



2021

Land as the Community to Which We Belong¹

Land Use

Little Narragansett Bay and the Coastal Salt Ponds



NARRAGANSETT BAY ESTUARY PROGRAM

¹ This title refers to this quote “When we see land as a community to which we belong, we may begin to use it with love and respect” by Aldo Leopold from the foreword to [A Sand County Almanac](#).



Science Update:
Land Use in the Little Narragansett Bay and
the Coastal Salt Ponds Between 2001-2016.

Narragansett Bay Estuary Program

NBEP-21-244

August 2021



CITATION

Narragansett Bay Estuary Program (NBEP). 2021. Science Update: Land Use in the Little Narragansett Bay and the Coastal Salt Ponds Between 2001-2016. NBEP-21-244. DOI: 10.6084/m9.figshare.14838819.

For more information, please contact Courtney Schmidt (courtney.schmidt@nbep.org)

ACKNOWLEDGEMENTS

Much of this update is based on the Narragansett Bay Estuary Program's *State of Narragansett Bay and Its Watershed*, a huge effort by over 60 partners to describe the status and trends of Narragansett Bay. The current staff and partners wish to thank former staff and partners for their hard work creating the solid foundation on which we stand.

FUNDING

Development of this document was funded by agreements CE00A00407 awarded by the EPA to NEIWPCC. Although the information in this document has been funded by the EPA, it has not undergone the EPA's publications review process and therefore, may not reflect the views of EPA and no official endorsement is inferred. The viewpoints expressed do not necessarily represent those of NEIWPCC or EPA. Mention of trade names, commercial products, or causes do not constitute endorsement or recommendation for use.

AUTHORS & REVIEWERS

Main Author

Courtney Schmidt, NBEP

Narragansett Bay Estuary Program Staff

Julia Bancroft

Mike Gerel

Julia Twichell

U.S. Environmental Protection Agency

Caitlyn Whittle

NBEP Science Advisory Committee

Members

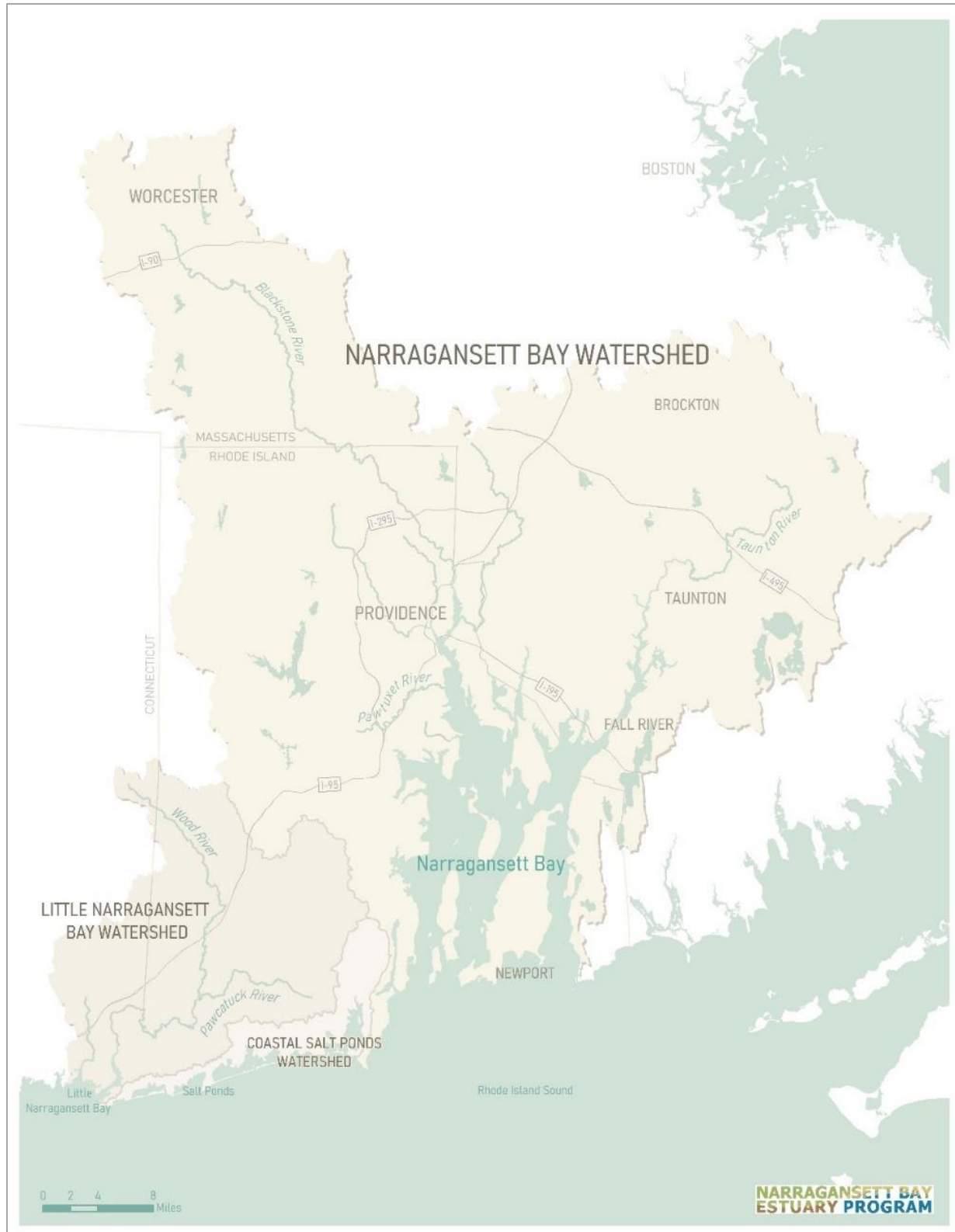
Anne Kuhn, USEPA

Richard Carey, MassDEP

Danielle Perry, Mass Audubon

NARRAGANSETT BAY ESTUARY PROGRAM AND ITS STUDY AREAS

The Narragansett Bay Estuary Program is part of the National Estuary Program, established in 1987 as an amendment to the federal Clean Water Act administered by the U.S. Environmental Protection Agency (EPA). The NBEP uses a voluntary, community-driven approach to enhance the water quality, wildlife, and quality of life in the Narragansett Bay, Little Narragansett Bay, Coastal Ponds, and their watersheds in Rhode Island, Massachusetts, and Connecticut. The landscape unites 2 million people across 113 communities in 3 states. It hosts diverse habitats that sustain wildlife and vital economies.



Map of Narragansett Bay Estuary Program Study Areas

PURPOSE

This science update presents an analysis of land use change in two of NBEP's study areas – Little Narragansett Bay and the Coastal Salt Ponds – focusing the changes in area (acreage) of forested and developed lands from 2001 to 2016. This report is the first time NBEP is presenting land use change for the Little Narragansett Bay and the Coastal Salt Ponds. For information on land use change in the Narragansett Bay Watershed, which is an update of the 2017 [State of Narragansett Bay and Its Watershed](#), please see our two page science update included in this download.

The purpose of these documents is to inform our audience on land use change in NBEP's study areas, and to identify areas for further research. NBEP hopes that this update stimulates discussion among our partners and land use experts. The audience for this piece is anyone who is interested in land use change, particularly environmental managers, members of land-trust committees, and the interested public.

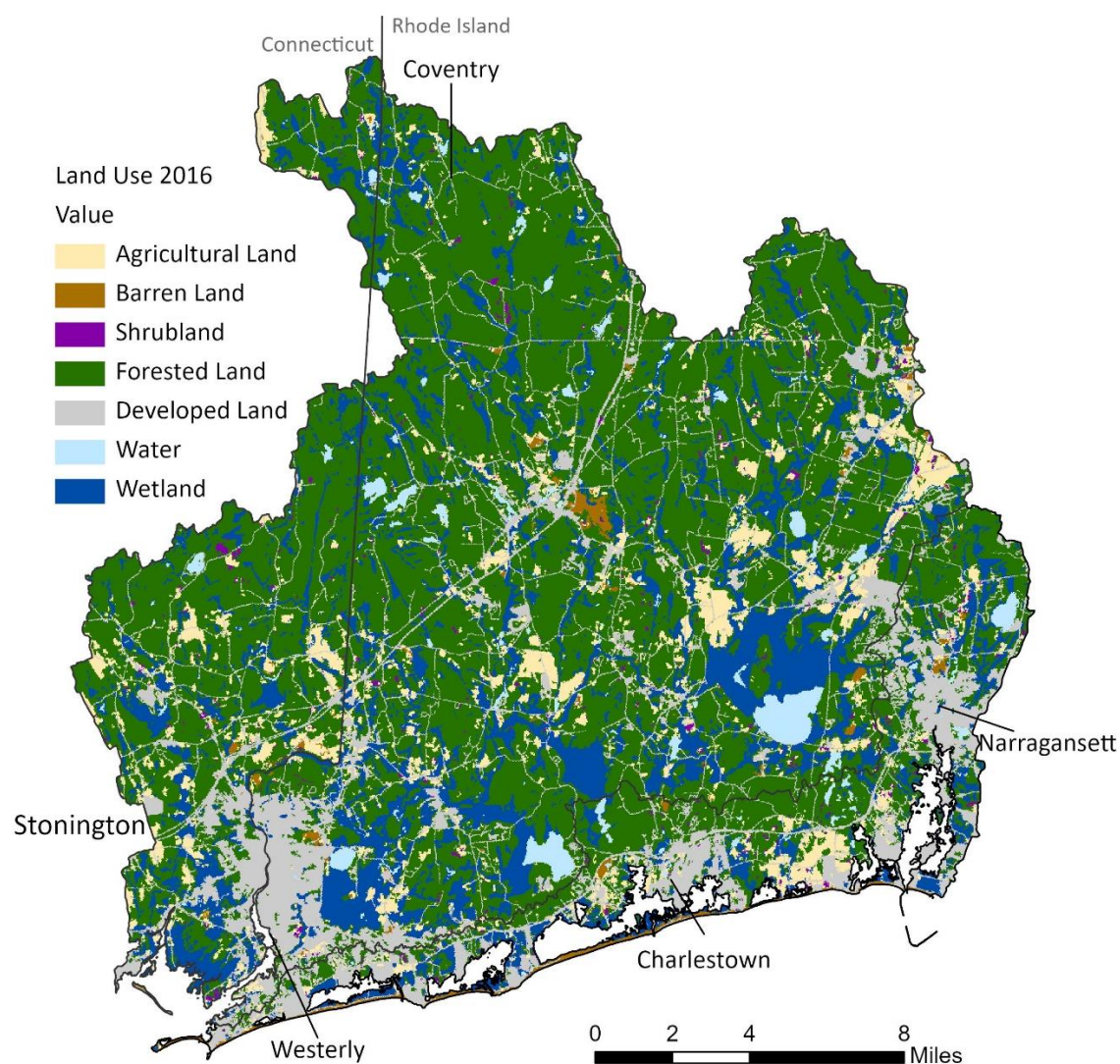


Figure 1. Land use in Little Narragansett Bay and Coastal Salt Ponds Watersheds.

WHAT IS LAND USE?

Land use describes how humans use and categorize land. Categories represent development, cultural, and economic practices. The two largest categories in terms of acreage for the NBEP study areas are developed land and forested land (Figures 1 and 2).

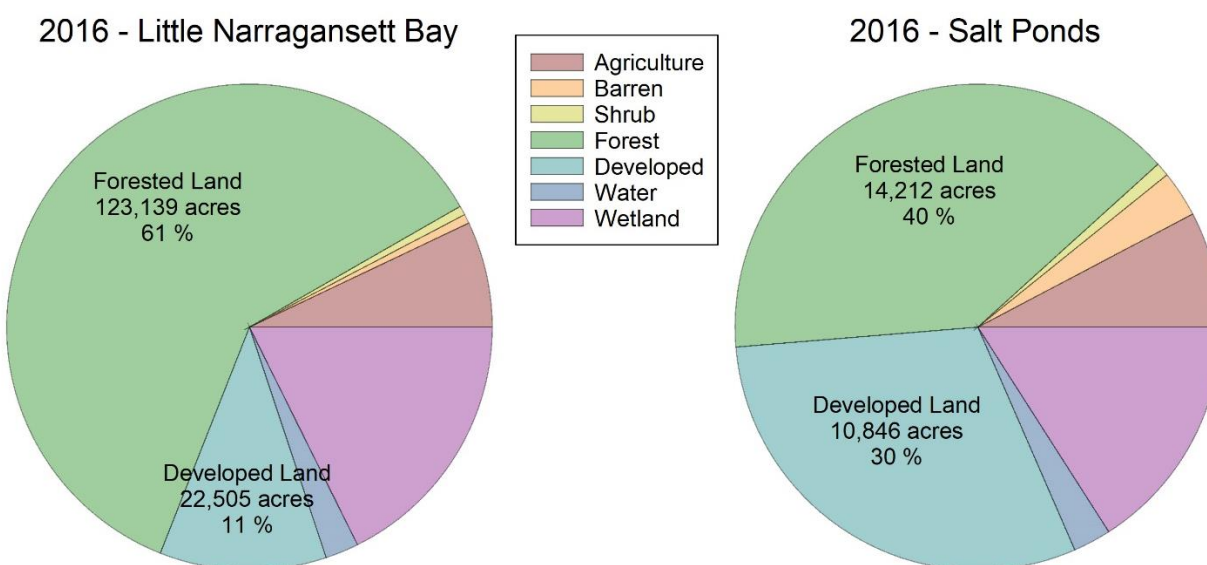


Figure 2. Land use in Little Narragansett Bay and the Coastal Salt Ponds from the 2016 National Land Cover Dataset. This figure highlights the status of forested and developed lands for 2016.

WHY LAND USE MATTERS?

Changes in land use, especially the conversion of natural lands to developed areas, affects hydrologic function, alters the delivery of nutrients to rivers and estuaries, affects terrestrial, aquatic, and estuarine wildlife and habitat conditions, and contributes to increased pathogens in recreational and shellfishing waters. Land use changes that reduce natural lands are an indicator of habitat fragmentation, diminishing habitat value as well as water quality and quantity (Tu and Xia 2006).

Conversion of natural land cover such as forests to a developed land use can significantly increase non-point source mobilization and streamflow patterns after rain events. Non-point source inputs are influenced by land use alteration, riparian buffer degradation, sediment from poorly managed construction sites, stormwater runoff, road

salt, atmospheric deposition of nutrients, failing septic systems, and other factors. Human population growth is a fundamental driving force in land conversion. As the population grows, the infrastructure to support homes, transportation, and commerce increases (Meyer and Turner 1992; August et al. 2002).

The conversion rate of natural lands to developed land outpaced the population growth rate in the Narragansett Bay Watershed over the last few decades (NBEP 2017). In the 2017 report, NBEP remarked that recent changes in land use were not uniformly distributed across the Narragansett Bay Watershed. Land use changes have varied temporally and spatially as the population has moved from the urbanized centers to the more suburban and rural parts of the Watershed. This remains true across all study areas (Narragansett Bay, Little Narragansett Bay, and the Coastal Salt Ponds).

METHODS

The methods used in this report are similar to the Land Use Chapter of the *Status of Narragansett Bay and Its Watershed* (NBEP 2017). The acreage reported in this update stem from National Land Cover Datasets (NLCD), clipped to the study areas, and then sorted by watersheds (study areas, HUC10, HUC12, etc.).

Data and methods are available here: <https://narragansett-bay-estuary-program-nbep.hub.arcgis.com/>



Aerial photograph of Point Judith, Rhode Island showing multiple land uses (Dave Cleaveland, <https://www.flickr.com/photos/maineimaging/5197964753/in/album-72157623609936621/>)

LAND USE IN LITTLE NARRAGANSETT BAY

Little Narragansett Bay is a 202,730-acre watershed in the southwest corner of Rhode Island (Figure 3). It contains the Wood and Pawcatuck Rivers, and a portion of the watershed is in eastern Connecticut near Stonington. The major city in the watershed is Westerly. Little Narragansett Bay has many more forested lands (61 percent of the watershed) than developed lands (11 percent of the watershed) (Table 4).

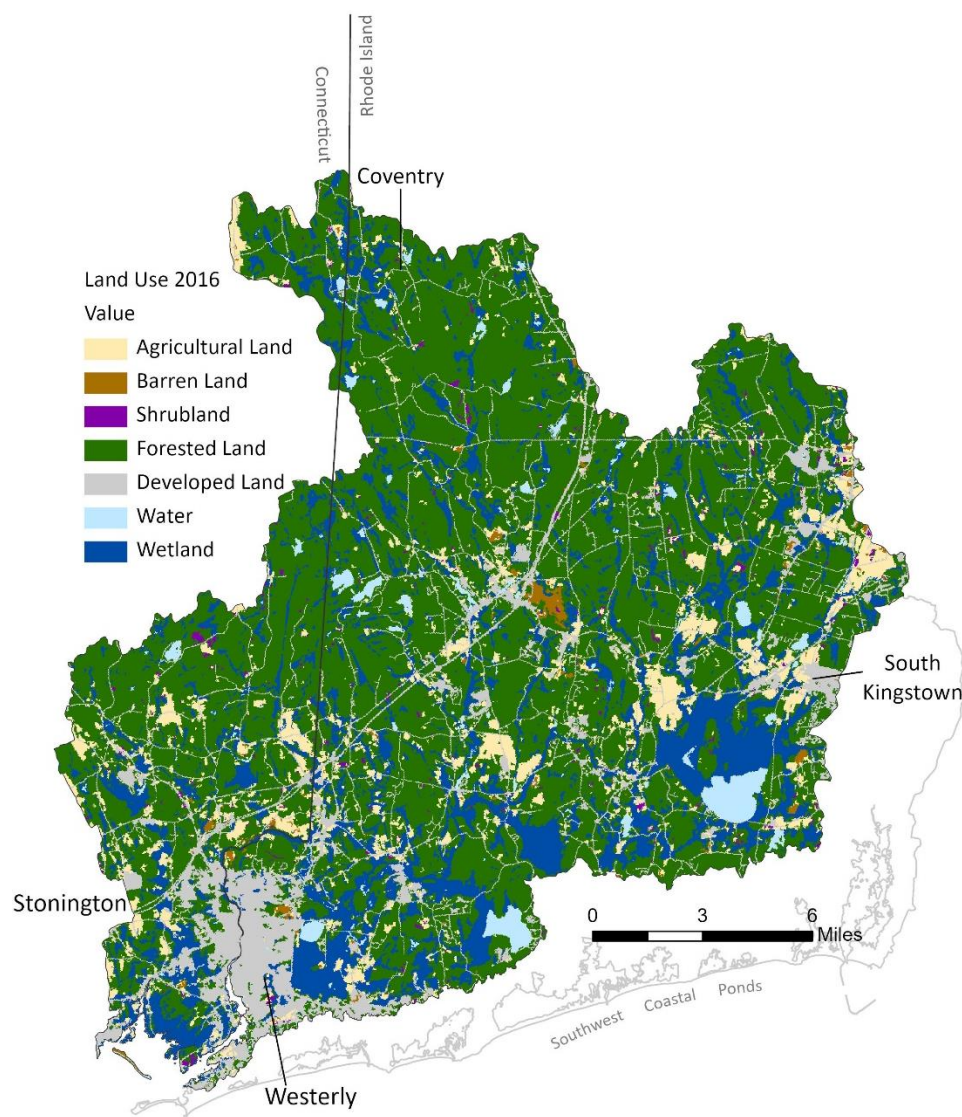


Figure 3. Land Use in Little Narragansett Bay based on the 2016 National Land Cover Dataset.

Table 4. Total area (acres) and percentage of developed and forested lands in the Little Narragansett Bay Watershed based on the NLCD. The watershed is 202,730 acres.

Land Use Category	2001		2011		2016	
	Acreage	Percent	Acreage	Percent	Acreage	Percent
Developed	21,740	10.7	22,416	11.1	22,505	11.1
Forested	124,920	61.6	123,257	60.8	123,139	60.7

STATUS OF DEVELOPED LANDS

The developed land area of the Little Narragansett Bay Watershed totaled 22,505 acres in 2016, representing 11 percent of the Watershed (Figure 2; Table 4). The Little Narragansett Bay Watershed has four HUC10 watersheds. The developed lands ranged from a low of 7 percent (4,024 acres) in the Wood River Watershed to a high of 18 percent (1,734 acres) in the Part of Southeast Coastal-Pawcatuck River to Eastern Point watershed, which includes the cities of Westerly and Stonington (Table 5). Of the 11 HUC12 subwatersheds, only one subwatershed had more than 50 percent of their area classified as developed (Lower Pawcatuck River), while the remaining subwatersheds had 18 percent or less of their land classified as developed.

STATUS OF FORESTED LANDS

There were 123,239 acres of forested land in the Little Narragansett Bay Watershed in 2016, constituting 61 percent of the Watershed (Figure 2; Table 4). The HUC10 watershed with the lowest percentage of forested land was the Part of Southeast Coastal-Pawcatuck River to Eastern Point, which had 42 percent (4,092 acres) forest (Table 5). The watershed with the highest percentage was the Wood River with 73 percent (41,986 acres) (Table 5). Of the 11 HUC12 subwatersheds, eight had more than 50 percent forest. The five subwatersheds with the highest percentages of forested land were the Upper Wood River, Ashaway River, Beaver River, Lower Wood River, and Shunock River (Table 5). The three HUC12 subwatersheds with the lowest percentages of forested land were the Lower Pawcatuck River, Chipuxet River-Pawcatuck River, and Part of Coastal drainages-Pawcatuck (Table 5). The Lower Pawcatuck River watershed also had the least amount of forested land (28 percent) (Table 5).

Table 5. Total area (acres) and percentage of developed and forested lands for the HUC10 watersheds and HUC12 subwatersheds in the Little Narragansett Bay Watershed. Both HUC10 and HUC12 watersheds are listed in descending order of percent developed lands in 2016.

Watershed Name	Developed Lands				Forested Lands			
	2001 Acreage	2016 Percent	2001 Acreage	2016 Percent	2001 Acreage	2016 Percent	2001 Acreage	2016 Percent
<i>HUC 10 Watershed Name</i>								
Part of Southeast Coastal-Pawcatuck River to Eastern Point	1,670	17.2	1,734	17.9	4,236	43.7	4,092	42.2
Lower Pawcatuck River	6,437	17.0	6,591	17.4	23,160	61.1	22,841	60.3
Upper Pawcatuck River	9,704	9.9	10,152	10.4	55,296	56.6	54,220	55.5
Wood River	3,926	6.8	4,024	7.0	42,228	73.6	41,986	73.2
<i>HUC12 Subwatershed Name</i>								
Lower Pawcatuck River	4,660	49.2	4,774	50.4	2,777	29.3	2,650	28.0
Chipuxet River-Pawcatuck River	1,848	11.2	1,734	12.3	7,121	43.3	4,092	42.2
Part of Coastal drainages-Pawcatuck Point to Eastern Point	1,670	17.2	4,562	17.9	4,236	43.7	18,836	51.6
Tomaquag Brook-Pawcatuck River	4,349	11.9	2,017	12.4	19,116	52.4	6,892	41.9
Usquepaug River-Pawcatuck River	1,219	9.0	1,283	9.5	7,331	54.0	7,160	52.8
Lower Wood River	1,410	7.7	1,448	7.9	12,865	70.3	12,798	69.9
Usquepaug River	1,777	7.6	1,809	7.8	16,011	68.7	15,668	67.2
Shunock River	800	7.6	814	7.7	7,351	69.4	7,296	68.9
Upper Wood River	2,516	6.4	2,576	6.6	29,363	75.2	29,188	74.7
Beaver River	512	6.5	516	6.5	5,717	72.4	5,664	71.7
Ashaway River	976	5.5	1,003	5.6	12,032	73.1	12,896	72.4

CHANGES IN DEVELOPED AND FORESTED LANDS

In the Little Narragansett Bay Watershed, the amount of land classified as developed increased from 21,740 acres in 2001 to 22,505 acres in 2016. The increase of 765 acres represented a change of 3.5 percent (Table 4; Figure 4). During the same period, the watershed lost 1,781 acres of forested land, a decline of 1.4 percent (Table 4; Figure 4). All four HUC10 watersheds experienced increases in developed land and concomitant decreases in forested land from 2001 to 2016 (Table 5). The HUC10 watershed experiencing the largest net percentage increase of developed land was the Upper Pawcatuck River, while the percentage loss of forested land was largest in Part of Southeast Coastal-Pawcatuck River to Eastern Point. At the finest scale of HUC12 subwatersheds, all but four (Beaver River, Shunock River, Part of Coastal drainage-Pawcatuck Point to Eastern Point, and Lower Pawcatuck River) of the 11 subwatersheds had increases in the amount of developed land. All subwatersheds had decreases in forested land from 2001 to 2016. Upper Wood River experienced the largest percent gain (~1 percent) in developed lands, while the Lower Pawcatuck River experienced the largest percent loss (~5 percent) of forested lands.

Since 2011, the Little Narragansett Bay Watershed has gained 90 acres of developed lands (0.4 percent) and lost 118 acres of forested lands between 2011 and 2016 (0.1 percent).

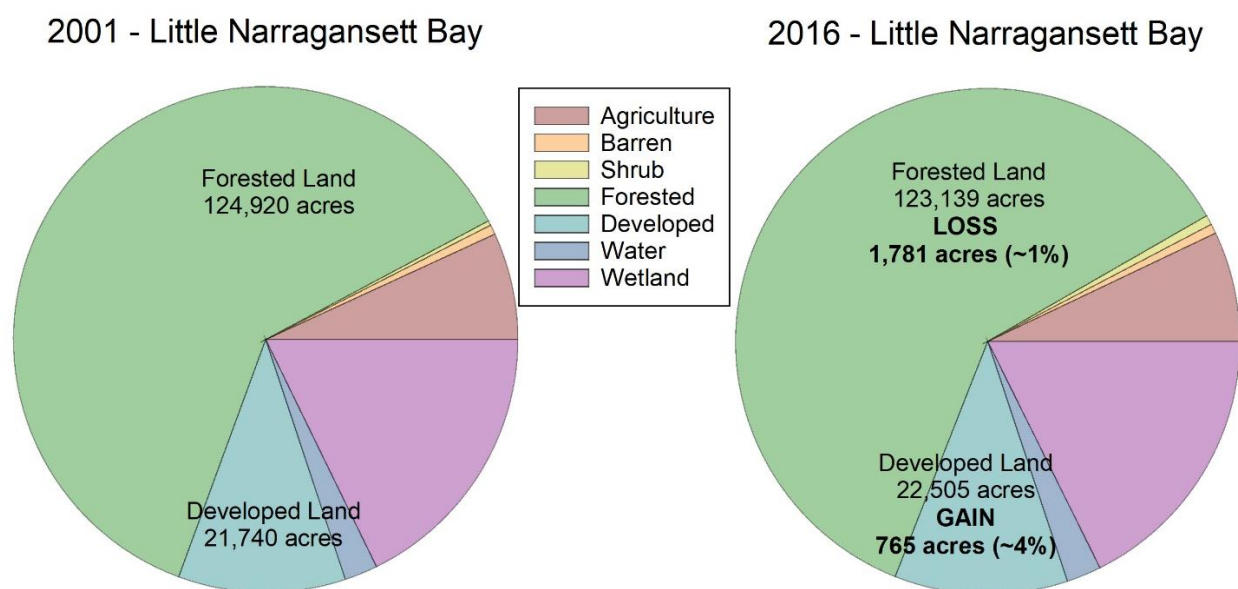


Figure 4. Land use charts highlighting changes in forested and developed lands in the Little Narragansett Bay between 2001 and 2016.

LAND USE IN COASTAL SALT PONDS

The Coastal Salt Ponds are a 35,800-acre watershed on the southern shore of Rhode Island. They present a unique ecosystem of coastal lagoons with reduced water flow from the Atlantic Ocean. This creates unique hydrology and ecology for each pond (see this story map on the Ponds:

<https://storymaps.arcgis.com/stories/1584ceb992de48c0bb80ea52b8abf386>). The Coastal Salt Ponds have more forested land (40 percent of the watershed) than developed land (30 percent of the watershed) (Table 6).

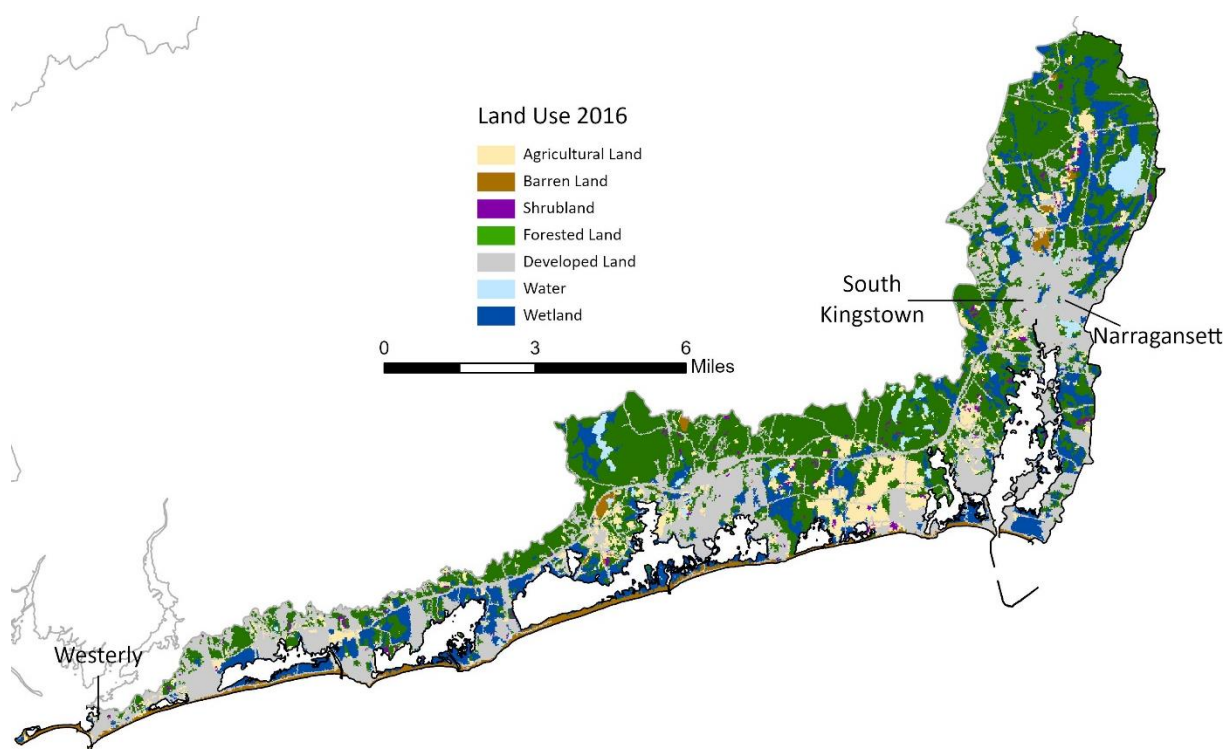


Figure 5. Land Use in the Coastal Salt Ponds based on the 2016 National Land Cover Dataset.

Table 6. Total area (acres) and percentage of developed and forested lands in the Coastal Salt Ponds Watershed based on the NLCD. The watershed is 35,880 acres.

Land Use Category	2001		2011		2016	
	Acreage	Percent	Acreage	Percent	Acreage	Percent
Developed	10,202	28.4	10,776	30.0	10,846	30.2
Forested	14,983	41.8	14,336	40.0	14,213	39.6

STATUS OF DEVELOPED LANDS

The developed land area of the Coastal Salt Pond Watershed totaled 10,846 acres in 2016, representing 30 percent of the Watershed (Figure 2; Table 6). The Coastal Salt Ponds include one HUC10, so the watershed acreage is the same as the HUC10. All three HUC12 subwatersheds (Saugatucket River, Point Judith Pond-Frontal Block Island Sound, and Ninigret Pond-Frontal Block Island Sound) have approximately 30 percent of their lands classified as developed (Table 7).

STATUS OF FORESTED LANDS

There were 14,213 acres of forested land in the Coastal Salt Pond Watershed in 2016, constituting 40 percent of the Watershed (Figure 2; Table 6). The three HUC12 subwatersheds range from 37 to 44 percent lands classified as forested. Ninigret Pond-Frontal Block Island Sound has the least and Saugatucket River has the most (Table 7).

CHANGES IN DEVELOPED AND FORESTED LANDS

In the Coastal Salt Ponds watershed, the amount of land classified as developed increased from 10,202 acres in 2001 to 10,846 acres in 2016. The increase of 645 acres was a 6 percent change (Table 6; Figure 6). During the same period, the Watershed lost 770 acres of forested land, a decline of 5 percent (Table 6). At the finest scale of HUC12 subwatersheds, all three subwatersheds gained developed lands; the most in the Saugatucket River, which gained 15 percent (444 acres) from 2001-2016. All HUC12 subwatersheds lost forested lands, ranging from three to seven percent (Table 7).

Since 2011, the Coastal Ponds have gained 70 acres of developed lands (0.6 percent) and lost 123 acres of forested lands between 2011 and 2016 (~1 percent).

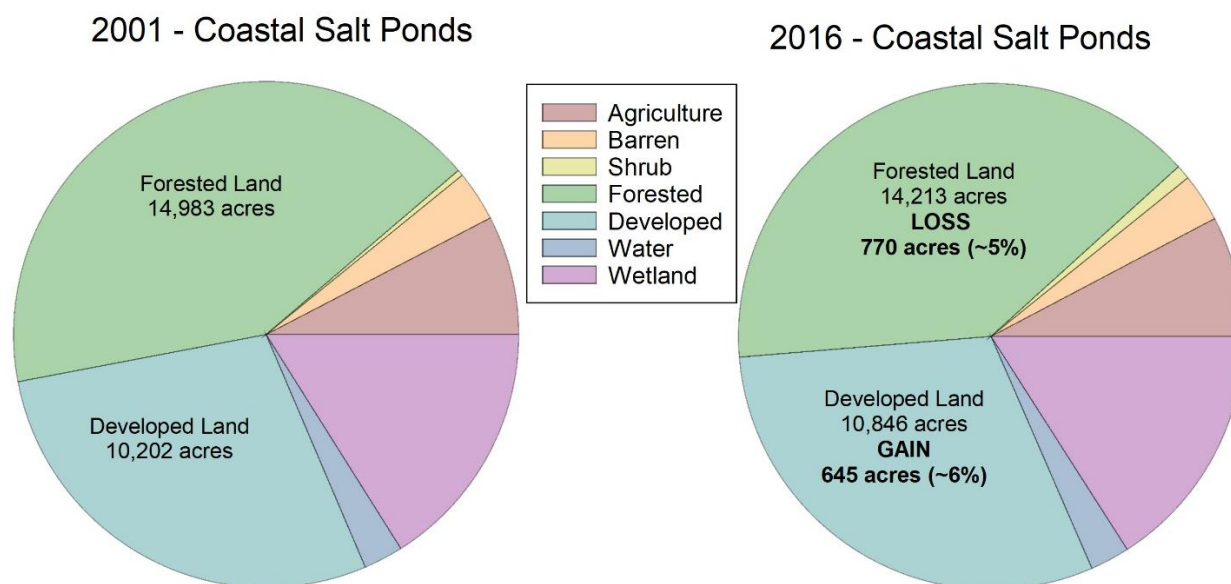


Figure 6. Land use charts highlighting changes in forested and developed lands in the Coastal Salt Ponds between 2001 and 2016.

Table 7. Total area (acres) and percentage of developed and forested lands for the HUC10 watersheds and HUC12 subwatersheds in the Coastal Salt Ponds Watershed. Both HUC10 and HUC12 watersheds are listed in descending order of percent developed lands in 2016.

Watershed Name	Developed Lands				Forested Lands			
	2001		2016		2001		2016	
	Acreage	Percent	Acreage	Percent	Acreage	Percent	Acreage	Percent
<i>HUC 10 Watershed Name</i>								
Fontal Block Island Sound	10,202	28.4	10,846	30.2	14,983	41.8	14,213	39.6
<i>HUC12 Subwatershed Name</i>								
Saugatucket River	2,897	26.3	3,341	30.4	5,255	47.8	4,869	44.3
Point Judith Pond-Frontal Block Island Sound	2,062	29.1	2,149	30.3	2,846	40.1	2,697	38.0
Ninigret Pond-Frontal Block Island Sound	5,242	29.5	5,356	30.1	6,882	38.7	6,647	37.4

WHAT DOES THIS MEAN?

Developed lands continue to increase while forested lands decrease. The declining trend of forested lands in recent decades historically points to the transformation of the watershed's landscape. At NBEP's study area scale, these land use changes may not appear large or dramatic, except over long time scales (such as from the 1800s to present; Figure 7). The Little Narragansett Bay and the Coastal Salt Ponds do show that at the finest scales, the HUC12 watersheds, these changes could be significant. Assessing changes at finer scales, such as within local context (i.e., what resources are proximal or downstream) is the best approach to identifying the total impact of land use change.

Acreage losses weaken the protection that forested lands offer for estuarine and inland water quality, habitat, and human health. The conversion of natural lands to developed lands affects these resources as changes in population lead to increased demand for new urban infrastructure in the form of impervious cover and wastewater systems. Urban sprawl typically results in loss of forested lands, as shown in this report. Sprawl has contributed to habitat fragmentation with smaller areas remaining to protect the Watershed's natural resources (Ricci et al. 2020).

Land development continues throughout the region, at the expense of other land cover and use types, such as forested and agricultural (August et al. 2002). Changes of natural habitat such as forests to developed lands impact how water is delivered to rivers and lakes, to groundwater, and ultimately to the Little Narragansett Bay and the Coastal Salt Ponds. Measuring the total area of land use change over time highlights the conversion of forest and other natural lands to residential, commercial, and industrial developed lands.

SOLAR ARRAYS

A new and growing development trend is ground-mounted solar photovoltaic arrays. This can create competition between preserving forested lands and green energy development.

In Massachusetts, between 2012 and 2017, **roughly 25%** of all new development was solar-related (Ricci et al. 2020). That included 6,000 acres of previously undeveloped land converted to large scale ground-mounted solar arrays. While we currently do not have comparable data for Rhode Island, anecdotally, solar array development is increasing.

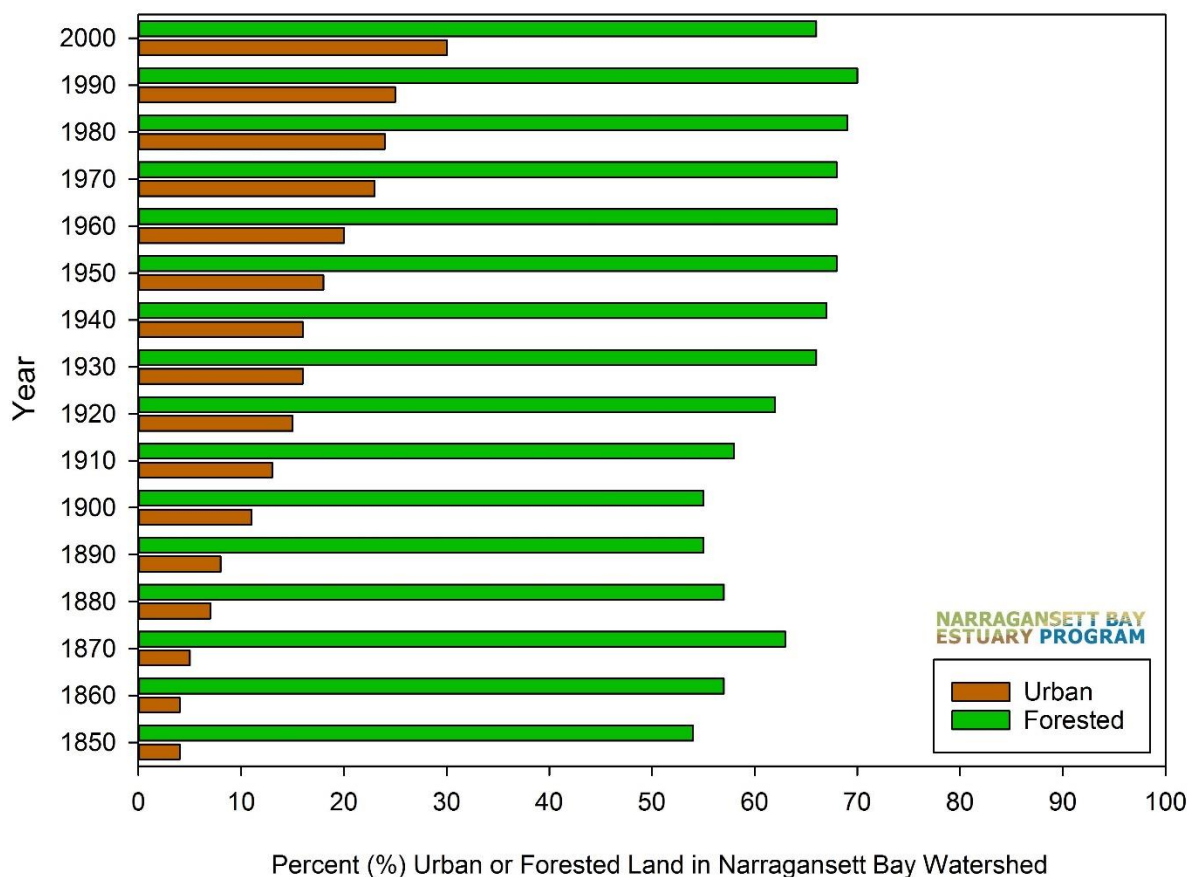


Figure 7. Historical changes in percentage of Narragansett Bay Watershed classified as forested (green) or urban/developed (brown). Based on Vadeboncoeur and colleagues (2010).

AREAS FOR FURTHER STUDY

This section describes new topics of interest or questions stemming from this land use update. These topics could be addressed by future work of the NBEP staff, partners, or others who are interested.

- How is land being developed? How do we address policies to ensure that development occurs with habitat preservation in mind?
- How do we balance the need for development (including green energy) with the need for forested lands?
- How can we better protect forests to protect water quality?
- How are forested lands surrounding wetlands changing? Forests are an important buffer for wetlands to protect water quality.

REFERENCES

August, P., L. Iverson, and J. Nugranad. 2002. Human Conversion of Terrestrial Habitats. Pages 298–224 in: *Applying Landscape Ecology in Biological Conservation*, K.J. Gutzwiller (Ed.). Springer, New York. 518 pp.

Meyer, W.B., and B.L. Turner II. 1992. Human population growth and global land use/land cover change. *Annual Review of Ecology and Systematics* 23:39–61.

Narragansett Bay Estuary Program (NBEP). 2017. *The State of Narragansett Bay and Its Watershed* (Ch. 5 Land Use, pages 108-134). Technical Report. Providence, Rhode Island.

<https://static1.squarespace.com/static/5eea260cea828333324dba1c/t/5faeff4003633f0646bd008a/1605304154786/Chapter-5-Land-Use.pdf>

Ricci, E.H., J. Collins, J. Clarke, P. Dolci, and L. de la Parra. 2020. *Losing Ground: Nature's Value in a Changing Climate*. Massachusetts Audubon Society, Inc. Lincoln, Massachusetts. 33 pp. <https://www.massaudubon.org/our-conservation-work/advocacy/shaping-climate-resilient-communities/publications-community-resources/losing-ground>.

Tu, J., and Zong-Guo Xia. 2006. Assessing the impact of land use changes on water quality across multiple scales in eastern Massachusetts. *Middle States Geographer* 39:34–42.

Vadeboncoeur, A., S.P. Hamburg, and D. Pryor. 2010. Modeled nitrogen loading to Narragansett Bay: 1850 to 2015. *Estuaries and Coasts* 33:1113–1127.