	45
Flood Hazard Area Control Act	23
Freshwater Wetlands Protection Act	23, 36, 38, 39
Geophysical provinces	7-8, 71
Governing Body	1, 95
Greenways	27-28, 64, 85
Groundwater	5-19

H – M

Hydrologic cycle	5,6
Lakes	44-55
Landfills	17, 121-122
Limestone	17-18
Lot size averaging	40
Manalapan Decision	73, 75
Municipal Land Use Law	1, 30, 40, 73-75, 88, 94, 114, 129
Municipal Utilities Authority	3

N – P

- National Flood Insurance Act102
- Natural Resources Inventory,
 see Environmental Resources Inventory
- New York/New Jersey Harbor Estuary ...110-115
- New Jersey Pollution Discharge
 Elimination System24
- NJPDES, see New Jersey Pollution Discharge
 Elimination System
- Nonpoint source pollution23, 29-31, 118
- Open space79-96, 116-117
- Open space plan85-86
- Organic chemicals10, 18
- Passive open space79-80
- Pedestrian safety137
- Pinelands Protection Act11
- Planning Board1, 2, 24, 27, 28
- Point source pollution23

R – T

- Recharge12
- Recycling122-128
- Residential Site Improvement Standards ...30-31
- Rivers20-33
- Sedimentation51-52
- Septic systems16-17, 32
- Shade tree commissions62, 63
- Shade Tree and Community Forestry
 Assistance Act63
- Slopes, steep70-78
- Soil Erosion and Sediment Control Act31
- Statewide Mandatory Source Separation
 and Recycling Act127-128
- Stormwater management28-31, 42
- Streams20-33, 118
- Stream corridors26-27, 42
- Surface Water Quality Standards24
- Traffic calming139
- Transfer of development rights40, 88
- Trees42, 55-69
- Tree City, USA61
- Tree harvesting ordinance67
- Tree protection ordinance64
- Tree removal ordinance67

W – Z

- Waste audit125
- Waste reduction124
- Waste, solid121-131
- Wastewater15-16
- Water conservation19
- Water Quality Management Plan24
- Watershed Management24, 46-48, 53, 116
- Wellhead protection12-13
- Wetlands34-43
- Wetlands Act of 197038
- Wetlands plants35
- Wild and Scenic Rivers Act25-26
- Zoning Board of Adjustment2

Acting Locally — Municipal Tools for Environmental Protection
has been printed entirely on recycled paper.