NATURAL RESOURCES

INTRODUCTION

Natural resources are an integral part of Charlestown's character. This element describes existing environmental conditions within the Town, and examines potential threats to those resources. Diversity and quality of resource types increases the aesthetic value of the Town and influence where residents choose to live, and where visitors choose to recreate. How the Town decides to use its land will ultimately affect the quality and diversity of its natural resources, and will affect the quality of life within the Town.

The issues to be considered in the natural resources element are compiled from concerns voiced by Town residents on the Comprehensive Plan Citizen Advisory Committee CPCAC, and through evaluation of available data. The issues guiding this element are similar to those of other elements of the comprehensive plan:

- Decisions about zoning and land use throughout the Town can be pivotal in preserving or degrading the environmental qualities of Charlestown;

- Degradation of the surface water quality in the coastal and freshwater ponds is related in part, to the density of development within their watersheds. It is also related to the condition of the septic systems serving the surrounding dwellings, and types of land uses permitted within the watershed;

- Protection of groundwater quality is vital because it is the Town's source of drinking water. The need to protect groundwater quality will dictate certain limitations on the type and density of development throughout most of Charlestown;

- The commercial potential of natural resources is important when considering the economic development of the Town;

- Protection and/or acquisition of open space for recreational areas can serve to protect unique wildlife or rare plant habitats, as well as protect groundwater quality over aquifer recharge areas;

- Promotion of tourism, to improve the economic condition of the Town, is linked to the maintenance of high quality natural resources;

- Generally, development south of Route 1 is threatened by severe storms, beach erosion, and rising sea levels. This development comprises a major portion of Charlestown tax base. Protection of coastal development and control of future development in high risk areas is important.

This element is organized into the following areas of discussion:

- o Goals and Policies - as put forth by Charlestown residents, and officials of the Town and State agencies;
- o Existing Conditions-describes the various types of resources and their present functions, values and conditions. Existing or potential threats to these resources are identified;
- o Current Regulations and Policies-describes the existing level of resource protection afforded by federal, state and local regulations;
- o Recommendations/Implementation - identifies measures to achieve the Town and State goals, and puts forth suggestions on how the Town can plan for the future.

GOALS AND POLICIES

The following goal was compiled from responses to the Town's public opinion survey and from discussions with residents, Town officials and CPCAC members. The goal stated represent the general direction in which action could be taken to resolve the issues that concern citizens and Town officials. The policies provide additional guidance toward achieving the goals.

Goals and Policies of the Town of Charlestown

Major Goal

To protect and encourage appropriate use of the town's natural and cultural resources, including groundwater and surface water (fresh water and salt water), a variety of wetland and upland habitats and wildlife, the barrier beaches, historic villages, historic cemeteries, tribal artifacts and sites, and scenic views and corridors.

Major Supporting Policies

- To allow and encourage development that protects the natural and cultural resources and reflects the natural constraints of the land.
- To protect natural and cultural resources through zoning and the development review process, using innovative techniques as they become available or feasible.
- To monitor water quality in the fresh water bodies and salt ponds through the volunteer pond watcher groups' efforts and other studies, identifying specific problems or improvements, and where necessary researching and implementing feasible improvements that remedy specific problems identified.

- To promote establishing protective undeveloped zones along water resources and other habitats through the use of setbacks, design standards, exactions, open space dedication, and where necessary the purchase of development rights or property.

Goals of the State of Rhode Island

The goals expressed in the State Guide Plan Overview and the Comprehensive Planning Act are generally similar to many of Charlestown's goals. The State goals focus on protection of natural resources and open space and using innovative development techniques to promote suitable development reflecting natural constraints. Other state goals include:

o Preserve distinctiveness of urban, suburban, and rural areas;

o Relate the use of land to natural characteristics;

o Protect surface water and groundwater quality, wetlands, inland rivers and waterways, and species diversity;

o Prevent encroachment on floodways;

o Coordinate development and use of State's water resources. Consider multiple use potential for all water resource development projects. Promote greater opportunities for water-oriented recreation;

The elements of the comprehensive plan are interrelated. Many of the discussion points raised in this section will apply to other plan elements as well, such as Open Space/Recreation or Land Use.

EXISTING CONDITIONS

The following pages present an inventory of Charlestown's natural resources. The different types of resources are presented in the following order:

- Geology
- Topography
- Soils
- Groundwater
- Surface Waters and Wetlands
- Floodplains
- Natural Habitats

Most of the figures which accompany this discussion are 1"=4000' scale version of larger scale maps (1"=2000') available at the Town Planning Department. These maps are based on data from the Rhode Island Geographic Information System (RIGIS) and have been enhanced or supplemented with local information.

Geology

The geologic history of an area affects topography, drainage patterns, and soil characteristics. Many of Charlestown's most notable features are a direct result of the recent geologic history, when glaciers advanced and retreated over New England. Charlestown's shore is affected by geologic processes that operate within a time scale of years or tens of years. Major geologic features are shown in Figure 1.

Bedrock Geology

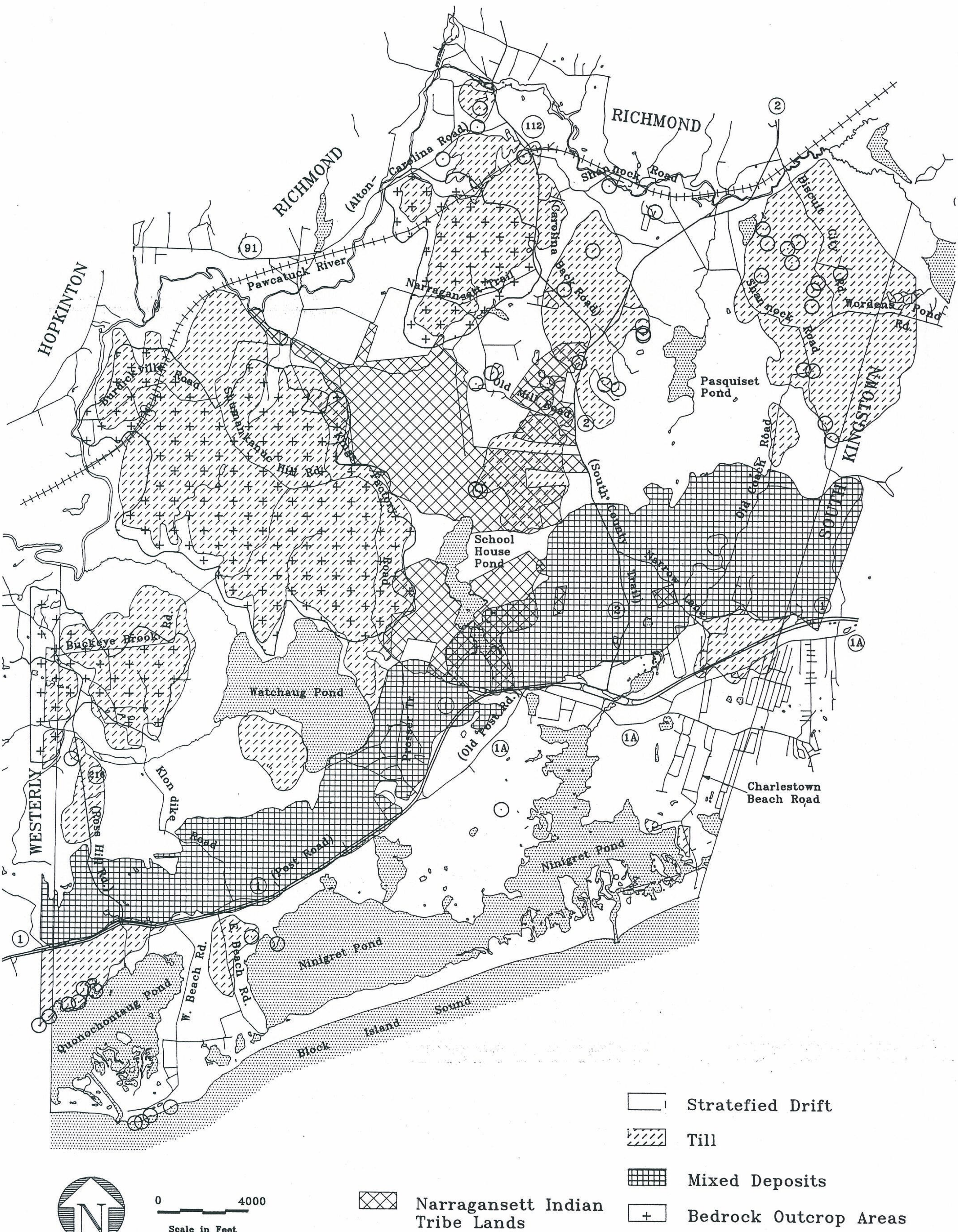
Most of the bedrock underlying Charlestown is either granite or gneiss (granite altered, or metamorphosed, by heat and pressure). Both of these are strong, compact rocks that are resistant to weathering. They have often been used as foundation rocks, and the Westerly Granite, found locally, was quarried and cut for monuments from the 1800s to the mid 1900s. The third general type of bedrock, found in the northeastern portion of the town, is a mixture of gneiss and schist. While the latter is also a compact rock, it contains distinct planes of weakness and weathers or breaks more easily than the gneiss or granite.

Generally, the bedrock has been weathered down to a nearly level surface. A few high points of bedrock form the cores of hills in town, and three ancient river channels in the bedrock now contain outwash deposits and wetlands.

The compact bedrock is a poor source of groundwater except for fissures in the rock.

Glacial Geology

Large-Scale Features: Glacial Advance. Before the glaciers advanced over the area, streams cut channels into the bedrock. As the glaciers moved south, they modified the landscape somewhat, carving the valleys deeper and wider, scraping off existing soil, and depositing a mixture of clay, sand, gravel, and stones (till) in their path.



Data Source: Map prepared by Vanasse Hangen Brustlin, Inc. from Town of Charlestown and RIGIS data.

GEOLOGY

Figure 1

CHARLESTOWN COMPREHENSIVE PLAN - 1991

The ice sheets advanced as far as Block Island, Cape Cod, Martha's Vineyard, and Long Island. These features are ridges of till piled up at the edge of the ice sheets (end moraine).

Till Deposits. In Charlestown, the accumulations of till generally occur on the hills. In certain areas such as Shumankanuc Hill the till layer is extremely thin, exposing bedrock ledges.

Large-Scale Features: Glacial Retreat. The retreat of the glaciers formed many of the important features of Charlestown's landscape: its varied topography, wetlands, and river drainage.

Coastal outwash plain. Glacial rivers from the melting ice laid down thick level plains of layered sand, silt, gravel, and stones, known as outwash deposits. The flat coastal land of Charlestown is an extensive outwash plain interrupted by one or two small till uplands.

Recessional moraine. As the ice sheet retreated, it hesitated north of the present coastal lands and piled up a ridge of till and outwash (recessional moraine) similar to the end moraine at Block Island. The ridge of the recessional moraine is prominent in Charlestown north of Route 1.

Outwash and till north of the moraine. While stalled north of the moraine, the glacier continued melting. The water coursed through ancient low-lying river channels underneath the ice, depositing outwash. The till covered hills were undisturbed. The river channels are apparent as deep narrow bands of outwash running southeast through Schoolhouse and Pasquiset Ponds. The fan-shaped lands on either side of Ninigret Cove were deposited as alluvial fans as the meltwater left the ice.

Small Scale Features. In addition to the large scale outwash plains and till uplands, the glaciers left a landscape dotted with smaller features that add diversity to the town's topography and its habitats.

Kettle Holes. Ice blocks that broke off from the ice sheets left deep holes in the accumulating sediment, which are known as kettle holes. The moraine and outwash plain are pockmarked with kettle holes, many of which have filled with water to become ponds.

"Kame" Terraces. Terraces of outwash material known as "kame" terraces occurred at the margins between glacial streams and ice.

Effects of Glacial Geology on Hydrology. The distribution of till and outwash affects groundwater and surface water drainage. Water passes slowly through the poorly sorted till and rapidly through the well-sorted outwash.

Groundwater. Till can generally provide an adequate source of drinking water for low volume wells, such as individual homes or small public wells. Outwash deposits provide abundant drinking water supplies but are also contaminated relatively easily.

Surface Water. Generally, streams today flow along the low-lying outwash channels. However, in Charlestown, the recessional (till) moraine essentially dams the surface water flowing from the north toward the ocean. The Pawcatuck River flows south into Charlestown, then flows westward around the moraine through another ancient river channel. The large ponds and swamps of interior Charlestown also reflect the blocked drainage; surface water and groundwater flowing toward the ocean is stopped and pools up behind the moraine.

Post-Glacial Geologic Processes

Sea Level Rise. Charlestown's shore is being modified by modern geologic processes, the effects of which are visible over the course of a human lifetime. The water melting from the glaciers has been pouring into the oceans for 10,000 years, raising the sea level to its current stand. The sea level is continuing to rise. Records from the Newport tidal gauge indicate that since 1929, the sea level has been rising at a rate of 28 cm (roughly 1 foot) in 100 years. The projected rate of sea level rise in the next 100 years ranges from one foot to eight feet, depending on the effects of global warming. Conservative estimates project a rise of approximately three feet over the next century. A large rise in sea level could affect a considerable amount of coastal land, as discussed in a later section on floodplains.

Barrier Beaches. Barrier beaches play an important role in Charlestown's coastal system. They shelter the salt ponds from the effects of the waves, providing a set of sheltered harbors and diverse habitats. They are part of Charlestown's attraction to visitors. The barriers serve as a buffer between the coastal communities in back of the salt ponds and storms, absorbing energy from storm waves.

Barrier beaches are made of sand from the glacial outwash and till that has been reworked and sorted by the ocean. The barriers are extremely dynamic features, continuously modified by currents, waves, tides, and wind. Often the sand of the barriers will shift around permanent structures that have been built, having potentially undesirable effects on the structures.

Erosion and Build-Up of Barrier Systems. Barrier beaches are visibly changed by storms. Generally, erosion of a beach after a storm is temporary, and the beach is built up to its full profile within a few days. Occasionally, storm waves erode parts of the dune in back of the beach. This may occur after a rapid series of severe storms, as in February 1978. The rebuilding process after such major storms can take years. Because both short term and long term erosion are regularly occurring events, it is important to build structures beyond the extent of the severe erosion. In Charlestown, the blizzard of 1978 eroded the shore back to a point within the current dune: structures built seaward of that point are at risk of erosion.

The landward portion of the barriers can be built up by sand carried in by storm waves. During extreme storms, such as the 1938 hurricane or the blizzard of 1978, waves erode the beach but carry sand into the dunes and the back barrier area. Sand waves several feet thick were deposited during the 1938 hurricane. These areas, out of the reach of most waves, become vegetated with marsh plants or grasses and shrubs and extend the barrier system landward. As the sea level rises, sand is increasingly eroded from the seaward edge of the barrier and deposited in the back dunes and flat. The barrier shape remains, but the entire system migrates inland. Evidence of this along Charlestown's beaches is the appearance of peat on the seaward shore: this had previously been the tidal marsh in back of the barrier. Because permanent structures on the barrier do not move as readily as sand, the barrier would eventually move out from under them.

Studies conducted over the past thirty years indicate that the south shore beaches are moving landward. Along the south shore, the shoreline has already eroded backward out from under houses and has left septic systems exposed.

Alongshore Sand Movement. Currents and waves carry sand alongshore, picking up and depositing sand. Headlands such as Quonochontaug Neck provide a small source of sand, which is deposited along the barrier systems. If the alongshore flow is interrupted, such as by a jetty or seawall, sand is deposited up-current of the obstruction and eroded down-current. This effect is apparent along all of the south shore breachways: currents have deposited sand west of the breachways and eroded east of the breachways. Occasionally, the sand deposited alongside the breachway walls spills over into the channels, requiring the channel be dredged to maintain access.

Wind. Where sand on the barriers is not held by vegetation, the wind can have a major effect on the barrier shape by eroding and re-depositing sand. The effects of the wind on the beach itself are minimal, for the beach receives enough sand from the waves to be replenished. However the dunes are quite susceptible to wind erosion.

Topography

Topography affects drainage, hydrology, flooding, slope stability, and the diversity of landscapes and habitats. As discussed previously, Charlestown's topography reflects its glacial and post-glacial geologic history superimposed on the bedrock. Figure 2 shows Charlestown's topography.

Topographic Features

The salient features of Charlestown from south to north include:

- Barrier beach systems - elevations are all below 20 feet;
- Coastal headlands - knolls of outwash or till, reaching elevations between 20 and 30 feet;
- Coastal ponds (salt ponds);
- Coastal outwash plain - reaching an elevation of approximately 50 feet at the base of the moraine, spotted with kettle holes;
- Moraine - knobby ridge also containing kettle holes, with numerous steep slopes. Running across the town parallel to Route 1, it physically separates the interior from the coast. Elevations at the top of the moraine range from

15% Slopes

30% Slopes

0 4000
Scale in Feet

United States Geological Survey 7 1/2 Minute Topographic Maps

TOPOGRAPHY

Figure 2

CHARLESTOWN COMPREHENSIVE PLAN - 1991

approximately 100 feet in the west to over 200 feet in the east;

- o Interior lowlands - flat low-lying areas - generally poorly drained; contain Watchaug, Schoolhouse, and Pasquiset Ponds. These areas drain west to the Pawcatuck River or very slowly under the moraine;
- o Interior uplands - generally bedrock high points covered by thin layers of till. May occur with "kame" terraces, level step-like outwash features with steeply sloping sides;
- o Pawcatuck River.

Steep Slopes

Steep slopes present difficulties for construction and increase the risk of erosion during construction. If steep slopes near water bodies or other wetlands are disturbed, the resulting erosion could carry sediment into the wetlands, harming aquatic wildlife or altering the flood storage ability of wetlands. Steep slopes may mark important habitats such as kettle holes and ponds. Steep slopes may also serve as valuable scenic resources, providing views or screening development.

Areas of steep slopes (15-30 percent and greater than 30 percent) can be measured on the United State Geological Survey (U.S.G.S.) topographic maps of the town shown on Figure 2. Extensive areas of steep slopes occur throughout the moraine. Other areas are found in the Burlingame Management Area.

Soils

Charlestown's soils were formed over a landscape of glacial till and outwash. Differences in soil types can be attributed to the physical and chemical properties of these underlying materials. The United States Department of Agriculture Soil Conservation Service (SCS) has mapped and classified soil types throughout the state. The Soil Survey of Rhode Island (SCS 1981) provides a detailed inventory of soils within the town of Charlestown. It is a valuable tool for land use planning. The soil survey describes the potentials and limitations of each soil type. Soil types (or soil series) are mapped on aerial photographs. This mapping technique facilitates the identification of areas with particular soil constraints or potentials. While the soil survey is extremely useful for planning purposes, it should be kept in mind that there is variation in the actual field conditions, and on-site investigation is necessary to determine critical features such as wetlands or septic system design parameters.

Soils are classified according to various physical and chemical conditions. These conditions include such aspects as the underlying parent material, slope of land, depth to the water table, permeability of the soil, depth to bedrock, and overall texture and structure of the soil. These conditions must be taken into consideration in determining the suitability of the land for particular uses.

Several issues of primary importance to Charlestown are related to soil constraints. Wastewater management and drinking water supplies are both directly linked to the soil, and require special planning. Protection of coastal and freshwater wetland resources depends on the identification of wet (hydric), or potentially wet soils. Priorities for the preservation of agricultural land can also be facilitated by the identification of prime agricultural soils.

The current State regulations regarding individual sewage disposal systems (ISDS) are primarily concerned with system design and construction standards, and then the treatment capacity of the soil. It is therefore, important for the Town to understand the limitation of soil types relevant to their ability to effectively treat sewage effluent.

Table 1 divides the soil types found within Charlestown into five constraint groups based on their suitability for residential development. The table is based on the Residential Soil Grouping System developed for the Rhode Island Geographic Information System. Of primary concern is the suitability for ISDS construction and treatment of sewage effluent. The information can be used by the Town to identify areas which are better suited for higher density development, those areas where only low density development is appropriate, and those areas where virtually any type of development is inappropriate.

Group A: Lowest Constraints

Soil types in Group A are identified as having the lowest constraints to residential development. They present the least amount of difficulty for the design and function of ISDS. The soils in this category include well drained and excessively drained soils. It should be noted that excessively drained, coarse textured soils, such as the Hinckley and Glocester-Hinckley complexes, allow ISDS effluent to rapidly enter groundwater. Poorly functioning ISDS in these soils could lead to increased level of nutrients and bacteria entering coastal and freshwater wetland systems, and aquifers. The broadest area of excessively drained soils found in Charlestown is the recessional moraine, located north of Route 1. Groundwater, as well as surface water flow from this region appears to flow toward the coastal ponds. High density development in this area could potentially have significant impacts on the coastal ponds.

Group B: High Water Table

Constraints Group B includes soils that are moderately well drained according to the SCS Soil Survey. As indicated in Table 1, they tend to have seasonally high water tables, and for this reason contain limitations on the installation of septic systems. Several of the soils in this group typically contain inclusions of poorly drained soils, and should thus be considered as potentially hydric.

Group C: Steep Slopes, Shallow Depth to Bedrock

Soil types also considered to present severe constraints to the installation and function of ISDS, are noted in Constraint Group C. These soils are located either on steep slopes (>15%) or where the depth bedrock is shallow. In Charlestown, the areas of concern are in the glacial moraine northeast of Tautog Cove,

CHARLESTOWN SOILS
Constraint Group A
Lowest Constraints

Symbol	Name	Parent Material: Till	Outwash	Organic	Alluvial	Eolian	Slope	Drainage Class	Acres	Percent of Total Soils
BhB	Bridgehampton					X	3-8%	WD	35	
BmB	Bridgehampton					X	3-8%	WD	20	
BnC	Bridgehampton-Charlton	X				X	8-15%	WD	650	
BoC	Bridgehampton-Charlton	X				X	3-15%	WD	10	
CdA	Canton-Charlton	X					0-3%	WD	15	
CdB	Canton-Charlton	X					3-8%	WD	105	
CdC	Canton-Charlton	X					8-15%	WD	180	
ChB	Canton-Charlton	X					3-8%	WD	5,570	
ChC	Canton-Charlton	X					8-15%	WD	1,810	
CkC	Canton-Charlton	X					3-15%	WD	55	
EfA	Enfield		X				0-3%	WD	620	
EfB	Enfield		X				3-8%	WD	170	
GhC	Gloucester-Hinckley	X	X					ED	1,830	
HkA	Hinckley		X				0-3%	ED	50	
HkC	Hinckley		X					ED	835	
HnC	Hinckley-Enfield		X					ED/WD	405	
MmA	Merrimac		X				0-3%	WD	590	
MmB	Merrimac		X				3-8%	WD	250	
Mu	Merrimac-Urban		X					WD	85	
NaB	Narragansett					X	3-8%	WD	10	
NbB	Narragansett					X	0-8%	WD	115	
NbC	Narragansett					X	8-15%	WD	35	
PaA	Paxton	X					0-3%	WD	50	
PaB	Paxton	X					3-8%	WD	25	
PbB	Paxton	X					0-8%	WD	100	
PbC	Paxton	X					8-15%	WD	90	
Pg	Pits, Gravel								100	
UD	Udorthents								215	
Ur	Urban								240	
WgA	Windsor		X				0-3%	ED	670	
WgB	Windsor		X				3-8%	ED	330	

Source: USDA SCS Soil Survey of Rhode Island, 1981

CHARLESTOWN SOILS
Constraint Group B
High Water Table

Symbol	Name	Parent Material					Slope	Drainage Class	Acres	Percent of Total Soils
		Till	Outwash	Organic	Alluvial	Eolian				
Dc	Deerfield		X					MWD	70	
Nt	Ninigret		X					MWD	5	
Pp	Podunk				X			MWD	5	
ScA	Scio					X	0-3%	MWD	35	
Ss	Sudbury		X					MWD	215	
StB	Sutton	X					3-8%	MWD	5	
SuB	Sutton	X					0-8%	MWD	75	
SvB	Sutton	X					0-8%	MWD	15	
Tb	Tisbury					X		MWD	200	
WcB	Wapping					X	0-8%	MWD	265	
WhB	Woodbridge	X					3-8%	MWD	35	
WoB	Woodbridge	X					0-8%	MWD	345	
WrB	Woodbridge	X					0-8%	MWD	60	
	Water								175	

Source: USDA SCS Soil Survey of Rhode Island, 1981

CHARLESTOWN SOILS
Constraint Group C
Slopes >15%
Extremely stony

Symbol	Name	Parent Material					Slope	Drainage Class	Acres	Percent of Total Soils
		Till	Outwash	Organic	Alluvial	Eolian				
CaC	Canton-Charlton-Rock	X					3-15%	WD	515	
CaD	Canton-Charlton-Rock	X					15-35%	WD	95	
CC	Canton-Urban	X						WD	5	
CeC	Canton-Charlton	X					3-15%	WD	1,505	
ChD	Canton-Charlton	X					15-25%	WD	315	
GhD	Gloucester-Hinckley	X	X					ED	1,215	
HkD	Hinckley		X					ED	60	

Source: USDA SCS Soil Survey of Rhode Island, 1981

CHARLESTOWN SOILS
Constraint Group D
Hydric Soils

Symbol	Name	Parent Material: Till	Outwash	Organic	Alluvial	Eolian	Slope	Drainage Class	Acres	Percent of Total Soils
Aa	Adrian			X				VPD	1,285	
Co	Carlisle			X				VPD	1,510	
Ma	Mansfield	X						VPD	10	
Mk	Matunuck			X				VPD	470	
Rc	Raypol					X		PD	125	
Re	Ridgebury	X						PD	20	
Rf	Ridgebury, Whitman Leicester	X						PD/VPD	960	
Ru	Rumney				X			PD	15	
Sb	Scarboro		X					VPD	430	
Wa	Walpole		X					PD	155	

Source: USDA SCS Soil Survey of Rhode Island, 1981

CHARLESTOWN SOILS
Constraint Group E
Highest Constraints

Symbol	Name	Parent Material Till/Outwash/Organic/Alluvial/Eolian	Slope	Drainage Class	Acres	Percent of Total Soils
Ba	Beaches					125
Pk	Pits, Quarries					50
Rp	Rock-Canton	X				30
UAB	Udipsamments					280

Key to Draiange Class: ED = Excessively drained; WD = Well drained; MWD = Moderately well drained;
PD = Poorly drained; Very poorly drained = VPD

Source: USDA SCS Soil Survey of Rhode Island northwest of Watchaug Pond and north of the Indian Cedar Swamp. Septic systems proposed for steep slope areas require special design to meet State ISDS standards. Placement of a septic system over shallow bedrock results in ineffective treatment of septage effluent due to the impermeability of the substrate.

Group D: Hydric Soils

Hydric soils, Constraint Group D, are considered to be poorly and very poorly drained according to the SCS criteria. These soils do not meet the minimum standards for ISDS design in terms of the distance between the water table and the bottom of the septic system. ISDS failure is common in these soil types, resulting in unsanitary conditions. Hydric soils are a good indication of location of wetland systems, and thus carry an additional constraint in terms of the impact to wetland functions and wildlife habitat.

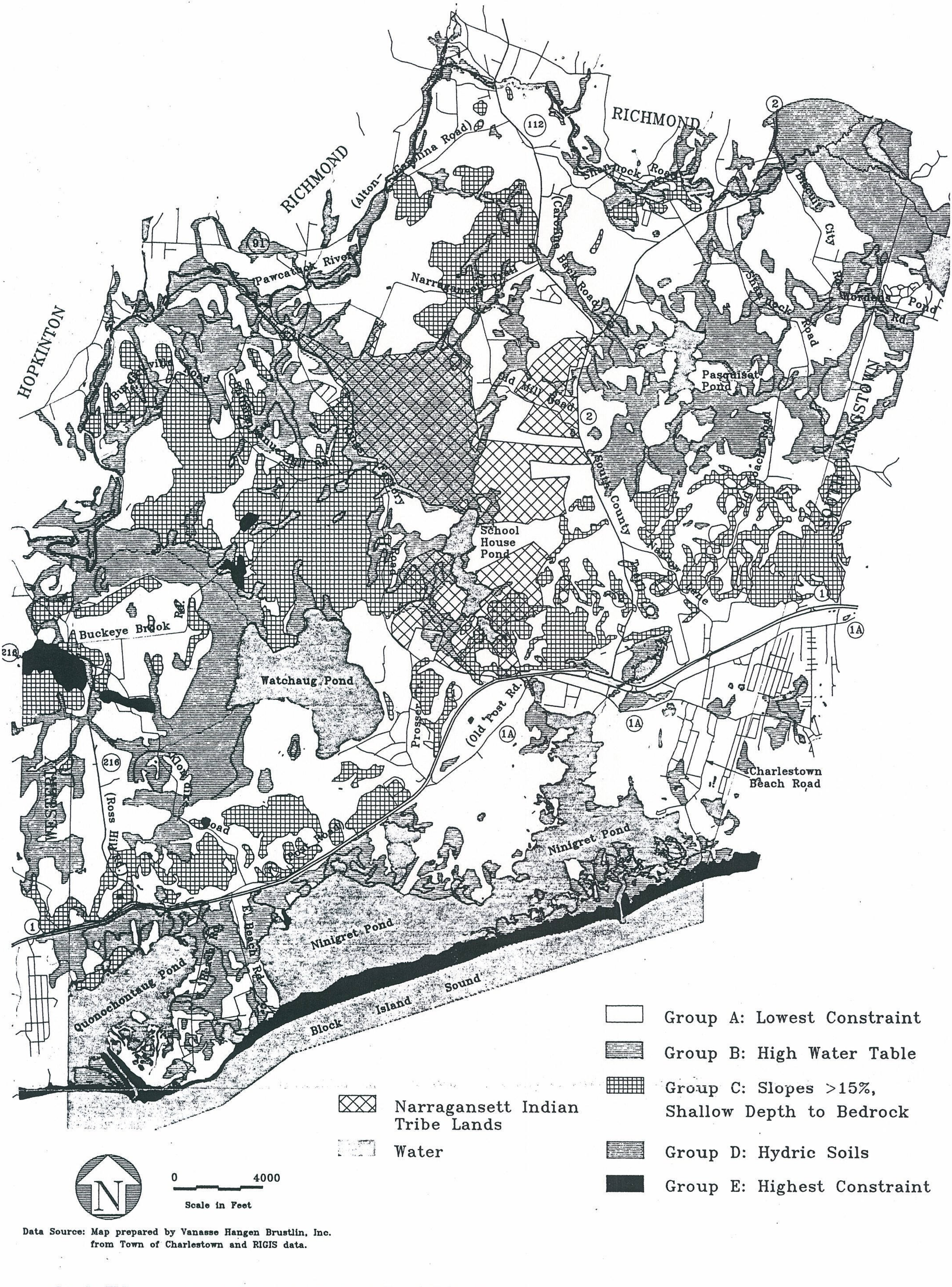
Soils and Groundwater

Protection of groundwater quality is linked to land use planning which is sensitive to the limitations and characteristics of the local soil types. Bacteria, nutrients and other pollutants which enter the groundwater will eventually effect the quality of the drinking water obtained from wells, or that which could potentially be obtained in the aquifer regions. The aquifer surrounding Pasquiset Pond, and that to the northwest of the Indian Cedar Swamp, contain a large percentage of excessively drained soils, as well as many areas of very poorly drained soils. The aquifer region that extends into the Poquiant Brook area is comprised mainly of very poorly drained soils. The upland soils surrounding the wetland area are identified as either excessively drained, or well drained with steep slopes and shallow bedrock.

Wetland Soils

The SCS Soil Survey is an extremely useful tool for identifying potential wetland areas. The soils which fall into Constraint Groups B and D are identified as having high water tables. As hydrology is the driving force behind wetlands, it is important to identify hydric and potentially hydric soils located within the town. While the soil survey should not be considered as a definitive depiction of wetland boundaries, it does provide general locations. Additionally, the Soil Survey can be used with other wetland mapping, described later, to identify areas of concern.

Land use planning around wetland systems containing open water areas should take into consideration the characteristics of the surrounding soils. Water bodies such as School House Pond, Deep Pond, Cross Mills Pond, and Tautog Pond, are surrounded by large areas of excessively drained soil. High density development in these areas could significantly impact the water quality of the ponds, as well as effect the rate of eutrophication.



Data Source: Map prepared by Vanasse Hangen Brustlin, Inc. from Town of Charlestown and RIGIS data.

SOIL CONSTRAINTS

Figure 3

CHARLESTOWN COMPREHENSIVE PLAN - 1991

Important Farmland Soils

Soil types which are particularly productive or otherwise important to agriculture have been identified by the SCS. In Charlestown, two categories occur: Prime Farmland Soils and Farmland Soils of Statewide Importance. The soil types within each of these categories are listed in Table 2. Farmland soils are shown in Figure 4. Comparison of the farmland soils map and the existing land use map shows that most of the few remaining farms in Charlestown occur on farmland soils which are prime or of statewide importance.

Groundwater

The groundwater in Charlestown plays two important roles:

- It provides nearly all residents, businesses, and visitors with water for drinking and washing from private and public wells;

- Groundwater is a major source of fresh water for the town's rivers, streams, and fresh and salt ponds.

Groundwater resources are also easily contaminated and are difficult and costly to clean up. Contaminants can affect the quality of well water and surface waters. It is important to protect the groundwater through planning and control of land use and contaminants.

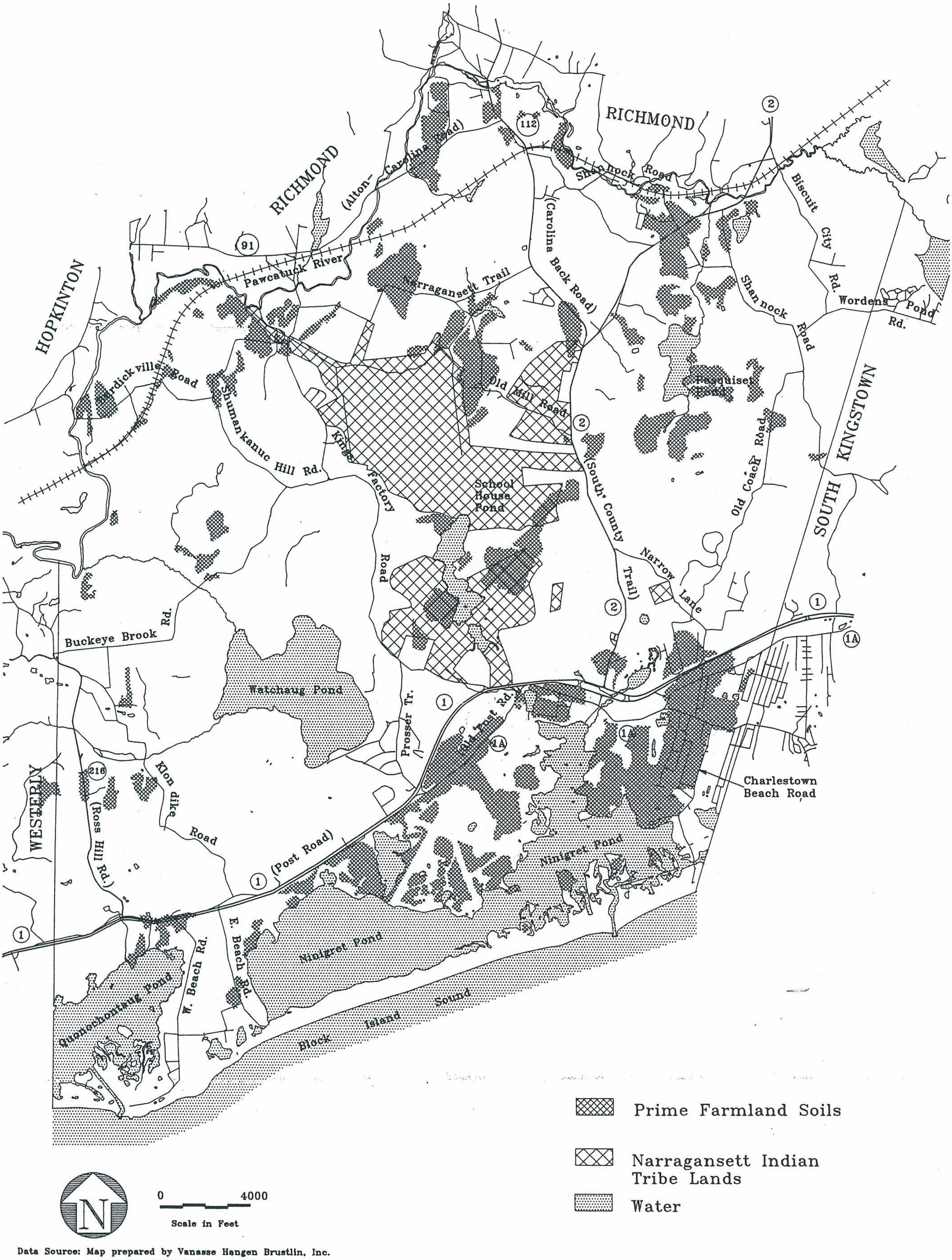
Groundwater Supplies: Sole Source Aquifer, Reservoirs, Recharge, and Other Outwash Areas

Groundwater flows through outwash, till, and to some degree bedrock. The large connected pore spaces of outwash deposits hold a great deal of groundwater and allow it to move easily. Outwash deposits generally are the most productive sources of groundwater in the northern (glaciated) states and are also quite susceptible to contamination.

Much of Charlestown is underlain by outwash, interspersed with isolated till uplands. The moraine contains mixed deposits, which transmit groundwater more easily than till but not as easily as outwash.

The drainage basin of the Wood-Pawcatuck River, encompassing most of the town north of the moraine, has been designated a Sole Source Aquifer by the U.S. EPA. The extensive outwash deposits provide a good supply of water, and the majority of residents and businesses in the watershed rely on the groundwater for potable water.

The sole source aquifer area contains the only designated groundwater reservoirs in Charlestown. Three deep channels of outwash in and near Charlestown represent areas of potentially high yield for drinking water (high yield aquifers, Figure 5). The State of Rhode Island has delineated the channels and the adjacent outwash as reservoirs and recharge areas, respectively, indicating the



Data Source: Map prepared by Vanasse Hangen Brustlin, Inc. from Town of Charlestown and RIGIS data.

FARMLAND SOILS Figure 4

CHARLESTOWN COMPREHENSIVE PLAN - 1991

CHARLESTOWN SOILS
Prime Agricultural Soils

Symbol	Name	Parent Material: Till	Outwash	Organic	Alluvial	Eolian	Slope	Drainage Class	Acres	Percent of Total Soils
BhA	Bridgehampton					X	0-3%	WD	240	
CdA	Canton-Charlton	X					0-3%	WD	15	
CdB	Canton-Charlton	X					3-8%	WD	105	
EfA	Enfield		X				0-3%	WD	620	
MmA	Merrimac		X				0-3%	WD	590	
MmB	Merrimac		X				3-8%	WD	250	
NaB	Narragansett					X	3-8%	WD	10	
Nt	Ninigret		X					MWD	5	
PaA	Paxton	X					0-3%	WD	50	
PaB	Paxton	X					3-8%	WD	25	
Pp	Podunk				X			MWD	5	
ScA	Scio					X	0-3%	MWD	35	
Ss	Sudbury		X					MWD	215	
StB	Sutton	X					3-8%	MWD	5	
Tb	Tisbury					X		MWD	200	
WhB	Woodbridge	X					3-8%	MWD	35	

Source: USDA SCS Soil Survey of Rhode Island, 1981

CHARLESTOWN SOILS
Farmland Soils of Statewide Importance

Symbol	Name	Parent Material Till/Outwash/Organic/Alluvial/Eolian			Slope	Drainage Class	Acres	Percent of Total Soils
BhB	Bridgehampton			X	3-8%	WD	35	
BmB	Bridgehampton			X	3-8%	WD	20	
Dc	Deerfield		X			MWD	70	
EfB	Enfield		X		3-8%	WD	170	
HkA	Hinckley		X		0-3%	ED	50	
HkC	Hinckley		X			ED	835	
HnC	Hinckley-Enfield		X			ED/WD	405	
Rc	Raypol			X		PD	125	
Re	Ridgebury	X				PD	20	
Wa	Walpole		X			PD	155	
WgA	Windsor		X		0-3%	ED	670	
WgB	Windsor		X		3-8%	ED	330	

Source: USDA SCS Soil Survey of Rhode Island, 1981

importance of these sources of groundwater. The Pasquiset Reservoir is almost entirely within the town. Charlestown shares the Indian Cedar Swamp/Schoolhouse Pond reservoir and recharge area with the Narragansett Tribe, and Charlestown contains a small portion of the recharge area associated with Poquiant Brook.

The other areas in town are underlain by outwash, till, or bedrock, which also provide groundwater. Non-reservoir outwash deposits, including the coastal area, provide enough groundwater for small community wells, whereas till, mixed deposits, and bedrock provide adequate supplies for wells serving individual homes and businesses.

Groundwater Flow in Charlestown

The flow of groundwater distributes water through Charlestown, and determines where contaminants will be distributed. Generally, the groundwater in Charlestown flows from the outwash deposits to surface water bodies, where it discharges. Groundwater south of the moraine flows to the coast and discharges in the salt ponds. A small amount of groundwater from just north of the moraine flows through the moraine toward the shore. However the groundwater north of the moraine generally flows toward and into Watchaug Pond and Poquiant Brook, Cedar Swamp Brook, and the Pawcatuck River. Near the shore, fresh groundwater often occurs as a lens riding over the more dense salt water. Wells along the coast tap into this fresh water lens.

If high volume wells were installed near surface water bodies, the wells would eventually draw water from the rivers, streams, and ponds. Likewise, an excessive amount of pumping near the coast may draw salt water into the wells.

The groundwater and wetlands of the the town are intimately related, especially where wetlands overlie the outwash deposits. In these areas, groundwater alternately discharges into streams, or is recharged by surface water entering the outwash deposits through the wetlands. The level of the groundwater (water table) influences the conditions of the wetlands, and the wetlands filter material out of water entering the outwash.

Public Wells in Charlestown

The town contains approximately 70 public water supplies, each serving 15 or more permanent connections or 25 or more people per day regularly throughout the year. Table 3 indicates the types of wells and the number of people served. Most of the wells are located along the south shore (See Figure 5), some of which serve several hundred people. The public wells in Charlestown include:

- Community wells for private water companies or mobile home parks;
- Non-community transient - Includes businesses, commercial establishments such as restaurants, shops, and motels, and campgrounds (public or private);
- Other public water supplies such as the Town Hall, Charlestown School, and Charlestown Senior Citizens Center.

Table 3 Public Water Supplies

Type	No. of Wells	People Served
Community Wells	9	2,369
Non-community transient - seasonal	33	3,400
Non-community transient - year-round	23	1,600
Public non-transient	5	550

Large wells north of the moraine include Burlingame Management Area and Campground (serving over 1,500 people seasonally), the Charlestown School, serving 425, and two mobile home parks serving 300. Kenyon Piece and Dye Works and Shannock village receive water from wells in Richmond.

Water Quality

Present Water Quality. The Rhode Island Department of Health (DOH) monitors the water quality for public water supplies and, along with the Department of Environmental Management (DEM), performs studies of private wells where problems might occur. Reports from various agencies indicate that generally the water quality in Charlestown is good (e.g. IEP, 1990; Lee Pare Assoc., 1988) In a few cases, wells have shown high levels of iron and magnesium, resulting from minerals in the soil.

The DEM has designated all mapped reservoirs and recharge areas and public community well recharge zones (2,000 foot radius) as class GAA, the highest classification possible (RIDEM, 1990). Other groundwater resources are designated class GA. These designations will be used in developing wellhead protection plans, and protecting water quality, discussed under Current Policies, below.

Known or Potential Point Sources of Pollution. RIDEM has mapped several known or potential contamination sources including four "point" sources, which can be traced to individual sites:

- United Nuclear Corporation site - Waste material from the United Nuclear Corporation leaked into the outwash deposits near Poquiant Brook. The waste material includes nitrates and strontium 90, a radioactive material. Since the spill was detected, the United Nuclear Corporation has ceased operations but has paid for monitoring the groundwater contamination. Studies indicate that the material has been flowing northwest through the wetland, emerging on the northern side of the Pawcatuck River and being diluted by the river water. Reports of measurements suggest that the strontium 90 has decayed to nearly imperceptible levels although nitrates still exceed safe drinking water standards. It is anticipated that the site will be released by the Nuclear Regulatory Commission and that United Nuclear Corporation will be allowed to sell the land in the near future;

- Rhode Island Department of Transportation Salt Piles - Until recently, RIDOT maintained an uncovered salt pile in Cross Mills. Well studies indicated high levels of sodium and chloride south of the salt pile. Sodium is not a regulated chemical in groundwater, but high levels raise health concerns related to high blood pressure. Chloride is a regulated contaminant. RIDOT has recently enclosed the salt in a covered structure to prevent rainwater from carrying the dissolved salt into the groundwater;

- Other mapped known or potential contamination sources include the Town's past and present landfill sites and the Kenyon Piece and Dye injection wells. The landfill sites have been carefully monitored and have shown no indication of groundwater pollution.

Known Non-Point Source Pollution. Non-point source pollution stems from numerous, dispersed sources and cannot be traced to a single point. Non-point source pollution includes septic system effluent, stormwater runoff from roads, lawn/agricultural fertilizer, pesticides, and animal waste. With the exception of animal waste, the non-point sources of pollution are generally associated with the density of development.

Reports issued by DEM and DOH indicate that wells along the south shore have shown high levels of several materials related to non-point source pollution. Wells in the Charlestown Beach area have shown high levels of fecal coliform, a bacteria associated with human and animal waste that may indicate potential health problems (RIPE, n.d.). Coastal communities have shown high levels of nitrate. Most reports indicate that nitrate nitrogen levels in groundwater are well within health standards but are elevated considerably over background levels, which could adversely affect the salt ponds (Olsen, S.J. V. Lee, and C. Collins, 1983). Both the bacteria and nitrates are associated with septic waste, as well as other sources such as runoff.

Threats to Groundwater Quality. The threats to groundwater quality are generally related to the density of development in Charlestown.

Septic Systems. Where site conditions are suitable, septic systems (ISDS) are quite effective in removing harmful bacteria and viruses when designed, installed, and maintained properly. Nitrate is not trapped or otherwise attenuated by septic systems in significant amounts. A large amount of septic waste in an area may produce levels of nitrate or microorganisms in groundwater that exceed health standards. Nitrate is also associated with eutrophication of salt water ecosystems, the degradation due to excessive algae growth. Excessive amounts of ISDS effluent can come from dense residential development, several large systems, such as associated with restaurants or motels, or heavily used camping areas.

The south shore is developed quite densely, and the number of septic systems per acre is considerably higher than what is recommended for maintaining water quality (2 acres per dwelling unit, R.I. Dept. of Administration Division of Planning, 1990). Studies during the early to mid 1980s linked water quality problems in the salt ponds with the density of septic systems on the south shore. Charlestown adopted larger lot zoning recommended in the studies to reduce the number of houses allowed along the south shore. However, many small lots that already existed can still be developed for residential use. Continued development along the south shore will increase the water quality problems. Because the land is already developed and still contains developable lots, zoning controls alone will not remedy the problem.

A recent study estimated nitrate loading from present and future land use, based on the town's current zoning and wetlands constraints (IEP, 1990). The study suggested that the salt ponds are suffering impacts from excessive nitrates due largely to ISDS effluent, and will continue to do so. The study indicated that the areas of Cedar Swamp, Saw Mill Pond, and Pasquiset Pond may also be threatened with nitrate problems. The first two could be contaminated with waste from the Industrial Research and Development properties.

Salt Water. The amount of pumping in wells along the south shore may lead to salt water intruding the coastal fresh water lens and entering drinking water. The intrusion of salt water may become more apparent over the long term as sea level rise drives salt water up toward present wells. A one-foot rise in sea level over the next thirty years may place many wells within the influence of salt water. Increased water use in these areas may also induce saltwater intrusion.

Other Sources. Other non-point sources of pollution include fertilizers and pesticides, petroleum storage tanks, and storage or disposal of other toxic materials such as dry cleaning solutions. Certain uses allowed by Town zoning are considered a moderate to high risk for groundwater contamination, including photo processing stores, hospitals, automobile repair shops, research labs, and manufacturing. The town contains several service stations, which may not have adequately protected tanks. Home fuel storage tanks may also leak petroleum products into the groundwater.

Potential Public Water Supplies

The groundwater reservoirs in Charlestown represent potential public water supplies, which the Town may wish to use in the future. Wells in these deposits, especially near the streams and Pawcatuck River, could yield substantial amounts of groundwater. A study performed in the 1970s indicated that the reservoirs could support a population of over 20,000 people, supplying 2-3 million gallons per day. This would require drawing some water from the Pawcatuck River and nearby streams, risking drawing in surface water contaminants and lowering the water level of the streams and wetlands and the river (Gonthier, J.B., H.E. Johnston, and G.T. Mamlberg, 1974). It may not be desirable to use the groundwater to such an extent, but the reservoirs represent an important alternative water supply to individual private wells.