Coastal Housing Premiums in the Narragansett Bay Watershed

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Executive Summary:

The purpose of this study is to understand how the Narragansett Bay watershed (NBW) generates value in the housing market, specifically by estimating the premium associated with houses in close proximity to the coastline of the watershed. The study examines over 32,000 housing transactions from the years 1992-2007 in the towns of Barrington, Bristol, Charlestown, Little Compton, Middletown, Narragansett, Newport, North Kingstown, Portsmouth, Tiverton, and Warwick. The hedonic pricing method was used to estimate two monetary premiums for houses in each town for three distinct distance categories: 0.00-0.10, 0.10-0.25, and 0.25-0.50 miles from the coast. These two premiums are an "average premium," which is the monetary premium associated with an average house in a given category in a specific town, and the "total premium," which is the average premium for a given distance category multiplied by the number of sales in a specific town in that distance category.

Average premiums (2017 dollars) ranged from approximately $60,000 (Barrington) to over $520,000 (Little Compton) for the distance category of 0.00-0.10 miles, $25,000 (Portsmouth) to $270,000 (Little Compton) for 0.10-0.25 miles, and $2,100 (Warwick) to $87,000 (Little Compton) for 0.25-0.50 miles (in 2017 dollars). The towns of Little Compton and Middletown consistently had among the highest average premiums across the three distance categories (likely due to higher selling prices in general). In terms of total premiums, values ranged from $3.7 million (Little Compton) to $51.3 million (Jamestown) for 0.00-0.10 miles, $4.3 million (Little Compton) to $31.7 million (Barrington) for 0.10-0.25 miles, and $2.7 million to $19.6 million (Barrington) for 0.25-0.50 miles. For total premiums, Little Compton ranked consistently low despite its high average premium due to its low number of housing sales. Barrington, Newport, Narragansett, and Portsmouth consistently ranked higher across all three distance categories.

In summing each category for all eleven towns, the closest distance category of 0.00-0.10 miles generated the highest premium of $310.7 million, while 0.10-0.25 miles generated $188 million, and 0.25-0.50 miles generated $100.6 million. Alternatively, summing up all three distance categories for each town left Barrington with the highest monetary premium ($89.0 million), followed by Narragansett ($77.1 million), North Kingstown ($76.9 million), and Newport ($76.8 million). These estimates indicate that coastal premiums generated a value of nearly $600 million in the select towns in the NBW from 1992-2007.

The paper starts by briefly discussing the NBW and its history, followed by a description of the data used, the concept of coastal housing premiums, and the methodology used in the study, and concludes with a summary of results.

Introduction:

The Narragansett Bay Watershed

The term "watershed" is used to refer to a geographical area where all waterbodies within its boundaries flow and drain into the same outlet (USGS, n.d.) – the NBW refers to the area where waterbodies flow into the Narragansett Bay. The NBW is comprised of two smaller watersheds – the Narragansett watershed and the Blackstone River watershed (Figure 1). Approximately 40% of the NBW falls in Rhode Island, which represents the coastal portion of the watershed (Figure 2), and the other 60% lies in Massachusetts (NBEP, n.d.).

Throughout history, settlers have recognized the value of coastal living in the NBW. Long before the arrival of colonists, the Narragansett tribe inhabited the coast during the summer months, drawn to the shores to harvest coastal resources like quahogs and oysters (Narragansett Indian Tribe, n.d.; Ocean SAMP, 2015). During early colonial times, settlers seeking a safe-haven from religious persecution in Europe and fellow colonies established themselves along the shore. As the colony grew, a booming international maritime trade industry developed in the 1700s, leading to increased settlements near Newport, one of the major ports of New England. By the mid-1800s, however, the maritime industry in Rhode Island was declining and industrialization took hold, creating urban centers like Pawtucket and Providence. These urban centers drew dense populations further inland, shifting major economic activity away from the coast. As populations were shifting, the value placed on the coast shifted as well – whereas it was previously valued for its rich offering of resources and strategic positioning, it began to gain recognition for its aesthetic benefits. In the coming decades, the wealthy elite began to build "summer cottages" (such as the Vanderbilt's and their home The Breakers), creating an element of elitism associated with living along the coast. This was accompanied by increasing amounts of tourism to destinations such as

Watch Hill, Narragansett, and Jamestown, drawing in visitors via steamboats and railroads from across the country (Ocean SAMP, 2015). This new wave of tourism established the recreational value of the Bay and added to the premium placed on visiting and living along its coasts. This premium is still very visible in the NBW today – coastal living is commonly associated with higher housing prices due to the benefits that arise from living in proximity to the shore (e.g. easier access to recreational areas).

Coastal Premiums

As discussed above, there is a premium (increase in housing price) associated with living near the coast – houses closer to the coast tend to have a higher value than their inland counterparts. Numerous studies from across the world have shown this to be the case, although this premium can vary due to several factors, such as location, quality of view, and water quality. Studies ranging from San Diego, California (Conroy & Milosch, 2011) to Avalon, New Jersey (Major & Lusht, 2004) have found that as houses get further from the coast, their prices tend to decrease, even if the houses have the same property characteristics (e.g. a house located within 0.5 miles of the coast would be worth more than that same house would be if it were located one mile from the coast). Typically, this premium is not linear, meaning it does not consistently decrease as houses get further from the coast; for example, the price difference between houses 0.25 miles and 0.5 miles from the coast is likely much greater than the difference in price between houses 2 miles and 2.25 miles from the coast. As a result, to better understand the impact of coastal proximity on housing prices, researchers create distance categories to put houses in and use these categories in comparison to houses that fall outside of the study zone (Benson *et al.*, 1998; Bourassa *et al.*, 2004; Conroy & Milosch, 2011, Major & Lusht, 2004 use this categorical approach). For example,

Conroy and Milosch found that in San Diego County, California, houses that were 0-500 feet from the coast had a premium of 102%, but that this premium declined to 63% for 500-1,000 feet, and went down to 22% for 4,000-5,280 feet, indicating that people highly value houses very close to the coast – they still value houses that are further away, but disproportionately less. Furthermore, many studies also take into account additional benefits when studying the premium associated with living near the coast. These can include whether or not the property has an ocean view, the quality of that view, distance to the nearest beach, and the quality of coastal water. Table 1 includes a more comprehensive explanation of what previous studies have found, and what factors they take into consideration when estimating a coastal premium in the housing market.

Data and Methods:

The Data

For our study, we only included towns with significant area along the coastline in the NBW. Bristol, Barrington, Jamestown, Little Compton, Middletown, Narragansett, Newport, North Kingstown, Portsmouth, Tiverton, and Warwick all fall completely within the boundaries of the watershed and have significant coastal exposure (see Figures 3A and 3B). Towns like Cranston and East Greenwich, although they are along the coast, were excluded due to their comparatively small coast to total area ratio (which left few observations of houses near the coast). The towns of East Providence, Pawtucket, and Providence were excluded because they lie far up the Providence River with little/no coastal exposure. South Kingstown was excluded because only a very small part of the town lies in the NBW. Finally, in the case of the cities and towns whose borders lie only partially in the NBW (Narragansett, Little Compton, Tiverton, and North Kingstown), we only studied the portions and houses that fall within the borders of the NBW. This left us with

eleven towns to include: Barrington, Bristol, Charlestown, Little Compton, Middletown, Narragansett, Newport, North Kingstown, Portsmouth, Tiverton, and Warwick.

In our analysis, we used Rhode Island housing transaction data that include property characteristics, sale prices, and sale dates. The property characteristics include structural information on the houses, such as the number of bedrooms and bathrooms, property lot size, house square footage, and year of construction. The sales data include the sale price and date for all housing transactions from 1992 – 2007 (years 2008 – 2013 were excluded to due lack of sufficient[1] sales data for those years).[2] Additionally, we only included transactions that were over $50,000 (we assumed that single-family houses sold under this price are atypical occurrences). Figure 4 shows all properties used in our analysis. Housing prices were adjusted to 3rd quarter prices for 2017, which was done using the Federal Housing Finance Agency's Housing Price Index.[3]

We used GIS to calculate the distance to the coast for each house in our data set. This distance measure was used to create the variables of most interest in our regression model (explained in the next section). It is important to note that this variable of distance to the coast is broad – it encompasses a multitude of benefits that are associated with living near the coast. These include closer proximity to shore access points where visitors can participate in beach or marine related activities. Figures 5 – 12 include public shoreline access points for these activities, including beach access, boat ramps, conservation areas and wildlife refuges, fishing sites, public parks, paths to the shore, and scenic view areas. Distances for these amenities were *not* included in this study because they are so closely related to a house's distance from the coastline – if a house

[1] After refining the data, there were 5 sales in 2013, 63 in 2012, 72 in 2011, 97 in 2010, 96 in 2009, and 95 in 2008. Every other year had at least 2,000 sales recorded, with an average of 3,900 sales per year.

[2] Houses can appear in the data set more than once if they were sold multiple times during this period. Their structural characteristics remain constant in the data set, but the prices vary depending on the transaction.

[3] All monetary values mentioned in this paper are in 2017 3rd quarter prices.

is closer to a public shoreline access point, then it is also closer to the shore. This type of relationship is referred to as "collinearity," and can skew the results of the regression. Therefore, we do not include specific variables for each of these amenities, but we assume that their value is captured by valuing a house's proximity to the coast (a coastal premium may include closer access to these amenities). Furthermore, there are other variables that may be useful in calculating coastal premiums, such as whether or not a house has a water view and the quality of that view. We do not include these variables in our study because they are not included in our data set. We assume, however, that some of their value is also captured by measuring the premium of distance to the coast.

Methodology

To understand the value of coastal proximity, we used the hedonic pricing method to estimate the impact that a house's distance to the coast has on its selling price. In economics, the hedonic method is used to understand the effect that certain amenities (positive attributes, such as access to public parks) or dis-amenities (negative attributes, such as distance to a coal power plant) have on housing prices. This is done by assuming that a house is a "bundle" of characteristics; this bundle includes a house's structural variables such as number of bedrooms, bathrooms, and square footage, among others. It also includes external variables that can affect a house's price, such as distance to a power plant, public park, major city, or school system, which are also important factors in determining a house's selling price. The hedonic method breaks down each of these characteristics to help understand their specific impact on a house's selling price. In our study, this is done by conducting a log-linear regression model. A regression model estimates the effect that these housing attributes ("dependent variables") have on the price of a house ("independent

variable"). Our dependent variables include a house's structural characteristics - the number of bedrooms and bathrooms, property lot size, house square footage, and year of construction. We also include the amenity, distance to the coast, as a dependent variable. Using this distance, we placed each house into one of four categories, assuming that, as discussed above, the relationship between premium and distance to the coast is not linear. These categories are: 0.00-0.10 miles, 0.10-0.25 miles, 0.25-0.50 miles, and 0.50+ miles (Figure 13). We ran the following regression model for each town:

$$P_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 {X_1}^2{}_{it} + \beta_3 X_{2it} + \beta_4 {X_2}^2{}_{it} + \beta_5 X_{3it} + \beta_6 X_{4it} + \beta_7 X_{5it} + \beta_8 D_{1it}$$

$$+ \beta_9 D_{2it} + \beta_{10} D_{3it} + \beta_{11} D_{4it} + \beta_{12} D_{5it} + \beta_{13} D_{6it} + \beta_{14} D_{7it}$$

P_{it} = logged selling price of a house in a given year, X_{1i} = lot size in acres, ${X_1}^2{}_i$ = lot size in acres squared, X_{2i} = living area in square feet, ${X_2}^2{}_i$ = living area in square feet squared, X_{3i} = number of bedrooms, X_{4i} = number of bathrooms, X_{5i} = number of half bathrooms, D_{1i} = 1 if has air conditioning, D_{2i} = 1 if house built 1680-1932, D_{3i} = 1 if house built 1933-1965, D_{4i} = 1 if house built 1966-1979, D_{5i} = 1 if house in distance category 0.00-0.10 miles, D_{6i} = 1 if house in distance category 0.10-0.25 miles, D_{7i} = 1 if house in distance category 0.25-0.50 miles

Note: in this data set, structural characteristics of houses do not vary over time, although time subscripts (*t*) are present in the above model

In interpreting the regression results from the hedonic analysis, each coefficient (β) indicates each specific variables (X) impact on price (P_{it}). For example, β_5 is the coefficient on the number of bedrooms on a house. If β_5 is equal to 0.10, then each additional bedroom in a house increases its price by 10% (holding all other characteristics constant). If a house has five bedrooms, its selling price will increase by 50%, assuming all other variables (e.g. lot size, number of bathrooms) remain constant. A more detailed explanation of interpreting the regression results will follow in the "Results" section. The variables of interest in this study are the coefficients (β_{12}, β_{13}, β_{14}) from the distance to coast categories (D_5, D_6, D_7). There are three β coefficients because each one represents the premium associated with each distance category, or its "premium percentage." The

reason that there is no β coefficient for the 0.50+ category is because it is an omitted group – it is used a benchmark for comparing the value of the distance categories.

Using these premium percentages from each town's regression, we calculated two monetary values for the town's distance categories – 1) the "average premium," which is the monetary premium for an average house in a specific distance category and 2) the "total premium," which is the sum of the average premiums for a town. The average premium was calculated by taking the average of the adjusted prices for houses outside of 0.50+ mile cutoff (the "benchmark" category) and then multiplying this average price by the premium percentage associated with each category.[4] For example, if in City A, the regression coefficient for distance to coastline of 0.00-0.10 miles is 0.40 (meaning there is a 40% premium) and the average adjusted housing price for houses outside of a 0.50+ mile cutoff is $200,000, then the average premium for City A in the 0.00-0.10 category would be $80,000 per house. The total premium for each category was calculated by taking the town's average premium for each category and multiplying it by the number of sales in that the respective category (broken down in Table 2).

Results and Discussion:

In the above section, we outlined the regression model used. We ran this model for each town – an example these results can be found in Table 3, which outlines the regression coefficients for houses in the Town of Barrington. This table can help understand how to interpret the coefficients for each variable. For example, the coefficient (β_6) on the number of bathrooms (X_4) is 0.056. This means that each additional bedroom in a house increases its selling price, on average,

[4] In this paper, the "average price" will refer to the average selling price of houses outside of the 0.50 study area, as this average price was used to as a comparison to generate the premium of coastal proximity.

by 5.6%, holding all other characteristics constant. The coefficient on half bathrooms is 0.071, meaning that for each additional half bathroom in a house, its selling price increases by 7.1% on average, all else constant. Moving on to lot size, there is a coefficient of 0.346 – each additional acre of land a house has increases its selling price by 34.6%. There is also a squared variable for lot size – this is because of the diminishing marginal return on lot size. For example, moving from one to four acres might increase a house's value considerably, but moving from 50 to 54 acres might not have the same effect. This squared term helps control for this trend and tells us that lot size acreage has a positive impact on housing price until about 13 acres.[5] Furthermore, the regression includes "dummy" variables such as a variable for air conditioning (recorded as 0 if a house does not have it, 1 if it does) – the coefficient on the dummy variable is 7.6% for Barrington, indicating that a house with air conditioning sells for 7.6% more than a house that does not have it, all other variables held constant.

Moving on to the variables of interest – distance to coast categories – the interpretation is as follows: if a house is within 0.00-0.10 miles of the coast, its selling price increases by 28.6%, 11% for 0.10-0.25 miles, and 6.4% for 0.25-0.50 miles. Again, it is important to remember to hold all other variables constant when interpreting these results. One way to conceptualize this is by taking two identical houses – House A and House B. These houses have the same number of bedrooms, bathroom, same living area and lot size, both have air conditioning, and were both built in the same year. However, House A is located within 0.00-0.10 miles of the coast, while House B is located 0.50+ miles away. The regression results tell us that House A, on average, will be worth 28.6% more in its selling price than House B, because House A belongs in the 0.00-0.10 distance category. It is also important to remember that these premiums are comparing houses

[5] This is calculated by setting the two terms equal to each other and taking the first derivative: $0.346x = 0.013x^2$.

within each category to houses that fall outside of the 0.50+ distance. Table 4 lists the coefficients for each distance category for each town, which will be discussed in greater detail below. As seen from this table, the coefficients for each category vary greatly by town. This could be due to several factors, such as quality of coast – for example, the coefficient is lower in Warwick (0.116) than Little Compton (0.964). This heterogeneity (difference) across the towns in this study is the justification for running the regression model separately for each town – the coastal premium can vary greatly from place to place, and it is important to include this distinction in our analysis to get the most accurate results.

As expected, there is a positive premium for houses in the 0.00-0.10 mile category for all towns, although the premiums vary considerably. Little Compton has the highest premium percentage of 96.4%, followed by Middletown (67.5%), Jamestown (49.9%), Newport (38.7%), North Kingstown (35.1%), Tiverton (34.3%), Narragansett (28.8%), Bristol (28.6%), and Portsmouth (22.1%). The lowest premiums are in Barrington (16.0%) and Warwick (11.6%). The mean premium percentage is 41.7%.

Table 5 lists the average and total monetary values for each town in this distance category. The monetary values vary greatly not only because of the difference in premium percentage, but because of the large discrepancy in average house price per town (Figure 14).[6] As a result, the average premium can range from approximately $30,000 in Warwick (average sale price of roughly $260,000) to over $521,000 in Little Compton (average sale price of approximately $540,000) (Figure 15), with a mean average premium of approximately $163,000. In the case of total premiums, towns that have high premiums but relatively few sales – like Little Compton (seven sales) and Middletown (33 sales) – generate the lowest total value $3.7 million and $8.2

[6] Average price of houses outside of the 0.50 mile distance to coast cutoff

million respectively (Figure 16). In comparison, Warwick, despite having the lowest average premium, generates the sixth highest total premium ($30.6 million) due to the high number of sales in the town (1,014). The towns with the highest total premiums are Jamestown ($51.3 million, 184 sales) and North Kingstown ($50.0 million, 363 sales), and the mean total premium is approximately $28.0 million.

Moving on to the second category, 0.10-0.25 miles, premium percentages decrease in all towns, as would be expected as houses get further from the coast. Little Compton once again has the highest premium percentage (50.0%), followed by Middletown (26.6%), Newport (20.7%), Tiverton (18.7%), North Kingstown (14.7%), Bristol (11.0%), Narragansett (9.6%), Barrington (8.4%), Jamestown (7.7%), and Portsmouth (6.3%) – the average premium percentage is 17.4%. Warwick, interestingly, has a very small negative premium percentage (-0.03%), indicating that houses within this proximity to the coast are worth less than houses outside the 0.50 mile range. This could potentially be because of the location of the T.F. Green (and its undesirable side-effects, such as noise pollution and traffic), or could be due to factors that are not considered in this study. As a result, it is excluded from our analysis for the results of this category. Another interesting observation is that the range in premium percentages among towns decreased by almost half compared to the first category, from 84.8% (Little Compton had a 96.4% premium and Warwick had 11.6%) to 43.7% (excluding Warwick, Little Compton has a 50.0% premium and Portsmouth has 6.3%). The biggest decrease in premium percentage occurred in Little Compton (46.4%), while the smallest decrease was in Barrington (7.6% decrease).

Again, there is a large discrepancy in the average premium, ranging from $31,000 in Barrington to $270,000 in Little Compton. Aside from Little Compton, the premium for all other towns are under $100,000 (Figure 17), with an average for all towns of $75,000. Examining the

total premium, Little Compton once again generates the lowest value ($4.3 million, 16 sales), while Jamestown has the highest total value ($38.3 million, 325 sales), followed by Barrington ($31.6 million, 1,018 sales). The remaining towns fall within the range of $11.0 million to $24.0 million (Figure 18), with an average total premium of $18.8 million.

Moving into the third distance category (0.25-0.50 miles), premium percentages again drop for all towns (apart from Warwick). Little Compton retains the highest premium percentage (16.1%), followed by Newport (8.8%), Tiverton (6.9%), Bristol (6.4%), Barrington (5.1%), Narragansett (4.3%), Middletown (3.6%), Portsmouth (3.5%), North Kingstown (3.4%), Jamestown (1.9%), and Warwick (0.8%), with an average of 6.0%. The largest decrease in premium percentage is again in Little Compton, with a decrease of 33.9% from the previous distance category. The smallest decrease occurred in Barrington, with a decline of 3.3%.

Average premiums follow the same trend as in previous categories, with Little Compton having the highest premium ($87,000) and Warwick the lowest ($2,200). The remainder of the towns fall approximately in between the $10,000 and $230,000 range (Figure 19), with an average of $18,000 among all towns. Looking at the total premiums, Barrington is highest ($19.6 million, 1,029 sales), closely followed by Newport ($18.5 million, 605 sales). The lowest values are, as in the other two categories, generated by Little Compton ($2.7 million, 31 sales) and Middletown ($3.5 million, 261 sales) (Figure 20). The mean total premium is $9.6 million.

In examining results from all three categories, we see sharp decreases in premiums even shifting from 0.00-0.10 to 0.25-0.50 miles from the coast – e.g. in North Kingstown, it drops from 35.1% to 3.4%. This trend indicates that there is a high premium associated with being in very close proximity to the coast (<0.10 miles), but that this premium experiences a sharp decline as houses get further away from the coast. This supports findings of previous studies discussed in the

"Coastal Premium" section. Another key observation is that certain communities maintain the highest coastal premiums out of all towns, including Little Compton and Middletown, although these towns tended to generate the lowest total monetary premiums for towns despite having premium percentages and high average house values, which is due to a relatively low number of housing transactions.

Furthermore, we summed the total monetary premiums by town and by distance category (Table 6). As expected, the total premium generated by all eleven towns was the highest in the 0.00-0.10 mile category ($310 million), followed by the 0.10-0.25 mile category ($188 million), and finally the 0.25-0.50 mile category ($101 million). This is despite having increases in overall number of sales further from the coast – there were 3,545 total sales in the 0.00-0.10 category, 6,409 in the 0.1-0.25 category, and 7,565 sales in the 0.25-0.50 category (Table 2). We also totaled the premiums for each town for all three categories (Figure 21). Barrington had the highest total ($89 million), followed by Narragansett ($77 million), North Kingstown and Newport (both $77 million), and Jamestown ($70 million). The lowest total premiums were generated by Little Compton ($11 million), and Middletown ($23 million), even though these towns have the highest premium percentages in the first two distance categories. The remaining towns fell between $34 and $62 million, with an average of $56.4 million among towns. In all, these eleven towns generated total monetary premiums of approximately **$600 million** for houses within 0.00-0.50 miles of the coast.

Conclusion

Premiums associated with coastal living have been established all across the world. This premium may capture a multitude of benefits, such as closer access to recreational sites or the

appreciation of the aesthetic value of the coast. In the NBW, this premium has potentially generated over $600 million from 1992-2007, illustrating the vast economic impact that the NBW has on the local economy. It is important to note that this number is an estimate that was generated using only one method of valuing the coast. There are many values and benefits generated by the NBW, some of which can be quantified, some of which cannot (or should not be) – these include aesthetic, environmental, social, cultural, and historic values, among others. This study captures only a sliver of the value of the watershed; this small portion, however, is still potentially worth over half a billion dollars.

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Tables and Figures:

Table 1: Summary of relevant literature

Author(s)	Study area	Variable studied	Major findings
Gardner Brown, Jr., Henry Pollakowski (1977)	Seattle, Washington, USA	-Distance to coast (ln continuous) -Open space in front of houses ("setback width")	-Relationship between distance to coast and premium is non-linear, influenced by open space associated with the house -More open space in front of house associated with higher premium near the coast -Houses with no open space in front have a sharp premium decline past 300 feet from coast
Earl Benson, Julia Hansen, Arthur Schwartz, Greg Smersh (1998)	Bellingham, Washington, USA	-Distance to coast (categorical – 0.1, 0.5, 1, 2 miles) -Water view quality (categorical)	-Water view quality and distance to the coast interact and both impact premium values -Highest premium for closest properties (<0.1 mi.) with unobstructed ocean view (68.3%) premium -Premium of view decreases as distance to coast increases
Christopher Major, Kenneth Lusht (2004)	Stone Harbor/Avalon, New Jersey, USA	-Distance to nearest beach (categorical, neighborhood blocks) -Proximity to the Bay (Bayfront – yes/no)	-A house within two blocks of the ocean is associated with a 207% premium, within one block a 73% and within two blocks 30% -Bay front properties associated with 73% premium
Steven Bourassa, Martin Hoesli, Jian Sun (2004)	Auckland, New Zealand	-Distance to coast (categorical – at coast, 1000m from coast, 2000m from coast) -Water view quality	-Higher quality views have highest premiums on coast -Premium of view decreases rapidly for houses further from the coast
Stuart Hamilton, Ash Morgan (2010)	Pensacola Beach, Florida, USA	-Distance to coast (continuous, meters) -Ocean view quality (continuous, degrees)	-Homeowners willing to pay $1,119 for each meter closer to coast -Homeowners willing to pay for increased scope of water view -Important to consider factors that comprise benefits of distance to

			coast (coastline access and water view), potentially separating these factors for better understanding
Stephen Conroy, Jennier Milosch (2011)	San Diego County, California, USA	-Distance to coast (categorical - 500, 1000, 2000, 3000, 4000, 5280 feet)	-Highest premium associated with closest category of < 500 ft. from coast (102%) -Premium is not linear – it quickly decreases for other categories -Premium represents other benefits associated with distance to coast (i.e. beach access, cleaner air)
Di Jin, Porter Hoagland, Donna Au, Jun Qiu (2015)	Marshfield, Duxbury, and Plymouth, Massachusetts, USA	-Distance to ocean -Seawall presence/type -Erosion rate	-House prices decrease as distance from the coast increases -1.0% drop in house price for every 1 km further away from ocean -Seawalls had positive impact on prices, erosion had negative impact on prices
Tingting Liu, James Opaluch, Emi Uchida (2017)	Narragansett Bay, Rhode Island, USA	-Distance to the coast -Water quality of nearest waterbody	-High levels of chlorophyll (indicator of water quality) associated with decreased premium in housing price, but effect diminishes as distance from coast increases

Note: Few studies that we came across dealt only with distance to the coast and its relationship to housing prices. Many studies include distance to the coast in conjunction with other related variables, such as whether or not a house has a water view and the quality of that view. In our data set, we do not have information on water view, and were unable to include this in our analysis.

Table 2: Number of housing transactions for study towns

	Number of Housing Transactions				
	Coastline Category 1 (0.00-0.10 miles)	**Coastline Category 2** (0.10-0.25 miles)	**Coastline Category 3** (0.25-0.50 miles)	**Omitted Category** (0.50+ miles)	**Total Transactions**
Barrington	635	1,018	1,029	474	**3,156**
Bristol	197	444	631	797	**2,069**
Jamestown	184	325	473	47	**1,029**
Little Compton	7	16	31	82	**136**
Middletown	33	116	261	1,400	**1,810**
Narragansett	377	690	1,012	267	**2,346**
Newport	144	541	605	982	**2,272**
North Kingstown	363	361	452	2,541	**3,717**
Portsmouth	448	598	508	941	**2,495**
Tiverton	143	239	275	931	**1,588**
Warwick	1,014	2,061	2,288	6,812	**12,175**
Total Transactions	**3,545**	**6,409**	**7,565**	**15,274**	**32,793**

Table 3: Example regression results for the Town of Bristol

Regression Results

	Dependent variable: Logged House Sale Price
	Results
	Barrington
Lot size (acres)	0.346***
	(0.021)
Lot size squared (acres)	-0.013***
	(0.001)
Living area (feet)	0.0004***
	(0.00002)
Living area squared (feet)	-0.00000***
	(0.000)
Bedrooms	-0.020**
	(0.009)
Bathrooms	0.056***
	(0.011)
Half bathrooms	0.071***
	(0.012)
Air conditioning	0.076***
	(0.015)
Within 0.0-0.1 miles of coast	0.286***
	(0.021)
Within 0.1-0.25 miles of coast	0.110***
	(0.015)
Within 0.25-0.5 miles of coast	0.064***
	(0.013)
House built 1680-1932	-0.056***
	(0.020)
House built 1933-1965	0.035*
	(0.018)
House built 1966-1979	0.089***
	(0.017)
Sold in 1993	0.005
	(0.032)

Sold in 1994	0.028
	(0.031)
Sold in 1995	0.021
	(0.032)
Sold in 1996	0.037
	(0.032)
Sold in 1997	0.031
	(0.031)
Sold in 1998	0.098***
	(0.029)
Sold in 1999	0.146***
	(0.029)
Sold in 2000	0.284***
	(0.030)
Sold in 2001	0.377***
	(0.030)
Sold in 2002	0.573***
	(0.031)
Sold in 2003	0.773***
	(0.030)
Sold in 2004	0.914***
	(0.030)
Sold in 2005	0.984***
	(0.030)
Sold in 2006	0.944***
	(0.030)
Sold in 2007	0.978***
	(0.033)
Constant	10.984***
	(0.038)
Observations	2,069

Note: *p<0.1; **p<0.05; ***p<0.01

Table 4: Regression results for coastline variables for all cities and towns

Regression Results			
	Dependent variable: log selling price		
Distance to coast	**0.00-0.10 mi.**	**0.10-0.25 mi.**	**0.25-0.50 mi.**
Barrington	0.160***	0.084***	0.051***
3,156 obs.	(0.019)	(0.018)	(0.017)
Bristol	0.286***	0.110***	0.064***
2,069 obs.	(0.021)	(0.015)	(0.013)
Jamestown	0.499***	0.077	0.019
1,029 obs.	(0.064)	(0.061)	(0.059)
Little Compton	0.964***	0.500***	0.161
136 obs.	(0.208)	(0.147)	(0.102)
Middletown	0.675***	0.266***	0.036**
1,810 obs.	(0.049)	(0.026)	(0.018)
Narragansett	0.288***	0.096***	0.043**
2,346 obs.	(0.024)	(0.021)	(0.020)
Newport	0.387***	0.207***	0.088***
2,272 obs.	(0.025)	(0.015)	(0.014)
North Kingstown	0.351***	0.147***	0.034***
3,717 obs.	(0.015)	(0.015)	(0.013)
Portsmouth	0.221***	0.063***	0.035**
2,495 obs.	(0.016)	(0.014)	(0.014)
Tiverton	0.343***	0.187***	0.069***
1,588 obs.	(0.025)	(0.020)	(0.019)
Warwick	0.116***	-0.003	0.008
12,175 obs.	(0.008)	(0.005)	(0.005)

Note: *p<0.10; **p<0.05; ***p<0.01

Table 5: House price premium associated with living near the coast, by town

Housing Price Premium Associated with Living Near the Coast

	Within 0.00-0.10 miles	Within 0.10-0.25 miles	Within 0.25-0.50 miles
Barrington	$59,423.44	$31,107.14	$19,026.69
Bristol	$86,889.15	$33,403.76	$19,417.51
Jamestown	$278,804.21	$43,081.29*	$10,652.30*
Little Compton	$521,670.33	$270,737.59	$87,393.96*
Middletown	$248,196.67	$97,960.44	$13,223.82
Narragansett	$101,692.36	$33,970.10	$15,136.80
Newport	$134,534.26	$71,935.35	$30,519.09
North Kingstown	$137,710.09	$57,632.56	$13,400.53
Portsmouth	$88,652.61	$25,317.48	$13,872.49
Tiverton	$103,052.91	$56,203.31	$20,708.19
Warwick	$30,134.47	$0**	$2,183.95*

Note: *indicates that the values shown here are not statistically significant
**this value was negative, but because of its lack of statistical significance, is represented as a 0 in tables and in maps

Table 6: House price premium totals for all categories and all towns

Total Premium Generated by Housing Transactions

	Within 0.00-0.10 miles	Within 0.10-0.25 miles	Within 0.25-0.50 miles	**Total – Within 0.00-0.50 miles**
Barrington	$37,733,880.00	$31,667,070.21	$19,578,460.00	$88,979,410.21
Bristol	$17,117,160.00	$14,831,269.91	$12,252,450.00	$44,200,879.91
Jamestown	$51,299,980.00	$14,001,417.75	$5,038,539.00	$70,339,936.75
Little Compton	$3,651,692.00	$4,331,801.45	$2,709,213.00	$10,692,706.45
Middletown	$8,190,490.00	$11,363,410.86	$3,451,416.00	$23,005,316.86
Narragansett	$38,338,020.00	$23,439,370.81	$15,318,440.00	$77,095,830.81
Newport	$19,372,930.00	$38,917,022.41	$18,464,050.00	$76,754,002.41
North Kingstown	$49,988,760.00	$20,805,354.78	$6,057,041.00	$76,851,155.78
Portsmouth	$39,716,370.00	$15,139,853.03	$7,047,224.00	$61,903,447.03
Tiverton	$14,736,570.00	$13,432,591.20	$5,694,753.00	$33,863,914.20
Warwick	$30,556,350.00	$0.00**	$4,996,874.00	$35,553,224.00
Total Premium	**$310,702,202.00**	**$187,929,162.42**	**$100,608,460.00**	**$599,239,824.42**

Note: **this value was negative, but because of its lack of statistical significance, is represented as a 0 in tables and in maps

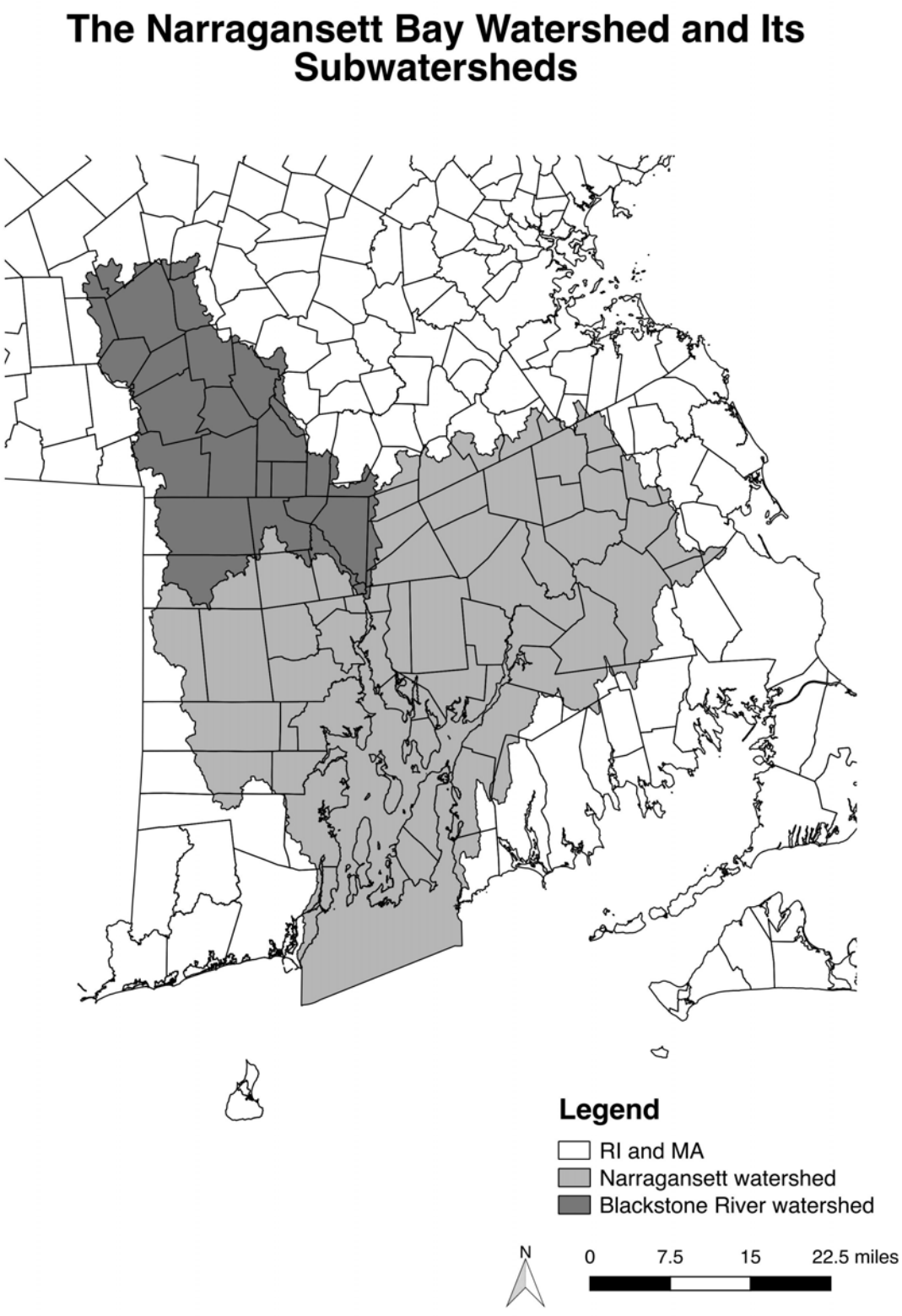

Figure 1: Narragansett Bay watershed and its subwatersheds – the Narragansett watershed and the Blackstone River watershed

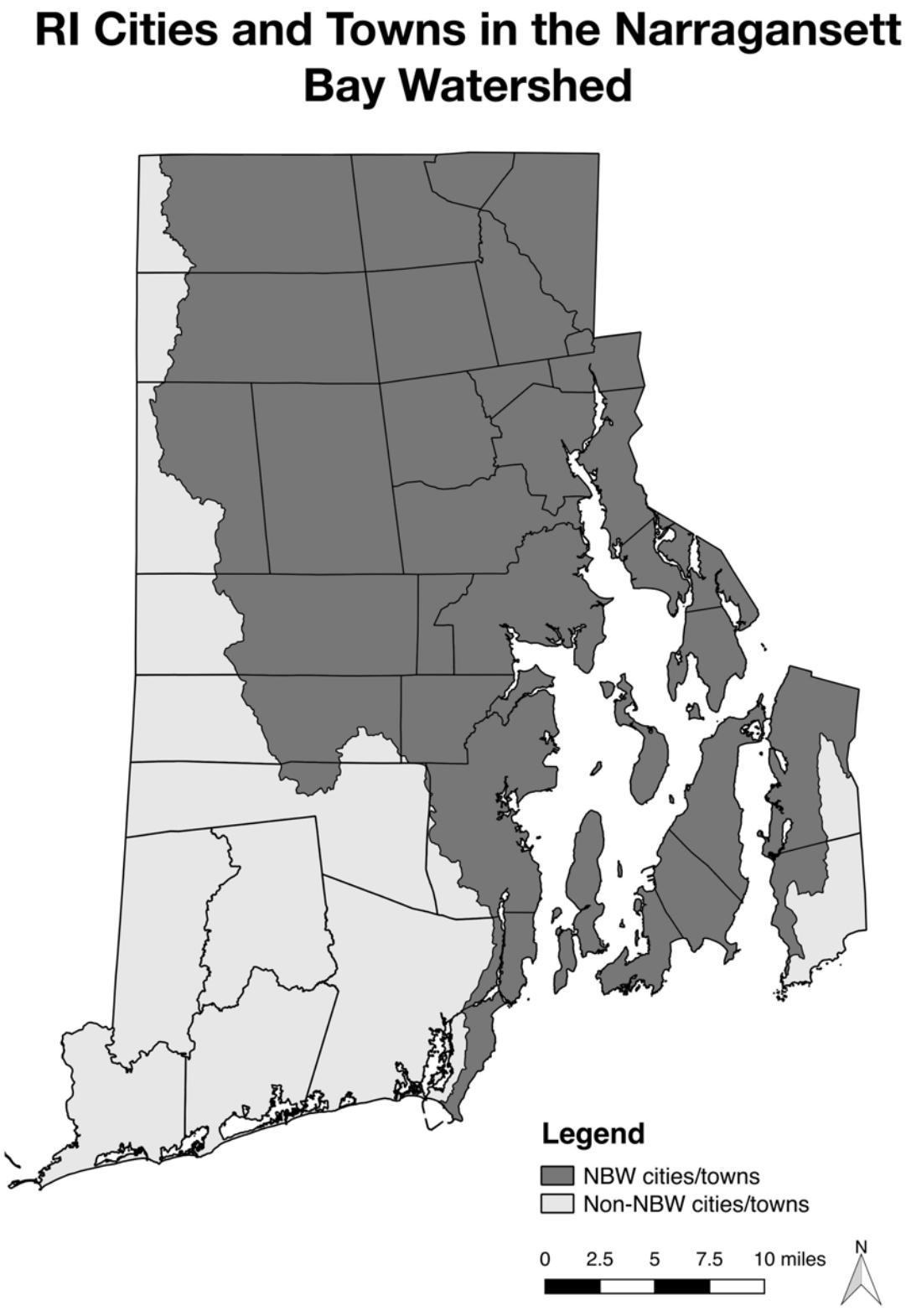

Figure 2: Rhode Island cities and towns in the Narragansett Bay watershed

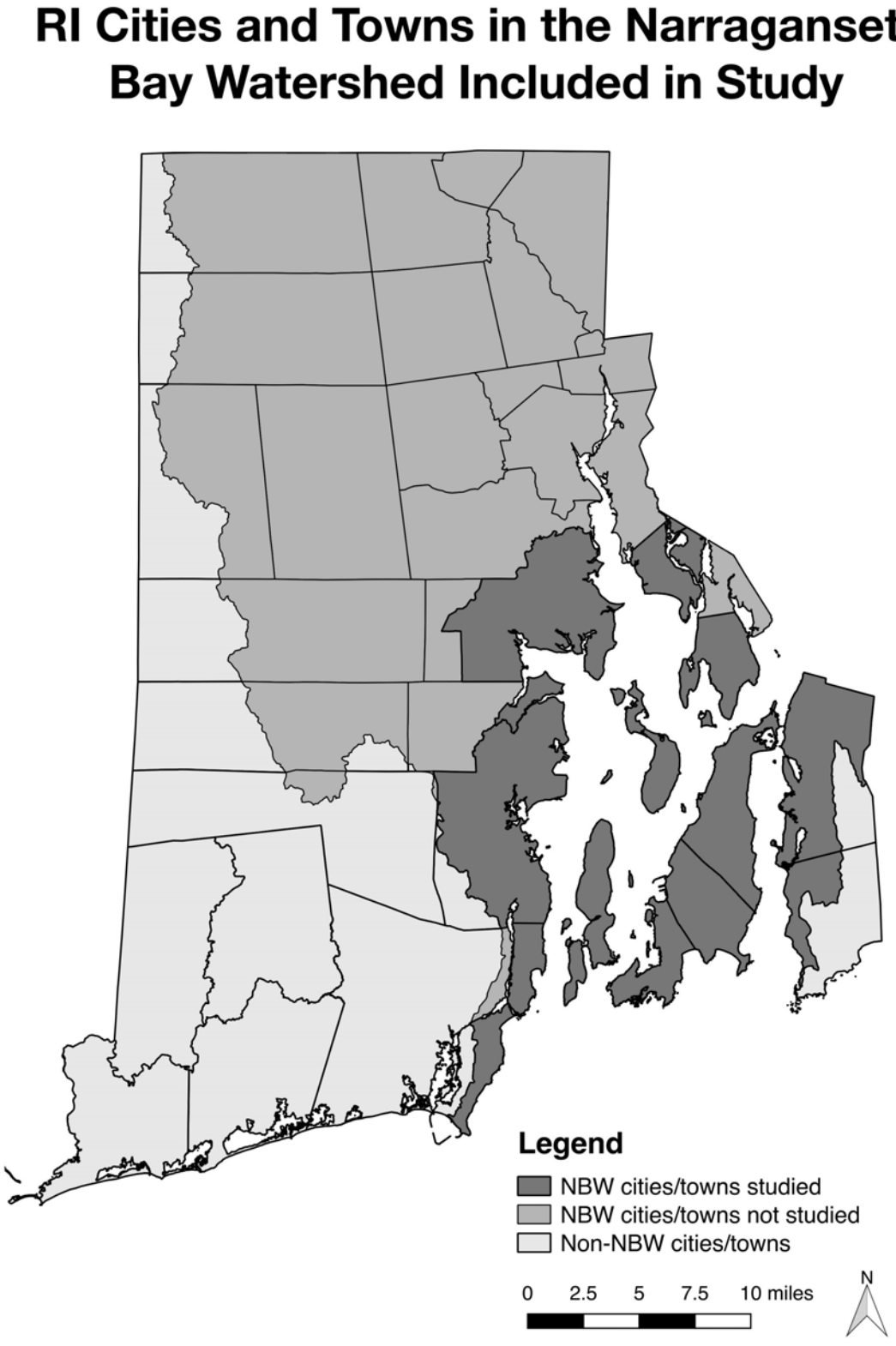

Figure 3A: Rhode Island cities and towns in the Narragansett Bay watershed included in this study

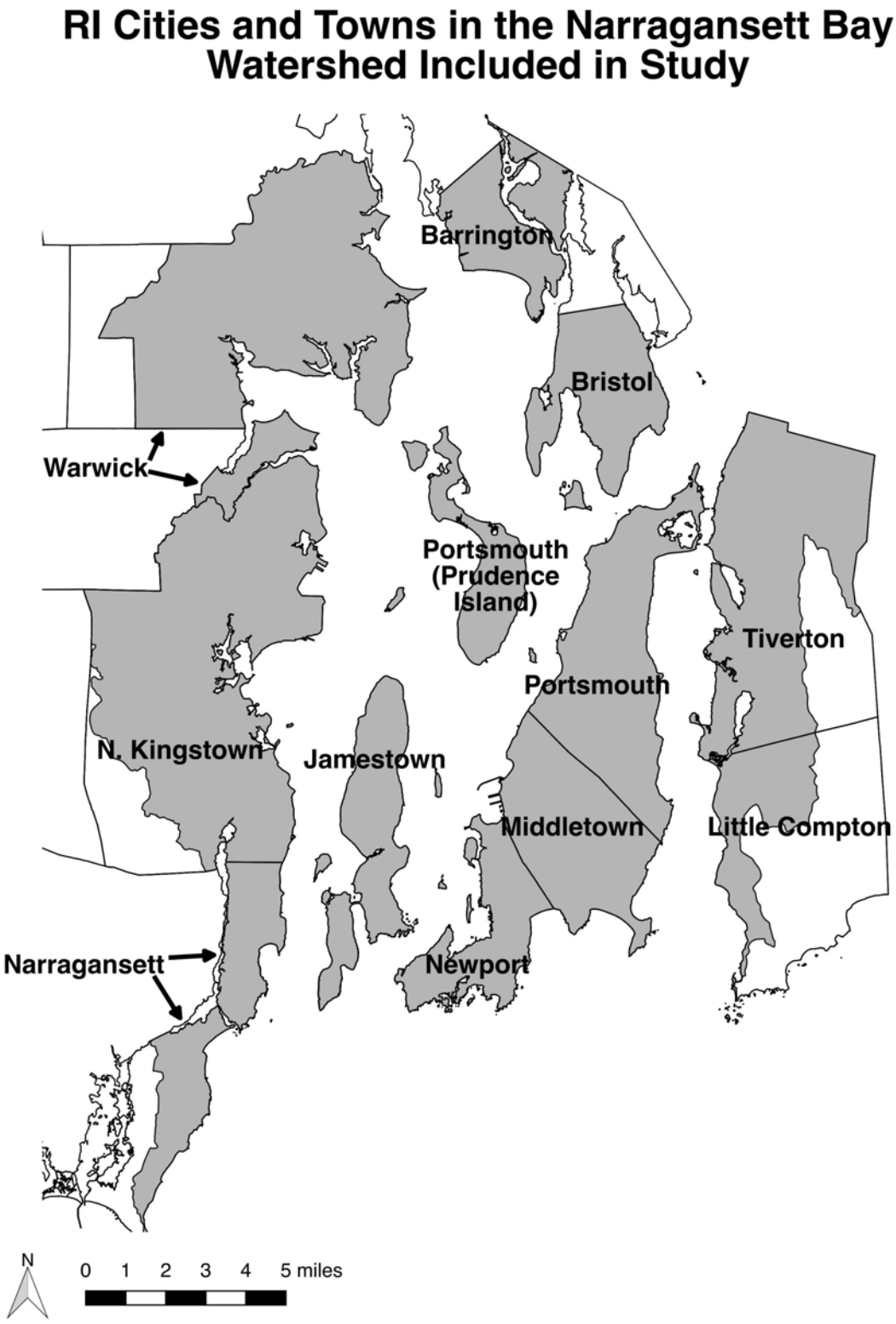

Figure 3B: Rhode Island cities and towns in the Narragansett Bay watershed included in this study, with town names

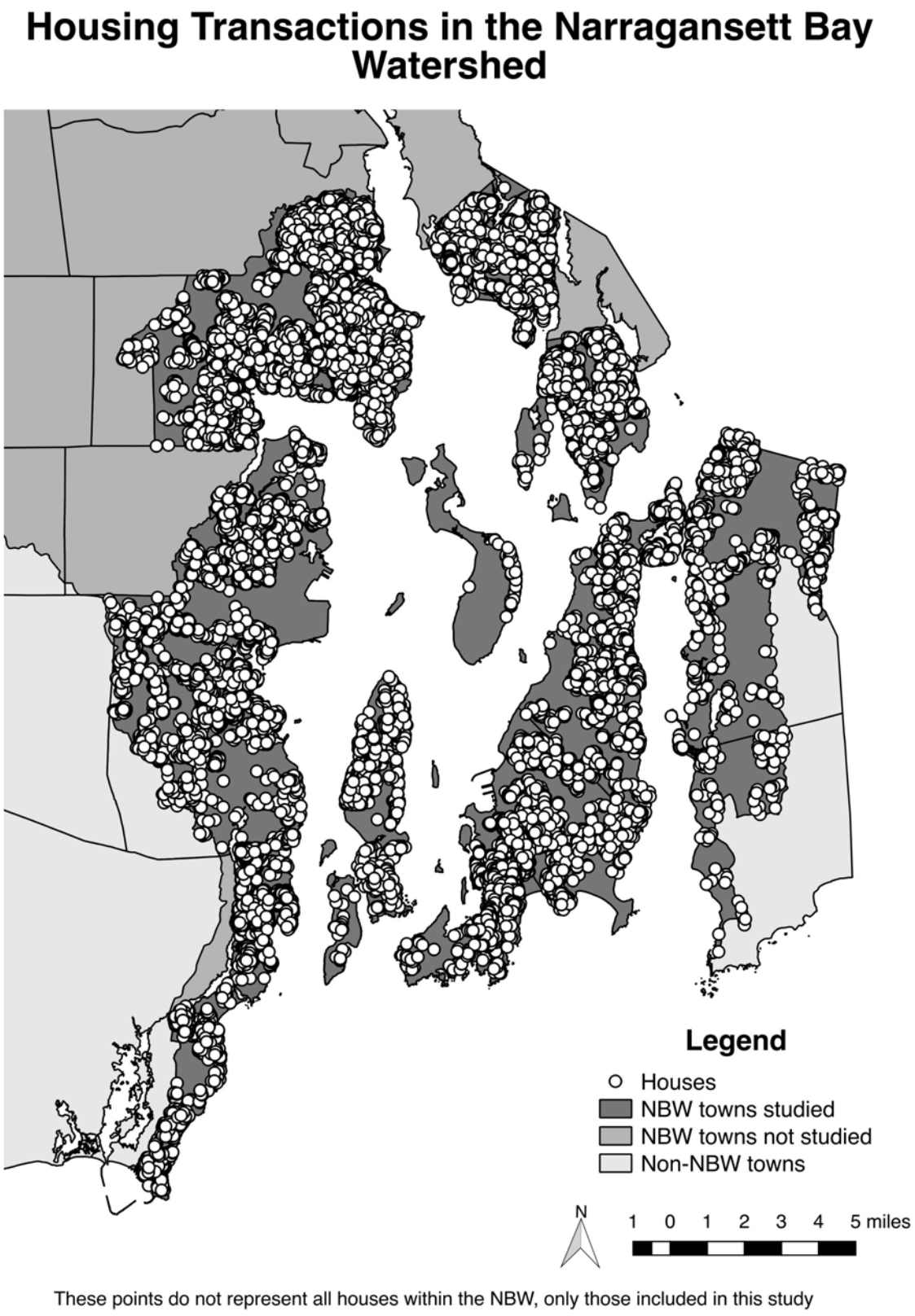

Figure 4: Housing transactions included in study

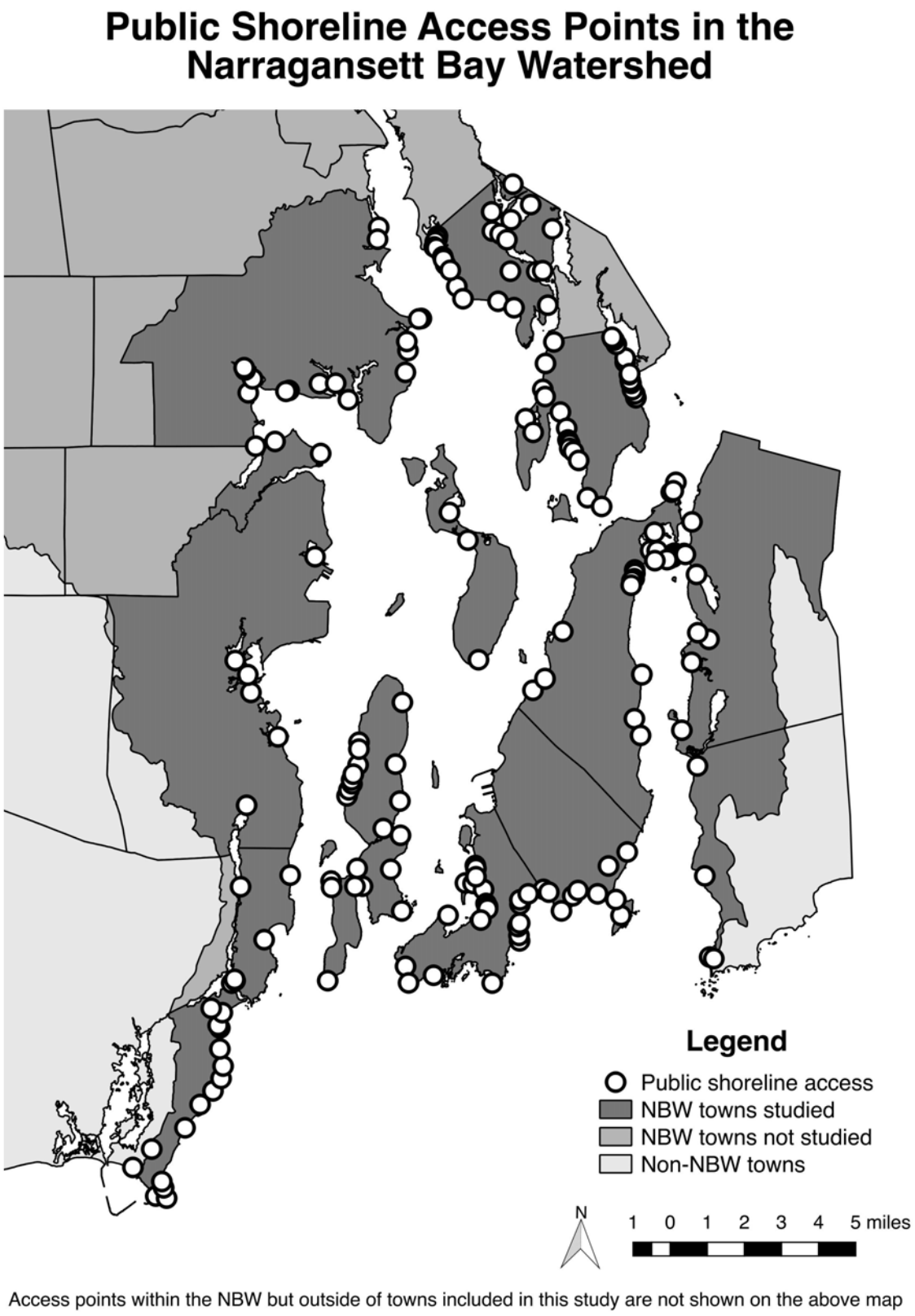

Figure 5: All public shoreline access points in study towns

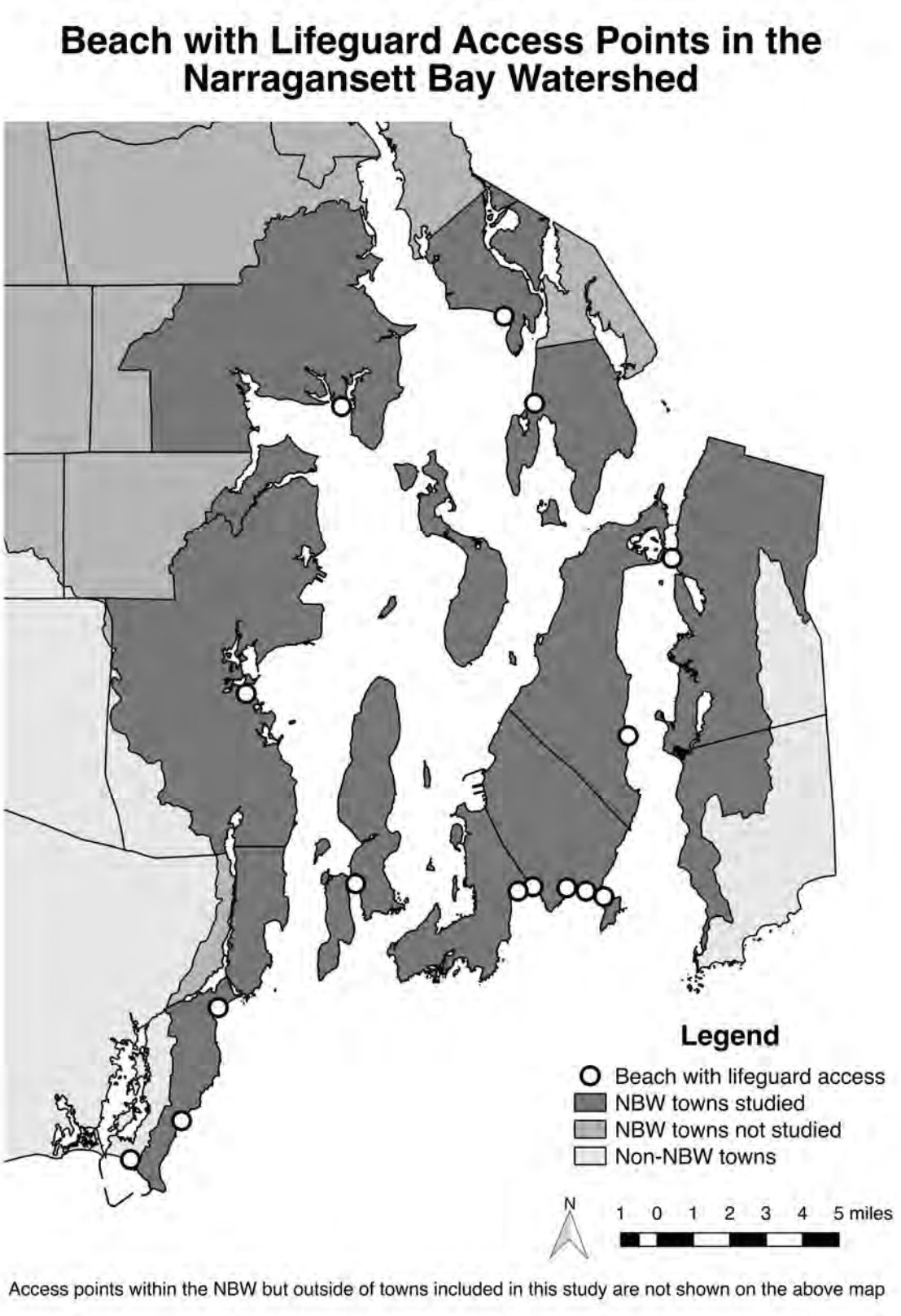

Figure 6: Beach with lifeguard access points in the study towns

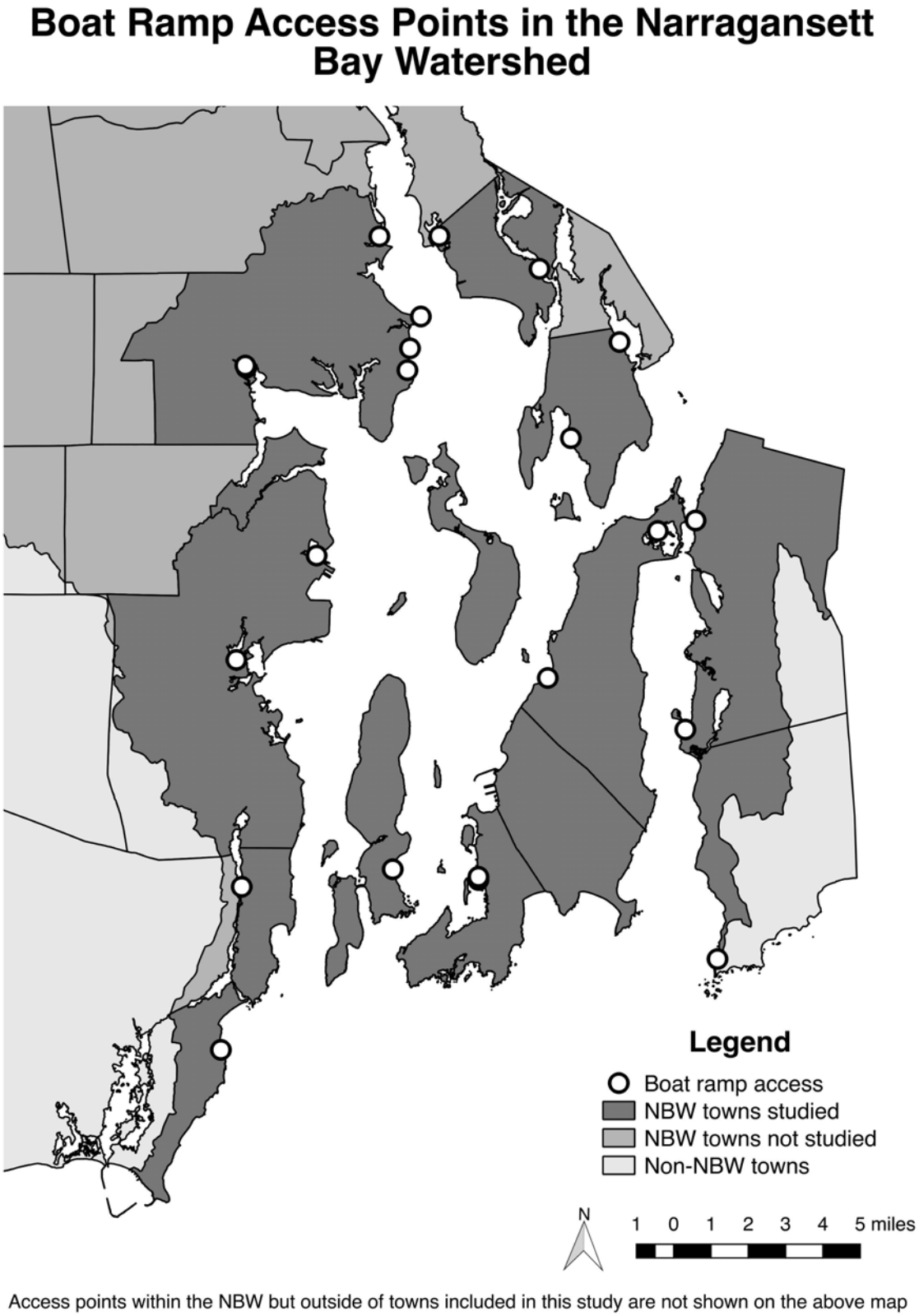

Figure 7: Boat ramp access points in the study towns

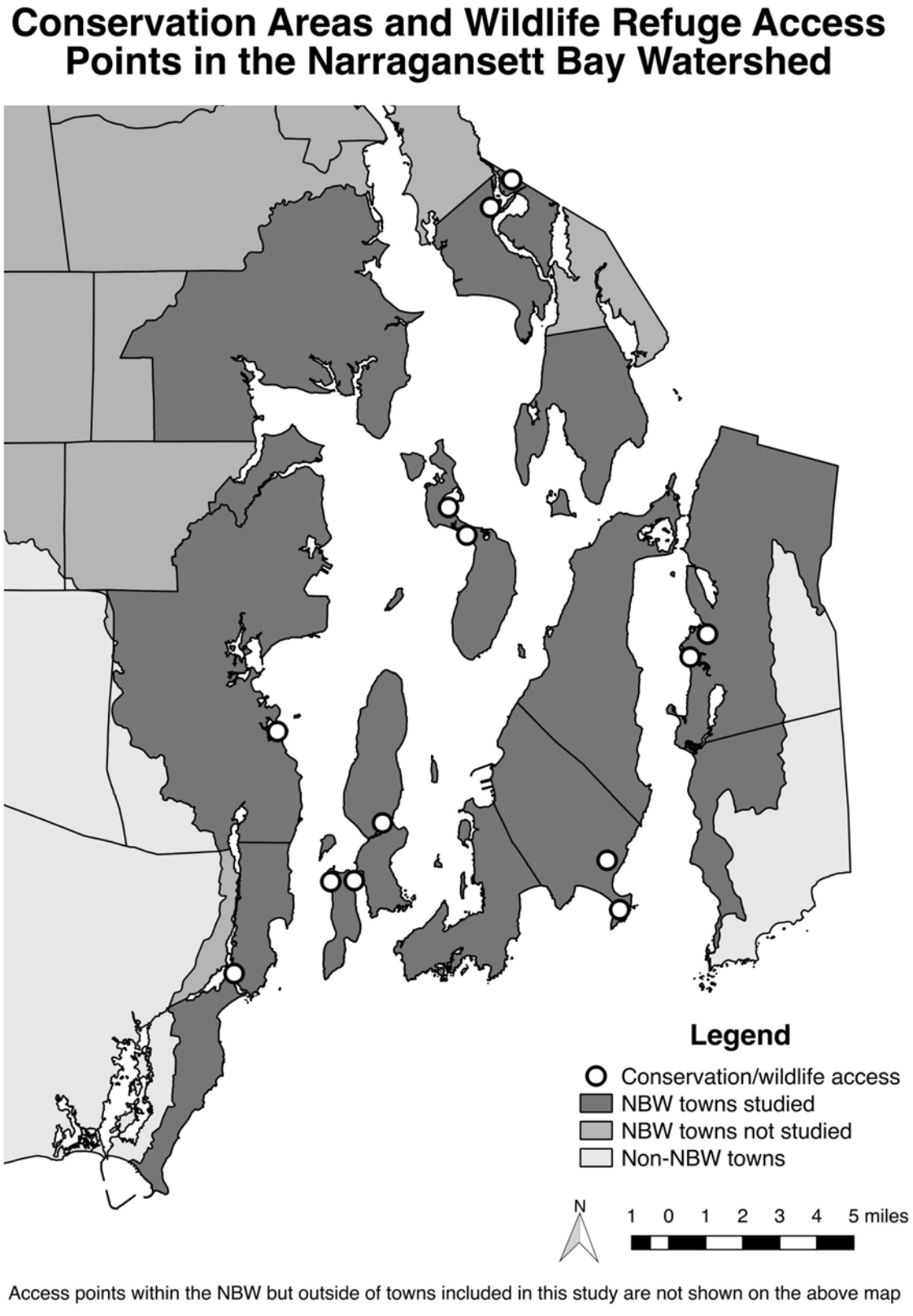

Figure 8: Conservation areas and wildlife refuge access points in the study towns

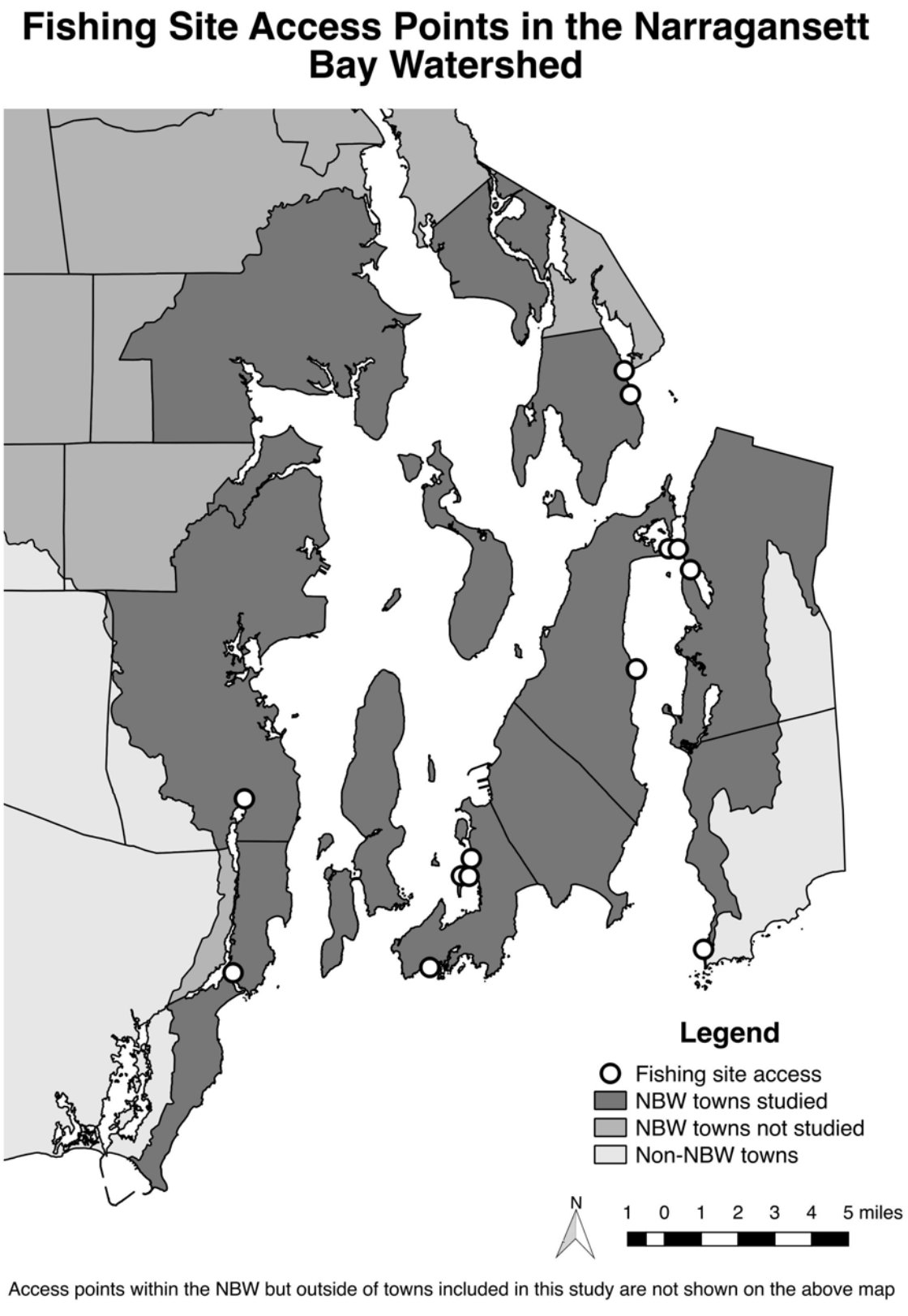

Figure 9: Fishing site access points in the study towns

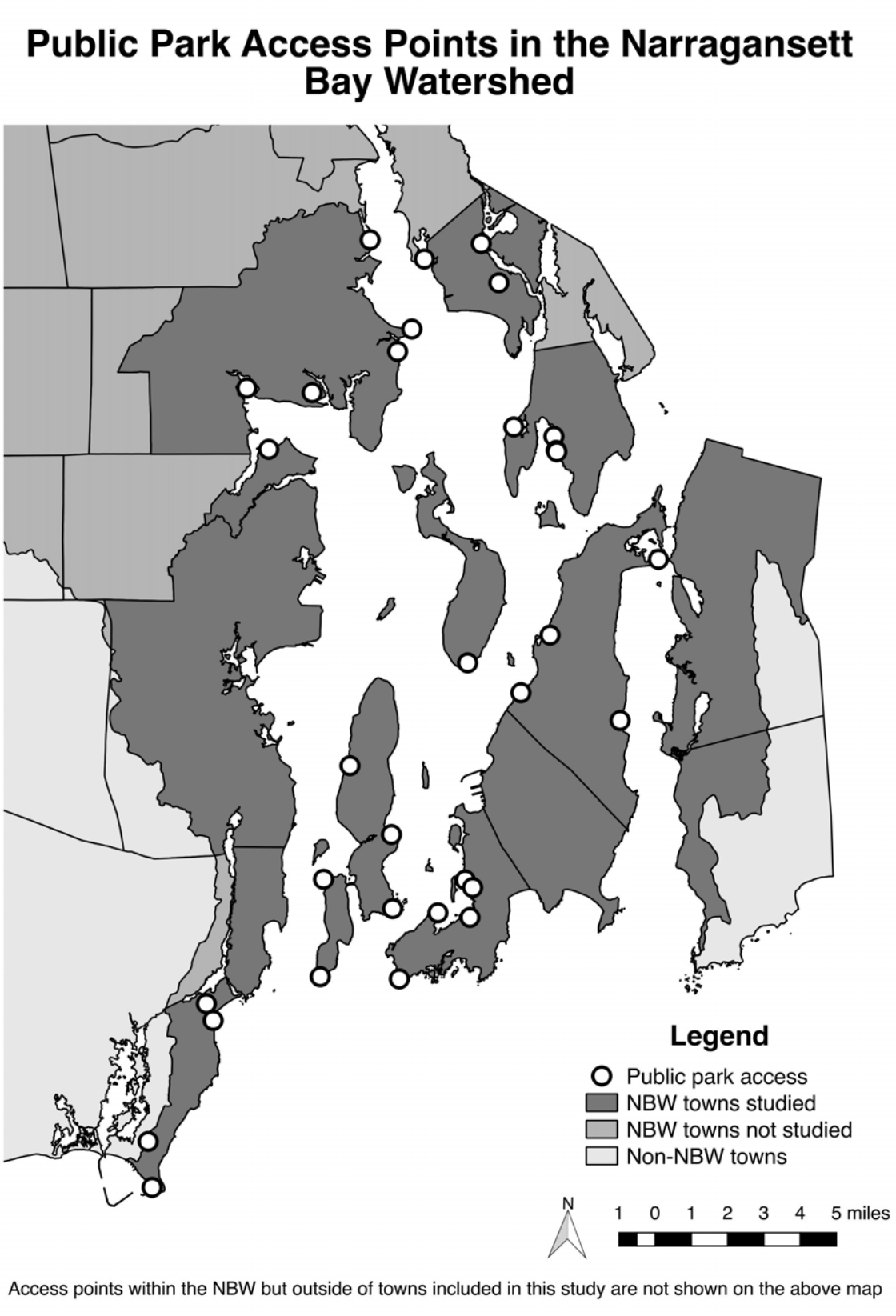

Figure 10: Public park access points in the study towns

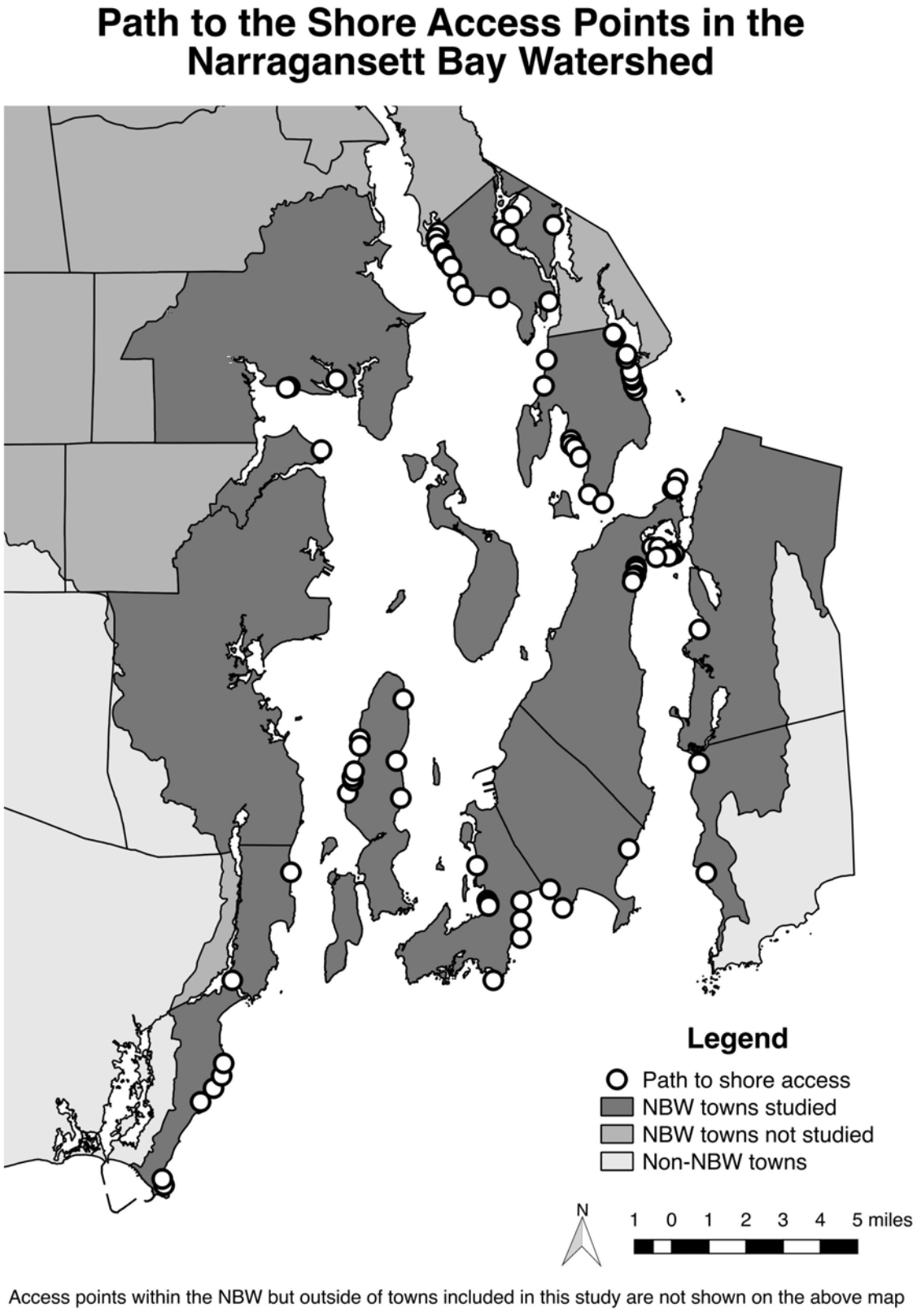

Figure 11: Path to shore access points in the study towns

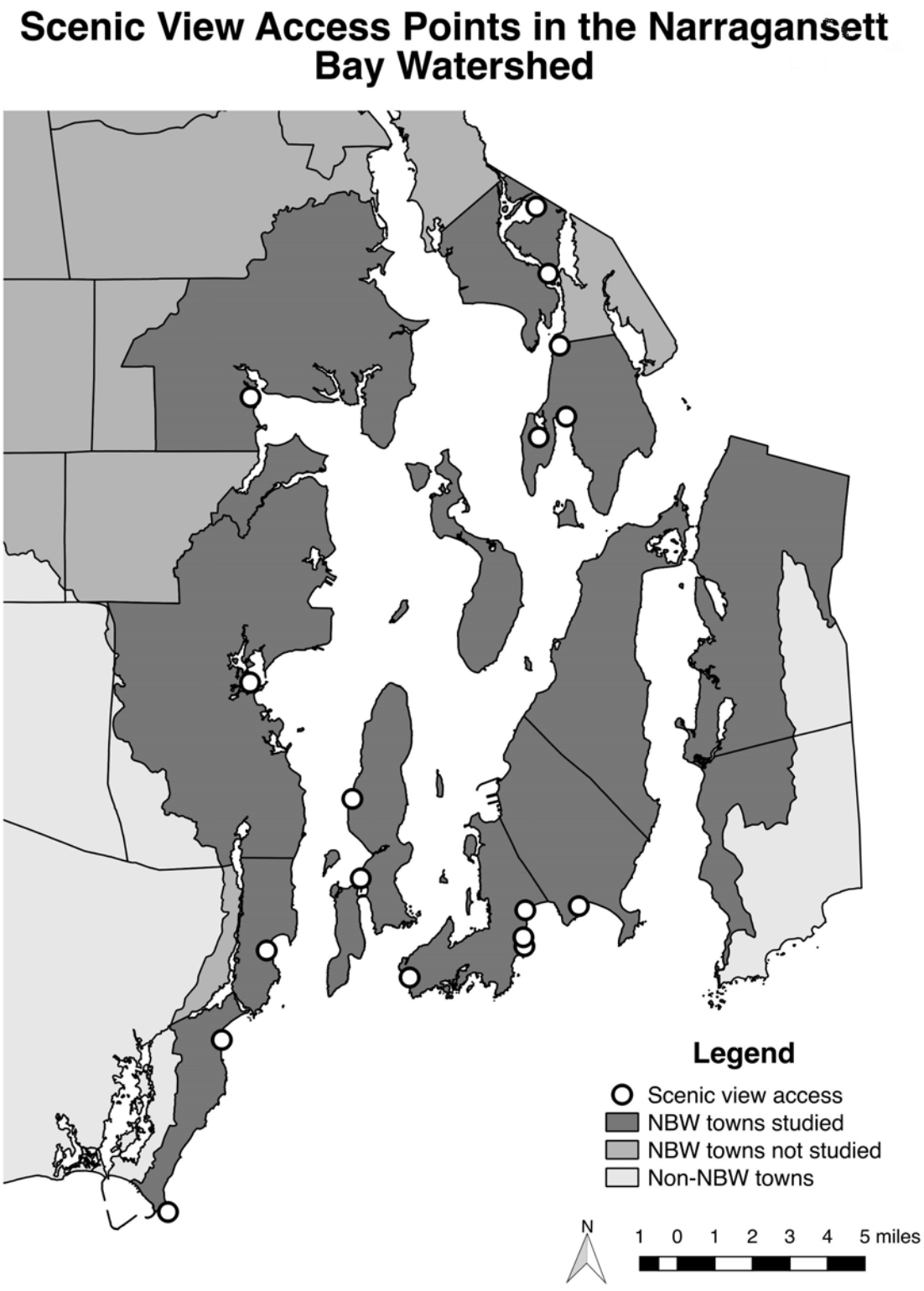

Figure 12: Scenic view access points in study towns

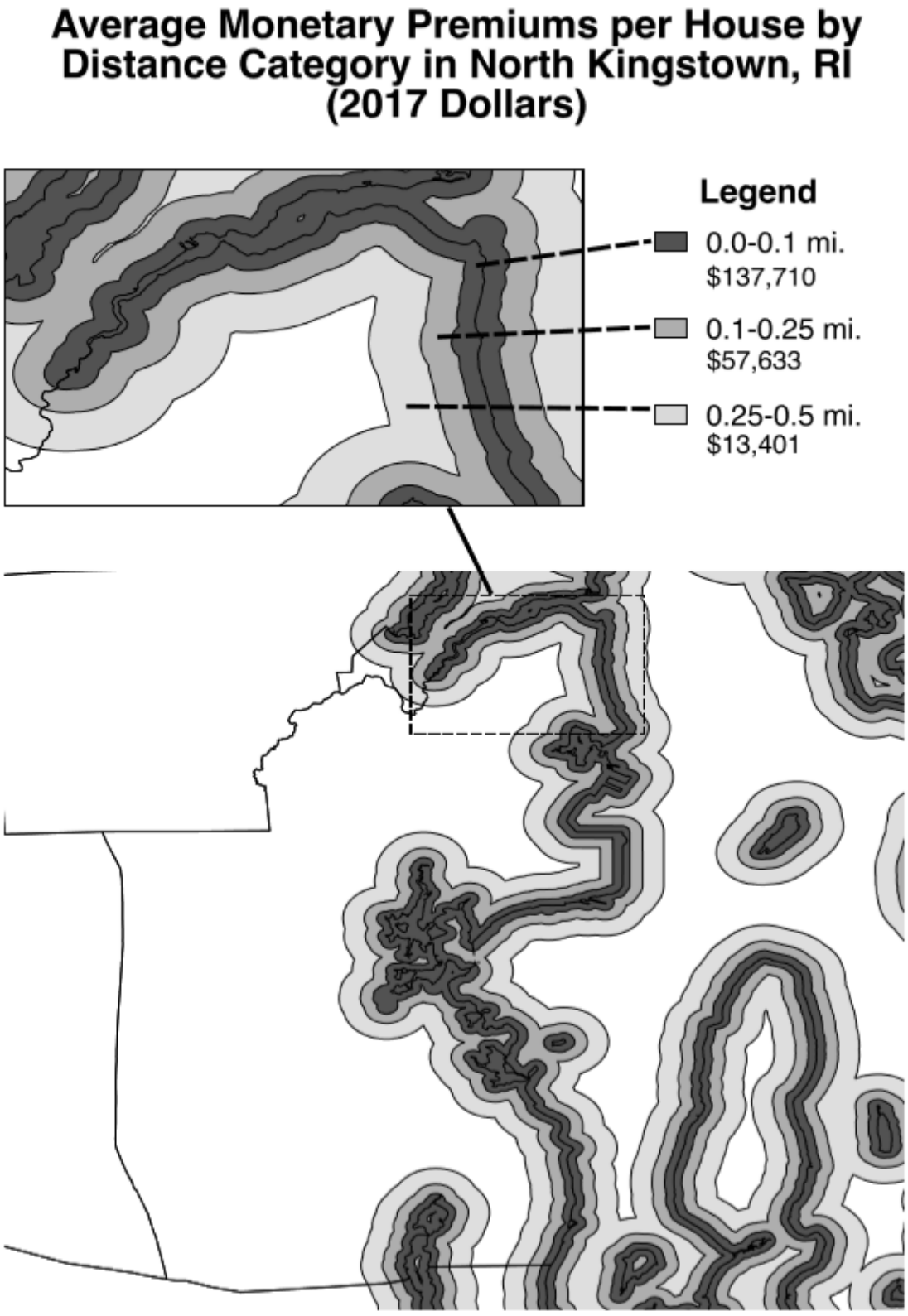

Figure 13: Example of distance categories in North Kingstown

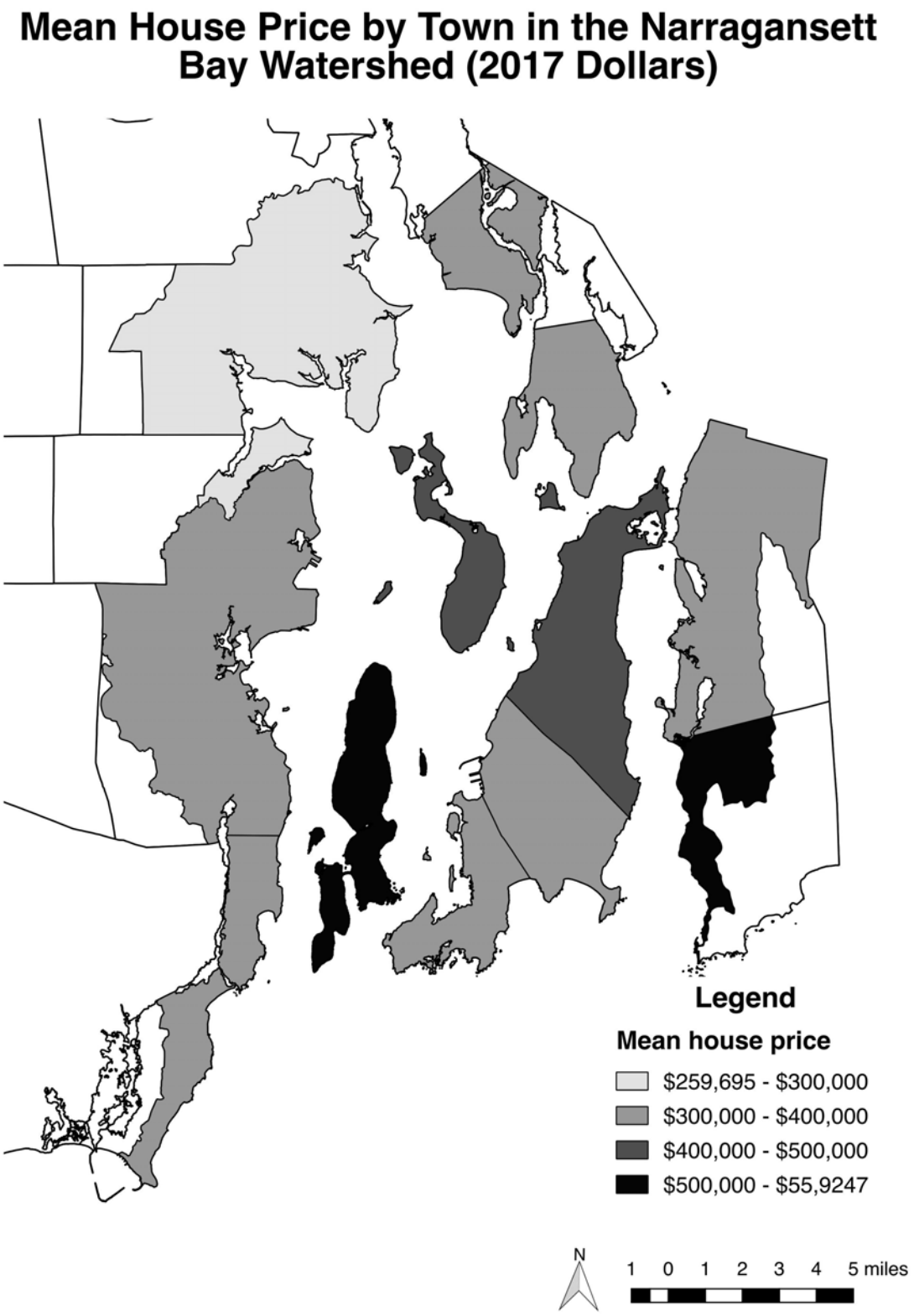

Figure 14: Mean house selling prices in study towns
Note: This is the average selling price of houses outside of the 0.50 mile distance from the coast

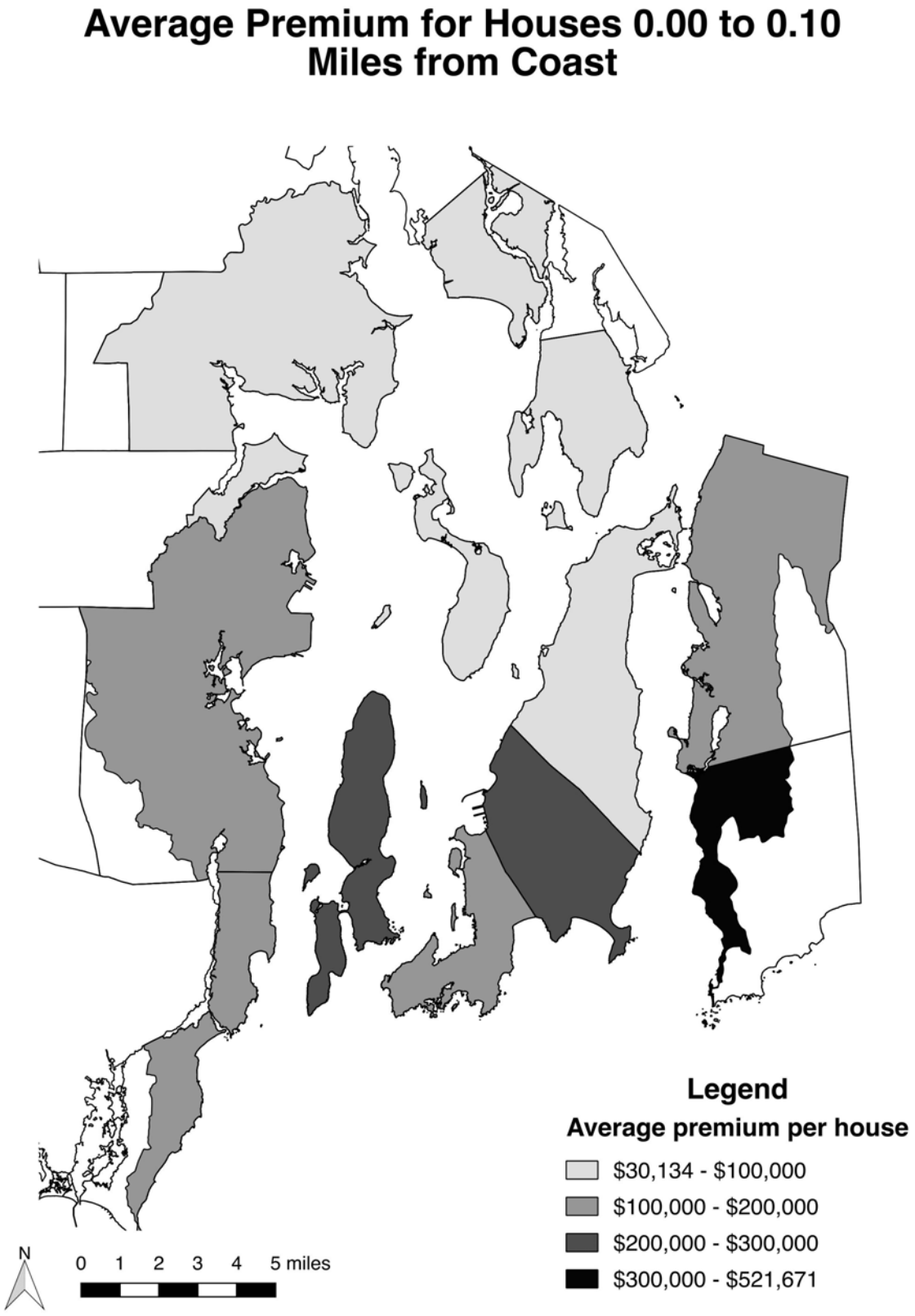

Figure 15: Average premium per house by town within 0.00-0.10 miles of coast

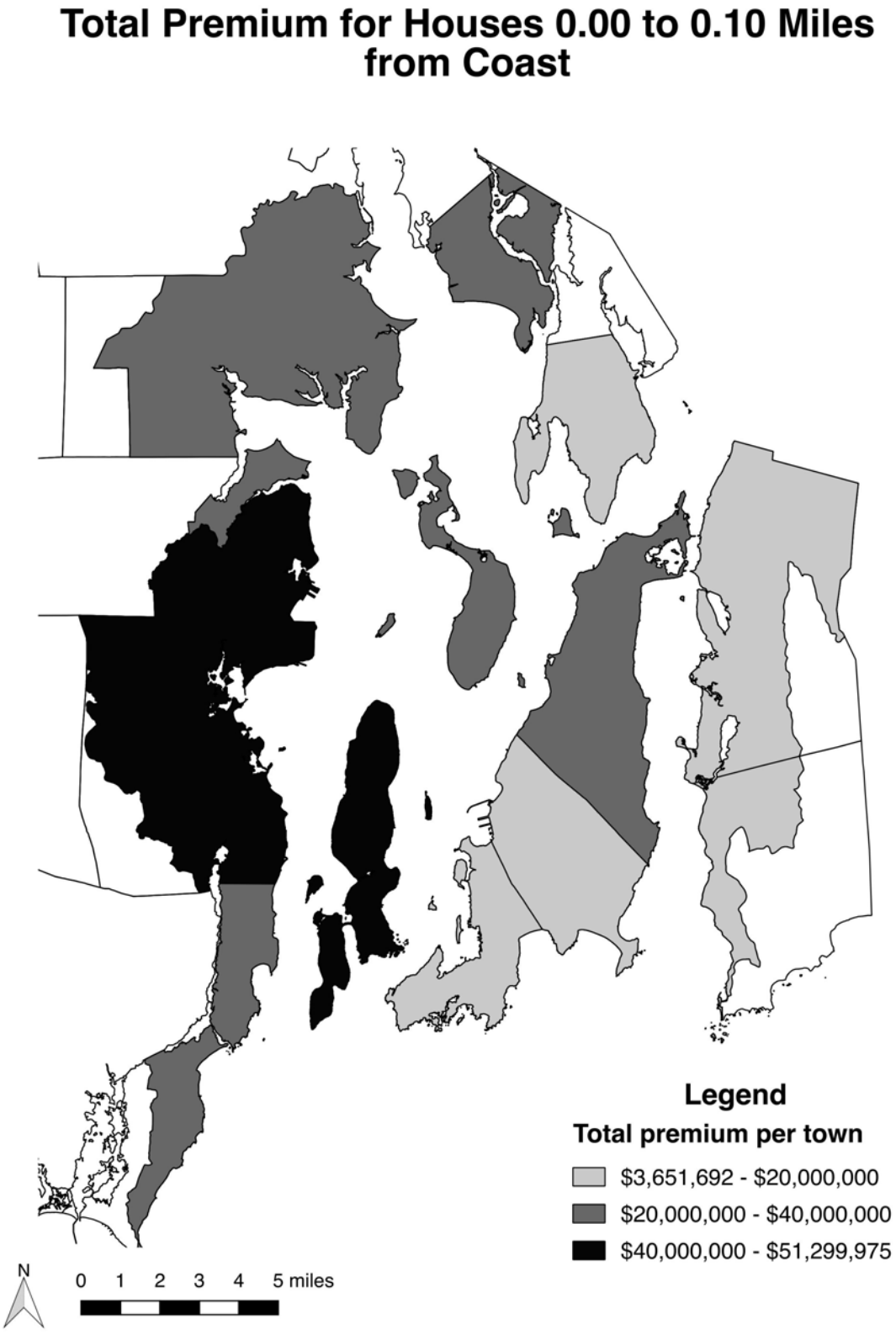

Figure 16: Total premium by town for houses within 0.00-0.10 miles of coast (number of sales in town multiplied by premium for each town)

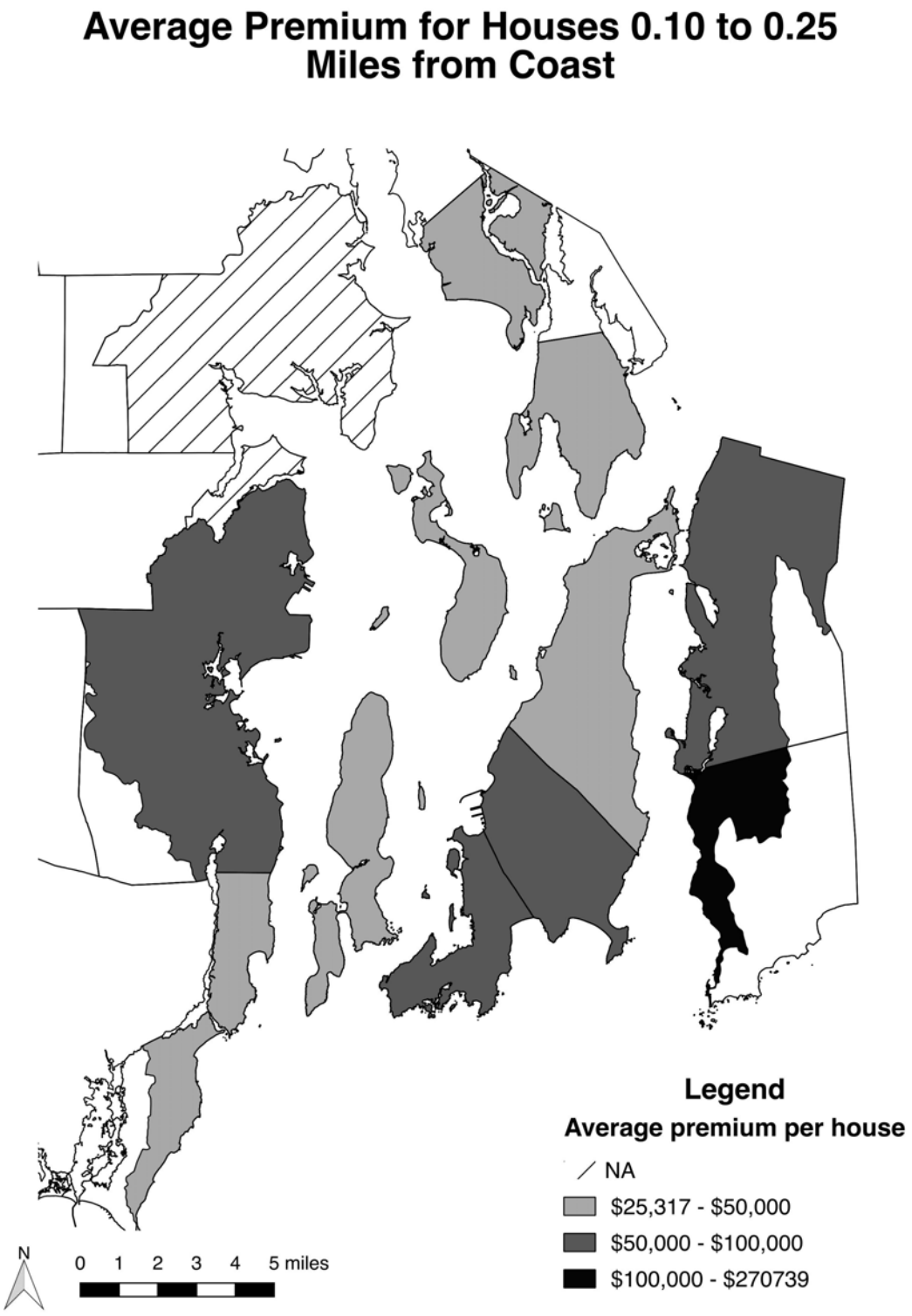

Figure 17: Average premium per house by town within 0.10-0.25 miles of coast
Note: "NA" indicates that there was a negative value generated in the regression results. As a result, we have omitted Warwick from this category.

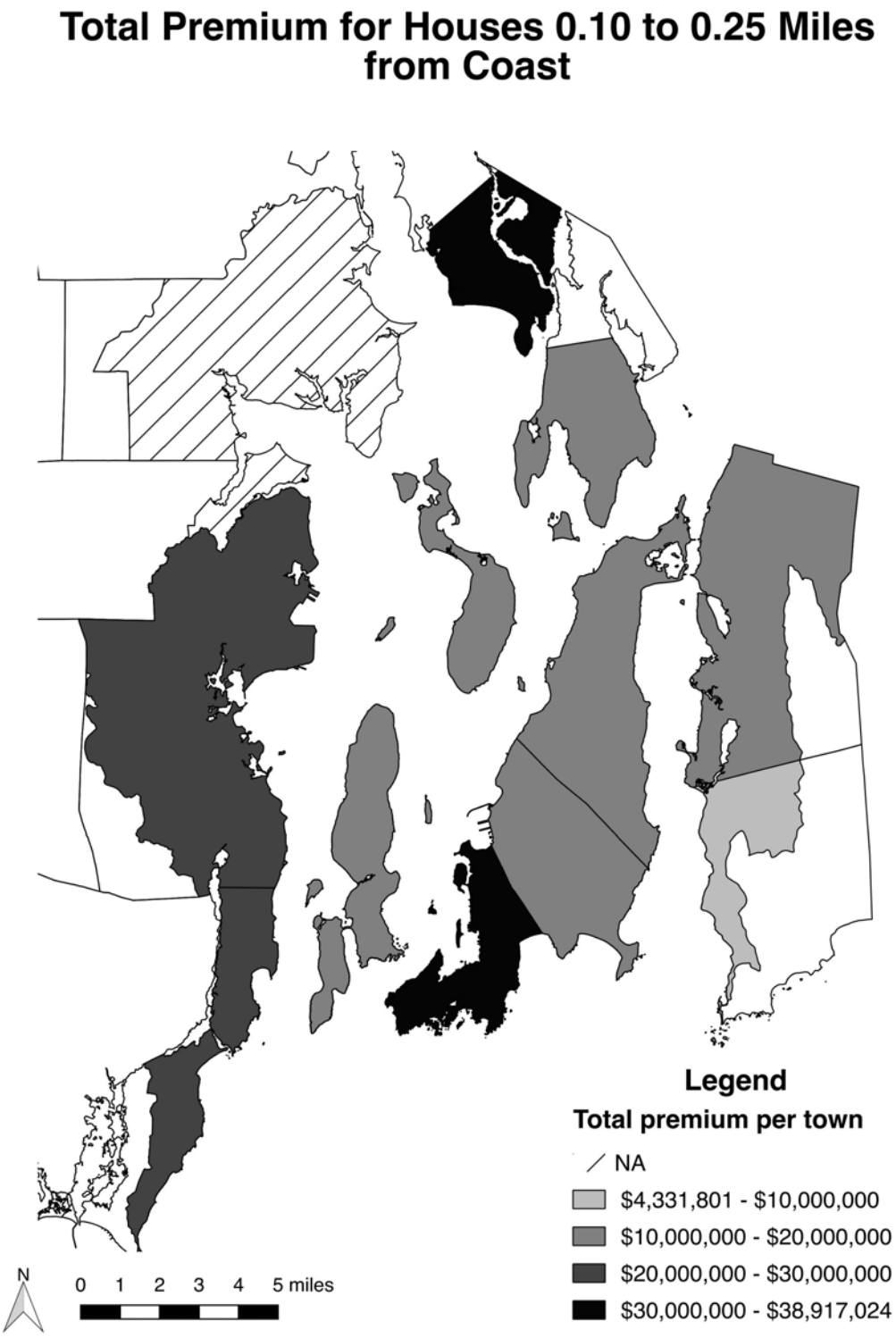

Figure 18: Total premium by town for houses within 0.10-0.25 miles of coast
Note: "NA" indicates that there was a negative value generated in the regression results. As a result, we have omitted Warwick from this category.

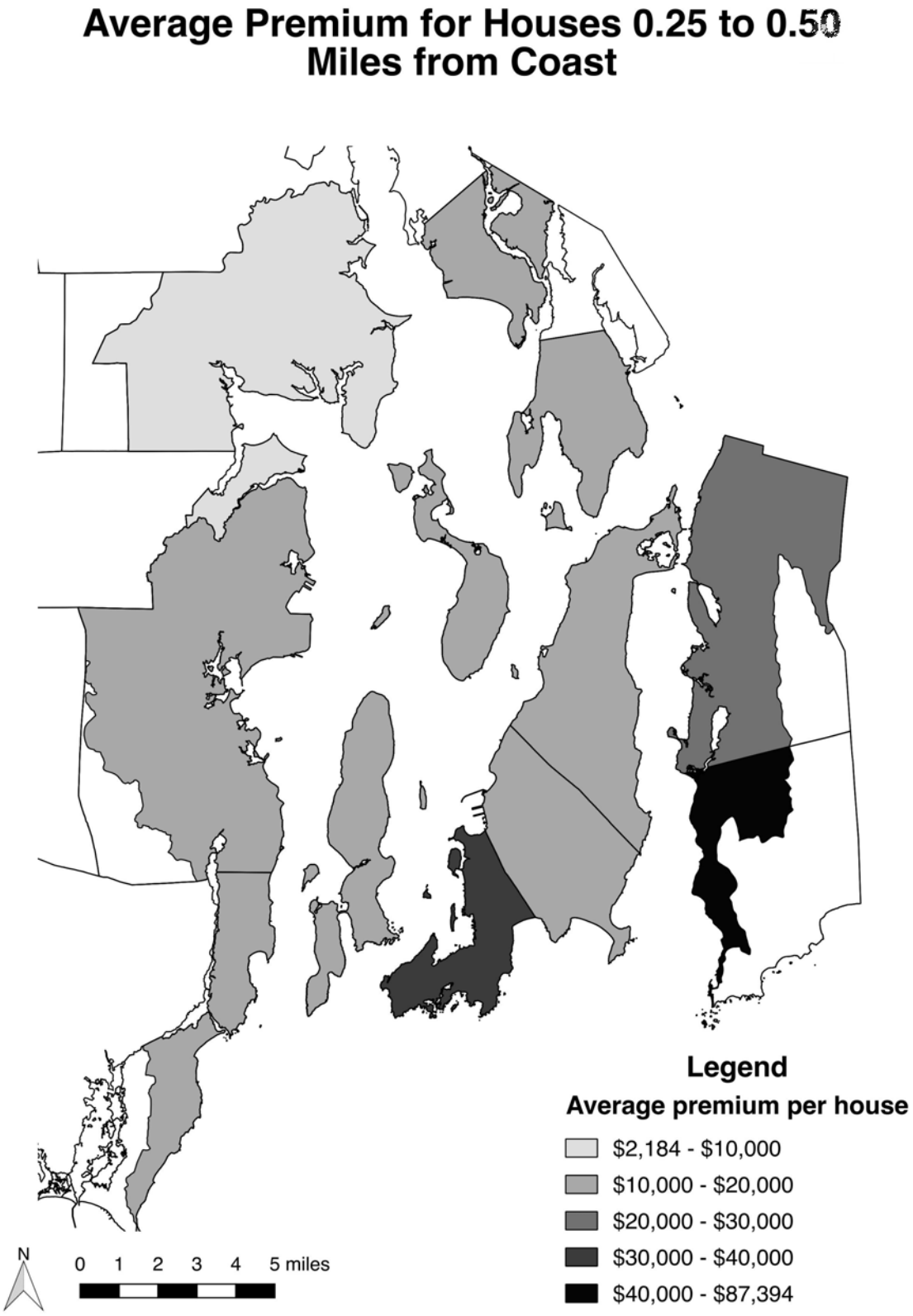

Figure 19: Average premium per house by town within 0.25-0.50 miles of coast

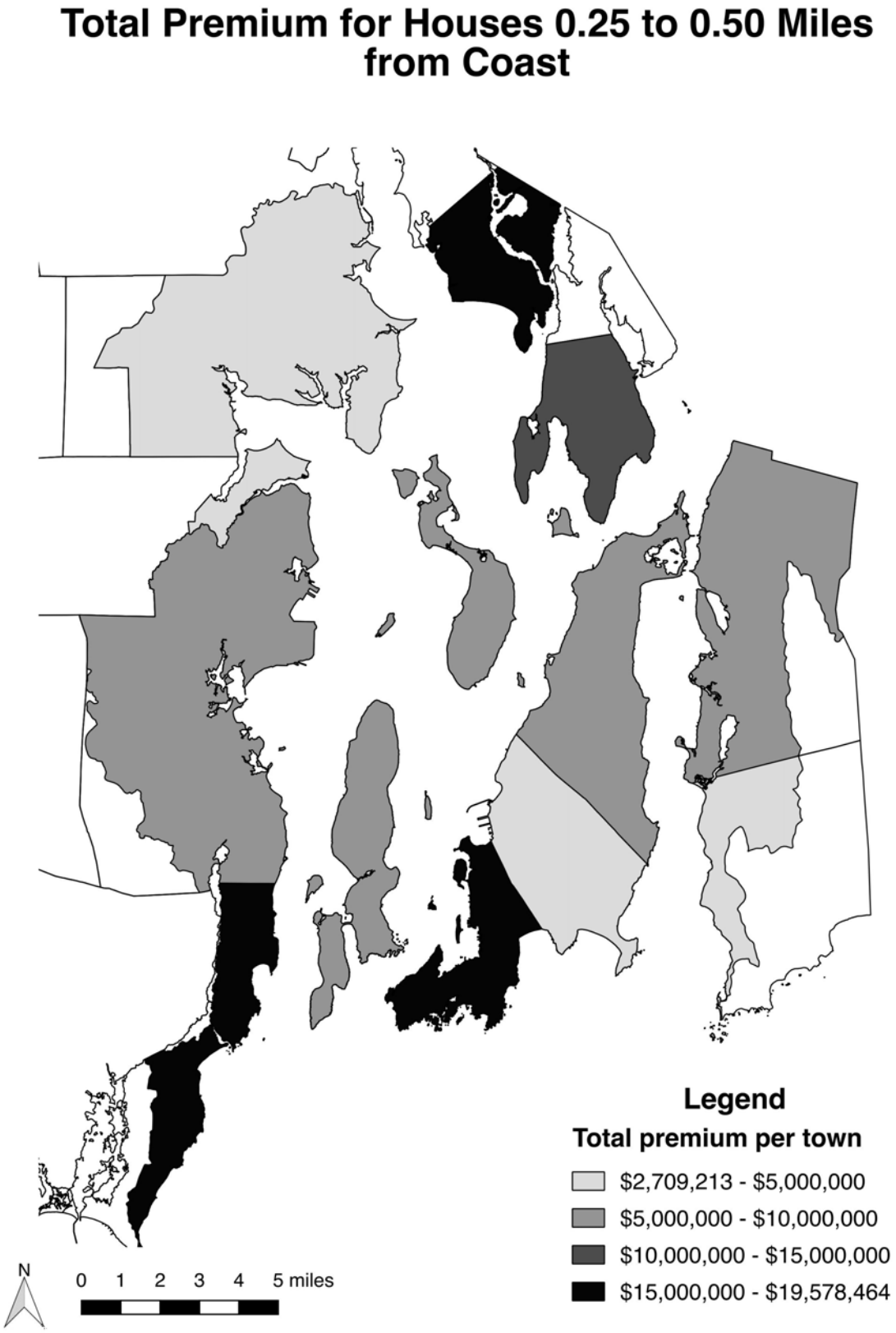

Figure 20: Total premium by town for houses within 0.25-0.50 miles of coast

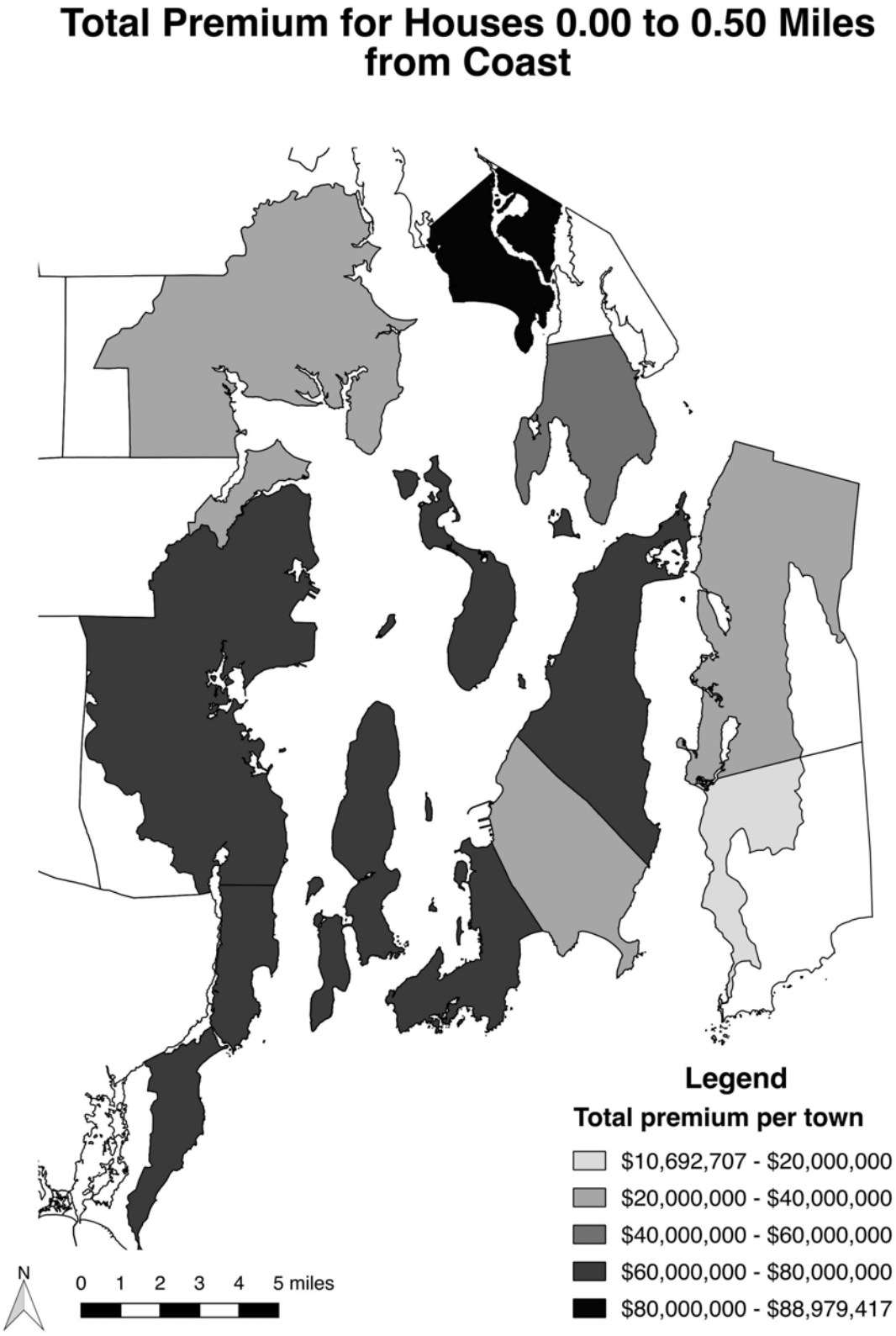

Figure 21: Total premiums for all houses within 0.50 miles of coast per town
Note: Warwick only includes houses 0.00-0.10 and 0.25-0.50 miles, not 0.10-0.25 miles