MANASQUAN RIVER WATERSHED MANAGEMENT PLAN

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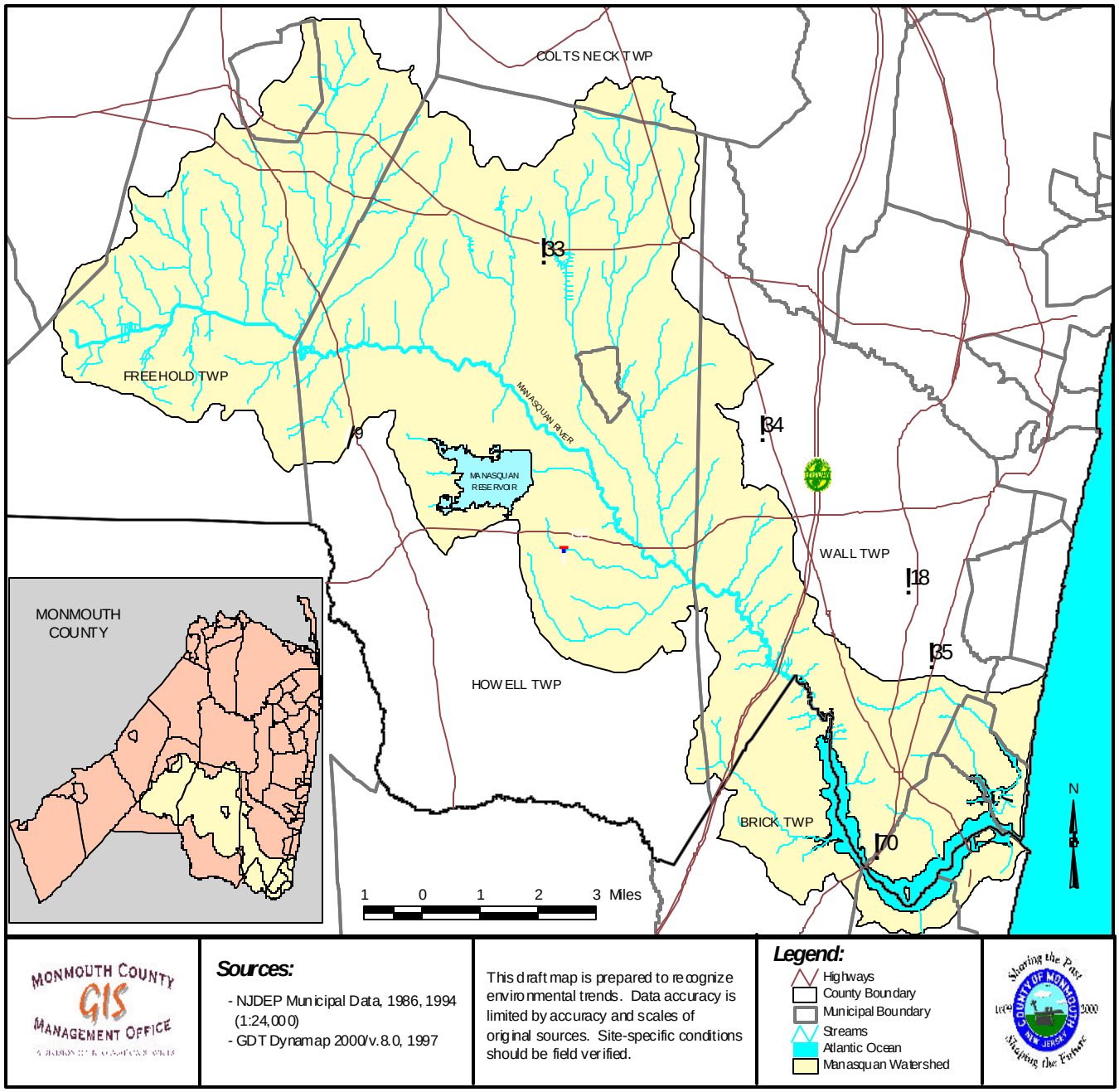
This management plan was produced with the assistance of Monmouth County and NJDEP pursuant to

Manasquan Watershed



MONMOUTH COUNTY GIS MANAGEMENT OFFICE

Sources:

- NJDEP Municipal Data, 1986, 1994 (1:24,000)
- GDT Dynamap 2000/v.8.0, 1997

This draft map is prepared to recognize environmental trends. Data accuracy is limited by accuracy and scales of original sources. Site-specific conditions should be field verified.

Legend:

- Highways
- County Boundary
- Municipal Boundary
- Streams
- Atlantic Ocean
- Manasquan Watershed

Sharing the Past Shaping the Future

Vision Statement

Improve the quality of life for the residents of the Manasquan River Watershed by focusing on aesthetic values and economic opportunities that will restore and protect the region's natural resources, recreational opportunities, and cultural heritage.

Preface

The Manasquan River Watershed Management Plan is an environmental protection plan that will protect and restore the watershed's natural resources for many years. The plan consists of a series of strategies that will protect our drinking water, surface waters, special habitats, and the unique historic character found in the Manasquan watershed. It articulates specific actions that many organizations will pursue to protect the Manasquan River and organize a community that is sensitive to the needs of this great river.

The actions contained in this plan have been developed with assistance from natural resource experts, advocates, and citizens. Since 1998, the Manasquan Watershed Management Group (MWMG) has held numerous public meetings to solicit citizen input in developing the plan. These ongoing meetings have also resulted in improving governmental planning through enhanced communication and coordination. With the advent of watershed management, governmental agencies will no longer plan and implement programs in isolation. Today's limited resources will require us to plan comprehensively and coordinate programs to maximize efficiency. This management plan is the first step towards that goal.

Funding for the development of this plan was provided by the National Oceanic and Atmospheric Administration through the New Jersey Department of Environmental Protection. Their support and leadership led to the development of a characterization report for the Manasquan River watershed that has served as a flagship document for the actions contained in this management plan. The characterization report entitled, Manasquan River Watershed Initial Characterization and Assessment Report, summarized the environmental condition of the watershed and identified the River's most pressing problems so that strategic planning could begin. The MWMG sponsored public brainstorming sessions to discuss actions capable of addressing the problems identified in the characterization report. The result is a management plan that articulates common sense solutions that will improve the overall health of the Manasquan watershed. The management plan contains four chapters that focus on water contamination, habitat loss, drinking water availability, and cultural losses.

This document reflects significant contributions from individuals, community groups, business leaders, and governmental agencies that share a common interest in a healthy environment and a prosperous region. Many thanks go to these participants for their substantial insights and contributions. This plan would not be possible without their ongoing support.

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Participants of the Manasquan Watershed Management Group

The following people have contributed countless hours to the development of this management plan and the advancement of efforts to protect the integrity of the natural resources and local economy in the Manasquan region. These participants are recognized here for their considerable contributions in developing strategies for the improvement and protection of the Manasquan River and its surrounding watershed. They deserve special recognition for developing strategies capable of protecting the Manasquan River for many years into the future.

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Introduction

The Manasquan River watershed is an impressive coastal resource. It supports abundant wildlife and a wealth of aquatic resources in an extremely diverse watershed unique to the mid-Atlantic region. Here, residents and tourists alike enjoy fishing, hunting, boating, sunbathing, and the natural serenity offered by the sea. Tourists from hundreds of miles away spend millions of dollars to bring their families to the shore in hopes of catching summer flounder, boating on the river, or just enjoying seafood in their favorite local restaurant. Conversely, residents look forward to the "off-season" to enjoy brisk early mornings where wildlife and waterfowl abound.

As the area continues to grow, additional stress is being placed on this coastal ecosystem. Growth trends indicate that most communities in the watershed will only see nominal growth since the area is nearly fully developed. However, several towns in the upper watershed will see significant changes. Based on projections from the 1990 Census count, Howell, Wall, and Freehold Townships will experience more than a 30% increase in population by the year 2020. Given the size of these towns, a 30 percent increase in population will significantly affect the Manasquan watershed. Being prepared for these changes will be more important than ever if water quality and resource goals are to be achieved. Historically, growth and development has brought new roads, additional sewers, excessive land consumption, increased demand for drinking water, increased congestion, and demand for increased services such as trash collection, police, fire, and schools. As these coastal communities continue to grow, additional wildlife habitat will be lost, pollutant loadings will increase, aquatic systems will be stressed, and demand for community services will increase. Consequences from these changes will ultimately translate into a less economically viable future and lower quality of life for residents.

Millions of seasonal visitors support the watershed's tourism industry. Recreational attractions like swimming, boating, fishing, and birding are all dependant upon healthy natural resources. Approximately 2,500 boats enjoy safe harbor docking in the Manasquan River which is the northern-most reach of the intracoastal waterway. The Manasquan Inlet is traversed by more than 1500 boats per day on a typical summer weekend. Current vacation trends indicate that tourists are now looking for more unique and memorable vacations. Most popular are vacation packages that include eco-tourism opportunities where families canoe and birdwatch in serene areas to learn about wildlife and unique ecosytems. They also enjoy visiting historic areas featuring native culture and traditions. To meet the needs of the future, providing these services will require preserving open space, enhancing historic sites, and promoting the Manasquan's natural treasures.

The region's diverse cultural essence is found at opposite ends of the river. One is near the mouth of the river where the venerable commercial fishing harbor is still active today. The other is in the upper watershed where farmers have been operating for more than 250 years. Orchards of all types were once prevalent in the watershed and provided fruits and vegetables to major cities. Today's farms contribute to the local economy and help provide the remaining open space and habitat for wildlife. Retaining a strong agricultural land base is important for maintaining a high quality of life for area residents. Farms also demand few services for the amount of land managed, resulting in less community infrastructure costs. These lands will be an important component of tourism trends in the future with tourists wanting to learn more about organic agriculture and desiring locally grown fruits and vegetables.

Although realizing a sustainable vision for the Manasquan watershed is an ongoing challenge, preparing for the future is easier today than ever before. More information is available about tourism trends, growth and development tools, agricultural practices, and aesthetic values. By bringing this information to the forefront, local communities can make better decisions about their future. Since 1998, the Manasquan Watershed Management Group has been fostering consensus on these issues by uniting different segments of the

community to produce the watershed management plan for the Manasquan River.

How to Use the Manasquan Watershed Management Plan

This document will serve as a blueprint for action for public agencies responsible for protecting the natural resources of the Manasquan River watershed. It is also a tool for citizens interested in the programmatic steps necessary to accomplish the goals outlined in the plan. The management plan has been designed for easy access and review. It provides a detailed summary of goals and actions, implementation tables, glossary of terms and acronym list. The introduction and State of the Manasquan River summarize the environmental conditions of the river and problems that should be addressed by the management plan. Other important points of information are provided below to further assist you in your review and understanding of this plan.

Action Plans for the Manasquan Watershed

The Manasquan River Watershed Management Plan contains four Action Plans for the long-term restoration and protection of the Manasquan River: Fishery Management (FM), Habitat Protection (HP), Drinking Water Quantity & Quality (DW), and Cultural Heritage (CH). Each Action Plan contains a goal and a series of actions presented as specific and attainable tasks, summarized both in text and table form. These actions to restore and protect the watershed constitute the MWMG's proposals for managing this vital natural and economic resource.

Specific action statements further characterize issues to be tackled. Solutions are then offered and supported by strategic tasks to be pursued. Summary tables provide pertinent information about who will implement the actions, the schedule for initiating the action, and how much each action will cost. Some actions can be implemented by partner agencies with existing resources while others will require new funds, creative financing, and new partners.

Agencies have identified actions in the table that can be implemented with existing resources by marking them "WER." However, some actions will require additional resources, in which case, the estimated cost is provided when available. Costs and implementation schedules that have yet "to be determined" are marked "TBD" in the summary tables. As implementation begins, participants will continue to identify and refine implementation schedules and costs. It should be noted that the cost information provided does not reflect the total cost of an action, only any supplemental funds needed to complete the overall effort.

An unprecedented number of organizations are involved in the development of this management plan as witnessed by the list of acronyms in the back of the document. Readers will need to familiarize themselves with the acronym list located in the back of the document.

Implementing the Plan

As the management plan is implemented, participants will reevaluate its progress in meeting identified goals. This process provides an opportunity to redirect efforts if new technology, new management approaches, or new discoveries provide insight on current approaches. Through this process, commitments will be reaffirmed and budgets can be planned to accommodate desirable strategies.

Tracking success will be supported by the numerous organizations and individuals involved in the development of the plan. In essence, this document can be called "a living document."

STATE OF THE MANASQUAN RIVER

From the mouth of the Manasquan Inlet, to the upper reaches of this great river in Freehold, wildlife and beauty abound. The Manasquan watershed encompasses approximately 82 square miles and hosts a river that flows for nearly 23 miles to the Atlantic Ocean. It supports numerous rare and threatened plant and animal species, forests and wetlands vital to migratory songbirds and waterfowl, and numerous commercially and recreational important finfish and shellfish species. This region is also experiencing rapid population increases resulting in land use changes that will impact this valuable river. Population projections suggest that several towns in this watershed will experience significant growth over the next 20 years. Based on projections from 1990 Census information, Freehold Township, Howell, and Wall will each experience more than a 30% increase in population by the year 2020. Managing both natural resources and future regional growth simultaneously presents a variety of challenges for this region. To meet these challenges, citizens, local, state and federal agencies, businesses, environmentalists, farmers, foresters, fishermen, boaters, and a host of other stakeholders combined their efforts to develop a management plan for all interests in the Manasquan watershed.

The Environmental Condition of the Manasquan River

Four primary concerns were identified by the Manasquan Watershed Management Group (MWMG) in the Manasquan River watershed: declines in fisheries, habitat loss, water quality and quantity conditions, and loss of cultural resources from development activities. Fecal coliform contamination is the predominant issue threatening the health of the Manasquan River as witnessed by years of shellfish bed closures in the estuary. The loss of natural filtering systems such as forests and open marshes to development has compounded matters for the shellfishery. Finfish are being harmed by water quality degredation and overfishing, and questions about base flows of fresh water necessary for their survival have been raised. These pressures on the fishery have hurt the region's historical dependance on fishing and maritime interests which could affect the unique character and identity of this region.

Fishery Management

Loss of habitat, combined with degraded water quality, has resulted in substantial changes in the watershed's living resources. Water quality degraded by fecal contamination, sedimentation, and chemical contamination has negatively affected the abundance of several fish species and the health of the shellfishery. Degraded water quality has also harmed nursery areas essential for the survival of juvenile fish that are dependant upon these habitats for food and shelter.

The Manasquan River estuary contains approximately 1,500 acres of shellfish beds comprised primarily of hard clams. In 1986, it was estimated that hard clams in the Manasquan River had a potential dockside value of $1.2 million, but the estuary had been closed to shellfishing since 1961 because of fecal contamination to the shellfish. In the early 1980's municipal and industrial point source discharges were eliminated from the River and significant improvements to water quality resulted. These water quality improvements led to the reopening of the beds in 1987 as long as the shellfish were removed

from the estuary and cleansed extensively through depuration or relay programs (30 days). Even though water quality improvements were apparent from point source reductions, fecal contamination problems persisted from stormwater outfalls, malfunctioning septic systems, and high densities of resident waterfowl. These persistent sources again led to the closing of all shellfish beds west of the Route 70 bridge in 1990.

More than 75 species of marine and estuarine fish species can be found in the Manasquan River at some stage of their life. Important marine and estuarine fish species include winter flounder, summer flounder, spot, weakfish, bluefish, striped bass, mummichog, stickleback, bay anchovy, Atlantic silverside, Atlantic menhaden, and American eel. The Manasquan River Estuary, along with the Shark River to the north, consistently yield some of the highest numbers of winter flounder among all of New Jersey's estuaries.

Research has begun to show elevated levels of potentially harmful contaminants in certain marine fish and crabs in some New Jersey waters. Even though the Manasquan is not a source of these contaminants, advisories have been adopted by the State to guide citizens on safe consumption practices. Fish advisories are based on PCB and dioxin contamination which are classified as probable cancer-causing substances. Advisories recommend that the general population not eat bluefish (over 6 lbs.), striped bass, or American eel more than once per week. For the American lobster, it is recommended that the general population should not eat green glands. High risk individuals such as women of child bearing age, pregnant women, nursing mothers, and children under 15 years of age, should not eat bluefish, striped bass, American eel, or the green glands of American lobster.

The Manasquan River supports a diverse assemblage of freshwater fish. Species such as white sucker, yellow perch, brook trout, brown bullhead, brown trout, rainbow trout, golden shiner and largemouth bass depend on the freshwater portions of the Manasquan River. Reports indicate that some limited trout production has occurred in the river, but most of the trout are from stocking programs conducted by the NJ Division of Fish and Wildlife. In 1997, a sea-run brown trout stocking program was initiated in the Manasquan River and since that time more than 50,000 brown trout have been stocked in the river in an effort to create a population of sea-run fish. Annual fish stocking in the Manasquan River includes rainbow trout and sea run brown trout in the estuary portion of the river and brook trout in the freshwater portion of the river.

The fish stocking program was expanded when the Manasquan Reservoir came on-line. The Reservoir was initially stocked with largemouth bass, smallmouth bass, bluegill sunfish, fathead minnows, alewife herring, and black crappie. Since then, annual stocking consists of rainbow trout, brook trout, hybrid striped bass, and tiger muskellunge with channel catfish stocked every other year.

Habitat Loss and Wildlife Impacts

Habitat loss and alteration have significant impacts on the ecology of the Manasquan River. Loss of

habitat directly reduces space, food, and other resources available to support plants, fish, and wildlife. Destruction of certain habitats may have effects disproportionate to their immediate area. This is especially true of wetlands, seagrass beds, and forests because of the important secondary benefits they provide. Destruction of freshwater and estuarine wetlands deprives waterfowl and shorebirds of important foraging and resting areas. Loss of wetlands and marshes also alters hydrologic conditions and decreases the natural ability of these habitats to consume pollutants and filter sediment from surface runoff. Wetlands also have the ability to absorb vast amounts of water making them capable of reducing the impacts of flooding. Beds of seagrass not only provide habitat for many marine species, but also play roles in limiting suspension of sediments, recycling nutrients added to the river, and protecting shorelines from erosion. Destruction of even small areas of forest can fragment remaining forests, reducing their value for birds reliant on interior forest habitats.

The Manasquan watershed has lost significant amounts of forest and wetland habitats since colonial times. Although the rate of loss has slowed considerably in recent years, there is concern that increased development due to projected growth in the watershed may again increase the loss of these important habitats. Although some impacts may be irreversible, natural processes of recovery, such as the regrowth of forests after timber harvesting, regrowth of fallow farmland, and the succession of vegetation in wetlands, have at least partially reduced the environmental consequences of some habitat loss. The time scale for recovery of habitats from disturbance varies tremendously. Recovery of some shoreline grasses may take only a year or two, while recovery of forested wetlands may take many decades. Other habitat losses are essentially permanent. For example, urban neighborhoods built along the river will likely never again be a healthy salt marsh.

Remaining salt marsh wetlands occur along the north bank of the river, along Crabtown Creek and into the Glimmer Glass area in Manasquan, and on the Point Pleasant Beach side between Gull Island and the Route 35 bridge. These wetlands are comprised primarily of salt marsh cordgrass and salt hay (*Spartina*). As the river narrows, tidal marshes are confined to an emergent floodway constrained by very steep upland slopes. Landward edges of the marshes, once dominated by cattail, has been inundated by an exotic common reed known as *Phragmites*. It should be noted that *Phragmites* have little natural resource value for wildlife, but can be effective at controlling erosion. More important species of plants for wildlife such as *Spartina*, sedges, and rushes can be found in smaller quantities. Woody shrubs such as pepperbush and holly rest are found among the predominant species of maple and elm trees. The Manasquan floodplains support an unusually wide range of wildflowers for the region. During the spring season, magnificent blooms of violets, trout lily, wild geranium, Dutchman's breech, ginseng, anemone, marsh marigold, and the very rare green dragon can be found.

The diversity of habitats provide food and shelter for wildlife dependent upon the Manasquan. Freshwater habitats support 44 species of herptiles such as bog turtles, snapping turtles, box turtles, leopard and bull frogs, and northern brown, eastern garter and rough green snakes. Forest habitats support 39 species of mammals including fox, deer, squirrels, raccoons, hares, skunks, rabbits, shrews, moles, and opossums. An incredible 243 species of birds rely on the Manasquan for their survival;

many of them dependant upon the abundant berry producing shrubs found in upland forests. Bird species include tanagers, warblers, waxwings, shrikes, thrushes, kinglets, wrens, nuthatches, titmice, flycatchers, dove, hummingbirds, woodpeckers, owls, hawks, quail, grouse, sandpipers, rails, herons, terns, ducks, geese, loons, and skimmers. Of these wildlife species, 18 are listed as endangered and 17 are listed as threatened by the NJDEP.

Water Supply

Drinking water supplies for the region has been a perplexing problem for many years. Population increases in the region in the 1960's and 1970's strained drinking water supplies and lowered aquifers to dangerous levels. In less than 20 years, aquifer levels dropped 140 feet allowing saltwater to infiltrate into these underground formations and contaminate the region's drinking water. Growing concern about drinking water supplies led to the construction and operation of the 770 acre Manasquan Reservoir System in July 1990. The reservoir is replenished by pumping water from the Manasquan River during periods of high river flow at an intake facility in Wall Township and supplemented by rain events in the 3.2 square mile drainage area surrounding the facility. The reservoir has the capacity to store 4.7 billion gallons of water and can supply a safe yield of 30 million gallons per day even during drought conditions.

The Manasquan Reservoir Water Supply System provides the region with a safe, dependable, and renewable water supply capable of reducing the region's dependence on depleted ground water supplies. The majority of the water from the reservoir is pumped to areas north of the Manasquan watershed, so most Manasquan watershed residents are still dependent upon ground water sources for their water supply needs. It is estimated that Manasquan watershed residents draw less than 2 million gallons per day from the reservoir and pump approximately 10.8 million gallons per day from ground water sources. A recent study indicates that these ground water withdrawals exceed recharge needs and creates a ground water deficit of nearly 2 million gallons per day.

Ground water sources for Manasquan residents, municipalities, and public purveyors are drawn from the confined, artesian portion of the Englishtown and Raritan-Magothy formations, and the Kirkwood-Cohansey aquifer system. The Englishtown aquifer ranges in depth from the surface, where exposed, to about 1,500 feet below sea level. It is approximately 100 feet thick in the vicinity of the Manasquan River watershed and has a recharge area of about 50 square miles. The Kirkwood-Cohansey aquifer ranges in thickness from a few feet to almost 80 feet. In the eastern portion of the Manasquan basin, the base of the aquifer approaches sea level and may be hydraulically connected with saltwater near the estuary and along the coastline. Water levels in this formation range from near or slightly above the ground surface to 20 feet below ground, and water recharge is expected to be high due to the perviousness of the Upper Kirkwood. However, recent study indicates that current withdrawals from the Kirkwood-Cohansey aquifer system have lowered water-table levels and caused reductions in base stream flow in Toms River, Metedeconk River, and Kettle Creek basins. This could be damaging to those riverine and estuarine ecosystems because these natural systems require a certain level of

freshwater to support many aquatic organisms.

Cultural Impacts

The Manasaquan River watershed is rich in history and cultural diversity. The area was first settled by the Paleo-Indians about 11,000 years ago or 9,000 B.C. in an area just south of Squankum Yellowbrook Road in Howell Township. This is one of the oldest settlement areas located in eastern North America. At that time, the watershed included grasslands and marshy areas with grazing mammoths, musk oxen, and caribou.

Thousands of years later, the Lenape Indians discovered the endless resources of the Manasquan watershed. During summer months, the Lenape would migrate to the shore from the Delaware River Valley and northern New Jersey to fish, farm, and barter with Dutch settlers and other Indians. The Lenape would gather mollusks and other marine delicacies to be dried and smoked for winter use. They also farmed in the upland areas of the watershed by growing corn, beans, and squash. Lenape children would collect wild berries for snacks, seasonings, and medicinal purposes.

Second generation settlers moved into the area from Long Island, Rhode Island, and Massachusetts to take advantage of the various resources found in the region. Throughout much of the watershed the soil and wetland conditions limited farming opportunities and required settlers to depend on subsistence farming. Consequently, the settlers were dependent upon the various natural resources found in the region and pursued opportunities in logging, brickmaking, mining, fishing, and the bog iron industry. These various industries led to the development of hamlets and towns throughout the region. Fishing hamlets existed around the mouth of the Manasquan River, towns developed from mining operations, and villages were built to support logging activities. As these various operations expanded, the need for improved transportation was recognized.

The regular travel between fishing hamlets, logging activities, brickmaking works, and ironworks produced at Allaire made the creation of roads a high priority. A series of Lenape trails were used as the basis for the earliest roadways such as County Route 537, New Jersey Routes 9 and 33, Allenwood Road in Wall Township, and Allenwood Lakewood Road and Herbertsville Road in Brick Township. The settlers widened these paths to accommodate horses and wagons which led to the construction of Old Squan Bridge over the Manasquan in 1768. More roads were built to link farms to each other, to mills, and to churches. Taverns were built along the early roads, particularly at the river crossings and cross roads, and became important gathering places, sometimes leading to small settlements. Examples are Mariner's Tavern, built in 1747 and later referred to as Our House Tavern at the bend in Adelphia Farmingdale Road, and Moore's Inn, built about 1787 at the corner of CR 537 and Stillwells Corner Road in Freehold Township.

As development continued in the region during the 1800's, more activity was found along the banks of the Manasquan River. Grist mills, saw mills, boatyards, taverns, villages, and churches could be found along the River. For more than 40 years, the Coast Wrecking Company operated out of Union

Landing (Brielle) and provided salvaging services for ships wrecked on the regions treacherous shoals. From the early 1800's, visitors from the Philadelphia area began to tour the area. Since lodging facilities were limited, tourists stayed in area farmhouses during their visits. In the 1870's and 1880's the railroads, already exporting marl from the area, expanded the use of their lines to offer summer excursions to people seeking recreation on the coast. The Manasquan area blossomed with vacationers from northern New Jersey, New York, and Philadelphia. Hotels and bathing pavilions were built in rapid succession to meet the needs of the summer visitors. The Manasquan region is strewn with historic sites dating to these early periods.

Conclusion

These historic sites define the character of the region and offer a culture unique to the Manasquan. As development continues in the region, the character and culture of the region can be enhanced or emulated offering a truly unique experience to those who enjoy what the Manasquan has to offer. This will require Manasquan watershed residents to come together to determine the future of the watershed. Care must be taken to protect sensitive areas, as well as natural, cultural, and economic resources, in order to accommodate new growth without losing the very amenities that attract us to the region.

Increased development will have a number of effects on the Manasquan River. First, developed lands tend to be major sources of nutrients, sediments, chemical contaminants and pathogens derived from road runoff, septic tank leachate, failing sewer lines, and lawn and garden chemicals. Second, urban development increases impervious surfaces in the watershed, reducing the amount of water that seeps into the soil and increasing surface runoff, which in turn may degrade stream habitat quality, increase transport of pollutants, and limit ground water recharge. Third, if development is poorly planned, the result may be losses of wetland and forest areas that serve important roles as wildlife habitat and protectors of water quality. In addition to the impacts of development, expected increases in boating, fishing, ecotourism, and other recreational uses will place additional stress on the Manasquan River ecosystem.

In order to meet environmental, economic, and recreational needs, Manasquan watershed residents and decision makers must be willing and able to make informed decisions about the future of the region. Such decisions are not always easy, but recognizing that economic prosperity depends on the health of the environment is a critical first step.

INDEX OF ACTION PLANS

Fishery Management

Goal: Water quality conditions will support healthy and abundant fish and shellfish populations safe for human consumption.

Habitat Protection

Goal: Watershed habitats will be sufficient to support diverse native wildlife populations.

Drinking Water Quantity & Quality

Goal: Adequate water supplies and healthy drinking water will be available to meet the needs of future generations.

Cultural Heritage

Goal: The region's unique character will be protected by promoting its cultural and historical landmarks and by enhancing opportunities for public access to these special areas.

Fishery Management

Strategy FM 1

Strategy FM 1 – Upgrade the shellfish classification for the Manasquan River estuary to Approved. The NJDEP Bureau of Marine Water Monitoring classifies the State's shellfish growing waters into four categories: Approved, Prohibited, Seasonal, and Special Restricted. The shellfish beds west (upstream) of the Rt. 70 bridge are currently classified as Prohibited. Waters east (downstream) of the Rt. 70 bridge are classified as Special Restricted. The classifications are based on the total coliform criterion for fecal contamination. Fecal contamination reaches waterways via surface runoff as well as direct discharges. Sources may include stormwater, wildlife, pets, failing septic systems, broken sewerlines, and discharge of sewage from boats.

Objective: Determine sources of fecal contamination and viable strategies to control fecal inputs.

Actions:

1. Analyze existing data to determine magnitude of fecal contamination from stormwater sources.
2. Determine species-specific sources of coliform bacteria thru DNA fingerprinting and collect/analyze data for information gaps identified from stormwater fecal contamination investigation.
3. Corrective strategies and appropriate implementing entities will be identified based on the results of stormwater data and species specific sources identified by DNA fingerprinting.
4. Determine if manure management and domestic animal waste programs are adequate to protect water quality.
5. Through the New Jersey Clean Vessel Act, provide year-round marine waste pumpout services at select facilities specifically supporting deep-water vessels and investigate the feasibility of a mobile pumpout for the Manasquan estuary.
6. Ensure compliance with the provisions of the No Discharge Area designation.
7. Investigate if commercial boats are contributing to fecal coliform contamination.

Strategy FM 1 Implementation Table

Actions	Lead Agency	Support Agencies	Costs	Start Action
1	NJDEP BMWM	MCDH(WER)	WER	2000
2	NJDEP BMWM	MU($30K) MCDH(WER)	$100K	2000
3	MWMG	NJDEP-DWM & DWQ	TBD	TBD
4	NRCS	FSCD/MCDH	$2,000	2002
5	NJDEP-DFW	MCDH/MTA/SGP	TBD	TBD
6	NJDEP	NJSP-MD/USCG	TBD	TBD
7	SGP		TBD	TBD

Strategy FM 2

Strategy FM 2 – Conserve, maintain and enhance the estuary as commercially and recreationally viable with specific reference to the estuary as a habitat for numerous fish and shellfish species such as, but not limited to, flounder, weakfish, striped bass, blue crab, eels, soft and hard clams and blue mussels. In order to determine the abundance and health of these important species, inventories and shellfish density maps need to be updated. Existing data are based on information collected nearly ten years ago. Furthermore, degradation of benthic habitat from eutrophication, reduced light penetration, sedimentation, boating activities, and intensive use will complicate recovery.

Objective: Collect distribution and abundance information necessary for the development of a fisheries habitat management and enhancement plan.

Actions:

1. Develop species-specific distribution and abundance profiles based on existing data (data base and GIS maps).
2. Collect updated data on distribution and abundance of important fish and shellfish species and continue annual abundance counts (for winter flounder specifically).
3. Compile data on fishing effort and landings (creel census).
4. Use nutrient loads and siltation as a fishery stress indicator.
5. Implement Atlantic Coastal Cooperative Statistics Program (ACCSP) recommendations in order to obtain reliable catch and effort data from the commercial and recreational fishery.
6. Develop a Fisheries Habitat Management and Enhancement Plan that includes submerged aquatic vegetation (SAV) distribution, SAV habitat survival requirements, and SAV protection strategies.

Strategy FM 2 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	NJDEP-DFW		TBD	TBD
2	NJDEP-DFW		10K	TBD
3	MWMG	NMFS	TBD	TBD
4	NJDEP-DFW		TBD	TBD
5	NJDEP-DFW		TBD	TBD
6	NJDEP-DFW		TBD	TBD

Strategy FM 3

Strategy FM 3 – Maintain the biological integrity of the Manasquan River and its tributaries. The NJDEP uses several methods to evaluate water quality such as macroinvertebrate assessments, fixed-location water and sediment sampling, shellfish water classification monitoring, and fish tissue analysis. Through these various monitoring methods, NJDEP has identified Turkey Swamp Brook and Debois Creek as severely impaired and several portions of the Manasquan River, Marsh Bog Brook, Mingamahone Brook, Stan Brook, and Marsh Bog Brook as moderately impaired. Strategies are necessary to target these identified areas as well as watershed-wide strategies to improve water quality conditions for aquatic organisms.

Objective: Identify contamination sources and develop management plan to reduce inputs.

Actions:

1. Determine if water quality degradation is coming from point sources, nonpoint sources, habitat destruction or multiple causes.
2. If contamination sources are from nonpoint sources or habitat destruction, provide a framework to develop a watershed-based stormwater and nonpoint source management plan. (see also HP2.5)
3. If point sources are found to be significant contributors, develop specific load reduction strategies through TMDLs for each source of contamination.
4. Develop TMDLs considering that the Manasquan River is the primary source for water supply for the Manasquan Reservoir.
5. Facilitate public involvement efforts during TMDL development process.
6. Continue to identify other portions of the Manasquan River not meeting water quality standards.
7. Determine the extent of water quality and habitat degradation from sedimentation and identify site specific strategies to remediate.
8. Identify habitat areas capable of providing water quality filtering benefits and identify strategies to restore and protect habitat.
9. Expand biomonitoring program to include other streams with known or suspected water quality problems. Utilize various data sources to identify suspect areas such as the volunteer monitoring program, stream walk program, and land use changes.
10. Implement best management practices (BMP) at marinas and waterfront properties that will protect water quality such as:
    a. improving fish waste management strategies.
    b. encourage marina operators to promote the use of hazardous waste collection systems for disposal of waste oils, paint solvents, cleaners, etc.
    c. exploring significance of contamination coming from power washing activities.
    d. promoting, through incentives, alternative materials for dock and bulkhead construction, replacement and repair such as recycled plastics.
11. Establish boat speed restrictions in areas impacted by sedimentation to reduce

resuspension impacts.

12. Promote citizen reporting of leaking waste storage and transport containers.
13. Work with municipal public works departments to ensure their facilities and yards are clean and practices are environmentally sensitive.
14. The State and municipalities should follow Monmouth County's lead by installing Compuspread computers on road salting trucks to reduce road salts and sand from entering the Manasquan River.
15. Encourage municipalities to follow similar procedures as NJDEP by restricting development approvals in areas not meeting water quality standards and areas with specific protective water classifications.

Strategy FM 3 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	NJDEP		TBD	TBD
2	MCPB/OCPB	FSCD/MCWRA	TBD	TBD
3	NJDEP-DWQ		WER	2000
4	NJDEP-DWM	MWMG	WER	2000
5	MWMG		TBD	2000
6	MWMG	NJDEP-DWM	TBD	TBD
7	MCDH	FSCD/MCMEC	TBD	TBD
8	MWMG		TBD	TBD
9	MCDH	NJDEP/BCC	$87,000	TBD
10a	MUN	NJDEP	TBD	TBD
10b	MCDH/OCDH		MCDH-WER	2000
10c	NJDEP		TBD	TBD
10d	MUN	MCDH(WER) NJDEP	TBD	TBD
11	NJSP-MD	NJBRC	TBD	TBD
12	MCDH	DOT	WER	2000
13	MWMG		TBD	TBD
14	DOT	MCPWE	TBD	TBD
15	MWMG	MUN	TBD	TBD

Strategy FM 4

Strategy FM 4 – Conserve and maintain natural base flow conditions to the Manasquan River and its tributaries. The hydrologic integrity of the Manasquan River is being jeopardized as urban and suburban development increases in the watershed. Natural flow regimes are altered as ground water is used for irrigation and household use. Ground water replenishment is restricted by impervious surfaces. Surfaces such as roadways, parking lots, and rooftops reduce the amount of water that seeps into the soil capable of providing the Manasquan River with a steady source of ground water. Furthermore, these hard surfaces accelerate surface runoff resulting in stream flashiness, scouring and erosion. Inhibiting subsurface flow in the Manasquan will have negative impacts on the fishery and riparian habitat.

Objective: Determine the consequences of fresh water losses to the river system and develop strategies to minimize environmental impacts.

Actions:

1. Conduct ground water recharge analysis to determine if the adequate base flow water supplies are going to the Manasquan River.
2. Conduct analysis of ground water/surface water interactions similar to what USGS has done for Toms River and Metedeconk River. Analysis of USGS stream flow data for development of hydrologic profile of each tributary. Estimate/confirm number of days base flow prevents draw for reservoir system.
3. Provide a framework to develop a watershed-based stormwater and nonpoint source management plan that protects water quality and provides adequate base flow for groundwater.
4. Limit artificial loss of water in subwatersheds not capable of meeting recharge needs by reducing impervious surfaces, sewerage, private irrigation wells, etc.
5. Identify ground water recharge areas and provide general protection strategies to municipalities for the protection of recharge zones.
6. Develop model ordinance that maximizes recharge opportunities at the municipal level.
7. Investigate the impact of private irrigation wells on the regions water supply.
8. Establish goals for impervious surfaces that result in the minimum impervious cover for specific land uses.

Strategy FM 4 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	NJDEP/NJGS		WER	Ongoing
2	NJWSA	USGS	$400K	TBD
3	MCPB/FSCD	MCWRA	$400K	2004
4	MUN		TBD	TBD
5	MCPB		TBD	TBD
6	MCPB	MUN/SBA	WER	TBD
7	NJDEP-DWM NJGS	USGS	TBD	TBD
8	MCPB		WER	TBD

Habitat Protection

Strategy HP 1

Strategy HP 1 – Conserve and enhance the quality and quantity of estuarine wetlands and freshwater wetlands. Freshwater and estuarine wetlands provide a variety of important environmental functions; including improvement of water quality, reduction in the frequency and severity of flooding, and habitat for waterfowl and other wildlife. As the Manasquan region has developed, coastal wetland losses have occurred due to sedimentation, erosion, and encroachment. Wetland integrity has also been jeopardized by the invasion of exotic plants such as *Phragmites*, Purple loosestrife, and Multi-flora rose.

Objective: Protect, restore, and create coastal and freshwater wetlands.

Actions:

1. Inventory and map existing coastal wetlands to appropriate scale; identify *Phragmites* dominated zones vs. *Spartina* dominated zones.
2. Identify the hydrologic function of wetlands in the watershed that would lead to improved management of wetland areas.
3. Identify ownership of each wetland parcel to assist in the development of strategies to protect and restore wetlands.
4. Develop wetland creation/restoration/enhancement plan (e.g., investigate feasibility of regrading *Phragmites* areas to establish *Spartina*).
5. Do not permit wetland creation in acid producing soils due to the inevitable loss of plant material.
6. Identify wetlands in need of special protection and implement strategies that maximize buffering capacity for water quality protection and habitat expansion.
7. Do not use buffer averaging methods in the watershed.
8. Use dredged material, when feasible, for wetland creation and shoreline stabilization.
9. Work with NJDEP and NJDOT in identifying potential wetland mitigation sites in the watershed.
10. Develop wetland mitigation site selection criteria specific to the watershed with special consideration towards old landfills that were formally wetlands and have good records of what is on the site.
11. Identify privately owned non-forested lands adjacent to wetlands for potential wetland mitigation sites. Lands identified as modified agriculture would be good candidates for mitigation projects.
12. Seek funding from the Wetlands Mitigation Council for projects on public lands as well as private lands.
13. Take advantage of existing education programs (i.e., MCPS Fisherman's Cove project) about the value of wetlands and what constitutes a healthy wetland.

Strategy HP 1 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	MCGIS	MCMEC	TBD	TBD
2	NJDEP		TBD	TBD
3	MCGIS		TBD	TBD
4	NJDEP-DFW	MCMEC/ACOE	TBD	TBD
5	NJDEP-LURP		TBD	TBD
6	NJDEP-LURP		TBD	TBD
7	NJDEP-LURP		TBD	TBD
8	NJDEP-BCE	ACOE	TBD	TBD
9	MWMG	NJDEP-LURP	TBD	TBD
10	MCPB	MWMG	TBD	TBD
11	MCGIS		TBD	TBD
12	MWMG		TBD	TBD
13	MWMG		TBD	TBD

Strategy HP 2

Strategy HP 2 – Maintain and restore stream corridors and protect riparian habitat along tributaries to the Manasquan River. Loss of riparian cover along tributaries has resulted in shoreline erosion, habitat loss, and loss of filtration buffering from land-based runoff. Restoring native vegetation along stream corridors is one of the most effective methods for improving water quality and habitat conditions. In extreme conditions where erosion has silted-in stream beds, it may be necessary to restore streams to more natural conditions.

Objective: Identify areas needing restoration and develop riparian restoration and protection plans.

Actions:

1. Analyze data from MCDH's freshwater "stream walk" program to evaluate riparian conditions – map at appropriate scale (GIS).
2. Identify impaired stream segments and identify possible causes of impacts/impairments.
3. Develop riparian restoration plan based on stream walk analysis.
4. Develop a general freshwater wetlands permit for stream cleaning (sediment removal).
5. Develop a policy/guidance document (MOU) for removing blocks from the Manasquan River and tributaries to reduce flooding and accommodate canoeing and kayaking while maintaining the integrity of a trout maintenance stream.
6. Develop regional stormwater management plans that prevent impacts to streams and their ability to handle additional pollutant loadings and volumes from subdivisions. Coordinate municipal stormwater management plans into one comprehensive regional plan. (see FM3.2)
7. Modify stormwater guidelines so that saturated (versus inundated) wetlands may be created where the hydrology supports it on the discharge side (downstream) of retention and detention basins. Design should consider ease of maintenance and prevent the creation of a mosquito breeding habitat.
8. Establish standards for new developments that address assimilative capacity.
9. Initiate an education campaign on stormwater management guidelines and stream corridor management for developers and homeowners.
10. Develop a multi-municipal waiver for the State's Residential Site Improvement Standards to reduce width requirements for new roadways and curbing requirements in the Manasquan watershed.

Strategy HP 2 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	MCDH	OCDH/MWMG	WER	Ongoing
2	MCDH	MWMG	WER	Ongoing
3	MCDH	OCDH/MCMEC	WER	Ongoing
4	NJDEP-LURP	MCMEC/MUN	TBD	TBD
5	NJDEP-DFW	MCMEC/MCPS MUN	TBD	TBD
6	MCPB	FSCD/MCWRA	TBD	TBD
7	NJDEP	NJDAG/DOT MCMEC	TBD	TBD
8	NJDEP		TBD	TBD
9	FSCD	MCMEC	$5,000	2002
10	MCPB	DCA	WER	TBD

Strategy HP 3

Strategy HP 3 – Conserve the unique ecosystems of the Manasquan floodplain. The Manasquan River floodplain is a unique system that cannot be matched by any other area in the State. This diverse system supports numerous plant species that are important to area wildlife. *Spartina*, sedges, rushes, and woody shrubs such as pepperbush and holly can be found along the edges of the River. The floodplains support a rare quantity of wildflowers for the region, and magnificent blooms of violets, trout lily, and the very rare green dragon are found during the spring bloom. These habitats provide food and shelter for 44 species of herptiles, 39 species of mammals, and 243 species of birds dependant upon the Manasquan. Of these wildlife species, 18 are listed as endangered and 17 are listed as threatened by the NJDEP.

Objective: Protect and preserve Manasquan floodplain habitat and the species that depend on the floodplain for their survival.

Actions:

1. Define and document floodplain uniqueness.
2. Identify specific stressors to the floodplain.
3. Identify and quantify the magnitude and extent of impacts from each stressor.
4. Identify ownership of impacted areas to integrate with strategy development process for remediation and protection projects.
5. Develop site specific strategies to minimize or eliminate floodplain stressors starting with those of most environmental significance.

Strategy HP 3 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	MCPS/OCPS	MWMG	TBD	TBD
2	MCPS/OCPS	MCPB/MCGIS	TBD	TBD
3	MCPS/OCPS	MCPB/MCGIS	TBD	TBD
4	MCGIS	MUN	TBD	TBD
5	MWMG	MCPS/OCPS	TBD	TBD

Strategy HP 4

Strategy HP 4 – Conserve and expand contiguous forest cover.

Loss of tree cover has serious implications not only for urban areas and the land but especially for the health of the Manasquan River. Native plant and animal species, including aquatic species, are reduced by forest loss and fragmentation. Polluted runoff from developed and agricultural land is the primary threat to water quality. Restoring tree cover has been identified as one of the most cost-effective ways to improve water quality.

Objective: Protect and restore forest cover and seek opportunities to expand contiguous forest cover in the watershed.

Actions:

1. Map existing forest cover to appropriate scale and verify in the field where necessary to confirm acreage and boundaries of existing contiguous forest.
2. Document ownership of forested lands to assist in the development of strategies to protect and restore forest cover.
3. Develop monitoring/tracking techniques to document changes in forest cover over time.
4. Draft land use policies, zoning policies, or incentives that encourage maintenance of existing forest conditions.
5. Take advantage of existing programs to expand forest cover in the watershed (e.g., brownfields).
6. Identify specimen trees on a watershed basis.

Strategy HP 4 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	MCGIS	MCPS/MCPB	TBD	TBD
2	MCGIS	MUN	TBD	TBD
3	NJDEP-DPF	MCGIS/MCPB	TBD	TBD
4	MCPB/OCPB	NJDEP-DPF MUN/MCSTC	TBD	TBD
5	MUN		TBD	TBD
6	MCSTC	MUN	TBD	TBD

Strategy HP 5

Strategy HP 5 – Improve tree and vegetative cover in existing urban and suburban areas and improve the design of landscaping in newly developed urban and suburban areas. Turf grass or lawns provide little or no wildlife habitat and minimize the land's water absorption capabilities. Furthermore, turf grass requires excessive maintenance such as trimming, watering, and fertilization. Techniques and guidelines should be established to improve backyard habitats by increasing native vegetation and reducing turf grass areas.

Objective: Expand tree and vegetative cover in developed urban and suburban areas.

Actions:

1. Compile and analyze existing shade tree ordinances in the watershed and make recommendations.
2. Quantify magnitude and extent of vegetation loss through land cover analysis (e.g., compare farmfield converted to suburban).
3. Document the extent of land use changes from Agriculture to urban/suburban/commercial and characterize their impacts.
4. Develop reforestation guidance (species selection based on region, grouping/clustering schemes, etc.).
5. Document economic opportunities associated with forest cover.
6. Implement a "river friendly" landscaping program by developing a homeowners guidebook and developers/landscapers guidebook.
7. Work with area nurseries to offer native plants at discount prices or bulk purchase discounts as an incentive.

Strategy HP 5 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	MCSTC	MCPB	TBD	TBD
2	MCGIS	MCPB	TBD	TBD
3	MCPB		TBD	TBD
4	NRCS/FSCD	RCE	TBD	TBD
5	NRCS	FSCD	TBD	TBD
6	RCE-ARMD	FSCD/MCSTC	TBD	TBD
7	MWMG		TBD	TBD

Strategy DW 1

Strategy DW 1 – Maintain a continued safe yield from the existing water supply.
The Manasquan Reservoir Water Supply System provides the region with a safe, dependable, and renewable water supply. But as the region's landscape continues to change from development, watershed conditions may no longer ensure a viable water supply. Computer simulation modeling is needed to recalculate system yield based on historical river flow records from 1931-1999 and representative operational conditions with future modeling to include new land use projection information and how it impacts river flows.

Objective: Ensure that water supply capabilities accurately meet user needs and future demand.

Actions:

1. Develop a new water supply safe yield analysis.
2. Estimate potential safe yield changes resulting from projected development.
3. Identify recharge areas necessary for protecting the regions water supply.
4. Develop land preservation strategies in identified recharge protection zones.
5. Monitor aquifer levels to determine water supply capabilities and to establish carrying capacity for water supply.
6. Develop growth management strategies that are consistent with water supply capabilities.
7. Offer education programs about water conservation practices, inter-basin transfer of water, water losses from sewerage, and benefits of wastewater reuse.
8. Implement landscaping education programs that utilize drought resistant plants and grasses to conserve water supplies.
9. Promote wide-scale tree planting for water retention through FSCD Conservation 2000 initiative.
10. Limit the use of residential sprinkler systems and irrigation practices as a water conservation method since Water Authorities experienced a 30% reduction in demand during the 1999 drought watering restriction period.
11. Investigate commercial water use consumption during drought warning and emergency conditions.
12. Implement programs to purchase lands surrounding the Manasquan reservoir to protect water quality and ensure that other land preservation programs compliment the effort.
13. Explore viable wastewater reuse options for the Manasquan region to conserve water supplies.
14. Develop conjunctive use strategies so that aquifers are used in conjunction

with reservoirs to maximize water use capabilities.

15. Develop a region-wide water conservation plan to ensure adequate water supplies.
16. Conduct a series of meetings with municipalities to develop ordinances that will be implemented through master plans capable of protecting the region's water supply.

Strategy DW 1 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	NJWSA	USGS	WER	Ongoing
2	NJDEP	USGS	$100K	TBD
3	MCPB	NJGS	$25K/WER	NJGS-Ongoing
4	MCPB	MUN	TBD	TBD
5	USGS	NJDEP-WSE	WER	Ongoing
6	MUN	OCPB/MCPB	TBD	TBD
7	MCPB/MCPS	NJWSA	WER	Env/Ed Center opening
8	FSCD	MUN/RCE	TBD	TBD
9	FSCD		TBD	TBD
10	MUN	MCWRA	TBD	TBD
11	NJDEP-WSE	NJDEP/MCWRA	$20K	TBD
12	NJWSA/NJDEP	MCPS	TBD	Ongoing
13	NJDEP	MRRSA	$25K	TBD
14	NJDEP-WSE	MUN/UTL	$75K	TBD
15	NJDEP/MCPB	NJDEP	$50K	TBD
16	MCWRA	MUN	$5K	TBD

Strategy DW 2

Strategy DW 2 – Ensure that the projections for an adequate water supply are

based on accurate data. One source of drinking water for the watershed comes from the unconfined Kirkwood-Cohansey aquifer system. In the eastern portion of the Manasquan basin, the base of the aquifer approaches sea level and may be hydraulically connected with saltwater capable of contaminating the aquifer. Recent study indicates that current withdrawals from the Kirkwood-Cohansey aquifer system have lowered water-table levels and caused reductions in base stream flow in Toms River, Metedeconk River, and Kettle Creek basins. The Manasquan Reservoir Water Supply System currently provides about 16 million gallons per day to the region and is capable of providing 30 million gallons per day. Currently, the NJDEP estimates that the water supply is adequate for the existing population, but computer simulation modeling based on growth projections is needed to determine future needs.

Objective: Develop water supply projections based on more reliable computer modeling.

Actions:

1. Revise existing statewide water supply plan based on new population projections.
2. Review and update water distribution policies based on new population findings.
3. Evaluate various data sources for consistency and ensure new policies account for probable data gaps.
4. Develop a new state water supply plan based on the 2000 Census considering water demand in specific basins.
5. Reconstitute stream base flow records based on the changing landscape conditions in the watershed such as the increase in impervious surfaces and the reduction in water recharge areas.
6. Conduct a growth build-out analysis for the region.
7. Develop water demand estimates based on full build-out.
8. Use build-out analysis as community education tool.

Strategy DW 2 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	NJDEP-DWM NJGS	NJWSA	TBD	TBD
2	NJDEP-DWM	NJWSA	TBD	TBD
3	NJDEP-DWM	NJWSA	TBD	TBD
4	NJDEP		TBD	2002
5	NJWSA	USGS	WER	Ongoing
6	MCPB	OCPB	TBD	TBD
7	NJWSA		TBD	TBD
8	MWMG		TBD	TBD

Strategy DW 3

Strategy DW 3 – Achieve and maintain ground water quality as set forth in NJDEP ground water standards. Ground water contamination has been identified in some areas of the Manasquan watershed. Low pH, elevated iron and manganese levels and low hardness values have been identified in localized areas. Some evidence suggests that saltwater intrusion is occurring in the Kirkwood aquifer in the Point Pleasant Beach area.

Objective: Identify ground water problem areas and develop strategies to remedy problems and protect ground water sources.

Actions:

1. Compile and analyze existing ground water quality data from all available sources such as USGS, DEP, NJWSA, and MCDH for watershed area.
2. Identify ground water contamination trouble spots and analyze high risk areas for remedial action.
3. Develop remediation strategies to address high risk areas.
4. Using GIS tools, identify and map all known underground storage tanks and identify when they were last leak tested.
5. Develop guidance for municipal tank testing programs for those not regulated by NJDEP.
6. Institute remediation program for failing tanks and create a replacement program based on when tanks are likely to begin failing.
7. Work with well-drillers on strategies to protect ground water from the impacts of wells such as sealing abandoned wells.
8. Identify and examine unofficial landfills when developing source-water analysis assessment.
9. Publicize the MCDH citizen reporting program to help identify unofficial or historic dump sites.
10. Promote State and National legislation that restricts the use of MTBE (methyl tertiary butyl ether) as a fuel additive that if spilled is capable of contaminating the region's drinking water. It is estimated that one cup of MTBE can contaminate 5,000,000 gallons of water.

Strategy DW 3 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	MCDH	OCDH/NJDEP-SRP	WER	Ongoing
2	MCDH	OCDH/NJDEP-SRP	WER	Ongoing
3	MCDH	OCDH/MWMG	WER	As needed
4	MCGIS	MCDH	TBD	TBD
5	MCDH	OCDH	WER	TBD
6	MCDH	OCDH	WER	Ongoing
7	NJDEP-WSE		TBD	TBD
8	NJDEP		TBD	TBD
9	MWMG	MCDH	TBD	TBD
10	MWMG		TBD	TBD

Cultural Heritage

Strategy CH 1

Strategy CH 1 – Preserve remnant landscapes in developing parts of the watershed. Road improvements, development and poor property management are destroying remaining remnant landscapes. These historic landscapes or unique areas define the character of the region and emulate the region's culture. "Unique areas" may be of cultural, historic, or ecological significance.

Objective: Preserve the unique identity of the region by preserving landscapes that typify the "Manasquan identity."

Actions:

1. Define what constitutes a unique area.
2. Identify unique areas and map digitally using GIS.
3. Identify site-specific encroachments and threats to unique landscapes.
4. Develop a community vision that reflects the unique characteristics of the region to create a distinct identity and implement through growth management tools.
5. Implement development policies that protect identified "unique areas".
6. Establish development design standards that protect identified unique areas and emulate historic characteristics of area.
7. Institute public acquisition program for unique areas.
8. Encourage and support agricultural preservation in the watershed to protect the regions historical, cultural, or ecological significance.
9. Work with municipalities in updating their 5 year master plans making them eligible for Shade Tree Commission funding.
10. Develop school curriculum on preserving the culture of the region as well as strategies for protecting these important areas.
11. Establish a "train the trainer" program for school teachers to educate students about cultural preservation.
12. Through grassroots efforts institute an annual celebration festival featuring the unique character and culture of the region.
13. Provide examples of communities that have already had success in emulating their cultural and historical significance such as the West Farms area, Kalmuk population centers, and the village character of Farmingdale.
14. Educate community about the costs of growth due to increasing infrastructure needs such as schools, police, fire, sewer, etc.

Strategy CH 1 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	MCPB	OCPB/MWMG	WER	completed
2	MCPB	MCGIS	WER	2000
3	MCPB	MUN/OCPB	WER	2000
4	MCPB/MUN	OCPB	TBD	TBD
5	MUN	MCPB/OCPB	TBD	TBD
6	MUN	MCPB/OCPB	TBD	TBD
7	MCPS	MCPB/MUN	TBD	TBD
8	MCADB	NRCS	TBD	TBD
9	MCSTC	MUN	TBD	TBD
10	MWMG		TBD	TBD
11	MWMG		TBD	TBD
12	MWMG		TBD	TBD
13	MWMG		TBD	TBD
14	MCPB/OCPB	MWMG	TBD	TBD

Strategy CH 2

Strategy CH 2 – Improve public access and recreational opportunities to the river, especially the estuary. Public access to the Manasquan River is limited due to private ownership of waterfront property and various user conflicts. Access sites that currently exist are overwhelmed thereby exacerbating access problems.

Objective: Identify appropriate areas for public access and provide facilities for their use.

Actions:

1. Map existing access points, condition and management responsibility.
2 Identify historic canoe access points such as on municipal properties.
3. Identify appropriate sites for public access.
4. Develop siting criteria and design criteria for public access facilities.
5. Implement public access improvement plans.
6. Erect signage at public access points that clarify right of way points.
7. Improve public access opportunities at bridge crossings and pursue access opportunities during bridge construction and reconstruction.
8. Encourage ecotourism opportunities through area Chambers of Commerce and private businesses.
9. Develop brochure and map of Manasquan area featuring public access points and sites unique in character.
10. Develop stream obstruction cleaning methods that facilitate canoe navigation, protect fish habitat, reduce flooding, and limit mosquito breeding.
11. Work with waterfront property owners to increase waterfront clean-up opportunities.
12. Explore conservation easements with private landowners that expand public access opportunities.
13. Construct low impact access points such as Manasquan scenic overlooks.
14. Increase enforcement of existing regulations on recreational boaters as well as Personal Watercraft (PWC) to reduce user conflicts and natural resource impacts.

Strategy CH 2 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	MWMG	MCGIS	WER	pending
2	MWMG		WER	completed
3	MWMG	MCPWE	WER	completed
4	MCPS	MCPWE/MUN MCPB	TBD	TBD
5	MUN	MCPWE	TBD	TBD
6	MUN	MCPWE	TBD	TBD
7	DOT	MCPWE	TBD	TBD
8	MWMG	MUN	TBD	TBD
9	MWMG		TBD	TBD
10	MCMEC	NJDEP-DFW MUN/MCPS	TBD	TBD
11	MWMG		TBD	TBD
12	MCPS/MCADB	MWMG	TBD	Ongoing
13	MUN	MCPWE/ MWMG	TBD	TBD
14	NJSP-MD		TBD	TBD

Strategy CH 3

Strategy CH 3 – Maintain estuarine waterfront for existing traditional maritime uses – recreational marinas and commercial fishing. Extensive development in waterfront areas is displacing traditional maritime facilities, an industry that has supported the Manasquan region for more than 100 years.

Objective: Develop incentives to maintain maritime uses in the Manasquan estuary.

Actions:

1. Develop inventory of infrastructure necessary to support waterfront maritime uses such as services and support businesses.
2. Once current zoning is mapped, identify conformance of maritime uses.
3. Conduct analysis of regulatory constraints and disincentives to maintenance and/or expansion of maritime uses.
4. Streamline regulatory requirements on the industry by establishing pre-approved uses, utilizing general permits, and modifying local zoning codes.
5. Investigate whether master plans adequately support maritime industry.
6. Promote the establishment of a marina and dockage facility preservation program.
7. Develop a Harbor Management Plan that includes dredging and disposal needs as well as an emergency response plan.
8. Provide tax incentives to the maritime industry and businesses that support the industry.
9. Develop marketing strategies that support the industry.
10. Investigate barriers that may inhibit the viability of the industry.

Strategy CH 3 Implementation Table

Actions	Lead Agency	Support Agency	Costs	Start Action
1	MWMG		WER	pending
2	MWMG	MUN	WER	pending
3	MWMG		WER	pending
4	NJDEP	MUN	TBD	TBD
5	MUN	MWMG	TBD	pending
6	MWMG		TBD	TBD
7	MWMG	MUN	TBD	TBD
8	NJDAT		TBD	TBD
9	MWMG		TBD	TBD

10	MWMG		WER	pending

Early Action Projects

During development of the Manasquan Watershed Management Plan, participants identified projects that needed to be initiated before completion of the plan. These projects were selected because of their ability to kick-start the process and to provide data essential for early success. Without successful implementation of these projects, many of the actions would have experienced significant delays. For example, several actions contained in the plan were dependent upon the results from sediment sampling for fecal coliform contamination. Early results will allow the group to target the most effective actions for implementation. The following projects were funded by the Manasquan Watershed Management Group (MWMG) to facilitate early and successful implementation of the management plan.

Boating and Fishing Access and Opportunities on the Manasquan River Estuary
This project provided the Manasquan Watershed Management Group (MWMG) with information necessary for developing action plans that will result in enhanced recreational boating and fishing opportunities on the Manasquan River Estuary. The report provided an inventory of existing boating and fishing access points, recommendations for enhancing and improving small boat and fishing opportunities, locations where additional small boat and fishing access facilities could be located, criteria for siting small boat and fishing access facilities, and identification of design options to be considered for new facilities.

Pumpout Usage in the Manasquan River Estuary No Discharge Area
The pumpout usage project provides information on boater compliance with the provisions of the Manasquan River Estuary No Discharge Area designation. The report highlights an updated inventory of pumpout facilities in the Manasquan River Estuary, a profile of pumpout facility usage as a measure of boater compliance with the provisions of the No Discharge Area designation, and recommendations for improving knowledge of, and compliance with, the provisions of the No Discharge Area designation. This effort led to public education programs about the importance of pumpout usage as well as the production of additional signage about the No Discharge Area designation.

Maritime Industries in the Port of Manasquan - Point Pleasant: Status, Trends and Needs
This project provides the MWMG with information necessary to achieve the maintenance of existing traditional maritime uses in the estuary (e.g., recreational marinas and commercial fishing). The report provides a historical profile of the development of the Manasquan-Point Pleasant area as a major coastal port, a profile of the existing maritime uses, services, and essential infrastructure, a description of current waterfront zoning in each of the municipalities surrounding the port, analysis of constraints on the maritime industries in the port, highlights of other programs that address maritime uses and port preservation, and recommendations for a comprehensive marine/maritime/port preservation and management plan.

Geographic Information System Land Use/Land Cover Analysis
The Monmouth County GIS Management Office is providing updated land use/land cover data for the municipalities within the Manasquan watershed that has improved analysis capabilities and regional decision-making. The NJDEP 1995 land use data (based on NJDOQQ's at 1"=1000' scale) was used as the starting data set. This was integrated with the Monmouth County 1997 orthophotography which increased accuracy to 1" = 100' scale. The merger also integrated the USGS Anderson coding system based on agricultural uses with the NRCS land use coding system based on urban runoff uses to provide a more comprehensive GIS tool. Existing land use data was from 1986 and 1991 and was grossly outdated. Also the data was developed at 1"=2000' scale and many smaller impacted areas within the watershed were missed. This project increased both the accuracy and uses of this vital GIS data layer and will allow the MWMG to make better decisions about wetland management strategies, identifying floodplain stressors, documenting forest cover and change, tracking land use changes on a watershed scale, mapping underground storage tanks, and identifying unique areas in need of special protection.

Manasquan River Sediment and Water Column Analysis for Fecal Coliform Contamination
The purpose of this project was to quantify bacterial contamination in the Manasquan River during dry events versus wet events in an effort to isolate potential sources of contamination. Wet events are defined as a significant rain events that provide one inch of rainfall in 36 hours or less. Fecal coliform, total coliform, and clostridia were sampled in the sediment and water column within the Manasquan Estuary. Information collected enabled the MWMG to focus on actions that target specific sources of fecal contamination with the goal of opening shellfish beds that are either closed or restricted in use. This project also formed a database that characterizes strains of *E. coli* from chosen organisms according to patterns of antibiotic resistance as well as strain-specific DNA fingerprinting profiles. In this process of multiple antibiotic resistance testing, *E. coli* is isolated from fecal samples using a sequential culturing on differential culture medias. Depending on the fecal sample being analyzed, this procedure can result in the identification of several hundred distinct strains of *E. coli*, known as isolates. Each isolate is then tested for its ability to grow on culture media in the presence of different concentrations of 10-12 antibiotics. Isolates showing different patterns of resistance represent different strains of *E. coli*. Each isolate is then frozen for subsequent use in DNA fingerprinting analysis. The fingerprinting analysis allows the MWMG to target resources to specific actions that address the *E. coli* of concern.

Education Materials
The MWMG has developed a variety of education and outreach materials as part of the public outreach campaign to bring attention to issues being addressed by the group. Education materials consist of newsletters, fact sheets, brochures, pamphlets, signs, as well as public presentations. Materials have been provided to libraries, schools, community groups, civic organizations, and to more than 400 people currently on the MWMG mailing list. Public presentations have been provided to environmental commissions, planning boards, municipal officials, civic organizations, business leaders, and a variety of community groups. Through these activities, the MWMG has received positive press

about their planning efforts and have been featured in several local newspaper articles.

GLOSSARY

Aquaculture - commercial raising and production of fish or shellfish

Aquifer - a water-bearing geologic formation, sometimes confined between clay layers and sometimes on the surface. The source of ground water for drinking, irrigation, wetlands, and estuaries.

Base Flow- the flow of a stream that occurs during periods when there is no runoff to the stream from a precipitation event.

Benthos - the assemblage of plants and/or animals living on the bottom of a body of water.

Best Management Practice (BMP) - refers to the practice considered most effective to achieve a specific desired result for protection of water, air and land and to control the release of toxins.

Buffer - a strip of native plants, trees, and shrubs adjacent to water bodies.

Coastal Area Facilities Review Act (CAFRA) - passed by the NJ Legislature to regulate development within a specific geographic coastal zone. CAFRA II amended the original act in 1993 to address single units of development near coastal waters and coordinate CAFRA Regulations with the State Plan.

Creel - the maximum number of fish allowed by law to be caught on a given day.

Coastal Zone Management Act (CZMA) - National Oceanographic and Atmospheric Administration (NOAA) provides funding for implementation and sets standards (including prevention of nonpoint source pollution) for states to comply with when they develop a plan to protect their coastal areas. NJDEP uses CAFRA regulations to implement this program. NOAA reviews state implementation every 3 years.

Department of Community Affairs (DCA) - a state agency which oversees local government activity, housing, finances, etc.

Department of Environmental Protection (DEP) - a state agency charged with protection and preservation of natural resources and control of toxins in the natural environment.

Department of Transportation (DOT) - a state agency charged with development and maintenance of transportation infrastructure in New Jersey.

Easement - a contractual agreement between a property owner and another party whereby the property owner relinquishes his/her right, usually to build on the land, in exchange for monetary or tax compensation.

Environmental Protection Agency (EPA) - a federal body charged with responsibility for natural resource protection and oversight of the release of toxins and other threats to the environment.

Estuary - a water body where salt and fresh water meet resulting in brackish water. These areas usually have associated marshlands and are critical nursery and feeding habitat for a variety of marine species.

Eutrophication - the natural aging process of water bodies, by siltation and organic decomposition, which reduces both water volume and oxygen levels. Surface run-off or airborne deposition of nitrogen and phosphorus accelerate this process.

Fecal Coliform Bacteria - an organism that is a normal part of the digestive system. The organism is used as an indicator of whether sewage (fecal matter from humans or animals) and associated pathogens have entered a water body.

Flood Hazard Area - total stream and adjacent area periodically covered by overflow from the stream channel containing 1)the floodway which is the channel itself and portions of the immediately adjacent overbank that carry the major portion of flood flow, and 2) the flood fringe beyond it which is inundated to a lesser degree.

Flood Plain - nearly level area adjacent to a water body, subject to inundation under heavy rain or blockage conditions (overflow area).

Geographic Information Systems (GIS) - computer mapping tool capable of overlaying data for manipulation and display.

Groundwater - all water below the surface of the land.

Habitat - the place in which a plant or animal normally lives.

Heavy Metals - a group of metals that are highly reactive (tend to bind with sediments and do not degrade). Such metals are toxic to life and continuously pose a threat because of resuspension.

Hydrologic - of or having to do with the properties or circulation of water on land, in groundwater or in the atmosphere.

Hypoxic - water having little dissolved oxygen (<3mg/L).

Impervious Surface - any surface through which rainfall cannot pass or be effectively absorbed such as roads, buildings, paved parking lots, sidewalks, etc.

Indigenous - native

Infrastructure - roads, schools, utilities, public facilities and other public services associated with development.

Invasive Species - plant or animal species whose growth or numbers become excessive and can hinder the functioning of an ecosystem.

Mitigation - process or projects replacing lost or degraded resources, such as wetlands or habitat, at another location.

Native Species - plants and animals naturally found in a particular region.

Nitrates - a form of the nutrient nitrogen that is readily absorbed by plants.

Nonpoint Source (NPS) - a diffuse source of pollution coming from land such as stormwater runoff and atmospheric deposition.

Nuisance Species - plants and animals having a negative impact on the natural environment

Nutrients - essential chemicals needed by plants and animals for growth. Excessive amounts of nutrients can lead to degradation of water (see eutrophication).

Organic - any chemical compound that is based on carbon.

Pathogen - disease-causing micro-organism including viruses, fungi and many bacteria.

Personal Water Craft (PWC) - often called by the brand name, Jetski, a one or two man, gas-powered vessel run by water propulsion.

Point Source - direct source of pollution such as waste water coming from a pipe or ditch.

Purchase of Development Rights (PDR) - the monetary compensation of a property owner in exchange for keeping a given property development-free.

Recharge - water that moves from the land surface through the soil to become ground water.

Residential Site Improvement Standards (RSIS) - a body of development rules, promulgated by DCA, that delineates infrastructure requirements for new residential areas. (Road widths, sidewalks, type of materials used, etc.)

Riparian - the natural land area adjacent to a river, stream, lake, or bay.

Runoff - the water that flows off the surface of the land, ultimately into streams and water bodies,

without being absorbed into the soil.

Safe Yield- the yield maintainable by a water system continuously throughout a repetition of the most severe drought of record, after compliance with requirements of maintaining minimum passing flows, assuming no significant changes in upstream or upgradient depletive withdrawals.

Siltation - process by which loose soil is transferred and builds up in streams, rivers, and lakes, causing changes in stream channels and in depth. It may result in filling in an area and/or causing flooding.

Spartina - common saltmarsh grass

Stormwater Runoff - water that moves across the surface of the land and empties into a body of water.

Stream Corridor - the area (containing wetlands, floodplains, woodlands, unique habitats, and steep slopes) which lies between relatively level uplands and stream banks and through which water, draining from the uplands, flows and is naturally cleansed and stored. Base flow for streams comes from ground water as springs and seeps.

Submerged Aquatic Vegetation (SAV) - aquatic vascular plants; often referred to as seagrasses.

Subwatershed - a small watershed within a larger watershed (i.e., Brielle subwatershed or drainage basin within the larger Manasquan watershed).

Sustainability - in a manner which ensures land and water resources will be able to meet the demands of humans in the future.

Sustainable Yields - the ability to continue to sustain profitable harvests from the land or water (usually in reference to farming or fishing practices).

Surface Runoff - water the flows over the land surface.

Tidal Wetland - a land area which is wet throughout most of the year as a result of tidal influences.

Total Maximum Daily Load (TMDL) - Total Maximum Daily Loads represent the assimilative or carrying capacity of the receiving water, taking into consideration point and nonpoint sources of pollution, as well as surface water withdrawals.

Transfer Development Rights (TDR) - a property owner's giving up of development rights on a piece of land in exchange for compensation.

Turbidity - a measure of the amount of material suspended in the water.

United States Geological Survey (USGS) - a federal agency which provides mapping of topography, aquifer levels, and areas where aquifers are recharged.

Watershed - the geographic area which drains into a specific body of water. A watershed may contain several sub-watersheds.

Wetlands - area having specific hydric soil and water table characteristics supporting or capable of supporting wetlands vegetation.

ACRONYMS

ACOE	Army Corps of Engineers
AMNET	Ambient Biomonitoring Network
ANJEC	Association of New Jersey Environmental Commissions
ASMFC	Atlantic States Marine Fisheries Commission
BCC	Brookdale Community College
BMP	Best Management Practice
CAFRA	Coastal Area Facilities Review Act
CH	Cultural Heritage
CWA	Clean Water Act
CZM	Coastal Zone Management
DCA	Department of Community Affairs
DGW	Discharge to Groundwater
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
DOT	Department of Transportation
DSW	Discharge to Surface Water
DW	Drinking Water Quantity & Quality
EPA	Environmental Protection Agency
ERI	Environmental Resource Inventory NRI
ESA	Endangered Species Act
FEMA	Federal Emergency Management Act
FM	Fishery Management
FSCD	Freehold Soil Conservation District
GIS	Geographic Information System
GPS	Global Positioning System
HP	Habitat Protection
IDI	Index of Biotic Integrity
IPM	Integrated Pest Management
LWV	League of Women Voters
MCADB	Monmouth County Agriculture Development Board
MCDH	Monmouth County Department of Health
MCGIS	Monmouth County Geographic Information Systems
MCMEC	Monmouth County Mosquito Extermination Commission
MCPB	Monmouth County Planning Board
MCPS	Monmouth County Park System
MCPWE	Monmouth County Public Works and Engineering
MCSTC	Monmouth County Shade Tree Commission
MCWRA	Monmouth County Water Resources Association
MLUL	Municipal Land Use Law

MOU	Memorandum of Understanding
MRRSA	Manasquan River Regional Sewerage Authority
MTA	Marine Trades Association
MU	Monmouth University
MUN	Municipalities
MWMG	Manasquan Watershed Management Group
NEPPS	National Environmental Performance Partnership System
NFIP	National Flood Insurance Program
NGO	non-governmental organization
NJBRC	New Jersey Boat Regulation Commission
NJDAG	New Jersey Department of Agriculture
NJDAT	New Jersey Department of Assessment and Taxation
NJDEC	New Jersey Department of Community Affairs
NJDEP	New Jersey Department of Environmental Protection
NJDEP-BCE	Bureau of Coastal Engineering
NJDEP-BFBM	Bureau of Freshwater and Biological Monitoring
NJDEP-BMWM	Bureau of Marine Water Monitoring
NJDEP-DFW	Division of Fish and Wildlife
NJDEP-DPF	Division of Parks and Forestry
NJDEP-DWM	Division of Watershed Management
NJDEP-DWQ	Division of Water Quality
NJDEP-LURP	Land Use Regulation Program
NJDEP-SRP	Site Remediation Program
NJDEP-WSE	Water Supply Element
NJGS	New Jersey Geological Survey
NJSP-MD	New Jersey State Police - Marine Division
NJPDES	New Jersey Pollutant Discharge Elimination System
NJWSA	New Jersey Water Supply Authority
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NPDES	National Pollutant Discharge Elimination System
NRI	Natural Resource Inventory
NPS	Non-point Source
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
OCDH	Ocean County Department of Health
OCPB	Ocean County Planning Board
OCPS	Ocean County Park Service
PDR	Purchase Development Rights
PWC	Personal Water Craft

RCE-ARMD	Rutgers Cooperative Extension - Agriculture & Resource Mgmt. Dept.
RFP	Request for Proposals
RSIS	Residential Site Improvement Standards
SAV	Submerged Aquatic Vegetation
SBA	Shore Builders Association
SDRP	State Development and Redevelopment Plan
SGP	Sea Grant Program at Rutgers
SRF	State Revolving Fund
SWAP	Source Water Assessment Plan
TBD	To Be Determined
TDR	Transfer Development Rights
TEA-21	Transportation Efficiency Act
TES	Threatened and Endangered Species
TMDL	Total Maximum Daily Load
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USDOC	United States Department of Commerce
USDOD	United States Department of Defense
USDOI	United States Department of Interior
USDOT	United States Department of Transportation
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTL	Utilities
WER	Within Existing Resources
WMA	Watershed Management Area
WSA	Water and Sewer Authorities
WWTP	Waste Water Treatment Plant