

Mapping & Characterizing the Natural & Cultural Resources of the Delaware Bayshore Region

SPATIAL DATA REPORT

Aaron A. Love & Richard G. Lathrop, Jr.

Grant F. Walton Center for Remote
Sensing & Spatial Analysis, Rutgers University

in partnership with the

South Jersey Bayshore Coalition

July 2007



TABLE OF CONTENTS

I. Introduction: Mapping and Characterizing the Natural & Cultural Resources of the Delaware Bayshore Region.....	1
II. Data Overview: Themes, Layer Descriptions, and Sources	
<i>Basemap and Reference</i>	
Coastline	3
Hydrography	3
Administrative Boundaries.....	3
Roads	3
<i>Land Use/Land Cover</i>	
2002 Land Use/Land Cover Update	4
2002 Estimated Impervious Surface Cover	5
<i>Agricultural Resources</i>	
State & County Preserved Farmland	6
2002 Active Agricultural Lands.....	7
Agricultural Development Zones.....	7
NRCS Farmland Soils Classifications	8
<i>Estuarine Zone</i>	
Tidal Wetlands & Tidal Waters.....	9
National Wetlands Inventory -- Estuarine & Marine Habitats.....	10
Shellfish Lease & Seed Beds.....	10
Anadromous Spawning Extents & Migratory Impediments.....	11
Colonial Waterbird Nesting Sites.....	11
Horseshoe Crab Spawning Habitat.....	12
Delaware Bay Bathymetry	12
<i>Habitat & Biodiversity</i>	
NJDEP Endangered & Nongame Species Program Landscape Data.....	13
NJAS Important Bird Areas.....	14
TNC Matrix & Umbrella Habitat Blocks	15
Natural Heritage Database Priority Sites	15
Natural Heritage Database Rare Plants & Ecological Communities.....	16
NJ Habitat Incentive Team Grassland Habitat Focal Analysis.....	17
<i>Water Resources</i>	
2002 Surface Waters	18
NJDEP Surface Water Quality Classifications.....	19

NJGS Estimated Ground Water Recharge Rates	20
NJGS Ground Water Aquifers and Confining Units.....	20
NJGS Aquifer Recharge Potential.....	21
NJGS Public-community Water-supply Wells.....	22
NJGS Well Head Protection Areas	22
NJDEP Water Supply Critical Areas	23
 <i>Historic & Cultural Resources</i>	
NJ and National Registers of Historic Places GIS Database	24
NPS Coastal Heritage Trail Sites.....	25
 <i>Open Space Inventory</i>	
Federal & Utilities Preserved Open Space	26
Non-profit Conservation Properties.....	26
New Jersey State-owned Open Space	27
County and Municipal Open Space.....	27
NJAS Delaware Bayshore Birding & Wildlife Trails.....	28
 <i>Planning Resources</i>	
State Pinelands Management Area.....	29
Coastal Area Facilities Review Act	29
State Sewer Service Areas.....	30
 III. GIS Data Source Citations.....	 31
 IV. Acknowledgements	 34
 Appendix A: Bayshore Thematic Map Series	
<i>(1) Basemap</i>	
Bayshore Region Basemap	36
<i>(2) Land Use/Land Cover</i>	
Level 1 Land Cover (2002)	37
<i>(3) Agricultural Resources</i>	
Preserved Farmland (2007)	38
Farmland Soils	39

(4) <i>Estuarine Zone</i>	
Estuarine Habitats	40
Horseshoe Crab & Colonial Waterbirds Habitat.....	41
(5) <i>Biodiversity & Wildlife Habitat</i>	
Landscape Project Habitat Rankings.....	42
Natural Heritage Database Priority Conservation Sites.....	43
Natural Heritage Database Rare Plants & Critical Communities Sites.....	44
Nature Conservancy Matrix Blocks & NJ Audubon Society Important Bird Areas.....	45
(6) <i>Freshwater Resources</i>	
Ground Water Aquifers & Critical Supply Zones.....	46
Well Head Protection Areas.....	47
Surface Waters.....	48
Ground Water Recharge Rankings.....	49
Aquifer Recharge Potential.....	50
(7) <i>Historic & Cultural Resources</i>	
Bayshore Historic Places.....	51
Coastal Heritage Trail Sites.....	52
Preserved Open Space	53
(8) <i>Planning & Administrative</i>	
Surface Water Quality Standards & Regional Planning Jurisdictions.....	54
State Sewer Service Areas.....	55

I. Mapping & Characterizing the Natural & Cultural Resources of the Delaware Bayshore Region

INTRODUCTION

This document describes the digital map data compiled at the Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA) at Rutgers University in support of the South Jersey Bayshore Coalition's ongoing resource protection and sustainable development initiatives. These data sets describe land cover features, land use and agricultural resources, natural resources, water resources, wildlife habitat, historic landmarks, and administrative and planning designations. Data were gathered from federal, state, and local government offices, as well as non-profit conservation organizations. Some data were created at CRSSA for this project.

The data were created and compiled in ESRI geographic information system (GIS) software, and are distributed in ESRI ArcGIS formats. Vector data are distributed as shapefiles and raster data sets in ESRI-compatible grids. Data sets are provided with FGDC-compliant metadata in XML and TXT formats.

The following pages provide browse graphics and individual synopses for each data set. For full metadata information consult the associated metadata files. Data sets are grouped thematically in eight categories:

- (1) Basemap and reference layers;
- (2) Land use/land cover layers;
- (3) Agricultural resources;
- (4) Habitat & biodiversity layers;
- (5) Water resources;
- (6) Historic & cultural resources;
- (7) Open space inventory;
- (8) Planning layers.

An appendix to this report includes the map series produced at CRSSA to accompany the data inventory. Twenty poster-sized thematic maps show all of the inventory layers for the Bayshore region.

BACKGROUND

The Delaware Bayshore study area covers 1,200 square miles in the southern New Jersey counties of Cape May, Cumberland, Gloucester, and Salem. The region extends inland to the upper reaches of the Maurice River and its tributaries, and is delimited by the watersheds that drain southwest into the Delaware River and Bay. West of the Bayshore area, river drainages lead to the Atlantic coastal bays and the ocean.

The northern half of the Bayshore region lies in the inner coastal plain, an area of rich agricultural soils that have shaped the region's largely rural development. Southern New Jersey produces a wide variety of vegetable, fruit, and field crops on thousands of acres of farmland. Soils in the outer coastal plain, covering the lower half of the Bayshore region, are

generally droughty and relatively sterile. Here farmland gives way to the mixed pine and oak forests of the southern Pine Barrens. Estuarine salt marshes border the shores of the Delaware Bay as far inland as three miles in many areas. These marshes are some of the most biologically productive ecosystems in the world, supporting a host of regional and migratory species. Underlying the entire region are essential ground water aquifers tapped by hundreds of public community water supply wells. The aquifers also feed streams, lakes, and freshwater wetlands where the water table reaches the surface.

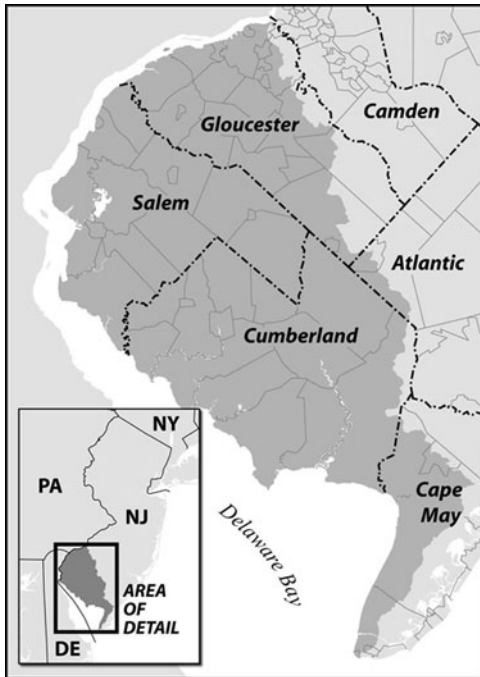


Figure 1: The South Jersey Bayshore region.

The South Jersey Bayshore Coalition is an alliance of nonprofit planning and conservation organizations concerned with preserving all of these resources in the Bayshore region. The Coalition's goal is to ensure the protection of the Bayshore's natural and cultural resources through farmland and open space preservation, historic sites protection, habitat conservation, and sustainable growth planning. In support of this goal the Coalition received a grant from the William Penn Foundation to promote the public interest in long-term natural resource protection and sustainable development in the Bayshore region by establishing and supporting local environmental commissions and by educating local officials and citizens.

This grant supported a region resources inventory conducted in partnership with the Center for Remote Sensing. Using a geographic information system (GIS) CRSSA has developed a database of digital map data that catalogs natural and cultural resources of the Bayshore. This digital data, as well as a series of print maps, will be publicly available to users through the world-wide-web, and will be distributed among the Coalition members for their use in their planning and advocacy efforts. Twenty poster-sized maps comprise the thematic map series that make the data immediately available to users without GIS software and expertise. The digital data can be used in a GIS for sophisticated spatial analysis and custom mapmaking, and will also be available in a web-browser application for general public access.

II. Data Overview: Themes, Layer Descriptions, & Sources

BASEMAP LAYERS

Basemap layers are included in the inventory to provide a geographical context for the natural and cultural resources data.



NJDEP Administrative Boundaries; 2002 Hydrography; 2002 Shoreline

County and municipal data layers are supplied by NJDEP. Boundaries were originally mapped from USGS topographic maps and orthorectified aerial imagery by NJDEP. Subsequent editing to correct mapping errors has been done using commercial reference maps and, in some cases, local parcel records.

Hydrography layers were downloaded from NJDEP in 2007. Streams are mapped from the DEP's surface water quality standards (SWQS) data set. Surface water polygons were extracted from the NJDEP 2002 Land use/Land cover vector update data.

The 2002 shoreline was created at CRSSA using 2002 air photos. Shoreline data downloaded from NJDEP was overlaid on the high-resolution air photos and edited where shoreline features have changed.



Highways & Local Roads

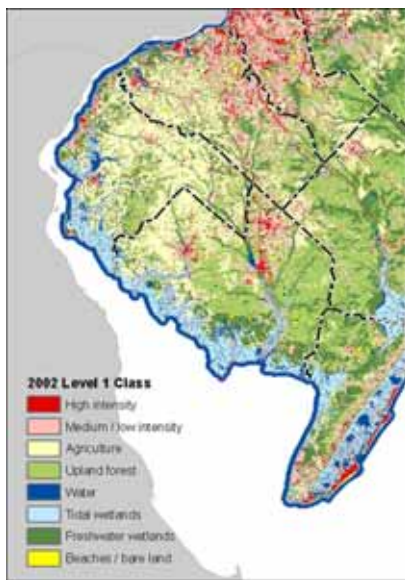
New Jersey roadways are mapped from NJDOT roads data published in 2007.

LAND USE/LAND COVER

Land cover describes the biophysical nature of the earth's surface, while **land use** classifications group landscape features that serve similar functions for human users. An area of grassland cover, for instance, could be used as a residential lawn, a cemetery, or a corporate office park. When used in combination land use and land cover data provide detailed information about landscape condition and processes affecting a particular place.

Land use/land cover (LU/LC) data is used as the basis for many natural resource and land planning projects. Time series data – i.e. LU/LC data collected for two or more different times – can provide important measures of landscape change, including how much area of a LU/LC class has been lost, how much gained, and which categories are most susceptible to change to a particular land use. Land cover data is important for habitat assessment, resource mapping, and for creating derived products like ground water recharge zones.

Standardized classification systems have been developed in a hierarchical manner: a Level 1 classification can be subdivided into categories of increasing specificity to suit project aims. The New Jersey Department of Environmental Protection (NJDEP) 2002 LU/LC data included in the GIS inventory is mapped to more than 70 Level 3/Level 4 classes, showing features down to 1 acre in size. This is a flexible baseline dataset that provides the specificity required for habitat analysis, but which can be aggregated to broader classes for cartographic representation.



2002 NJDEP Land Cover Data

The Bayshore region is characterized by great expanses of unbroken tidal marshes abutted by scrubby wetland forest and rich agricultural soils. The wide range of environments in this region is characterized by more than 70 categories in the NJDEP 2002 land use/land cover (LU/LC) data.

Land LU/LC cover data was mapped from the NJDEP 2002 vector LU/LC update released in January, 2007 for the entire state. Three land cover products have been prepared for the Bayshore project:

1. Level I -- 30 meter resolution data maps 8 general land cover classes for regional-scale analysis. This data was rasterized from the 2002 vector classification.

2. Level II -- 10 meter resolution data incorporates basic land use distinctions (i.e. residential vs. commercial vs. industrial) and is useful for quick mapmaking and general viewing.

3. The original Level III / IV vector data has been aggregated for the entire Bayshore area from individual Watershed Management Areas (WMAs).

The 2002 NJDEP LU/LC vector data was created by comparing the 1995/97 LU/LC layer from NJDEP's geographical information systems (GIS) database to 2002 1 foot resolution color infrared (CIR) imagery and delineating areas of change. Minimum mapping unit (MMU) is 1 acre.



2002 Estimate Impervious Surface Cover

Impervious surface coverage was extracted from the NJDEP 2002 LU/LC data and rasterized for easier use at 10 meter grid cell resolution. Values for each 10 meter cell represent the averaged impervious cover, in square meters, for a 100 square meter area. Values therefore represent both the total cover (in m²) and the average percent cover for the corresponding ground area.

From visual inspection of homogenous land use polygons, any build up and/or paved surfaces were considered to be impervious, and the percent impervious coverage for the polygon was estimated in 5% increments. Highly developed areas such as multi-lane highways and industrial complexes are close or equal to 100% impervious. Medium- to low-density development characteristic of residential areas is lower – generally between 5 and 40% impervious. Forests, wetlands, and other undisturbed landscapes, as well as urban grasslands, have no impervious cover.

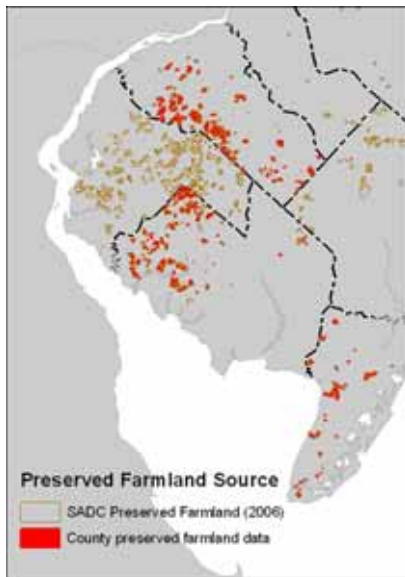
Increasing impervious coverage within a watershed can be seen in declining environmental quality. As hard surfaces replace porous natural cover, watershed flooding frequency and intensity increase with erosion rates. Ground water recharge areas are lost, and non-point source water contamination increases. These direct effects of land cover conversion to impervious surface have cumulative negative consequences for drinking water supply and quality, habitat health and structure, and species biodiversity. Impervious surface coverage may be used as a more direct measure of human impact on the landscape than land use data alone.

Potential uses of this dataset include impervious coverage calculations by watershed zones as a measure of ecological integrity: disturbed watershed with greater relative impervious coverage represent areas prone to more frequent and more severe flooding due to loss of recharge area. Impervious surface is also a good measure of total built versus 'natural' or vegetated area because it takes into account areas of natural cover within an urban or suburban matrix.

AGRICULTURAL RESOURCES

The following data layers describe the Bayshore's characteristic agricultural landscape. The farmland soils of Gloucester, Salem, and Cumberland counties are considered some of the best in the state. These areas were cleared shortly after European settlers arrived more than 300 years ago and have been farmed continuously since. Bayshore soils support a variety of crops, from field grains to vegetables and fruit orchards. For nearly as long this produce has been sold in the markets of the region's metropolitan neighbors.

But high costs, development pressures, and dwindling interest in agriculture have taken a toll on the Garden State. Much of the rich farmland in the northern Piedmont region has succumbed to suburban development as Philadelphia and New York expanded towards each other. There is now a continuous urban belt across the state. The state and local governments began pushing aggressively to save the remaining farms on the western side of the Bayshore area. Comprehensive farmland preservation programs, offering a number of options to farmers, have been adopted jointly by the State and counties. The layers below show the record of this work, and what remains to be done.



Preserved Farmland

Farmland preservation is a special form of open space preservation that allows operating farms to remain in the hands of farmers while development rights for the property have been temporarily or permanently purchased. The program, which receives support from the State and local governments, and from non-profit conservation organizations, offers financial incentives to farmers to keep farmland under cultivation and protected from development.

Farmland is usually preserved in one of four ways. Landowners who want to continue farming their land can sell their development easements. When landowners sell development easements, they still own their land but sell the rights to develop it for anything other than agriculture. Those deed restrictions remain in force for any future owners. Some farmers and landowners may want to donate the development rights for all or a portion of the land they own.

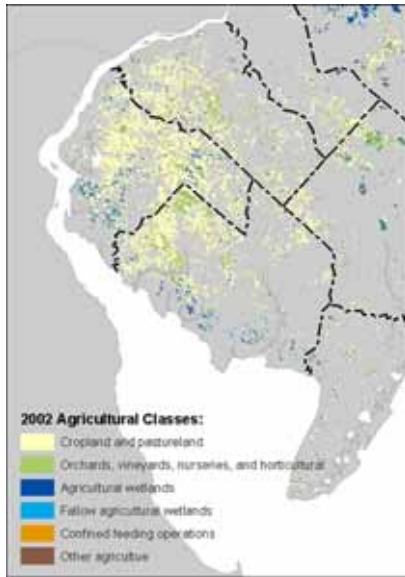
If a landowner wants to sell a farm outright, the State Agriculture Development Committee (SADC) can purchase it at fair-market value under its fee simple program. The SADC then auctions the farm to a private owner with agricultural deed restrictions in place that ensure its permanent preservation. This option also provides other farmers with opportunities to purchase land at reasonable prices that reflect only farmland values, not development potential.

Finally, landowners can choose to voluntarily restrict development on their land for a period of eight years. Although landowners receive no payment for this, they are eligible to apply for cost-sharing grants for soil and water conservation projects, as well as for the Farmland Preservation Program's other benefits and protections.

Preserved farmland parcels are mapped from several sources. County data was supplied by the Cape May, Cumberland, and Gloucester County planning departments. Salem County farmland preservation data was in draft form and unavailable for the GIS inventory. These data sets include conservation easements and fee-simple purchases. Data are current for various dates (by county) between 2005 and 2007.

The SADC preserved farmland GIS data set is current through January 2007 and includes SADC, county, and non-profit easements, purchases, donations, and 8-year preservation properties

(Farmland preservation methods summarized from SADC materials)



Active Agricultural Lands

The following agricultural classes were extracted from the NJDEP 2002 LU/LC vector data to map actively cultivated land:

- 2100 – Cropland and pastureland;
- 2140 – Agricultural wetlands (cranberry farms & modified uplands);
- 2150 – Former agricultural wetlands (becoming shrubby not built-up);
- 2200 – Orchards, vineyards, nurseries, horticultural areas, sod farms;
- 2300 – Confined feeding operations;
- 2400 – Other agriculture.

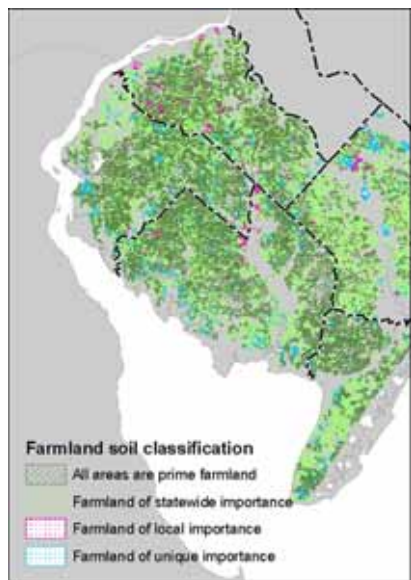


Agricultural Development Zones

(These data sets have not been approved for public distribution by their originators)

Agricultural development areas are zones within a county where agriculture is the preferred – though not exclusive – land use. County Agriculture Development Boards (CADB) delimit the boundaries of ADAs to encourage long-term farmland preservation efforts. The CADBs consider factors like the extent of high-quality agricultural soils, existing zoning and concentrations of existing farmland when drawing ADAs, which are then certified by the State Agriculture Development Committee (SADC). A farm's inclusion within an ADA is a standard prerequisite for funding eligibility under the SADC's farmland preservation protocol.

ADAs for Cumberland and Salem were provided by county planning officials. Cape May ADAs were digitized from a scanned survey map provided by the Cape May Planning Department – these designations have not been verified by the County. All of Gloucester County is classified as an ADA.



NRCS Farmland Soils Classifications

Farmland soils classifications for the New Jersey Bayshore counties of Atlantic, Cape May, Cumberland, Gloucester, and Salem were mapped from the National Resource Conservation Service (NRCS) Soil Survey Geographic (SSURGO) county GIS databases. Four NRCS farmland soils classifications are mapped: prime farmland soils, soils of statewide importance, farmland of local importance, and unique farmland. These designations reflect the suitability of different soils types for the cultivation of a wide variety of crops, and are determined by NRCS.

The NRCS farmland soils classifications are used for farmland appraisals by the State Agriculture Development Committee (SADC) to evaluate farmland qualification and priority for preservation purchases and easements. NRCS SSURGO data are the SADC standard for appraisals.

This data set was compiled as part of the Delaware Bayshore GIS inventory of natural and cultural themes for the South Jersey Bayshore Coalition. The GIS inventory centralizes important spatial data sets for the Bayshore watersheds that pertain to a wide variety of different planning tasks. The inventory includes many land use, natural resources, historic, cultural, and administrative themes.

1. Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops and is also available for these uses. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed according to acceptable farming methods, Prime Farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.

2. Soils of State Importance are nearly Prime Farmland and economically produce high yields of crops when treated and managed according to acceptable farming methods, Some may produce yields as high as Prime Farmland if conditions are favorable.

3. Farmland of local importance includes those soils that are not prime or statewide importance and are used for the production of high value food, fiber or horticultural crops.

4. Unique soils qualify as significant farmland if being used for special crops.

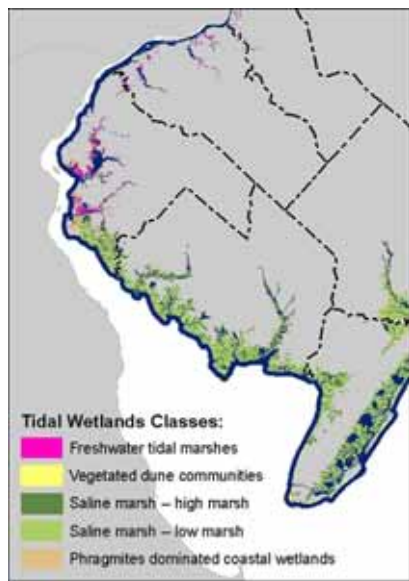
Prime farmland and farmland of state significance was extracted directly from the NRCS SSURGO data using the 'MAPUNIT' table associated with the spatial database. Unique soils were extracted from the NRCS SSURGO data and clipped to actively cultivated areas using the New Jersey Department of Environmental Protection (NJDEP) 2002 vector land use data. Unique soils do not qualify unless used for special crops. Clipping the data masks out large areas of that do not qualify for the designation.

Farmland of local importance was mapped from several sources. Due to varying designations between the NRCS, SADC, and county sources, all soil types listed by these sources are included in this database. As with the 'Unique soils' data, these areas have been mapped only on where currently farmed. See the layer metadata for specific classification types.

ESTUARINE HABITAT LAYERS

Estuarine systems consist of tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean. In the estuarine zone ocean water is at least occasionally diluted by freshwater runoff from the land. Offshore areas with typical estuarine plants and animals are also included. The marine system consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the water regimes are determined primarily by the ebb and flow of oceanic tides.

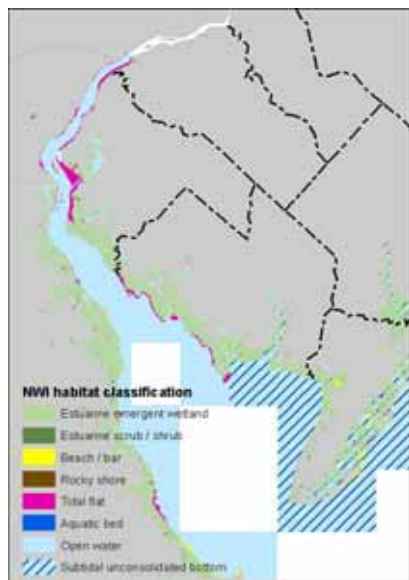
Estuarine communities are among the most productive ecosystems in the world. In the Bayshore region they provide invaluable habitat for many regional and migratory species, from the transcontinental red knots to horseshoe crabs and anadromous American shad. Many stretches of the Bayshore's extensive tidal wetlands are already protected as wildlife refuges and other public lands. The estuarine zone also provides a buffer against coastal storms that can bring devastating floods with tidal surges.



Tidal Wetlands & Tidal Waters

The following tidal wetlands classes were extracted from the NJDEP 2002 LU/LC vector data:

- 6111 - Saline marsh (low marsh)
- 6112 - Saline marsh (high marsh)
- 6120 - Freshwater tidal marshes
- 6130 - Vegetated dune communities
- 6141 - Phragmites dominated coastal wetlands



National Wetlands Inventory (NWI) Estuarine & Marine Habitats

NWI habitat classifications for the estuarine and marine zones were extracted to complement 2002 land cover classifications. The strength of the NWI data is in its comprehensive scope – the NWI includes many tidal and subtidal habitat types that are not mapped in standard land cover classifications.

NWI digital data files are records of wetlands location and classification as developed by the U.S. Fish & Wildlife Service. The purpose of this survey was not to map all wetlands and deepwater habitats of the United States, but rather to use aerial photointerpretation techniques to produce thematic maps that show, in most cases, the larger ones and types that can be identified by such techniques. The objective was to provide better geospatial information on wetlands than found on the U.S. Geological Survey topographic maps. It was not the intent of the NWI to produce maps that show exact wetland boundaries comparable to boundaries

derived from ground surveys. Boundaries are therefore generalized in most cases.

This data was mosaiced at CRSSA from the original quad-based vector files. Estuarine and marine system polygons were extracted for Delaware Bay. (System descriptions are excerpted from Cowardin et al., “Classification of Wetlands and Deepwater habitats of the United States,” USFWS, 1978.)



Shellfish Beds (Delaware Bay)

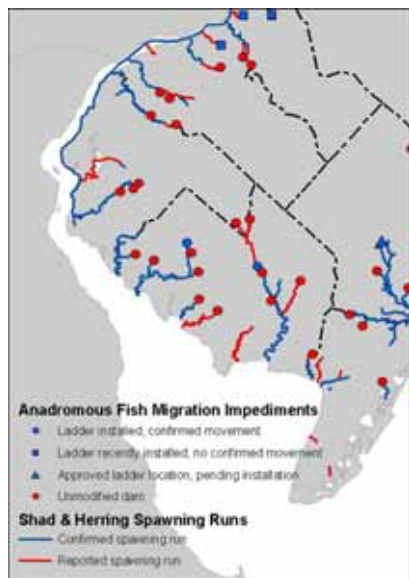
(This data set has not been approved for public distribution by the originator)

These datasets show the general area of shellfish leases and oyster seed beds off the New Jersey coast in the Delaware Bay. The Bureau of Shellfisheries of the NJDEP Division of Fish and Wildlife administers the shellfish leasing program which supports private aquaculture activities via the leasing of bay bottom for shellfish culture. Statewide, approximately 30,000 acres of bay bottom are currently leased by commercial interests, primarily for the culture of oysters and hard clams.

Since the 19th century seedbeds have been used by the shellfish industry to raise oysters from seed to transplant to growing beds further south in the Delaware Bay where salinity levels are higher. Oysters grow faster and reach a larger size in the southern beds, but low recruitment and the prevalence of oyster diseases like MSX and

Dermo make the southern area of the Bay less suitable for seed oysters.

This data was provided by the Bureau of Shellfisheries and does not represent the full extent of naturally productive shellfish beds. Naturally productive areas are not leased because the bureau and the Atlantic Coast Shellfish Council (empowered by statute to grant shellfish leases) want these areas to remain open for all shellfishers to use. Besides the active shellfish industry in Delaware Bay, recreational and commercial shellfishing is common in New Jersey’s back bays, and in Raritan Bay.



Anadromous Spawning Extents & Migratory Impediments

This data set contains selected rivers and streams where river herring (alewife and blueback) and American shad have been documented or reported to spawn according to year 2005 published data from the NJDEP Bureau of Freshwater Fisheries. Listed impediments to the spawning migration of anadromous fish, as well as locations of proposed and existing fish ladders, in the state's freshwaters are listed in a second point file. River and stream segments are delineated to an upper spawning extent corresponding to a migratory impediment or the furthest confirmed or reported usage by the migratory species.

Spawning habitat for these and other anadromous fish species declined as migratory impediments, mostly in the form of dams, were built on NJ streams and rivers, preventing the upstream migration of fish during the breeding season in the spring. Particularly on large rivers, dams have been fitted with fish passage devices like fish

ladders to allow migrating fish to bypass dams and reach upstream spawning grounds.

This data set was created at CRSSA from published descriptions of locations and extents and using NJDEP state rivers GIS data and USGS topographic maps to delineate migratory limits. The data was mapped in segments according to confirmed or reported status up to a listed barrier or upper extent, typically an impediment like a dam or a road.

These layers were compiled for the entire state. Attribute information for fish ladders and spawning extents included in this data set is current as of 2005, the date of publication of the mapped data, and may not be complete. It is noted and emphasized that all unlisted waters in coastal drainages have the potential to support anadromous fishes up to the first upstream barrier where suitable habitat is available.

It is noted and emphasized that all unlisted waters in coastal drainages have the potential to support anadromous fishes up to the first upstream barrier where suitable habitat is available.



Colonial Waterbird Nesting Sites

This data set contains reported nesting locations for beach nesters, long-legged waders, and terns and skimmers along New Jersey's coastal marshes and beaches. These areas represent critical habitat for threatened and endangered colonial nesting species, including piping plovers, black skimmers, and several varieties of terns.

The data was compiled from Endangered and Nongame Species Program (ENSP) datasets, including version 2.0 of the Landscape Project habitat files; from surveys completed for habitat studies in Barnegat Bay by Rutgers University researchers; and from surveys conducted by NJDEP ENSP biologists.



Horseshoe Crab Spawning Habitat

The CRSSA Delaware Bayshore Horseshoe Crab Spawning Habitat Mapping Project consisted of an inventory of the Delaware and New Jersey shorelines of the Delaware Bay to assess the availability and spatial distribution of spawning habitat for horseshoe crabs (*Limulus polyphemus*). The CRSSA project classified the Bayshore's beaches into five categories of spawning habitat suitability: optimal, suitable, less suitable, avoided and disturbed. This dataset includes only the shoreline land cover polygons assessed as suitable or optimal spawning habitat on the New Jersey shore of Delaware Bay.

Habitat was classified by visual interpretation of high spatial resolution (1 meter or better) color/color infrared digital aerial photography acquired in 2002. Optimal and suitable habitat consists mainly of undisturbed sand beach with little or no peat. Less suitable habitat includes exposed peat in the lower and middle intertidal zone. For more information on these data go to:

<http://crssa.rutgers.edu/projects/delbay/>.



Coastal Bathymetry for the Delaware Bay

Shown at left is a 3 arc-second coastal relief grid from the National Geophysical Data Center (NGDC), NOAA Satellite and Information Service. The horizontal resolution of the grid cells is nominally 90 meters. The vertical resolution of the grid cells is bimodal: grid elevations of the onshore areas of the coastal zone are taken directly from the USGS/NIMA DEMs, which are resolved to one meter, whereas grid elevations in the offshore areas are resolved to one tenth of a meter.

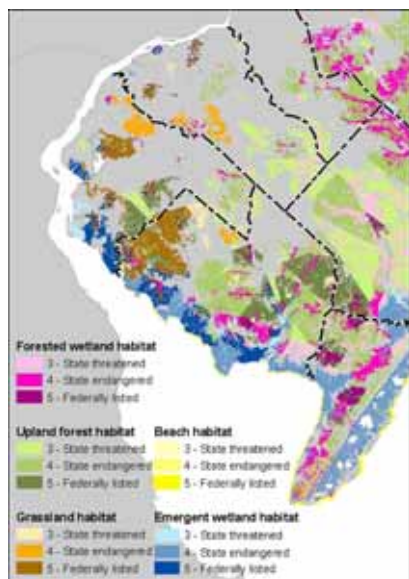
The vertical accuracy of the soundings is 0.3 m in 0 - 20 meters of water, 1.0 meter in 20 - 100 meters of water, and 1% of the water depth in 100 meters of water. The horizontal accuracy of the soundings is generally 30 meters, but it can vary from as fine as 15 m in ports and estuaries to as coarse as 75 meters in the offshore areas.

This dataset was mosaiced from 1° by 1° grids for US coastal waters distributed online by NOAA NGDC. Land elevations within the gridded dataset come from the United States Geological Survey/ National Image Mapping Agency (USGS/NIMA) 1:250,000 or 1° DEMs of the states. Water depth soundings are compiled from hydrographic surveys conducted by the National Ocean Service (NOS) and from various academic institutions. The surveys were carried out using a variety of sounding methods including 16- and 17-beam swath mapping systems, single-beam echosounders, and lead-line sounding method. These latter surveys date as far back as the late 1800's. See layer metadata for detailed process steps for grid creation from soundings and bathymetric maps.

BIODIVERSITY

Every species is dependent for survival on its habitat, its physical environment. As habitats shrink or become fragmented before continual urban and suburban growth species are displaced, or simply disappear. Biological diversity – or biodiversity – is a concept that encompasses both the variety of living organisms and the number of different ecosystems they inhabit. Negative human impacts on biodiversity through poorly planned development and land management are usually very difficult or impossible to reverse. Because we rely on New Jersey’s natural environment for food, clean air and water, and because we value the aesthetic and experiential benefits of the state’s wildlife and open spaces, it is critical that human growth be balanced by natural conservation and preservation efforts.

These biodiversity layers highlight valuable species habitat throughout the region, assessed by non-profit conservation organizations and NJDEP programs. Habitat regions are identified and ranked using species presence data, as well as habitat suitability models to identify known and suitable habitat. These layers are included as resources to help prioritize conservation acquisitions, for developing stewardship policies for existing preserved habitat, to guide regional planning efforts by identifying conservation priorities, to aid in regulatory processes, and for public citizens interested in wildlife advocacy.



NJDEP ENSP Landscape Project Habitat Layers

This data set is a product of the NJDEP Endangered and Nongame Species Program (ENSP) Landscape Project, a pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey.

The data was created by intersecting imperiled and priority species data with NJDEP 1995/97 land use/ land cover data. Each patch is coded for the number of sightings of priority, state threatened, state endangered and federally listed species present. These critical habitat maps were developed to provide users with peer-reviewed, scientifically-sound information. They have been designed for use by anyone, but especially individuals and agencies with the responsibility for making land-use decisions, i.e., municipal and county planners and local planning boards, state agencies, and natural resource and lands managers.

The goal of the Landscape Project is to protect large, contiguous blocks of forest, grassland and wetlands to assure the survival of imperiled species over the long-term. Small patches of fields, forests and wetlands interspersed with development provide habitat for common species that do well living near humans, but do not provide the necessary habitat for most of our imperiled wildlife, species that often require large contiguous tracts of habitat for survival.

Five habitat types are ranked: emergent wetlands, forests, grasslands, forested wetlands, and beaches. Rank 3, 4, and 5 habitat regions were extracted, identifying potential habitat for state threatened, state endangered, and federally listed species respectively.



NJAS Important Bird & Birding Areas

(This data set has not been approved for public distribution by NJAS)

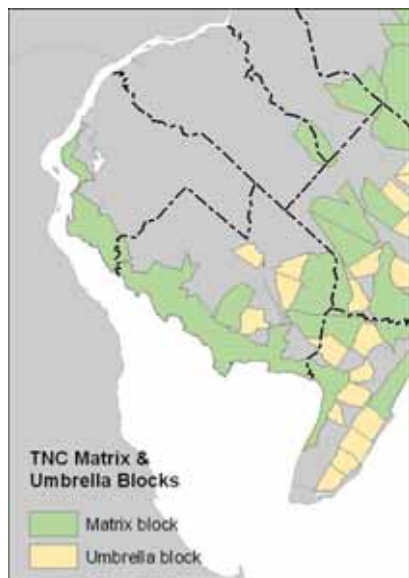
This data set includes Important Bird and Birding Areas (IBBAs) identified by the New Jersey chapter of the Audubon Society (NJAS). These are sites within New Jersey that provide essential habitat for birds (Important Bird Areas, or IBAs) or sites that are exceptional for bird watching. This data set includes only IBAs from the Delaware Bay, Atlantic Coastal, and Piedmont regions that intersect the South Jersey Bayshore Coalition GIS inventory area.

The Important Bird Areas Program is a global effort to identify and conserve areas that are vital to birds and other biodiversity. The program is overseen in the United States by the Audubon Society through its regional chapters. New Jersey Audubon Society, working closely with the New Jersey Endangered and Non-game Species Program and the National Audubon Society, has expanded the IBA initiative in NJ with the IBBA Program. This program identifies areas that provide essential habitats for sustaining bird populations (Bird Areas) as well as areas that are exceptional for bird watching (Birding Areas).

The objectives of the NJ IBBA Program include:

- (1) Identification of a network of sites that will help sustain naturally occurring populations of birds in NJ and sites which are exceptional for bird watching;
- (2) Ensuring the continued viability of these areas through conservation and ecotourism efforts;
- (3) Raising public awareness of the value of habitat for birds and other native wildlife;
- (4) Generating increased support for conservation by educating private industry, landowners, and other stakeholders about the economic and educational value of bird watching.

Nominated birding and habitat sites in New Jersey are verified by NJAS staff after assessments that consider each site's habitat value for regionally, nationally, and globally significant bird species. These final sites represent a variety of different habitat types and support a wide range of breeding, wintering and migrating species of birds.



TNC Matrix & Umbrella Sites

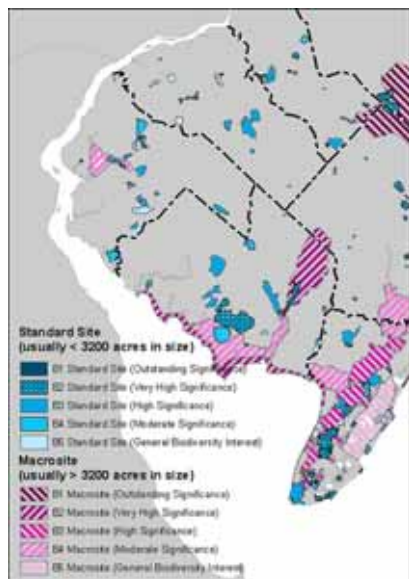
(This data set has not been approved for public distribution by TNC)

The Nature Conservancy (TNC) has identified large remaining habitat blocks in the Bayshore region that deserve priority conservation status. These large habitat areas, called matrix and umbrella blocks, were selected by analyzing land cover data to find contiguous natural land cover areas that remain overwhelmingly undeveloped and unbroken by large roads.

Matrix blocks generally describe natural areas of 10,000 acres or larger that are dominated by forest or marsh cover. The 10,000 acre threshold is based on an examination of the average size of large-scale natural disturbances (e.g. hurricanes) that occur in the eastern U.S. Scientists agree that if habitat areas were at least 10,000 acres then any natural disturbance would likely leave at least some portions of the area untouched, which could then serve as a refugia for the

affected zones.

Umbrella blocks are smaller than the matrix areas due to division of habitat by large roads and developed areas. They are almost entirely undeveloped regions of 4,250 acres or more. This threshold reflects the largest average acreage needed by one individual of any potential umbrella species in New Jersey. An umbrella species is an organism whose habitat requirements overlap those of a significant number of other species. Protecting this species thus provides an ‘umbrella benefit’ for many others.



Natural Heritage Database Priority Sites

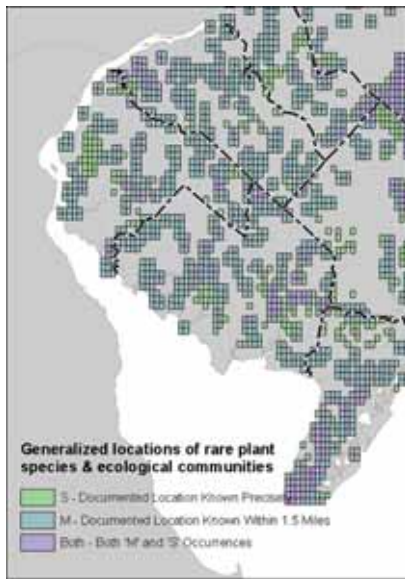
The Natural Heritage Priority Sites Coverage was created to identify the best habitats for rare plant and animal species and natural communities through analysis of information in the NJ Natural Heritage Database. Through this database, the Office of Natural Lands Management (ONLM) identifies critically important natural areas to conserve New Jersey's biological diversity. The database provides detailed, up-to-date information on rare species and natural communities to planners, developers, and conservation agencies for use in resource management, environmental impact assessment, and both public and private land protection efforts. Using the database, ONLM has developed this coverage of Natural Heritage Priority Sites that represent some of the best remaining habitat for rare species and exemplary natural communities in the state.

These areas are considered to be top priorities for the preservation of biological diversity in New Jersey. If these sites become degraded or destroyed, we may lose some of the unique components of our

natural heritage.

Each site is ranked according to its significance for biological diversity using a scale developed by The Nature Conservancy and the network of Natural Heritage Programs. The ranks can be used to distinguish between sites that are of global significance for conservation of biological diversity vs. those that are of state significance. The scale ranges from B1 to B5: sites ranked B1-B3 are generally of global significance; sites ranked B4-B5 are state-significant.

This data set was published by the NJDEP Office of Natural Lands Management in 2001.



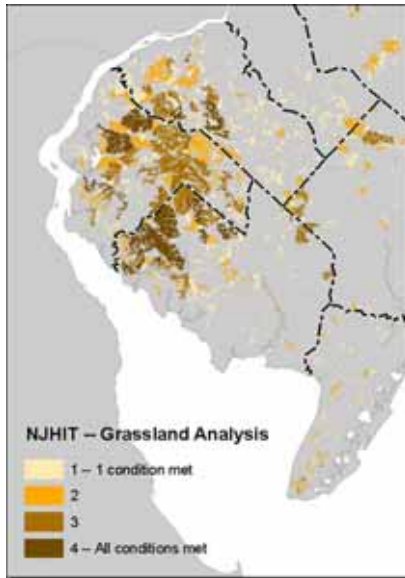
Natural Heritage Database Rare Plants & Ecological Communities

This data set provides a general portrayal of the geographic locations of rare plant species and ecological communities. It does not contain data for animal species. The Natural Heritage Grid Map was produced using computer-generated vector-based polygons that divide the boundary lines of each USGS 1:24,000 scale topographic map into 100 grid cells. If a rare plant species or ecological community has been documented from anywhere within a cell, the entire cell will be coded as containing an occurrence of a rare plant species/ecological community. An associated data table can be linked or related to the NHPGRID table in order to display information about the individual rare plant species/ecological community occurrences within any cell.

The Natural Heritage Grid Map was produced to provide a general portrayal of the geographic locations of rare plant species and ecological communities for the entire state without providing sensitive detailed information. By consulting the map, users can do broad scale analysis of potentially sensitive areas to determine the generalized location of rare plant species and ecological community occurrences.

The Natural Heritage Grid Map is not a complete record of rare and endangered plant species habitat. It reflects data on known occurrences of rare plant species and natural communities compiled in the Natural Heritage Database as of February 2004. It includes both historically and recently documented habitat. Two types of occurrence data are incorporated in this file - the location of some rare plant species or ecological community occurrences is precisely known, while for other occurrences the location is only known to within 1.5 miles.

This data set was published by the NJDEP Office of Natural Lands Management in 2004.



NJHIT Grassland Habitat Focal Analysis

In 2005, the ENSP performed an additional analysis of the Landscape Project Grassland Layer to not only identify the best remaining examples of agricultural grasslands in New Jersey but also to prioritize those areas with high restoration potential and conservation value. This new layer used Landscape's Conservation Rank as one of the four base variables. This analysis was conducted for the New Jersey Habitat Incentive Team (NJHIT), a coalition of private and public partners formed to promote conservation practices on private land. The NJHIT analysis further prioritized the patches coded with Conservation Ranks 1 -5 with a set of four variables. Patches are displayed, or valued, by the total number of the four variables they are coded for. The four variables selected are as follows.

1. 202 ha (500 ac) grassland -- Patches are coded yes/no if they meet the minimum size of 202 contiguous hectares (500 acres);

2. 0.4 km (0.25 mi) to open space -- Patches are coded yes/no if they are within 0.4 km (0.25 mi) of preserved open space. The open space data set used is the NJDEP Green Acres Program coverage for New Jersey. This layer includes tax-exempted open space parcels. The open space designation does not necessarily mean it is grassland open space.

3. 0.8 km (0.5 mi) to preserved farmland -- Patches are coded yes/no if they are within 0.8 km (0.5 mi) of preserved farmland. This data set was also provided by the NJDEP Green Acres Program.

4. Endangered and threatened species presence -- Patches are coded yes/no based on the landscape conservation ranking. Patches coded 3, 4, or 5 in the original Landscape Project data (state threatened, state endangered, or federally listed species present) received a 'yes' and patches coded 1 or 2 (suitable or priority concern habitat) received a 'no.'

WATER RESOURCES

Human development is threatening water supply and water quality in the Bayshore region. Negative pressure from excessive pumping on both sides of the state is drawing salt water into underground freshwater aquifers. Some aquifers are shrinking from top and bottom: seasonal water withdrawals for irrigation, industrial, and private use draw down water tables, sometimes to the point that levels do not recover. This in turn negatively affects the streams, rivers, and wetlands fed by water tables, and vegetation and wildlife by extension. On the surface, pavement and buildings create impervious areas where water does not infiltrate back to the water table, but runs off, exacerbating flooding during storms and causing erosion. Contaminants wash off streets, lawns, and fields, leach from septic systems, and are emptied at point-sources.

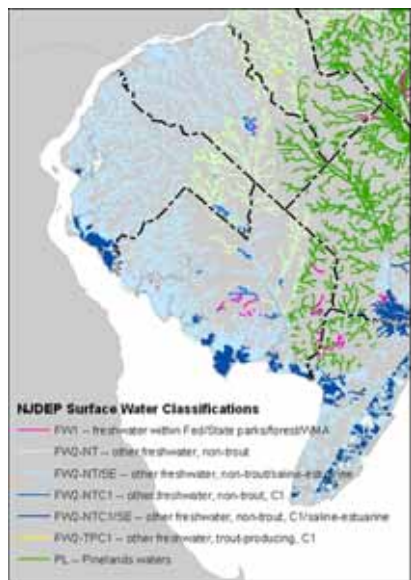
New Jersey residents rely both on ground and surface sources for drinking water. If these sources are to be preserved unpolluted and undiminished, such supply and water pollution pressures must be eased through better planning and regulation. The following GIS layers and accompanying maps provide information about where our water comes from, how it is replenished, how it is withdrawn, and how it is regulated.



Surface Waters – Mapped from NJDEP 2002 Land use/Land cover data

The following water classes were extracted from the 2002 LU/LC:

- 1419 – Bridge over water;
- 5100 – Streams and canals;
- 5200 – Natural lakes;
- 5300 – Artificial lakes;
- 5410 – Tidal rivers, inland bays, and other tidal waters;
- 5420 – Dredged lagoon.



NJDEP Surface Water Quality Classifications

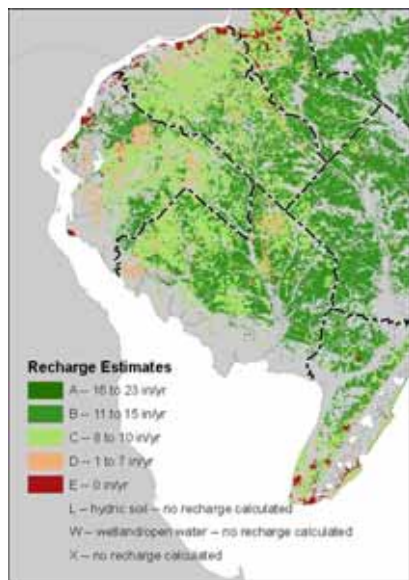
Water quality standards are established by federal and state governments to ensure that water is suitable for its intended use. The federal Clean Water Act (P.L. 95-217) requires that wherever possible water-quality standards provide water suitable for fish, shellfish, and wildlife to thrive and reproduce and for people to swim and boat.

All waterbodies in New Jersey are classified by NJDEP as either freshwater (FW), pinelands water (PL), saline estuarine water (SE) or saline coastal water (SC). Freshwater is further broken down into freshwater that originates and is wholly within federal or state parks, forests, or fish and wildlife lands (FW1) and all other freshwater (FW2). The water quality for each of these groups must be able to support designated uses that are assigned to each waterbody classification (see Surface Water Quality Standards NJA.C. 7:9B-1.12). In addition to being classified as FW1 and FW2, fresh waterbodies are classified as trout-producing (TP), trout-maintaining (TM) or nontrout waters (NT). Each of these classifications may also be subject to different water quality standards. Tributary streams that are not explicitly classified by the NJDEP take the classification of the river into which they flow.

Streams may also carry a C1 anti-degradation classification. C1 or Category One waters are designated for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s).

The determination of whether or not water quality is sufficient to meet a waterbody's designated use(s) is based on numerous surface water quality parameters. Some examples of surface water quality parameters include fecal coliform, dissolved oxygen, pH, phosphorous, and toxic substances. NJDEP also evaluates water quality by examining the health of aquatic life in a stream.

This data was published by the NJDEP Division of Landuse Management, Bureau of Freshwater & Biological Monitoring in 2006. Streams line work is originally from USGS 1:24,000 DLG files, updated from the 1986 photoquads.



NJGS Estimated Ground Water Recharge Rates

Ground water recharge is defined as the water that infiltrates the ground and reaches the water table regardless of the underlying geology. It supports aquifer recharge, stream baseflow and wetlands.

NJGS calculates annual estimated recharge rates from local factors that affect water infiltration, including land use/land cover, soil type, and local climate. Recharge is not calculated for hydric soils, wetlands, or open water.

Recharge values range from 0 to 23 inches/year. The highest recharge rankings are found in the Mullica and Barnegat Bay watershed areas, in the heart of the Pine Barrens. The high recharge areas represent areas of conservation priority and generally correspond to watersheds with low altered land cover, impervious cover, and riparian disturbance percentages.

Ground water recharge was extracted from GIS data published by the New Jersey Geological Survey (NJGS) in 2004.



NJGS Ground Water Aquifers & Confining Units

An aquifer is a body of geologic material that can supply useful quantities of ground water to natural springs, surface waters, wetlands, and water wells. The geology of the Coastal Plain, which underlies most of the Bayshore region, is that of a 'layer cake' or strata of gravels, sands, silts, and clays that were deposited as river deltas, seafloor, and beaches through geologic time. The saturated gravel and sand layers, being more permeable, are water-storage formations that are tapped by public and private water wells. The silt and clay layers, which impede the movement of water, are called confining beds. Confining beds can isolate aquifers from sources of contamination.

Three major aquifers in the Bayshore region are significant for water supply: the Potomac-Raritan-Magothy aquifer system (commonly referred to as the "PRM"), the Mt. Laurel-Wenonah aquifer, and the Kirkwood-Cohansey aquifer system. The Coastal Plain strata is not horizontal, it dips gently to the southeast. A result of this dip of the strata is that each aquifer projects to the land surface

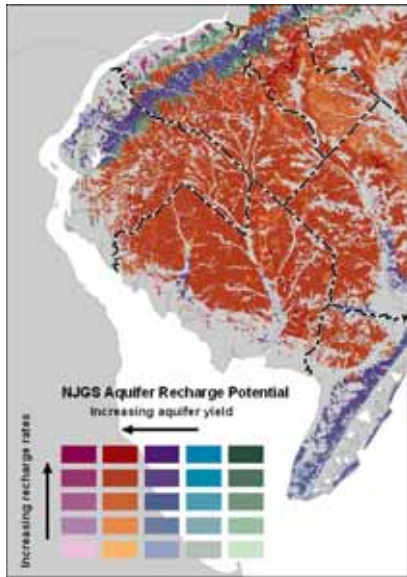
in a sequential manner. The part of the aquifer exposed at the land surface is referred to as the outcrop. Water enters each aquifer from rainfall directly on the outcrop, referred to as the recharge area. Local recharge from rainfall and induced infiltration from streams are the primary sources of water to the Coastal Plain aquifers. Because of the dip, each aquifer layer only exists from its outcrop and then to the southeast. Thus, the PRM exists from the Delaware River and underlies most of the Bayshore region, though it lies at ever-increasing depths eastward towards the Atlantic.

Tabular attribute data includes brief aquifer descriptions (substrate type, water quality, mineral content, etc.) and aquifer yield ratings for high-capacity wells. The five aquifer-rank values (A,B,C,D,E, corresponding to yield ranges in gal/min) are based on a statistical analysis of median yields for over 8,000 high-capacity wells. Median yield is the statistical value for which there are an equal number of

wells yielding greater and lesser volumes of water. Each aquifer or confining unit is assigned a rank based on its median yield.

This data was published by the NJDEP New Jersey Geological Survey in 1999.

(Aquifers explanatory text adapted from A. S. Navoy, "Gloucester County Ground-water Resources and Issues," USGS.)



NJGS Aquifer Recharge Potential

Aquifer recharge, or recharge to water-bearing geologic units, is defined as the ground water that reaches the water table in the uppermost geologic unit with a thickness of 50 feet or greater. The water-table aquifer rankings map was combined with the ground water recharge map to produce a map of aquifer-recharge potential. This produced a composite ranking of 25 possible aquifer-recharge potentials that show the relationship between ground water recharge areas and the underlying water-table aquifer.

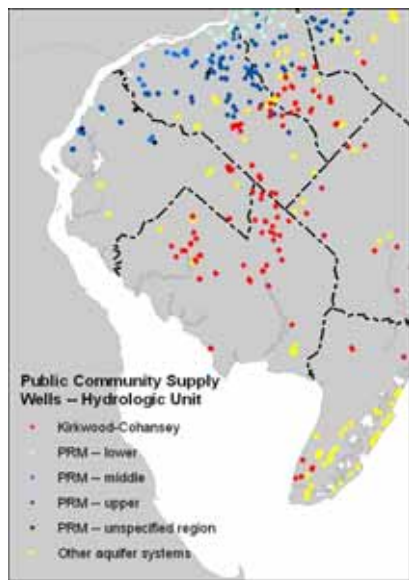
Ground water recharge rates vary independently across the underlying aquifers. High-ranked ground water recharge areas can be found on low-ranked aquifers. This indicates infiltration or recharge at higher rates than the aquifer can absorb. This excess recharge provides water to wetlands and for stream baseflow.

When high-rank ground water recharge areas are located over high-ranked aquifers, this indicates an area where recharge rates are matched more closely to the aquifer's ability to absorb this water and are indicative of important aquifer-recharge areas. In the Bayshore region such areas are found over the Potomac-Raritan-Magothy, Englishtown, and Kirkwood-Cohansey outcrops.

Ground water recharge calculation is summarized above. How much ground water that infiltrates beyond the root zone and actually makes it into the aquifer is predicted based on how much water can usually be pumped from wells drilled into the aquifer. Aquifer rankings are calculated from statewide well data, and factor in well yield, hydraulic conductivity, specific capacity, transmissivity, and storativity.

This analysis assumes that any later flow of ground water along boundaries of differing hydraulic conductivity has not been incorporated in this map, and that the influence of topography on recharge is factored in the ground water recharge methodology.

(Text modified from NJGS open-file map (OFM) 31, "Ground-water recharge and aquifer recharge potential for Cape May County, NJ.)



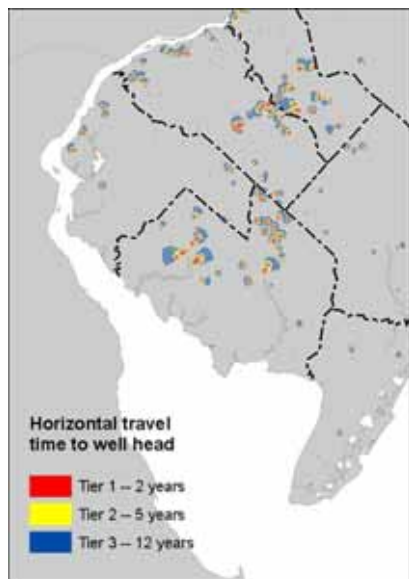
NJGS Public-Community Water-Supply Wells

The Public-Community Water-Supply (PCWS) Wells contains information for the wells in New Jersey that supply potable water to public communities. The NJDEP has cataloged and field-located PCWS wells as part of the Source Water Area delineation process. The data contained within is from the NJGS Wells Database.

The public water supply wells are grouped into two categories based on the type of water supply system they support. Public community water supply systems have at least 15 service connections used by year-round residents, or regularly serve at least 25 year-round residents. An example is a municipal system that services single-family residential homes. A non-community water system is a public water system used by individuals other than year-round residents, such as hospitals or restaurants, for at least sixty days of the year. This data set only includes public-community water-supply wells.

Tabular attribute data includes well depth, casing diameter, static water level (the depth to top water in the well prior to pumping), pumping capacity, and the aquifer system that each well taps.

This data was published by the NJDEP New Jersey Geological Survey in 2006.



NJGS Well Head Protection Areas

A Well Head Protection Area (WHPA) in New Jersey is a map area calculated around a Public Community Water Supply (PCWS) well in New Jersey that delineates the horizontal extent of ground water captured by a well pumping at a specific rate over a two-, five-, and twelve-year period.

When pumping, a well draws nearby ground water from areas of higher hydraulic pressure. The longer the well pumps, the greater is the distance from which water will flow through the aquifer to the pumping well. If the well continues to pump for twelve years, ground water may be drawn from about a mile up-gradient of the well. Time of travel (TOT) of ground water varies depending on the rate of pumping and aquifer characteristics such as transmissivity, porosity, hydraulic gradient, and aquifer thickness.

Each WHPA is divided into three sequential tiers based on the TOT component. The tiers are used to assess the relative risk of contamination to the well by placing a higher priority on pollution sources, prevention, and remedies in the tiers closest to the wells.

The goal of New Jersey's Well Head Protection Plan (WHPP) is to prevent contamination of ground water resources that provide drinking water to roughly half of the state's population. Delineation of WHPAs is part of this plan. These areas are a priority for prevention and cleanup of ground water contaminants. Other components of the WHPP Plan include pollution-source inventories, development and implementation of best management practices to protect ground water, land-use planning, and education to promote public awareness.

Once the WHPA is delineated potential pollution sources may be managed in relation to their location within the WHPA. In addition, protective land uses, such as preserved open space, may be established. In instances where a public supply well has already been contaminated, the WHPA provides investigators with an area in which to search for potential pollution sources and responsible parties.

Tier thresholds of two, five, and twelve years TOT reflect the time necessary to assess and contain various contaminants – including bacteria, viruses, and chemical pollutants – and published statistics on the extents of various contaminant plumes.

This data was published by the NJDEP New Jersey Geological Survey in 2002.

(Explanatory text adapted from NJGS open-file report (OFR) 03-1, “Guidelines for delineation of well head protection areas in New Jersey,” NJDEP, 2003.)



NJDEP Water Supply Critical Areas

The New Jersey Water Supply Management Act of 1981 established a water diversion permit system and fee schedule for withdrawals of more than 100,000 gallons per day (gpd) from surface or ground water in an effort to regulate mainly commercial and industrial withdrawals and public water suppliers.

The Act included provisions for the mapping of water supply critical areas where withdrawals could be curtailed and new allocations restricted to prevent the drawdown of aquifers and, at the coasts, saltwater intrusion into the fresh ground water beds. Critical Area 1 covers most of Monmouth and parts of Middlesex and Ocean counties.

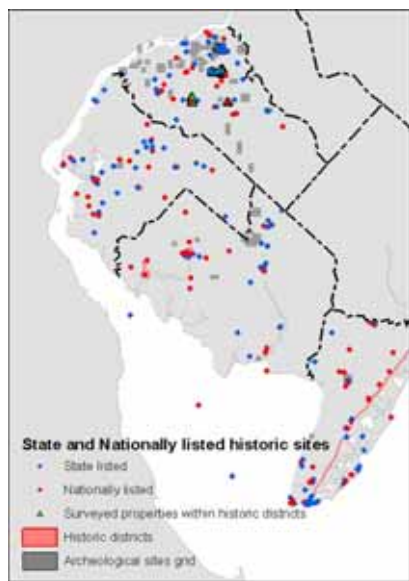
The Act was amended in 1993 to establish a second area of critical water supply concern in the region of Atlantic, Burlington, Camden, and Gloucester counties. In Critical Area 2 withdrawals from the Potomac-Raritan-Magothy (PRM) system of aquifers were first limited in 1996, since which time new demand has shifted to surface waters (mainly the Delaware River) and shallower aquifers. USGS monitoring wells in the PRM system have subsequently shown that water levels stabilized following the NJDEP designation. However, there is recent concern about increased usage in areas south of and adjoining Critical Area 2 where drops in PRM levels and in the overlying Mt. Laurel – Wenonah aquifer have occurred.

HISTORIC & CULTURAL RESOURCES

These historic and cultural data sets provide thematic connections between all of the remaining layers. Archeological sites, colonial farmsteads and 17th century settlements, 18th century battlegrounds, 19th century industrial works, and modern ecotourism attractions are the link between soils, wildlife, water and timber resources, extractive practices, and landscape change through more than 300 years of European settlement. These are ties to a history of farming that began with the clearing of the area's forests in the 1600s and other land management practices that have largely shaped the Bayshore region we know today.

This area's rich agricultural soils, particularly east of the Cohansey River, and its historically abundant shellfisheries, made South Jersey the supplier to its metropolitan neighbors, but ensured that the Bayshore region remained culturally distinct. While the lucrative shellfish industry created millionaires, their wealthy enclaves were surrounded by expansive bayside salt marshes. In Cumberland, where the soils transition to the sterile sands of the Pine Barrens, sawmills, glassworks, and other regional industries made Bridgeton, Millville, and Glassboro prosperous commercial centers. Though somewhat reduced in extent in the past decades, South Jersey's farming community is still a major economic force in the region, and, with its estuarine marshes, a defining landscape of the South Jersey Bayshore.

The purpose, then, of this historic and cultural sites inventory is to catalog those places that have best define the region's distinct character to ensure their preservation and continued stewardship. The data sets also recognize the dual service of many areas as important habitat and recreation resources



NJ & National Registers of Historic Places GIS Database

This database is built from NJDEP Historic Preservation Office (HPO) spatial data for historic properties in the Bayshore region. The New Jersey and National Registers of Historic Places are the official lists of historic properties and districts worthy of preservation. Inclusion in the Registers provides benefits and protection for listed resources, and the information generated through the nomination process contributes to the growing body of knowledge about historic places in New Jersey.

Historic properties may be discrete sites or buildings, thematic areas or historically cohesive districts. Historic properties listings from the HPO itemize the buildings, structures, sites, objects, and districts listed on both registers. These properties and historic districts all meet the New Jersey and National Register criteria for significance in American history, archaeology, architecture, engineering or culture, and possess integrity of location, design, setting, materials,

workmanship, feeling and association.

Archeological properties are generally undeveloped sites that contain significant artifacts of previous settlement. Such site include prehistoric Native American settlements, cemeteries, stone quarries, fish weirs, and a wide variety of special purpose locations where specific food and nonfood resources were collected and/or processed. Historic archaeological sites occur in conjunction with historic districts, buildings, and structures, including industrial and commercial buildings such as mills and warehouses, although they frequently remain after above-ground portions of the properties no longer remain. They also include battlefields, for example, where associated buildings may never have existed, but where evidence of human activity survives in or on the ground. Cemeteries, as well as remains of engineering features such as canals, bridges, dams, and early roadways, are also archaeological sites.

Historic sites are mapped to encourage preservation and stewardship programs, and to improve public awareness of New Jersey's many and various historic resources. The New Jersey Historic Preservation Plan (NJHPP) connects the efforts of historic preservation with those of land preservation: both are concerned with maintaining valuable regional identities formed over centuries of settlement. Their goals are similar, and the NJHPP outlines similar preservation strategies – private and public partnerships, tax incentives, and land use planning and regulatory provisions – which rely on inventories such as this to move forward.



NPS Coastal Heritage Trail Sites

Congress authorized the New Jersey Coastal Heritage Trail Route in 1988 to provide for public understanding and enjoyment of sites and resources associated with the coastal area of New Jersey. The Trail stretches nearly 300 miles along the Atlantic seaboard, connecting significant historic, cultural, and natural sites between the Raritan, Barnegat and Delaware Bays.

Trail destinations were selected to fulfill several themes. Historic settlements highlight the state's coastal industries and agriculture, including glassmaking, iron smelting, and salt hay and cranberry production. Maritime history sites include lighthouses, life saving stations, forts, and museums that document the state's seafaring culture. Coastal habitats and wildlife migration sites provide wildlife viewing and recreation opportunities at some of the most important migratory stopover sites on the Atlantic Seaboard. Regional welcome centers are full-service facilities offering trail and regional orientation and information for visitors.

The Trail is a vehicular trail and is not a continuous route. The Trail links destinations by routes on local and county roads, State and U.S. highways. Trail destinations are grouped by five regions: the Delsea, Abescon, Cape May, Barnegat, and Sandy Hook regions. The regions feature birdwatching areas, wetland and wildlife preserves, parks, marinas, and American Revolution and Civil War sites. The Delsea, Absecon and Cape May Regions also have bicycle routes recommended by the South Jersey Wheelmen.

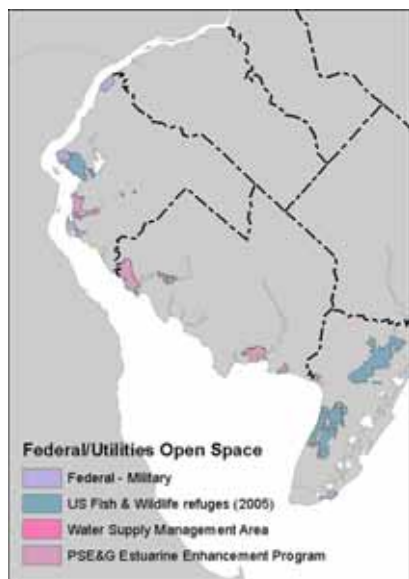
The Park Service maintains hard-copy maps of Trail regions, and lists of Coastal Heritage sites, but this data has not previously been collected in a unified GIS database. Sites, routes, and areas on the Trail were mapped at CRSSA from NPS lists and hardcopy maps of Trail destinations using GIS open space, roads, and historic properties data.

Online site listings at the Coastal Heritage Trail website (<http://www.nps.gov/neje/>) and region-wide maps downloaded from NPS supplemented the list of sites provided by Philip Correll, NPS Project Director for the Coastal Heritage Trail Route. Cycle routes were mapped from the 'Cape May and Abescon' and 'Delsea' regions maps using NJDOT 2005 roads data. Historic points, parks, wildlife management areas, and other points of interest were located from NJDEP open space layers, non-profit open space GIS data, US Fish and Wildlife Service digital data, and NJDEP historic sites GIS layers. Sources for each point are listed in the tabular attribute data.

OPEN SPACE INVENTORY

The Bayshore region is fortunate to enjoy very extensive tracts of public open space. State Parks and Wildlife Management Areas on the coast are complemented by three National Wildlife Refuges and the notable Estuarine Enhancement Program wetland restoration sites. Non-profit conservation organizations are well-represented and have been instrumental in recent preservation efforts to secure remaining contiguous habitat areas.

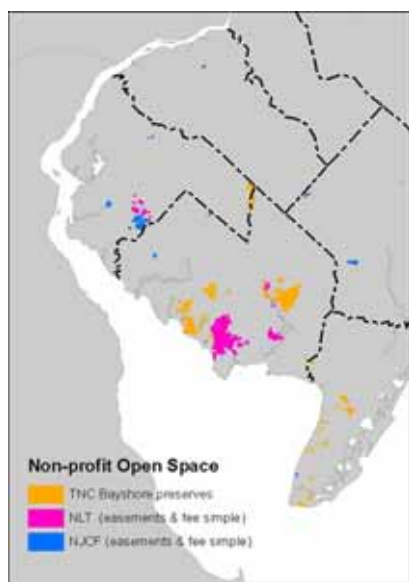
Remaining conservation targets are highlighted by the Biodiversity themes, and there remains many thousands of acres of farmland that are still open to potential development.



Federal Open Space / PSE&G / Water Supply Management Areas

Federal open space data is mapped primarily from year 2001 NJDEP open space data. National Wildlife Refuge boundaries are mapped from year 2005 US Fish and Wildlife Data.

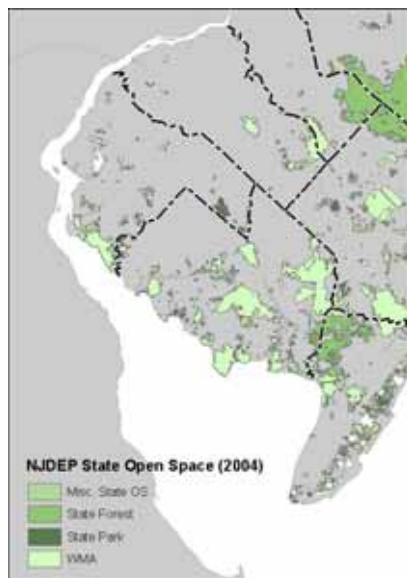
PSE&G Estuarine Enhancement Program sites and Water Supply Management Areas are likewise mapped from year 2001 NJDEP data. These datasets have not been accessible for public download from NJDEP for several years.



Non-profit Conservation Properties

(These data sets have not been approved for public distribution by their originators)

Non-profit open space was mapped from data provided by the three primary non-profit landholders in the Bayshore region. Nature Conservancy preserves data was provided in 2005; Natural Lands Trust fee-simple preserves and conservation easements data was provided in August of 2006; New Jersey Conservation Foundation fee-simple and easements data was provided in December of 2006. These data sets were current as of time of delivery.

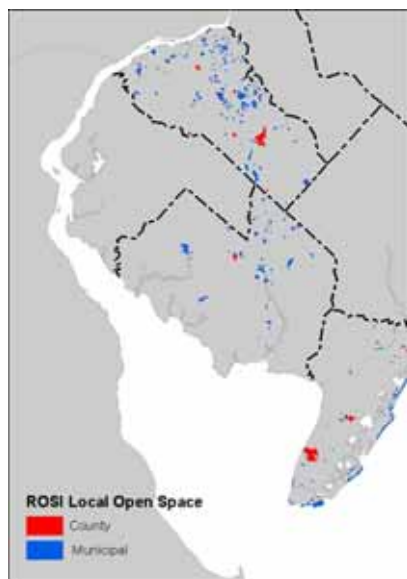


State of New Jersey Open Space

State open space is mapped from year 2004 open space data available from NJDEP. This data set contains protected open space and recreation areas owned in fee simple interest by the State of New Jersey Department of Environmental Protection (NJDEP). Types of property in this data layer include parcels such as parks, forests, historic sites, natural areas and wildlife management areas. The data was derived from a variety of source maps including tax maps, surveys and even hand-drafted boundary lines on USGS topographic maps. These source materials vary in scale and level of accuracy. Due to the varied mapped sources and methods of data capture, this data set is limited in its ability to portray all open space lands accurately, particularly the parcels purchased prior to 1991.

Prior to properties purchased in 1995, there may be parcel boundary omissions or erroneous additions due to inaccurate source data. Boundary adjustments to these earlier pre-surveyed parcels have not/do not occur unless inconsistencies arise between those delineations and new adjacent acquisitions. At that time, if possible, positional problems were and will be resolved as well as any tax record inconsistencies. This mapping program does not actively update static areas. It is too expensive to survey or too time consuming to go through old deeds to update boundary lines.

Purchases after 1995 required certified NJSPC surveys as part of the property transaction. These surveys are entered directly into the data layer and serve as the latest property boundaries. Survey entries are current to December 2004.



County and Municipal Open Space

Mapping local open space has long been a challenge for GIS users. Data quality varies significantly from source-to-source, and the absence of a single state-wide repository makes it difficult to compile a definitive data set. The varying GIS capabilities and interests at the county and municipal levels leads to inconsistent coverage even within relatively small study areas. Finally, the unavailability of county-wide digital parcel data – from which most local open space data sets are mapped – until recently impeded efforts to generate digital data.

Three sources of local open space data were tapped for the Bayshore inventory. The first was the county Planning and GIS offices, which were able to supply some basic data for three of the counties. The second resource is a NJDEP year 2000 local open space statewide dataset. Finally, CRSSA used digital parcel data to map open space listed with the NJDEP Green Acres Program Recreation and Open Space Inventory (ROSI). The ROSI lists all

open space parcels in the state that have received Green Acres funding, as well as many unfunded parcels. Data was retrieved from the online database in December, 2006. Parcel matching was completed for Cape May, Cumberland, and Gloucester counties (parcel data was not available for Salem) with an overall parcel match rate between the ROSI listings and parcels of 82% (see report at end of this section for more information about ROSI open space mapping methods and results).

Although three of the four Bayshore counties supplied composite open space files for the Bayshore Inventory, the data was poor in quality. We received no open space layers for Salem County. Missing identification and questionable coverage prevented the use of Cape May and Gloucester counties open space data: many records in the two datasets contained little or no attribute information. The data files include some non-profit, state, federal, and preserved farmland open space with local (county and municipal) parcels, but obvious omissions indicate that the mapping is not reliable. Other included parcels are publicly-owned facilities like administrative offices and schools that do not qualify as open space.

Local open space data for Cumberland, accessed through the county's internet mapping service (IMS), proved more reliable. Comparison with NJDEP's 2000 local open space coverage and the NJDEP Greenacres Recreation and Open Space Inventory open space parcels (discussed below) showed consistency between the layers.

Although the Bayshore GIS database includes all data compiled from these three sources, local open space was mapped for the Bayshore posters only from the ROSI, NJDEP, and Cumberland data sets.



NJAS Delaware Bayshore Birding & Wildlife Trails

NJAS Birding and Wildlife Trails use our existing state, county and local transportation infrastructure (roads, waterways, public transportation) to connect each region's birding and wildlife-watching sites. The Birding and Wildlife Trails (BWT) Guide for the Delaware Bayshore area offers a collection of 2-3 day local driving loops that connect the sites where people can go to view the areas' wildlife and spend some time outdoors. Trail stops also include historic and cultural sites, and recreation areas suitable for activities like boating, hiking, and fishing.

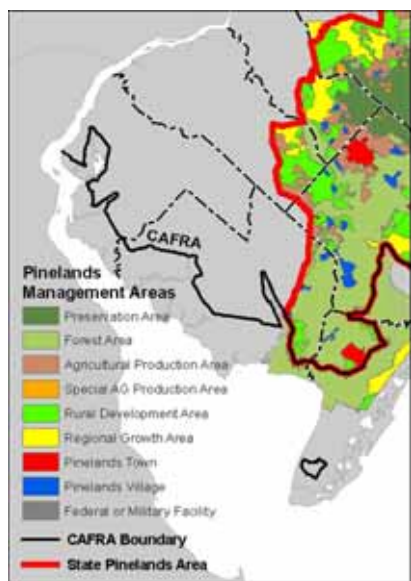
The program is intended to raise public awareness of New Jersey's many wildlife opportunities and so to strengthen conservation efforts. But the trails also offer opportunities for local communities to benefit from the economics of ecotourism as visitors enjoy wildlife viewing and recreational activities in the area.

The Delaware Bayshore Birding and Wildlife Trails is funded by the New Jersey Department of Transportation (NJDOT), and is a cooperative effort among New Jersey Audubon Society, NJDOT, NJ Department of Environmental Protection and NJ Department of Travel and Tourism.

PLANNING

Two regional planning districts overlap in the Bayshore area, both enacted for the protection of delicate environmental systems of the coastal zone and the Pine Barrens. The Coastal Area Facilities Review Act gives the Department of Environmental Protection regulatory authority over many types of development within a coastal zone that ranges in width from several thousand feet to more than 20 miles on the Atlantic and Delaware Bay coasts. The Pinelands Area is administered by a joint commission of local and state representatives with a mandate to protect critical Pine Barrens habitat through regional zoning oversight and environmental regulations.

The other theme in this category concerns state regulatory oversight of surface and ground water quality through designated sewer service areas.



Pinelands Management Areas

The Pinelands National Reserve consists of approximately 1.1 million acres in southern New Jersey. The Reserve was the first in the nation when designated in 1978, and represents a unique partnership between local municipal governments, the State, and the Federal government to protect the region's many natural resources and preserve the historic culture and landscape of the Pine Barrens.

900,000 acres of the Reserve are managed under the Pinelands Comprehensive Management Plan (CMP), adopted in 1980. Federal and state legislation established regional zoning areas and development controls for the purpose of focusing growth in appropriate zones and protecting large, unbroken forest and wetlands areas. Reserve areas within the Coastal Area Facilities Review Act (CAFRA, see below) are not included in the State Pinelands Area. Development in this overlapping region is subject to the state's Coastal Management Program, which is required to carry out the purposes of the state and federal Pinelands legislation.

The CMP specifies environmental and planning standards to protect wetlands, wildlife, water and air quality, historic and scenic resources, and regionally-significant agriculture. The Pinelands is jointly overseen by representatives of the county and State governments through the Pinelands Commission, whose staff work with municipal governments to review development applications and permits. The Commission also conducts scientific research and environmental monitoring programs, and regularly reviews and evaluates the CMP.

The following are the general management categories for the Pinelands (summarized from Pinelands Commission documents):

- 1. Preservation areas** -- conventional residential, commercial and industrial development is largely prohibited. In general, only new land uses compatible with the ecology of the central Pines are allowed.
- 2. Forest areas** – provide a buffer zone around the preservation area. The same land uses that are permitted in the Preservation Area District are permitted in Forest Areas. Municipalities are also given the option of including certain other new uses, such as limited commercial establishments.
- 3. Agricultural Production Areas** – areas intended to accommodate and encourage farming. Blocks of more than 1,000 acres of active farmland and adjacent farm soil are grouped into Agricultural Production Areas where farming and related activities will remain the dominant land use.

4. Regional Growth Areas -- designated in municipalities found to be experiencing development pressure and to be capable of accommodating growth.

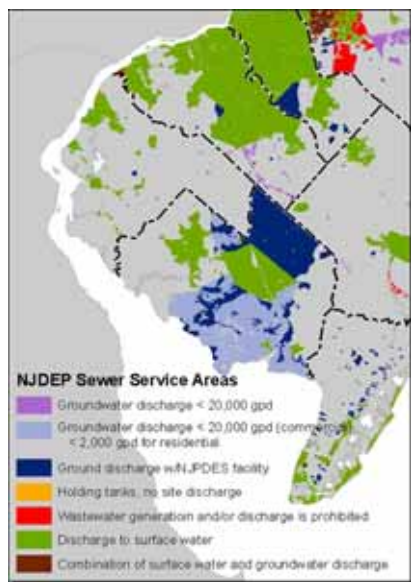
5. Rural Development Areas – transition zones that meet neither the stringent environmental criteria for Forest Areas nor lie squarely in the path of development like Regional Growth Areas. The Plan attempts to protect the characteristic Pinelands features that can be found there while allowing modest development to proceed and giving municipalities as much leeway as possible to determine land uses.

Coastal Area Facilities Review Act (*boundary shown above*)

This data shows the administrative boundary of the Coastal Area Facilities Review Act (CAFRA), a state planning zone encompassing New Jersey's Atlantic and Bayshore coastal regions.

In 1973 the Coastal Area Facilities Review Act (NJS.A. 13:19) created a coastal planning area where the State oversees permitting for many development activities involved in residential, commercial, and industrial development. The goal of the law was to regulate coastal development that threatened delicate coastal environments and those with negative health impacts. State permits are required for new building, grading, shoreline protection structures and other site preparations within environmentally sensitive zones and for development projects that exceed certain area or unit thresholds.

The NJDEP Division of Land Use Regulation (LUR) reviews applications for compliance under the CAFRA guidelines. NJDEP Coastal Zone Management Rules for CAFRA zones are enumerated in N.J.A.C. 7:7E.



NJDEP State Sewer Service Areas

Sewer service areas mapping shows the planned method of wastewater disposal for specific areas, i.e. whether the wastewater will be collected to a regional treatment facility or treated on site and disposed of through a Surface Water (SW) discharge or a ground water (GW) discharge. Areas not specifically mapped represent either water features where no construction will occur or land areas that default to individual subsurface disposal systems discharging less than 2,000 gallons/day (GPD) where the site conditions and existing regulations allow.

This mapping, in conjunction with the text of the associated Water Quality Management Plan (WQMP), is used to make consistency determinations under the Water Quality Management (WQM) Planning rules. This GIS data shows existing and future sewer service (i.e., areas where sewer service is already offered, as well as areas that have been identified for a particular wastewater treatment regime in the event that an application is made). New service

applications must be consistent with these designations – as well as other regulatory provisions like water discharge controls – or must qualify for an amendment.

SSA areas were originally mapped from paper maps and, in some cases, from verbal descriptions of sewer service areas. Some of these maps are now several decades old and may not reflect regulatory changes that affect wastewater treatment practices in environmentally sensitive areas. The mapping is dynamic: changes are made and the data updated as amendments are granted and errors discovered in the data.

This data was created by the NJDEP Division of Watershed Management (DWM), Bureau of Watershed Regulation (BWR). The data set was published in October, 2006.

III. GIS Data Source Citations

Land Use/Land Cover

NJ Department of Environmental Protection (NJDEP): Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). 2007. NJDEP 2002 Land use/land cover update. NJDEP: BGIS, Trenton, NJ. Vector GIS data for Watershed Management Areas (WMAs) 16 (Cape May), 17 (Maurice, Cohansey, Salem), & 18 (Lower Delaware). Last accessed January, 2007. <http://www.nj.gov/dep/gis>.

Agricultural Resources

Cape May County Planning Department. Unpublished data. Cape May County, New Jersey preserved farmland (September, 2005). Vector GIS data provided in October, 2006.

Cumberland County Department of Planning & Economic Development. Unpublished data. Agricultural development areas in Cumberland County, New Jersey. Vector GIS data for Cumberland County provided in November, 2006.

Cumberland County Department of Planning & Economic Development. Unpublished data. Cumberland County, New Jersey preserved farmland (2006). Vector GIS data for Cumberland County provided in November, 2006.

Gloucester County Public Works Department, Planning Division. Unpublished data. Gloucester County, New Jersey preserved farmland (May, 2005). Vector GIS data for Gloucester County provided in July, 2006.

Grant F. Walton Center for Remote Sensing & Spatial Analysis (CRSSA). Unpublished data. Agricultural development areas in Cape May County, New Jersey. Vector GIS data created at CRSSA from a scanned map provided by the Cape May County Planning Department in November, 2006.

NJ Department of Agriculture (NJDA): State Agriculture Development Committee (SADC). 2007. Preserved farmland in New Jersey (January, 2007). NJDA: SADC, Trenton, NJ. Vector GIS data for New Jersey.

Salem County Agriculture Development Board; White Environmental Services. Unpublished data. Agricultural development areas in Salem County, New Jersey. Vector GIS data for Salem County provided in November, 2006.

U.S. Department of Agriculture (USDA): National Resource Conservation Service (NRCS). 2006. Soil survey geographic (SSURGO) county geodatabases, ver. 2.2.1. USDA: NRCS, Fort Worth, Texas. Vector GIS data for counties in southern New Jersey, last accessed 2/2/2006. <http://soildatamart.nrcs.usda.gov>.

Estuarine Zone

Grant F. Walton Center for Remote Sensing & Spatial Analysis (CRSSA). 2005. Delaware Bayshore horseshoe crab spawning habitat mapping project. Vector GIS data for the Delaware Bay. Last accessed June, 2007. <http://crssa/projects/coastal/hcrab/index.html>

National Oceanic & Atmospheric Administration (NOAA): National Geophysical Data Center (NGDC). Published online, accessed in 2005. 3 arc-second (90 meter) bathymetry digital elevation model. Raster GIS data. <http://www.ngdc.noaa.gov/mgg/coastal/coastal.html>

NJDEP: Division of Fish & Wildlife, Bureau of Shellfisheries. Unpublished material. Commercial leased shellfish grounds and eastern oyster seed beds off the New Jersey coast in the Delaware Bay. Vector GIS data for Delaware Bay provided in May, 2006.

NJDEP: Division of Fish & Wildlife, Bureau of Freshwater Fisheries. 2005. Locations of anadromous American shad and river herring during their spawning period in New Jersey's freshwaters, including known migratory impediments and fish ladders. NJDEP, Trenton, NJ. Report describing spawning extents & impediments used to map features at CRSSA.

U.S. Fish & Wildlife Service (USFWS). Various dates. National wetlands inventory. USFWS, St. Petersburg, Florida. Vector GIS data for New Jersey, downloaded at CRSSA by USGS 1:24,000 topographic map quadrangles.

Habitat & Biodiversity

NJ Audubon Society (NJAS), Important Bird & Birding Areas (IBBA) Program. Unpublished data. Draft Important Bird Areas (IBAs) in the Delaware Bayshore region in New Jersey. Vector GIS data provided in June, 2007.

NJDEP: Division of Fish & Wildlife, Endangered & Nongame Species Program (ENSP). 2004. Landscape project habitat maps for New Jersey, version 2. NJDEP: Division of Fish & Wildlife, Trenton, NJ. Vector GIS data. Last accessed September, 2006. <http://www.state.nj.us/dep/fgw/ensp/landscape/>.

NJDEP: Division of Fish & Wildlife, ENSP, NJ Habitat Incentive Team. Unpublished data. NJHIT grassland habitat focal analysis. Tabular GIS data for New Jersey, designed to be used in conjunction with NJDEP ENSP Landscape Project grassland habitat vector GIS data. Provided in June, 2006.

NJDEP: Office of Natural Lands Management (ONLM). 2001. NJDEP Natural Heritage grid map. ONLM, Trenton, NJ. Vector GIS data for New Jersey. Last accessed June, 2006. <http://www.nj.gov/dep/gis>.

NJDEP: Office of Natural Lands Management (ONLM). 2001. NJDEP Natural Heritage Program priority sites. ONLM, Trenton, NJ. Vector GIS data for New Jersey. Last accessed June 2006. <http://www.nj.gov/dep/gis>.

The Nature Conservancy: New Jersey Chapter. Unpublished data. Matrix and umbrella blocks habitat analysis. Vector GIS data for New Jersey provided in June, 2007.

Water Resources

NJDEP: Division of Landuse Management, Bureau of Freshwater & Biological Monitoring. 2006. NJDEP surface water quality standards of New Jersey. NJDEP: Division of Landuse Management, Trenton, NJ. Vector GIS data. Last accessed January, 2007. <http://www.nj.gov/dep/gis>.

NJDEP: NJ Geological Survey (NJGS). 2004. Ground-water recharge estimates for New Jersey. NJDEP: NJGS, Trenton, NJ. Vector GIS data for WMAs 16, 17, & 18. Last accessed May 2005. <http://www.state.nj.us/dep/njgs/>.

NJDEP: NJGS. 1999. NJGS aquifers and confining units of New Jersey. NJDEP: NJGS, Trenton, NJ. Vector GIS data. Last accessed July, 2006. <http://www.state.nj.us/dep/njgs/>.

NJDEP: NJGS. 2004. Aquifer recharge potential for New Jersey. NJDEP: NJGS, Trenton, NJ. Vector GIS data. Last accessed June, 2007. <http://www.state.nj.us/dep/njgs/>.

NJDEP: NJGS. 2006. Public-community water-supply wells of New Jersey. NJDEP: NJGS, Trenton, NJ. Vector GIS data. Last accessed June, 2007. <http://www.state.nj.us/dep/njgs/>.

NJDEP: NJGS. 2002. Well head protection areas for public-community water-supply wells in New Jersey. NJDEP: NJGS, Trenton, NJ. Vector GIS data. Last accessed June, 2007. <http://www.state.nj.us/dep/njgs/>.

Historic & Cultural Resources

NJDEP: Natural & Historic Resources (NHR), Historic Preservation Office (HPO). 2004. Merged inventory of historic properties. NJDEP: NHR, Trenton, NJ. Vector GIS data. Last accessed June, 2006. <http://www.nj.gov/dep/gis/>.

National Park Service (NPS). Print maps, accessed online in June, 2006. New Jersey Coastal Heritage Trail destination maps. <http://www.nps.gov/neje/>.

NJDEP: NHR, HPO. 2002. New Jersey and national registers of historic places. Print listings of registered historic places, accessed online in October, 2006. http://www.state.nj.us/dep/hpo/1identify/nrsr_lists.htm.

Open Space

Cape May County Planning Department. Unpublished material. Cape May County municipal and county open space (September, 2005). Vector GIS data provided in October, 2006.

NJDEP: Green Acres Program. Online database, accessed in March, 2007. Green Acres recreation and open space inventory (ROSI). Searchable online database of county and municipal open space, listed by lot/block. <http://www.state.nj.us/dep/greenacres/openspace.htm>.

Cumberland County Department of Planning & Development. Published online, accessed in November, 2006. Cumberland County municipal and county open space. Vector GIS data. <http://151.204.59.210/cogs/viewer.htm>.

NJAS: Birding & Wildlife Trails Program. Unpublished data. Delaware Bayshore birding and wildlife trails. Vector GIS data provided in May, 2006.

NJ Conservation Foundation (NJCF). Unpublished data. NJCF protected lands in the Bayshore region (November, 2006). Vector GIS data provided in November, 2006.

NJDEP: Green Acres Program. 1999. NJDEP federally owned, protected open space 1:12,000. NJDEP, Trenton, NJ. Vector GIS data.

NJDEP: Green Acres Program. 1999. NJDEP Municipal and county protected open space 1:12,000. NJDEP, Trenton, NJ. Vector GIS data.

NJDEP: Green Acres Program. 2005. NJDEP state owned, protected open space and recreation areas in New Jersey (December, 2004). NJDEP, Trenton, NJ. Vector GIS data. Last accessed January, 2007. <http://www.nj.gov/dep/gis/>.

Natural Lands Trust (NLT). Unpublished data. NLT protected lands in New Jersey (August, 2006). Vector GIS data provided in August, 2006.

TNC. Unpublished data. TNC protected lands in the Bayshore region (July, 2005). Vector GIS data provided in July, 2005.

USFWS: Region 5, National Wildlife Refuge System, Realty Division, Cartography & Spatial Data Services Branch. 2005. USFWS national wildlife refuges in the Bayshore region. USFWS, Region 5 Office, Hadley, Massachusetts. Vector GIS data. Last accessed July, 2005. <http://northeast.fws.gov/gis>.

Planning Layers

NJDEP: Bureau of Tidelands. 1995. Coastal Area Facilities Review Act boundaries, New Jersey. NJDEP: Bureau of Tidelands, Trenton, NJ. Vector GIS data. Last accessed June, 2007. <http://www.nj.gov/dep/gis/>.

NJDEP: Division of Watershed Management (DWR), Bureau of Watershed Regulation (BWR). 2006. New Jersey Statewide Sewer Service Area. NJDEP: DWR, BWR, Trenton, NJ. Vector GIS data. Last accessed March, 2007. <http://www.nj.gov/dep/gis/>.

NJDEP: OIRM, BGIS. 1994. Pinelands Area boundary of New Jersey. NJDEP: OIRM, BGIS, Trenton, NJ. Vector GIS data. Last accessed March, 2007. <http://www.nj.gov/dep/gis/>.

NJ Pinelands Commission. 2003. New Jersey Pinelands management areas. NJ Pineland Commission, New Lisbon, NJ. Vector GIS data. Last accessed July, 2007. <http://www.state.nj.us/pinelands/landuse/gis/data/index.html>.

IV. Acknowledgements

This project was funded by a grant from the William Penn foundation, administered by the Association of New Jersey Environmental Commissions (ANJEC) for the Bayshore Coalition. All maps and data were compiled at the Grant F. Walton Center for Remote Sensing & Spatial Analysis (CRSSA) in July, 2007 with the invaluable assistance of Patti Burns and Sandy Batty of ANJEC, Suzanne McCarthy of the Delaware Valley Regional Planning Commission, and Eric Stiles of the New Jersey Audubon Society. We gratefully acknowledge the assistance of John Bognar and Jim Trimble of CRSSA in all aspects of this project.