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Coastal Zone Management Problems: RI Coastal Lagoons and Barriers

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by

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INTRODUCTION

The barrier spit-lagoon complexes that stretch along the south shore of Rhode Island are among the state's most valued natural resources (Figure 1). The area has the most rapidly growing year round residential population in the state and every summer, thousands of tourists come from all over the region to fish, boat, and bath on these shores. Their relatively-shallow depth and isolation from major cities have for the most part not made them attractive for intense commercial development. There is a long history of attempts to manage the lagoons and beaches to enhance their fisheries production and tourist appeal. As relatively small coastal systems with restricted exchange with offshore waters, they are particularly susceptible to the impacts of even residential and light commercial development on the shoreline and in the entire watershed. This field trip is designed to explore some of the ways in which the geology of the lagoons and barrier spits constrains patterns of development and options for coastal zone management.

For instance, most of the south shore lagoons, known locally as salt ponds, had permanent breachways constructed in the 1950s in order to enhance productive oyster fisheries, increase flushing, and improve access to the sea for recreational boating. The breachways are major controls of the ecology of the ponds since they regulate exchange with the ocean, which alters the nutrients and salinity, the flushing, the sedimentation rate on the flood tidal delta and access to the sea for migrating fish. These parameters are basic ingredients controlling the kinds of life that flourish in the ponds. We know from the past that changes in the size, duration and location of the breachways dramatically affected the ecology of the ponds. We also know that attempts to alter the breachways to better manage the ponds, have had far-reaching and often unforeseen consequences. Ironically, the stabilization of the breachways increased the flushing and salinity in the ponds enough to cause the demise of the very fisheries they were meant to enhance. As permanent connections to the sea, they accelerated the rate of sedimentation on the flood tidal delta building shoals that restricted, even proved harzardous to recreational boating.

CHARLESTOWN BREACHWAY

The Charlestown Breachway (stop 1) is a prime example of the problems inherent in attempts to manage complicated ecosystems. Before it was reinforced, the breachway would open and close several times a year in response to storm overwash and longshore drift. The opening and closing of the breach resulted in a pulsed salinity, conservative circulation, brackish environment in the ponds that was exceedingly productive. Indian shell middens on Fort Neck and Foster's Cove indicate that the ponds have produced abundant oysters for at least 1000 years.

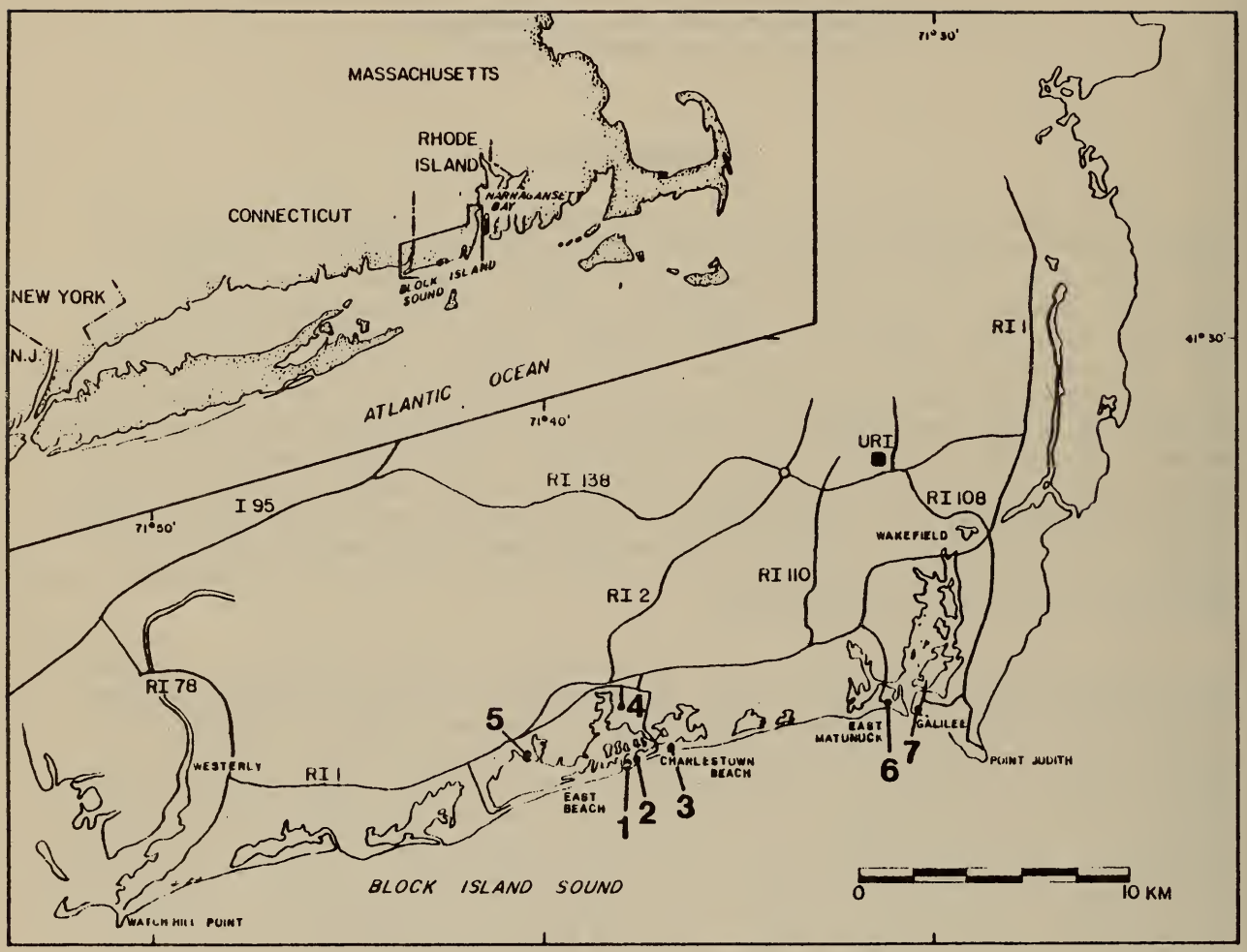


Figure 1. Rhode Island's south shore barrier spits and lagoons, which stretch from Watch Hill east to Point Judith. Field trip stops are enumerated on the map.

Reports from early fisherman indicate that they also supported extremely abundant finfish yields as well. Thousands of pounds of oysters, perch, and alewives were fished from these ponds in the 1800s and early 1900s.

Attempts to reinforce the breachway to make a permanent connection to the sea started at least 100 years ago. In the late 1800s, when Narragansett Bay supported an enormous oyster fishery, the state looked to Charlestown and Green Hill Ponds as a steady source of oyster seed to be transplanted to the commercial beds in the Bay. Even though the oysters spawned prodigiously in the ponds, it was thought that the set would grow better if the ponds were flushed with more seawater. So in 1881, the state paid for the Charlestown breachway to be reinforced with a rock wall on the west side and leased out sections of the pond for oyster culture (Figure 2).

For decades afterwards, the breachway shoaled in every year as longshore currents sealed off the entrance. Every other year the state would have it dredged out. In 1952, the permanent breachway was constructed, reinforced with granite riprap and dredged to its present configuration of 2 meter depth and 34 meter width.

However, the opening of the permanent breachway eventually caused the loss of the uses of the pond that it was meant to enhance. Oysters that once covered the sand flats along the back of the barrier and were harvested by the hundreds of bushels, can only be found in coves where fresh water comes into the ponds via springs or streams. The abundant brackish water finfisheries no longer exist. Sand eroded from the barrier beach is carried in through the breachway and deposited on a flood tide delta that is rapidly shoaling inside the pond (Figure 3). Boaters and fishermen can no longer easily navigate the channels that wind through the sand flats and out through the breachway. Fishermen and local residents fear that accumulating sediments are blocking adequate flushing of both Charlestown and Green Hill Ponds. If flushing becomes too reduced, the ponds or back coves will stagnate and choke with algae leading to the eventual death of fish and shellfish due to low oxygen. Some local residents are alarmed that east basin will soon be filled in and they will be living on sand flats instead of a pond. Local residents are demanding that something be done about the breachway to stop the ponds from shoaling, to insure that the excellent water quality is retained and that the fin and shellfish resources continue to be healthy and productive.

Jon Boothroyd (1981) has researched the processes of erosion and sedimentation in Ninigret Pond. The data will be used to help the state agencies decide how to make sound management decisions regarding breachway manipulation and dredging in the pond. The geological research and the constraints of geological processes on the various options available to the state will be discussed at the site.

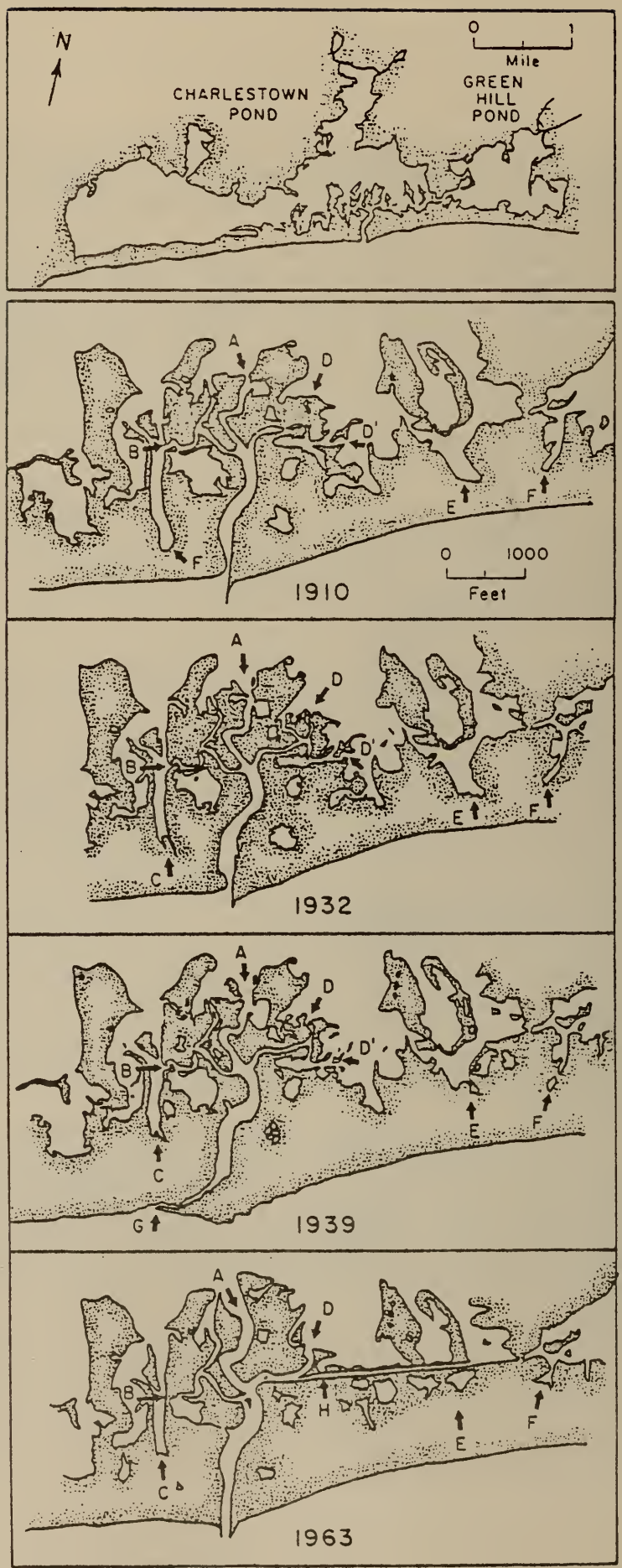


Figure 2.

Maps of Charlestown and Green Hill ponds showing changes in the breachway and major tidal delta channels over time.

Figure 3. Photograph of the Ninigret Pond flood tidal delta and adjacent barrier spits. Photo taken June 28, 1981 by Jon Boothroyd.

GREEN HILL AND CHARLESTOWN EAST BEACH

The Green Hill and Charlestown East Beach (Stop 2 and 3) is a developed barrier spit beset by a host of difficult management problems. It is an eroding beach and an active overwash area. It is an east-west oriented beach with a prevailing southwest breeze and ocean waves which make the beach and any development particularly susceptible to storm damage not only of hurricane magnitude but even in more common storm events. Beach and dune erosion occur during southeasterly winter storms, and during late summer and fall hurricanes. Measurements using time series aerial photographs indicate that the south shore barrier beaches and foredune ridge are eroding at an average rate of 0.2 m yr^{-1} (Regan 1976). Fisher and Simpson (1980) determined that some areas are eroding more rapidly than others, and give the accelerated rate of 0.7 m yr^{-1} for those localities.

Twenty-four hurricanes have caused coastal erosion and flooding during the past 165 years (1815-1980). Two very large hurricanes in 1938 and 1954 (Carol) resulted in huge hurricane surges, 4.4 m and 3.0 m above mean high water respectively (Olsen and Grant, 1973).

The storm surge from these hurricanes washed huge volumes of sand over the barriers and swept houses, roads, automobiles, and people over the barrier and across the ponds onto the far shore. There have been numerous winter storms that have also caused severe erosion of the beach and overwash into these ponds. The blizzard that stalled New England in the winter of 1978 also did considerable damage to the houses on Charlestown East beach. Two houses were lost, several were severely damaged.

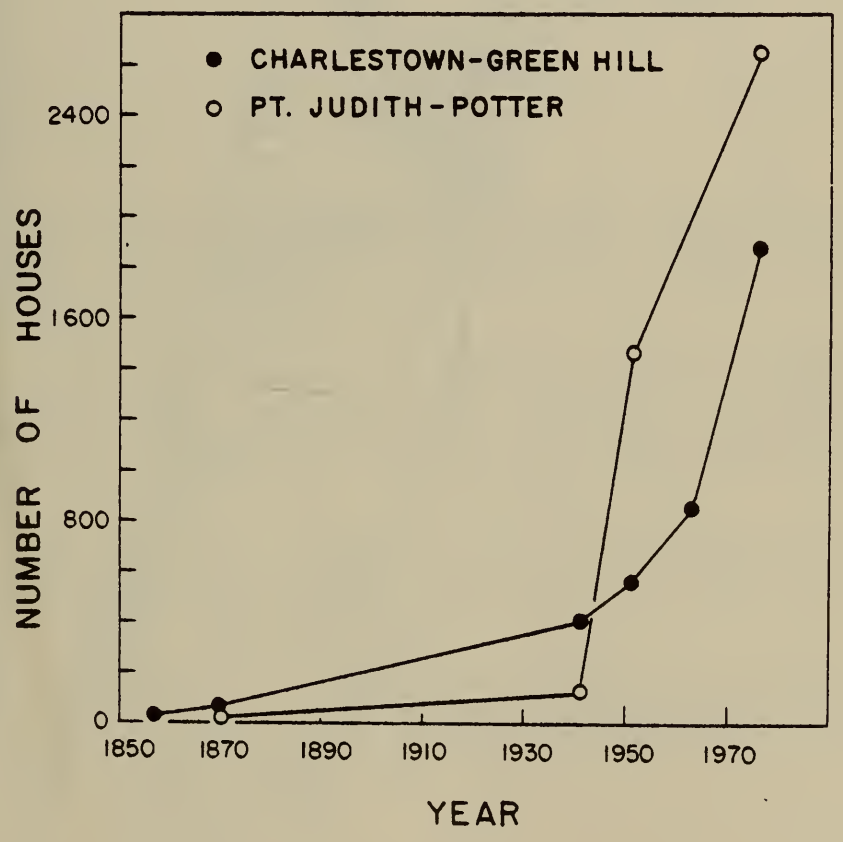
As a result of the extensive flooding and millions of dollars of destruction caused by the hurricanes of 1938 and 1954, coastal Rhode Island towns bought into the federal flood insurance program. The flood insurance program has subsidized development of barriers where local banks would not. The ways in which the flood insurance program has exacerbated problems of barrier beach management will be discussed with pertinent examples demonstrated at stops 2 and 3.

LIMITATIONS OF OUTWASH SOILS TO DEVELOPMENT

The Fosters Cove development (stop 5) is an excellent example of the constraints that the glacial outwash soil around the ponds put on residential development. After World War II, the standard of living improved enough for people to be able to afford summer houses on the south shore. Most of these houses had cesspools or piped waste directly into the ponds. Since housing was only seasonal, there was little noticeable pollution of the ponds. However, since the highways were improved in the 1950's putting the south shore in easy commuting distance to industiral centers, the south shore has accomodated dramatic increases in residential development (Figure 4). Virtually all of the houses within the watershed have septic systems and private wells. Public sewers and town water have only recently been installed around Point Judith Pond. Since the direction of

flow is toward the ponds (Figure 5) and the percolation rates are very high in the glacial outwash plain, septic seepage is contaminating groundwater and the ponds. During the summer months, coliform levels in Green Hill, Trustom, Cards and upper Point Judith ponds are above recreational fishing standards. These ponds are important recreational fishing areas.

Furthermore, the additional nutrient loading is contaminating drinking wells and probably accelerating eutrophication of the ponds. In contrast to fresh water systems where phosphorus is the limiting nutrient in coastal waters, nitrogen is limiting. Most of the nitrogen in septic sewage is oxidized to nitrate in the groundwater around the ponds. Since nitrate does not bind to soil particles especially co se outwash soils, it travels with the groundwater to the ponds. These issues will be discussed in relation to Fosters Cove where a proposed residential development has the potential for particularly negative impacts on the coastal zone. The cove is one of the last good oyster spawning areas in the state. Due to the narrow construction where it connects to Ninigret Pond, flushing is reduced and it is particularly susceptible to the ills of eutrophication due to increased nutrient loadings from surrounding development.



gure 4. A graph of the dramatic increase in residential development in the outwash plain surrounding the ponds. Particularly rapid growth has accrued since the 1950s.

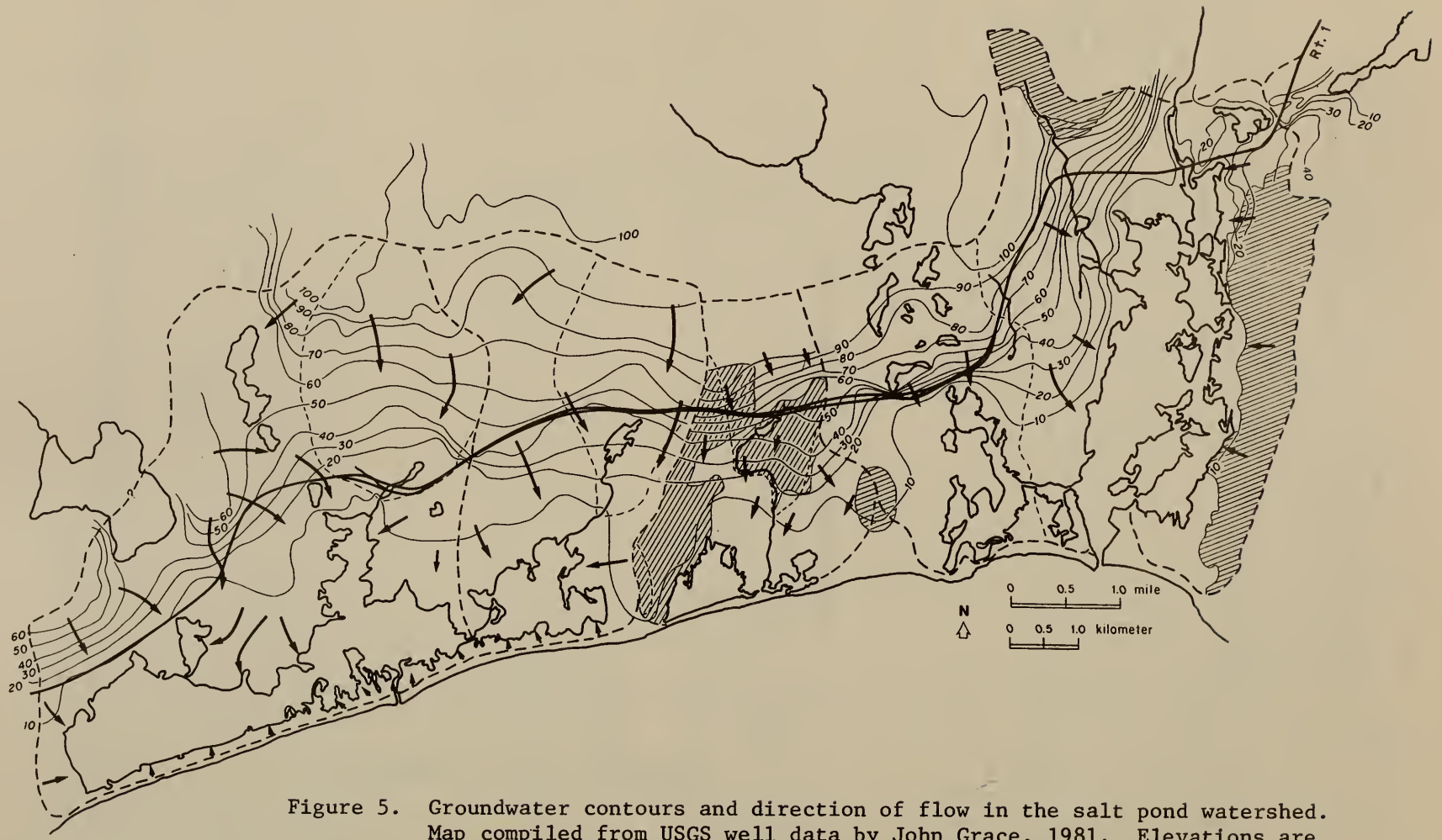


Figure 5. Groundwater contours and direction of flow in the salt pond watershed. Map compiled from USGS well data by John Grace, 1981. Elevations are in feet above mean sea level. The crosshatching represents glacial fill in what is otherwise glacial outwash and morrain deposits.

LARGE SCALE RECREATIONAL BEACH FACILITIES

The state bathing pavilion at East Matunuck beach (stop 5) is an instructive contrast to the bathing pavilion at Sand Hill Cove (stop 6). At East Matunuck, the location of the parking lot exacerbates the overwash process, shunting sand and gravel over the barrier and filling Succatash Marsh, a state wildlife sanctuary. The pavilion is built high on an unprotected coast where hurricane surges have already washed over the barrier and into Potter and Point Judith Ponds. The beach is eroding relatively rapidly making it susceptible to future storm events in contrast to Sand Hill Cove beach, which is in the lee of the protective breakwaters of the Harbor of Refuge. The management problems inherent in the recreational structures will be discussed. The development of the Port of Galilee and harbor dredging and spoil disposal practices will also be explored.

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Itinerary

The field trip will leave from the Keaney parking lot beside the athletic fields, University of Rhode Island. It involves walking on beaches and dunes. Sneakers or tennis shoes are recommended.

Distance (In Miles) Tot.	Cum.	Routes and Stops
0	0	Leave Keaney parking lot, turn right (west) on RI 138.
0.6	0.6	Intersection of RI 110 at lights. Turn left (south) on RI 110. This route, also called Ministerial Road.
3.8	4.4	Tuckertown Four Corners, intersection of Wordens Pond Road on the right (west), and Tuckertown Road on the left (east). Located on ice-contact deposits just north of the Charlestown end moraine. Proceed south through the intersection and up onto the moraine.
0.7	5.1	Backside (ice-contact slope) of Charlestown moraine.
1.3	6.4	Intersection with Old Post Road, and beginning of proximal outwash plain. Proceed south to US 1.
0.2	6.6	US 1, go west past exits to Moonstone and Green Hill beaches. Charlestown moraine on the right.
1.2	7.8	Charlestown Beach exit: exit from left lane onto US 1, north.
0.3	8.1	Exit right at Charlestown Beach breachway sign. Proceed 100 yards to stop sign (intersection with US 1A); continue straight through stop sign. Passing over proximal outwash plain (former potato farms).
0.5	8.6	Turn left at Stop sign onto Schoolhouse Road; follow Beach/Breachway signs.
0.1	8.7	Turn right onto Charlestown Beach Road. Proceed south on the outwash plain; across a small till upland, and down to the lagoon.
1.3	10.0	Green Hill Pond bridge: Charlestown Pond with dredged channel to the right; Green Hill Pond to the left (small island with house is a till upland). Beyond the pond is Green Hill, a drumlin.
		Bear left off bridge onto back barrier. Proceed 200 yards.
0.2	10.2	Bear right to travel west along the back barrier. Example of a developed barrier spit, most structures built since 1970.
0.5	10.7	Location of CHA-EZ profile.

0.1 10.8 Two houses on left lost in 1977-78; passing area of active overwash.

0.1 10.9 Charlestown Breachway (State Camping Area gravel parking lot).

STOP 1. Charlestown Breachway.

Leave breachway parking lot, heading east along back barrier.

0.2 11.1 Location of CHA-EZ beach profile.

STOP 2. Charlestown Beach.

Return east along the back barrier.

0.5 11.6 At the junction of Charlestown Beach turn right, proceed 100 feet toward the ocean, make a sharp left and continue east along the barrier spit.

0.5 12.1 STOP 3. Green Hill Beach.

Walk to pole No. 8850.

0.7 12.8 Return west along the barrier turning right onto Charlestown Beach Road to the Green Hill Pond Bridge. Drive north along Charlestown Beach Road.

1.3 14.1 Intersection Charlestown Beach Road and Schoolhouse Road. Turn left at stop sign on Schoolhouse Road.

On your left housing developments are being built on proximal outwash plain, where the eolian mantle is Bridgehampton silt-loam, some of the finest agricultural soil in the state.

0.4 14.5 Intersection of Schoolhouse Road and US 1A. Bear left along US 1A south. WATCH CLOSELY FOR NEXT TURN.

0.1 14.6 Turn left private gravel road, follow it till it ends in a borrow pit.

0.2 14.8 STOP 4. Outwash Gravel.

0.2 15.0 Return out the gravel road to Rt. 1A. Turn left (west) US 1A.

0.5 15.5 Cross Mills Village. A water driven grist mill operated here in the 1700's grinding corn grown on the local coastal farms where the outwash soils were fertile, relatively rock free, and the climate mild compared to farms north of the moraine. We also pass the entrance to Fort Ninigret, a major summer encampment and trading post for the Niantic Indians. Artifacts indicate that it was a center for trade with other tribes and with the Dutch in colonial times.

0.6 16.1 Intersections of US 1A and US 1. Proceed east 300 yards and exit left across the median strip (Proceed west on US 1).

0.7 16.8 On your left is an abandoned Charlestown Air Station developed to train night fliers during WW II. It was a proposed site for a nuclear generating station.

0.7 17.5 On your left is Foster's Cove and Charlestown Pond. On a clear day Block Island can be seen on the horizon.

0.4 17.9 Exit left across median at the Hitching Post hot dog stand and proceed south across outwash plain to the pond (private road).

0.5 18.4 Bearing left, stop at the grey house with a sign saying "Seeley": (2nd house on right).

STOP 5. Foster's Cove.

Return to US 1.

0.6 19.0 Turn right on US 1 heading east. Drive east several miles along the Charlestown moraine.

8.4 27.4 On your right is Perch Cove, a kettle hole connected to the north end of Potter Pond.

0.7 28.1 Exit right off US 1 at East Matunuck State Beach, Jerusalem, Snug Harbor sign. Head south on Succotash Road, traveling over ablation moraine and kame terrace.

0.7 28.8 Potter Pond bridge. Point Judith Pond is on the left connected under the bridge to Potter Pond on your right. The salt marsh south of the bridge is growing on a relic flood tidal delta. The houses on the right are built on fill and glacial islands.

0.6 29.4 Bear right into the East Matunuck State Beach. Park in the State Beach parking lot next to the beach pavilion.

STOP 6. East Matunuck.

Return north along Succotash Road; over Potter Pond bridge to US 1.

1.9 31.3 Bear right onto US 1 heading east. The marinas on your right are on upper Point Judith Pond.

3.8 35.1 Exit right off US 1 at sign for Point Judith, Scarborough, and Galilee. Proceed up off-ramp; turn right onto Woodruff Avenue; follow signs for Point Judith. Bear right at lights onto RI 108 (south). Drive south on RI 108 several miles, through to intersection with traffic lights. You are traversing along Point Judith end moraine.

4.2 39.3 Fisherman's Memorial State Park on right: the site of coastal defense gun batteries guarding the east entrance to Narragansett Bay during WW II.

0.1 39.4 Exit right off RI 108 onto the Escape Road. So many lives were lost at Galilee during the hurricane of 1938 that the road was built as a hurricane escape route. Ironically, only the gravel foundation fill was in place in 1954 when Hurricane Carol washed all gravel onto the tidal flats on the north side of the road.

1.2 40.6 Turn left (south) at T-intersection. This is the village of Galilee, the major commercial fishing port in the state and the terminal for the Block Island ferry.

0.4 41.0 Turn right into the parking lot at the breachway.

STOP 7. Point Judith Breachway.

END OF TRIP