

The Town of Bristol Recycling Program: A Policy Analysis

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Executive Summary

We have analyzed the various policy options that are available to the Town of Bristol for reforming its trash and recycling system by examining the experience of other Rhode Island communities that have adopted a variety of different trash and recycling collection systems. We encourage the Town of Bristol to explore the adoption of an automated 64-gallon trash and an every other week 95-gallon recycling system. Our calculations assume that this type of system will yield an annual savings of approximately \$66,712 (not taking into consideration savings from lower workers compensation rates), while having an approximate annual cost of \$77,250. Our calculations, therefore, suggest that the cost of adopting the automated system will be approximately \$10,538 per year. Any additional increase in tipping fees will likely cause savings to exceed costs. This type of system reduces the amount of trash produced at a significant rate, while also decreasing the operating costs associated with weekly recycling collection. By reducing the collection of recycling by fifty percent, there will be the possible added long-term savings of doubling the life of recycling collection trucks. There are also a number of other non-measurable environmental and social benefits to consider, including the protection of trash and recycling containers from animals, less litter, convenience for the less mobile and the elderly, and the improvement of working conditions for DPW employees. Transitioning to a 64-gallon trash collection system will require significant modifications in how Bristol residents manage their trash and recycling habits and so, in order to cut back on contamination of recycling and illegal dumping, in the future Bristol might consider allowing residents to purchase "Pay-As-You-Throw" bags for trash that exceeds the capacity of the 64-gallon trash cart.

Introduction

The Town of Bristol is located in Rhode Island's East Bay and in 2010 had a census population of 22,954 residents and 9,315 housing units. The town is part of a peninsula, the west side of which is home to Colt State Park overlooking the Narragansett Bay and the east side of which oversees the Mount Hope Bay. Bristol is home to the longest running Fourth of July festival, which began in 1785 and brings visitors from all over the state and country to observe Independence Day.

History of Bristol Recycling

The Town of Bristol's employees from the Department of Public Works (DPW) are responsible for the curbside pick-up of trash and recycling. It is one of less than a handful of Rhode Island towns providing the municipal pickup of trash and recycling, while most other jurisdictions contract with private companies for trash and/or recycling collection. On the east side of town is the Bristol Transfer Station, which is a temporary holding area for trash and recycling that is bound for Rhode Island's central landfill, operated by Rhode Island Resource Recovery Corporation (RIRRC), a quasi-public agency located in Johnston, RI. RIRRC charges a disposal fee for each ton of trash called a tipping fee. In January 2016, RIRRC went through the rulemaking process to create a fee pricing structure and procedure, which bases the municipal tip fee off of the potential cash expenses needed on a two year basis. During FY18, the tipping fees increased from \$32 per ton to \$39.50 per ton, and in FY19 the fee will be raised to \$47 per ton. The dramatic increase in tipping fees has caused local communities to consider new ways of minimizing the impact of the higher cost of municipal and solid waste disposal.

Trash and recycling is collected weekly in Bristol and residents are asked to furnish their own trash containers, which are to weigh no more than fifty pounds and are to hold no more than thirty gallons of waste. As a condition of trash pickup, Bristol residents are required to leave a recycling bin curbside with their trash. The ordinance was instituted January 1, 2016. At the current cost of \$3.38 per bin, the Town of Bristol provides each resident with one free lidless 22-gallon recycling bin per year and additional bins can be purchased for \$5.

DPW's recycling collection is independent from its trash collection and on each day of the week two recycling trucks collect recycling that is left curbside. On typical recycling collection days, recycling trucks are driven by one DPW employee who dismounts the truck at each residence, deposits recyclables into a trough on the side of the truck, then remounts the truck and travels to the next stop. In 2017, the DPW operated four recycling trucks, which required fuel, insurance, and maintenance costs of approximately \$48,000. To deliver recycling services, DPW hires two full-time truck drivers and an additional employee is hired to work eight hours every week over the course of a year. During FY2017, these costs were approximately \$111,500. Bristol's recycling program is managed daily by the Bristol DPW and overseen by a volunteer, town-chartered committee that seeks to educate town residents about recycling.

The Town of Bristol is considering making changes to its recycling program by automating the collection of curbside recycling, which will require the purchase of 64-gallon or 95-gallon recycling carts. Prior to beginning our analysis, we wanted to know the extent to which Bristol residents already had recycling capacity and so we drew a simple random sample of Bristol residences to observe whether Bristol residents already owned 64 or 95 gallons of recycling capacity equivalent in their own recycling bins or barrels. Through our analysis of Bristol recycling data, we discovered that Bristol residents who place their recycling curbside leave about 31 gallons of recycling capacity out each week, with a margin of error of +/- 1.8 gallons of recycling capacity. If the typical Bristol resident leaves 31 gallons of recycling capacity curbside, then we can assume that additional capacity exists for recycling if the Town of Bristol wishes to institute 64-gallon or 95-gallon recycling carts.² The appendix includes a variety of recycling maps that show the density of recycling in the town of Bristol, the extent to which recycling bins are full or not, and the residences in our sample that did not leave recycling curbside. Because our analysis suggests that the average Bristol resident does not already possess 64 or 95 gallons of recycling capacity, we turn now to our analysis of the Town of Bristol's options for reforming its recycling program.

Standard Policy Options Based on Preexisting System³

Contract out Recycling and Trash Collection

In 2013, the Rhode Island Public Expenditures Council (RIPEC), by the request of the Town of Bristol, produced a study detailing the cost savings of contracting out Bristol DPW's trash and recycling program. In it, RIPEC examined the complete cost of operating DPW operations and used several assumptions to forecast future expenditures. It projected that DPW expenditures would rise from \$3.3 million in FY2013 to \$4.1 million by FY2018. The study found that *eliminating all trash collection positions* through privatization led to a projected savings of \$1.1 million between FY2014 and FY2018. Additionally, the *elimination of all positions* related to the recycling program led to a projected cost savings of \$521,612 between FY2014 and FY2018. When taken together, RIPEC found that eliminating all positions relating to the trash and recycling programs would lead to projected savings of \$1.6 million. The RIPEC study also found that given the high costs of operating the composting program, with FY2013 costs of \$831,383 and projected revenues of \$74,158, that Bristol should consider alternatives to the composting program. Altogether, the RIPEC study recommends that if privatization of trash and recycling is not pursued, then "[o]ptions to increase recycling rates should be evaluated" (RIPEC 2013, p. 17). We turn now to examining how to increase the Town of Bristol's recycling rates.

Do Nothing

² It is possible that Bristol residents already have 64 or 95 gallons of recycling capacity but only leave an average of 31 gallons of recycling capacity curbside because, on average, Bristol residents only produce 31 gallons of recyclables on a typical week. Whatever the case, if Bristol residents left 64 or 95 gallons of recycling capacity curbside, then we would be on even more solid footing that replacing 22-gallon bins with the 64 or 95-gallon carts would not likely affect the recycling rate in Bristol.

³ We thank RIRRC for its assistance collecting data associated with the variety of organizations that have adopted the variety of different systems for recycling and trash receptacles.

The Town of Bristol maintains the option of continuing to furnish 22-gallon bins to residents. However, with tipping fees increasing to \$47/ton FY19, the Town of Bristol will likely see the annual cost of refuse collection increase. For the sake of simplicity, we will assume that tipping fees increase from \$32 to \$47 and will ignore the \$39.50 increase in between. If we use the number of MSW tons in 2017 (7,754) and assume that this figure will remain constant, then with tipping fees increasing from \$32 to \$47 there is an increase in fees paid from \$248,128 to \$364,438, an increase in fees of \$116,310 per year. Doing nothing also ignores the possibility that tipping fees may continue to increase in future years. Holding trash tons at Bristol's current level, a ten percent increase in tipping fees to \$51.70 would cost Bristol approximately \$400,881 per year, a twenty percent increase in tipping fees would cost Bristol approximately \$437,325 per year, and a thirty percent increase would cost Bristol approximately \$473,769 per year. By holding the trash tonnage constant at 7,754 and the tipping fees constant at \$47 per ton, Bristol can expect to accrue \$1,822,190 in tipping fees over a five year period and \$3,644,380 in tipping fees over a ten year period. Keeping trash tonnage constant, the increase in the tipping fee structure means that Bristol can expect to pay an additional \$581,550 over a five year period, an additional \$1,163,100 over a ten year period, or an additional \$2,326,200 over a twenty year period. On the basis of these conservative estimates, it is clear that **doing nothing to address the tipping fee increase will impose substantial costs on the residents of Bristol.**

Expand the Number of Recycling Bins Furnished to Residents

The most inexpensive, albeit least predictable, option at the Town of Bristol's disposal is to increase the number of blue 22-gallon recycling bins that are available to town residents. These recycling bins cost the town approximately \$3.84 per bin. We collected data on the number of residents using the 22-gallon blue bins (see appendix) and it is clear from our study that a large number of Bristol residents do not use the 22-gallon blue bins provided by DPW. DPW, in concert with Bristol Recycles, might consider determining ways to furnish residents with additional blue bins if residents are already reaching capacity with their existing bins. There is no baseline of comparison for us to predict the increase in recycling and the amount of trash reduction by moving to this system. We also cannot predict the amount of long-term savings that will accrue by furnishing more bins to residents. However, it should be noted that one downside of maintaining the lidless blue bins is that using them does not solve the problem of recyclables blowing into the streets on windy recycling days. The burden of increasing the bins will also fall disproportionately on segments of our community that struggle to bring the bins to the street. Recycling and trash carts are manufactured with wheels that allow residents to easily wheel 64 or 96 gallons of recycling and trash capacity to the curb in one trip, while placing two to three 22-gallon bins to meet the same capacity as a 64 or 96-gallon cart requires additional trips, which might cause some residents to be less motivated to recycle. Overall, while we conclude that expanding the number of 22-gallon bins to residents is **likely the least costly option for increasing recycling capacity, we nevertheless acknowledge that the lidless bins cause litter, do not make recycling any more convenient for less mobile populations, and, therefore, we are not optimistic that selection of this option will lead to long-term cost savings by reducing tipping fee costs.**

Costs and Savings Related to Cart-Based Systems

In this section of the analysis we will consider the adoption of 64 or 96-gallon cart-based recycling systems. Towns adopting the cart-based system must give consideration to the costs and benefits associated with purchasing carts, purchasing the right equipment for the mechanical collection of carts, and other savings.

Costs Associated with 64 or 95-Gallon Carts

There are significant costs associated with the adoption of 64 or 95-gallon cart systems. In order to understand these costs better, we took into consideration the experience of other towns in Rhode Island that underwent the transition to a cart-based system. Coventry, a town with its own municipal employees delivering trash and recycling collecting services, instituted a 64/95-gallon system four years ago, and was charged approximately \$58 per cart for containers with an eighteen year warranty (less expensive carts are available with ten year warranties). Bristol expects to be charged \$65 per cart for a 64-gallon cart and \$70 per cart for a 95-gallon cart.⁴ If the town of Bristol adopts a 64/64-gallon system, then it will purchase 9,500 carts. If Bristol chooses to institute the 64-gallon recycling and the 64-gallon trash cart system, and we base the system on the 9,500 housing units needing **two 64-gallon carts (one for recycling and one for trash)**, then Bristol can expect to spend approximately \$1,235,000 on two carts. A 95-gallon trash and recycling cart system will cost approximately \$1,330,000. A hybrid 64/95-gallon system will cost approximately \$1,282,500.⁵

Costs Associated with Automated Recycling and Trash Trucks

Yet, Bristol must also consider the cost of purchasing equipment so that workers will no longer be required to manually dump the contents from trash carts and recycling bins into DPW trucks. The trucks that are used for recycling and trash collection have a typical lifetime of five years. Equipment that allows for the automated collection of trash and recycling carts will cost the city approximately \$20,000 to \$30,000 more per vehicle than one that is not outfitted with such equipment. If we assume that the equipment has a lifetime of five years, then we will assume

⁴ Our calculation of \$65 for a 64-gallon cart and \$70 for a 96-gallon cart is based on our discussions with Bristol officials, but other estimations for the prices of a 64 or 96-gallon cart are \$55 and \$65 respectively.

⁵ If the initial costs of instituting the automated system are too high, Bristol might consider phasing in such a system if it cannot afford the initial cost of \$1,080,540. One option is to furnish the entire town with 64 (or 95) gallon recycling carts and then adopt 64 (or 95) gallon trash carts at a later year. Another option is to furnish the entire town with 64 (or 95) gallon trash carts and then adopt the recycling carts at a later year. Another option is to furnish one-half of the town with a 64/64 (or 95/95 or 95/64) system and then to phase in the other half of the town during another year. All trash trucks would need to be outfitted with the equipment needed for mechanical collection if the entire town goes to trash. If the town furnishes all residents with the recycling carts instead, then both of the recycling trucks will need to be equipped with the proper system for automating. If a 64-gallon recycling barrel and 64-gallon trash barrel system is instituted in one-half of the town, the one-half of the recycling trucks and one-half of the trash trucks will need the required equipment to implement the automated system. If the town decides to institute a 64/64 (or 95/95 or 95/64) gallon system in one-half of the town, then we recommend starting with the one-half of routes that will maximize savings.

that the **extra equipment for automating trash and recycling pick-up will cost about \$4,000 to \$6,000 per year.** Bristol should also take into consideration that if a 95-gallon system for recycling is adopted and collection is made every other week, then it can expect there to be long-term savings of extending the life of the equipment by running it only one-half of the time.

Savings Associated with Lower Workers Compensation Payments

Out of all the services delivered by the town, refuse and recycling collection garners the highest percentage of workers compensation claims than any other job classification in the Town of Bristol at a rate of 26% of claims. Over a five year period (2012-2017), Rhode Island Trust paid out \$242,768, a total of approximately \$48,553 per year in payments. In FY18, alone, the premium paid by the Town of Bristol to Rhode Island Trust was \$114,539. Moving toward an automated system should save costs associated with lower workers compensation payments, but these savings should be anticipated with a great deal of caution when taking into consideration the way that Rhode Island Trust, the workers compensation insurance provider, calculates annual premiums. Rhode Island Trust calculates annual insurance premiums for services delivered by town workers by considering the town's "experience factor." The "experience factor" includes the number of injuries or claims that are experienced through service delivery in Bristol. We learned that, while the adoption of automation will reduce the number of injuries on the job, it can take up to three to five years for Bristol to fully realize its annual insurance savings under an automated recycling and trash collection program. Taking into consideration the tenuous nature of these cost savings, we will avoid estimating the savings that will be experienced under a workers compensation system that will not be fully realized until three to five years following the adoption of automation. Nevertheless, the added benefit of automation will enhance workers safety by keeping workers from dismounting the trucks and no longer having to lift recycling bins and trash barrels to deposit into the trucks.

Intangible Benefits

There are also benefits to the adoption of recycling and trash carts that cannot be monetized. One benefit is that recycling receptacles will have lids unlike the currently used lidless bins. Having no lid causes recyclables to litter the streets when strong wind gusts knock over the blue bins. The large carts also contain enough room for large pieces of cardboard that will no longer require placement outside of the typical 22-gallon bin. Cart lids keep recyclables dry during rain and stop snow from accumulating on top of recyclables. Both of these factors allow RIRRC's Materials Recycling Facility (MRF) to sort the recyclables in an efficient manner. Wet materials slow the production line down and decline the quality of the recyclables. The lids will also keep water runoff from recycling containers from reaching stormwater systems and will prevent animals from accessing the contents of the recycling bin. There is also the added benefit that residents will no longer need to carry bins curbside but will, instead, be able to roll out 64 or 95 gallons of recycling curbside in one trip. This may have added benefits for elderly residents or residents who are physically unable to lift recycling bins. Lastly, while it may seem that the larger bins will use more space, the vertical height of the cart will actually minimize the storage footprint of recycling bins. Rather than having three 22-gallon recycling bins alongside one another, the 64-gallon cart is the equivalent to stacking nearly three 22-gallon recycling bins on top of one another, which will provide more convenient storage of recyclables.

Other Costs

One downside of having the lids on the carts is that DPW will not be able to easily see the contents of the carts due to the lid and, therefore, may not be able to leave a cart behind and tag it for noncompliance. This could lead to an increase in contamination in recycling loads as a whole. RIRRC can reject recycling loads that either contain ten percent non-recyclables by weight or volume, or if there are prohibitive items such as a propane tank. Larger contaminants can fit inside of recycling carts, which is an issue. Rejected recycling loads are rebilled as trash (\$47/ton) plus incur a \$250 load handling fee to landfill it. It should, however, be noted that based on the experience of other towns moving to cart systems the improvement of the recycling rate offsets the rejected recycling loads. There are other consequences of moving toward the larger recycling and trash carts that must also be considered. The public, for instance, may be initially dissatisfied with the transition to larger receptacles. Some residents will complain about the size of the 64-gallon containers even though the footprint of the 64-gallon cart is no larger than the footprint of the 22-gallon recycling bin. There may also be residents who prefer placing the small 22-gallon bins in garages, decks, or on porches. These residents can still use 22-gallon bins for storing recycling, but they will be required to dump the contents of the bin into the larger recycling cart when having their recycling collected.

Policy Options Based Upon Experience from Other Jurisdictions

Institute a 96-Gallon Recycling Cart System and Allow Residents to use their own Trash Barrel

If Bristol is considering the adoption of an automated system, one option at the town's disposal is to furnish residents with 96-gallon recycling bins and to collect recycling once every two weeks. The communities of East Providence (Contracted), East Greenwich (Contracted), North Providence (Contracted), and Lincoln (Contracted) all adopted this style of system. The recycling rate, the trash tons, and the recycling tons were calculated both two years before and two years after these communities adopted the 96-gallon recycling cart system. We can predict on the basis of what we have learned from these communities that there likely will not be a sizeable increase in the recycling rate given that recycling increased by only 1.1%, while they experienced a reduction in the tons of trash by 0.8%. **If we apply the reduction in trash experienced in other jurisdictions having adopted the 96-gallon cart system to the 7,754 tons that are produced in Bristol, then we will assume a 0.8 percent reduction in the amount of trash that is sent to the Johnston Landfill. This amounts to a reduction of 62 tons of trash and an annual savings of \$2,916 if tipping fees remain constant at \$47/ton.**

Institute a 96-Gallon Recycling Cart System and 96-Gallon Trash Cart System

Very few communities, besides West Warwick, have instituted a 96-gallon recycling cart system alongside a 96-gallon trash cart system. The recycling rate, the trash tons, and the recycling tons were calculated both two years before and two years after West Warwick adopted the 96-gallon trash cart and 96-gallon recycling cart system. On the basis of this system West Warwick, which collects recycling every other week, increased recycling tons by 14.29% and decreased trash tons by 4.87%. **Using Bristol's 7,754 tons of trash as our baseline, we will assume that a 4.87% trash reduction in Bristol will yield a 377 ton decrease in the amount of trash**

produced. The savings experienced under this type of system will likely yield an annual savings of \$17,748 if tipping fees remain constant at \$47/ton.

Institute a 64-Gallon Trash Cart and 96-Gallon Recycling Cart System

The Town of Coventry instituted a 64-gallon trash cart and 96-gallon recycling cart system. Its implementation of the cart system differed substantially from other town systems in that both carts were collected by town workers weekly (it is more common for 96-gallon carts to be collected bi-weekly). The 64-gallon trash cart provides less capacity for trash, but the 96-gallon cart offers an additional 31 gallons of recycling capacity compared to the 64-gallon cart. This additional recycling capacity encourages recycling, while the smaller capacity of the 64-gallon trash cart encourages residents to deposit recyclables into their recycling carts. The recycling rate, the trash tons, and the recycling tons were calculated both two years before and two years after Coventry adopted the 64-gallon trash cart and 96-gallon recycling cart system. After instituting this system, the Town of Coventry saw its total tons of recycling increase by 14.64% and the total tons of trash reduced by 11.72%. **Using Bristol's 7,754 tons of trash as our baseline, we will assume that a 11.72% trash reduction in Bristol will yield a 908 ton decrease in the amount of trash reduced. The savings experienced under this type of system will likely yield an annual savings of \$42,712 if tipping fees remain constant at \$47/ton.**

Institute a 64-Gallon Recycling Cart System and Allow Residents to use their own Trash Barrel

One option is to institute a 64-gallon recycling system that will allow residents to continue using their own trash barrels. Cumberland has adopted this type of system with success, although it is different from Bristol in that the town employs a contractor to collect recycling. The recycling rate, the trash tons, and the recycling tons were calculated both two years before and two years after Cumberland adopted the 64-gallon cart recycling system. After adopting this system, Cumberland reduced trash tons by 12% and saw its recycling tons increase by 19%. **If we assume that Bristol will share the same experience as Cumberland by adopting a 64-gallon recycling system, while also allowing residents to furnish their own trash barrels, then we can expect the tons of trash in Bristol to be reduced by 930 tons and an annual approximate tipping fee savings of \$43,732.56 if tipping fees remain constant at \$47/ton.**

Institute a 64-Gallon Recycling Cart and 64-Gallon Trash Cart System⁶

Another option for the Town of Bristol is to institute a 64/64-gallon recycling and trash cart system. In Resource Recovery's calculations of the recycling rate, the trash tons, and the recycling tons both two years before and two years after each of Rhode Island's communities adopted the 64/64-gallon cart systems yielded a recycling tonnage increase of 8.08% and a trash tonnage reduction of 13.99%. If we use the experience of other Rhode Island jurisdictions as a guide to predict what may happen in Bristol by adopting a 64/64-gallon system, then we might expect that Bristol recycling tonnage will increase by approximately 8.08%, while trash tonnage will be reduced by approximately 13.99%. If we base our predictions on Bristol's Calendar Year 2017 recycling and trash figures (2,320 tons recycling and 7,754 tons trash), then a 8.08% increase in recycling tons yields an absolute total of approximately 187 additional

recycling tons, while a 13.99% decrease in trash tons yields an absolute total of approximately 1,085 reduced tons of trash. **If we assume that Bristol will share the same experience as these communities adopting the 64/64 cart systems, then we can expect the tons of trash in Bristol to be reduced by 1,085 tons and an annual approximate tipping fee savings of \$50,985 if tipping fees remain constant at \$47/ton.**

Recommendation and Summary

A summary of our results is contained in Table 1, where we have approximated the potential savings of moving toward a 64-gallon or a 96-gallon recycling system. Our analysis demonstrates that Rhode Island communities adopting a cart-based, automated recycling system unequivocally experience a significant amount of trash reduction, which leads to lower expenditures on tipping fees. The front-end costs of purchasing carts represent the most significant costs when considering an automated trash and recycling collection system, but when those costs are spread over the lifetime of the cart it becomes clearer that the tipping fee savings and operating cost savings offset the cost of purchasing the carts. Our recommendation for the Town of Bristol follows.

If the experience of other Rhode Island communities is considered, the 64/64 cart recycling and trash system is the most effective way of reducing the amount of trash produced and sent to the Johnston Landfill, but it is not the most cost-effective approach to reforming the recycling program. If the primary value is on reducing the amount of trash tons, while also saving on operating costs, then the policy option that has been adopted by Coventry - the adoption of a 64-gallon trash and 95-gallon recycling cart - may be the best option. Our calculations assume that this type of system will yield an annual savings of approximately \$66,712, while having an approximate annual cost of \$77,250. Within three to five years, the Town of Bristol can expect additional savings to accrue when it begins reducing its workers compensation experience rate. This type of system reduces the amount of trash produced at a significant rate, while also decreasing the operating costs associated with weekly recycling collection. We recommend that Bristol explore the possibility of adopting a 64/95 cart system similar to the one adopted by Coventry, with one modification. While Coventry instituted weekly pick-up of both recycling and trash, we recommend that Bristol consider the bi-weekly collection of recycling in order to experience the savings of reducing recycling collection by fifty percent. By reducing the collection of recycling by fifty percent, there will be the added long-term savings of doubling the life of recycling collection trucks. There are also a number of other non-measurable benefits to consider. The adoption of a lidded trash and recycling system will have public health benefits by preventing animals from reaching the contents of the containers. There is also the added benefit of the lidded carts preventing trash and recycling from littering the town and the bodies of water surrounding the town on windy days. It will also be more convenient for Bristol residents, including the less mobile and the elderly, to wheel trash and recycling carts curbside and minimizing the number of trips required to do so. Finally, there is the added benefit of saving on fuel and maintenance, maximizing the lifetime of recycling trucks, and improving the working conditions of DPW employees.

The adoption of the 64-gallon trash system will encourage better recycling habits among Bristol residents, although there will likely be resistance among residents who will have less room for trash. One option, not considered here, is to adopt a hybrid system whereby residents are furnished 64 gallons of weekly trash collection, 95 gallons of bi-weekly recycling collection, and the option of purchasing “Pay-As-You-Throw” trash bags for any additional trash items that do not fit in the 64-gallon trash cart.

Table 1: Approximate Costs of Recycling Program			
	FY 2017 Status Quo (Recycling Weekly)	64-Gallon System (Recycling Weekly)	95-Gallon System (Recycling Bi-Weekly)
Annual Fuel, Insurance, Maintenance	\$48,000 (Recycling Only)	\$48,000 (Recycling Only)	\$24,000 (Assumes reduction of 50% due to bi-weekly collection)
Additional Cost for Mechanical Arm	\$0	\$60,000 (\$12,000 annual over five year life of equipment)	\$60,000 (\$6,000 annual over ten year life of equipment)
Annual Workers Comp (Recycling = 21.6% workers compensation premium)	\$24,740	\$4,948 (80% reduction)	\$2,474 (\$4,948 x .5)
Recycling Carts with 18 year warranty	\$0	\$617,500 (64-Gal Recycling Only) (\$34,306 annual over 18 years) \$1,235,000 (64/64) (\$68,611 annual over 18 years)	\$665,000 (95-Gal Recycling Only) (\$36,944 annual over 18 years) \$1,282,500 (64/95) (\$71,250 annual over 18 years) \$1,330,000 (95/95) (\$73,889 annual over 18 years)
Tipping Fees @ \$47/ton assuming 7,754 tons	\$364,438	\$320,706 - \$313,443 (~\$43,732.56- \$50,995 annual savings)	\$361,522 - \$321,726 (~\$2,916 - \$42,712 annual savings)
		Approximate Annual Savings: \$43,732 (64) \$50,995 (64/64) (Note: Savings do not	Approximate Annual Savings: \$26,916 (95) \$41,748 (95/95) \$66,712 (64/95) ⁷

⁷ Coventry instituted weekly collection of both trash and recycling under its 64/95 barrel system. Therefore, it is possible that bi-weekly collection of 95-gallon recycling carts may not reduce trash tons at the same rate as the weekly collection of 95-gallon recycling carts.

		<p>include additional benefits of reduced Workers Comp for trash/recycling)</p> <p>Approximate Annual Costs: \$46,306 (64-Gallon Recycling Only) \$80,611 (64/64)</p> <p>(Note: Costs do not include mechanical arm for trash trucks; add approximately \$12,000 annual)</p>	<p>(Note: Savings do not include additional benefits of reduced Workers Comp for trash/recycling)</p> <p>Approximate Annual Costs: \$42,944 (95-Gallon Recycling Only) \$79,889 (95/95) \$77,250 (64/95)</p> <p>(Note: Costs do not include mechanical arm for trash trucks; add approximately \$12,000 annual)</p>
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APPENDIX A

Study Methodology

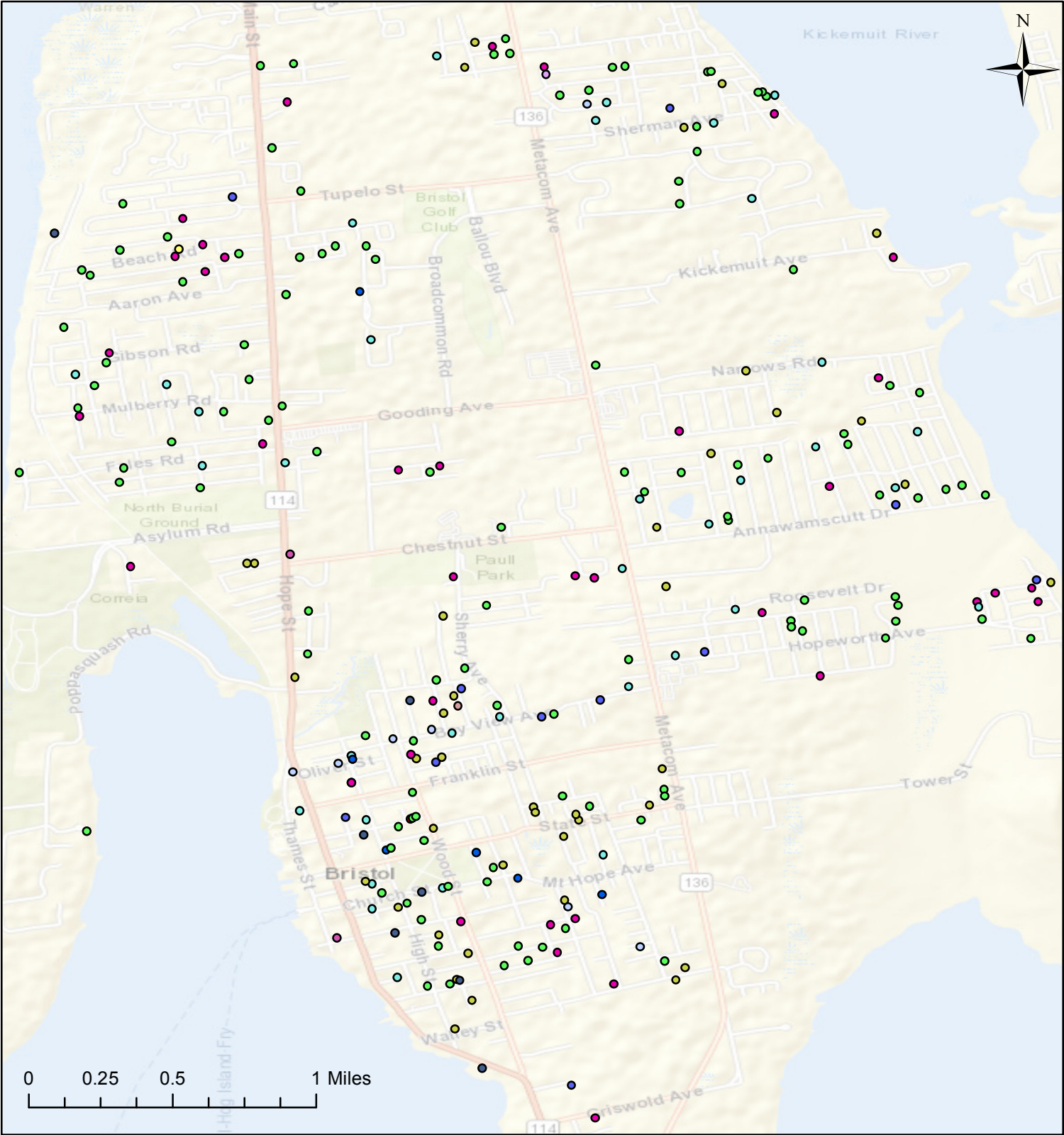
In October 2017, we designed a unique recycling study to learn more about the rate at which Bristol residents recycle and to determine if any geographical patterns exist relating to the rate of recycling. In order to conduct the study, we drew a simple random sample of 373 Bristol residences. The residences were sorted into lists that corresponded with the day on which recycling is collected at that residence. For each recycling route, a volunteer was sent in the morning to each of the respective addresses to collect data on the number of recycling bins that were curbside, the sizes of the bins that were curbside, and whether the bins were full or not. One lead investigator and one study participant conducted a pilot data collection effort on Oct. 9 in anticipation of issues arising during data collection and modified the data collection instruments on the basis of the pilot study. That same week, study participants were trained to collect data and the next week of October 16-20 was dedicated to data collection. This week was chosen because it was a “typical week” where no holidays existed and we could reasonably assume that it is a typical recycling week (e.g., a week during the Fourth of July will yield more recycling than is normal). By choosing a “typical week” to conduct our study, we are confident that we have identified a baseline by which to judge non-typical recycling weeks (e.g., holidays, festivals, etc.).

There are both strengths and weaknesses of our study. One strength is the precision by which we are able to learn the rate of recycling, the location of recycling, and the capacity that Bristol residents already have to recycle. In many other jurisdictions, learning the rate and location density of recycling would be impossible because it would require those collecting data to examine the inside of recycling carts by lifting the lids. Because Bristol’s bins are lidless, we were able to observe whether or not the recycling bins were full, which allowed us to approximate the extent to which residents with their recycling curbside had enough capacity to recycle. Like any study, we are deeply aware of limitations to the data collected by our volunteers. For instance, not all residences placed recycling curbside by the time our volunteers arrived to collect data. There are a multitude of reasons why these residents did not have recycling or trash receptacles curbside. These residents may have been away on vacation, the house may have been vacant, or the resident may have waited until later in the day to place recycling curbside. Of our 373 residences sampled, 105 residences did not have recycling curbside which averages to be about fifteen residences per recycling route through our data collection. From the remaining 268 residences, however, we were able to draw some conclusions about the rate of recycling in Bristol.

The utility of our data will likely be more useful at a future date when we can examine the impact of policy interventions, such as marketing efforts, to improve Bristol’s recycling rate. We will be able to do this by collecting another round of data after the policy intervention has occurred and examining the impact it has had on the recycling behavior of Bristol residents.

Total Capacity of Recycling in Bristol, RI

Created by: Devina S. Thakur | URI Graduate Student



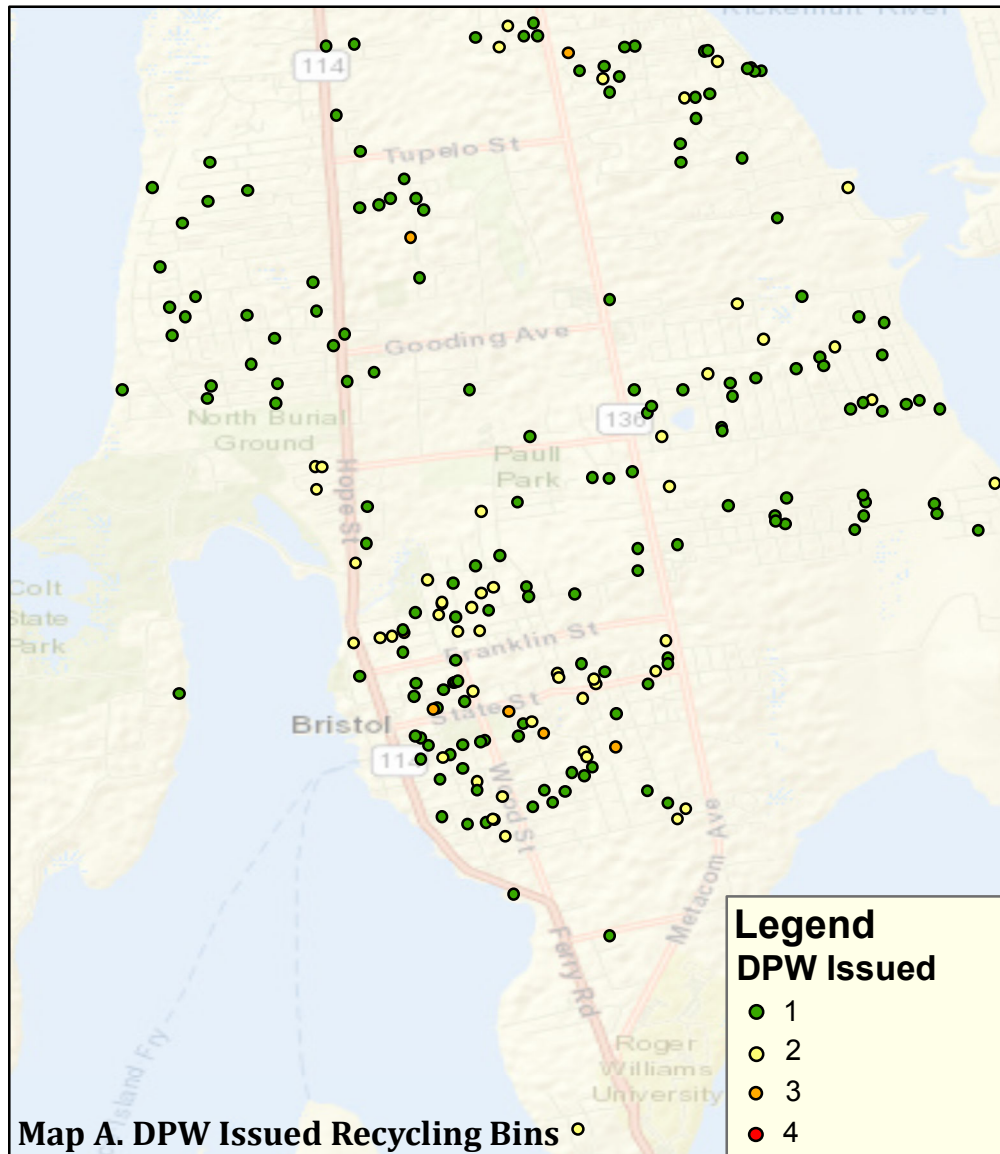
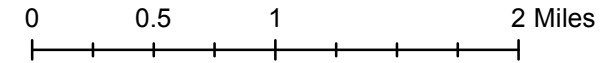
Legend

16	22	32	38	44	54	60	64	66	76	82	88
----	----	----	----	----	----	----	----	----	----	----	----

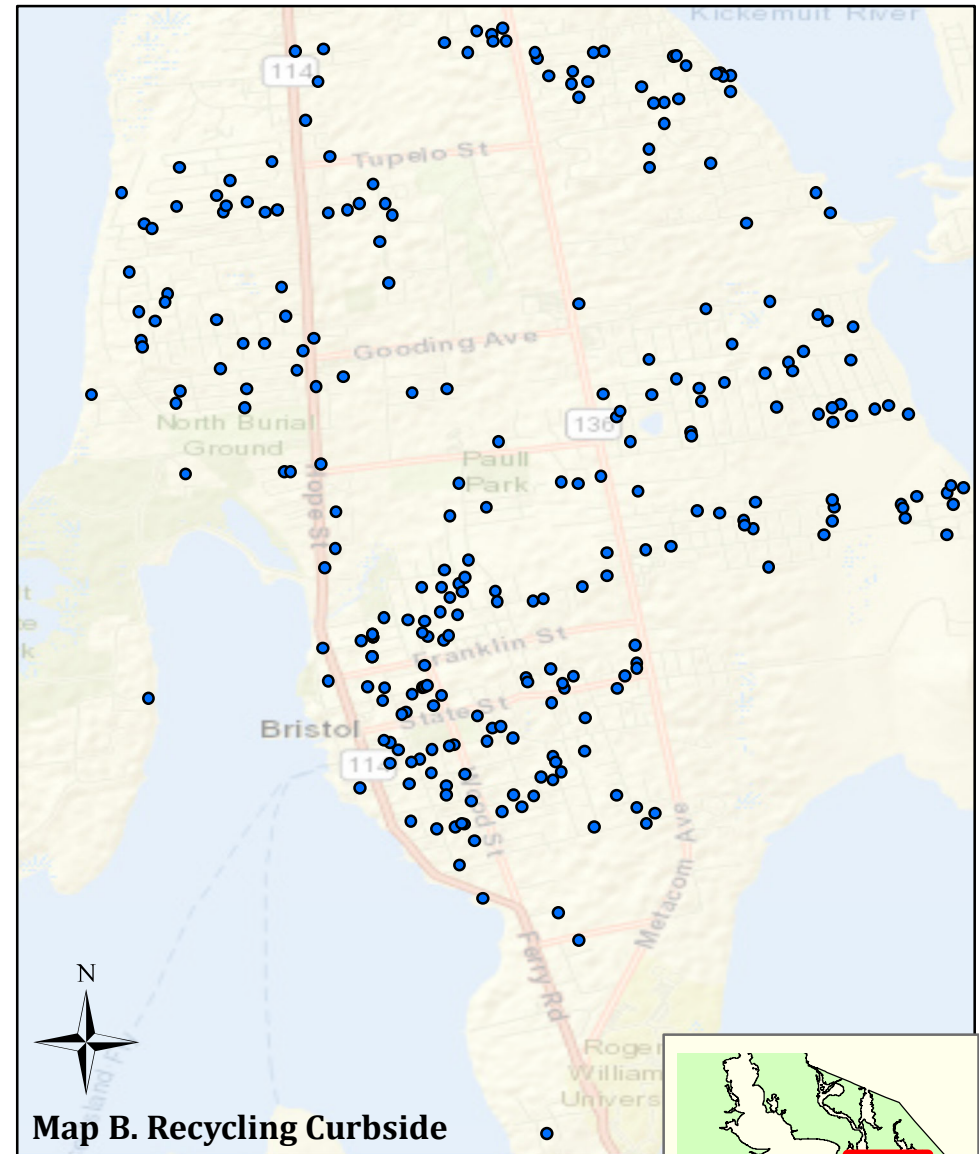
This map represents the capacity that each residence is recycling which ranges from 16 gallons to 88 gallons. This was concluded by adding the sum of a maximum of four recycling bins.

Town of Bristol, Rhode Island Recycling

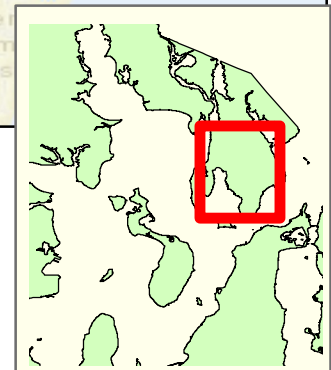
Created by: Devina S. Thakur | URI Graduate Student



Map A. DPW Issued Recycling Bins. This map represents the amount of 22-gallon bins that have been issued by the Town of Bristol's Department of Public Works (DPW).

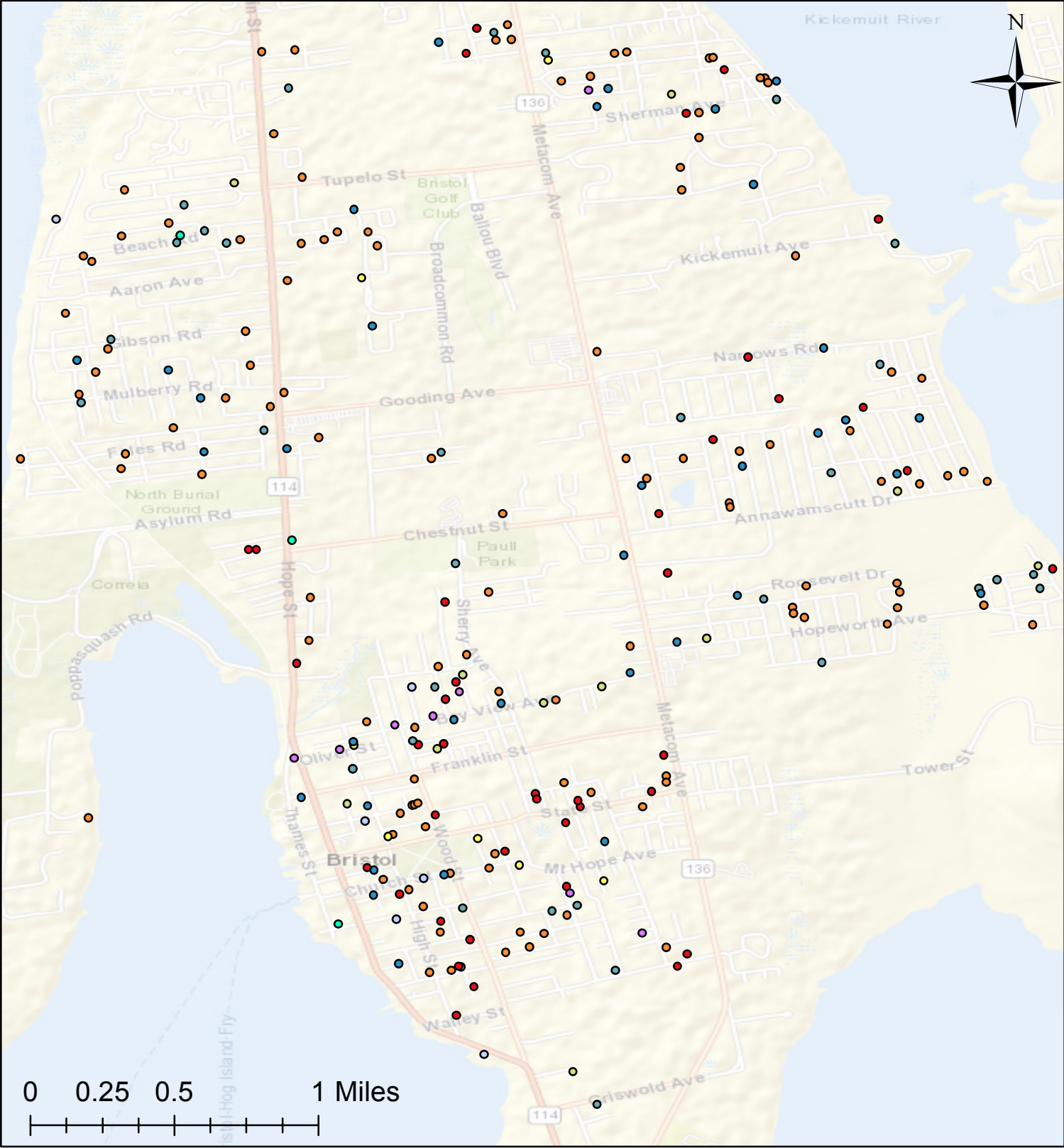


Map B. Recycling Curbside. This map represents the total amount of recycling being done in the town of Bristol consisting of both the 22-gallon and 16-gallon bins.



Total Recycling Bin Collection

Created by: Devina S. Thakur | URI Graduate Student



Legend

- 16
- 16, 16
- 16, 16, 16

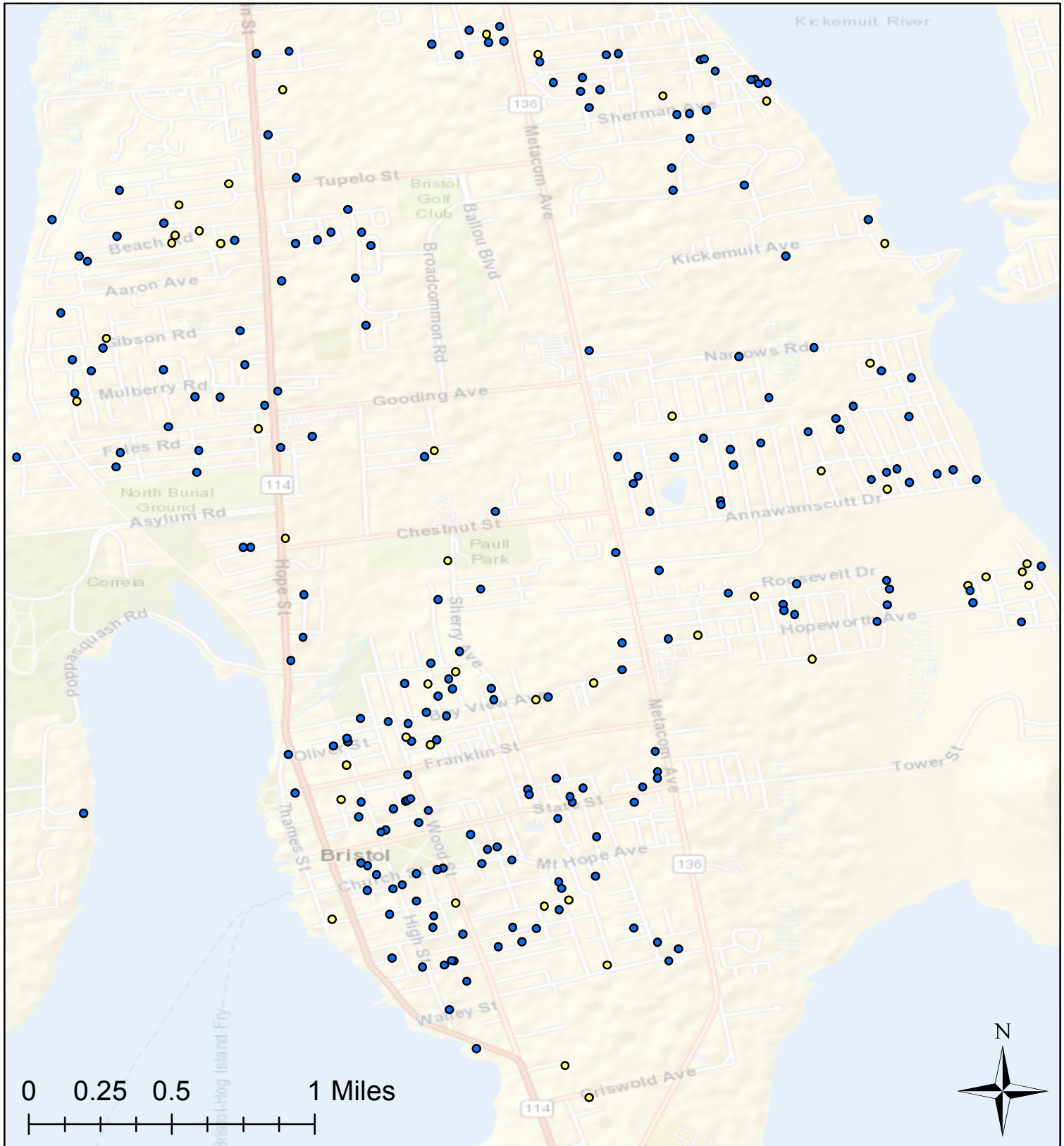
- 22
- 22, 22
- 22, 22, 22
- 22, 16

- 22, 22, 16
- 22, 16, 16

This map represents the total data collection of recycling bins. This is represented by what house has multiple bins as well as what size recycling bins each house has.

16-Gallon vs 22-Gallon Recycling Bin

Created by: Devina S. Thakur | URI Graduate Student



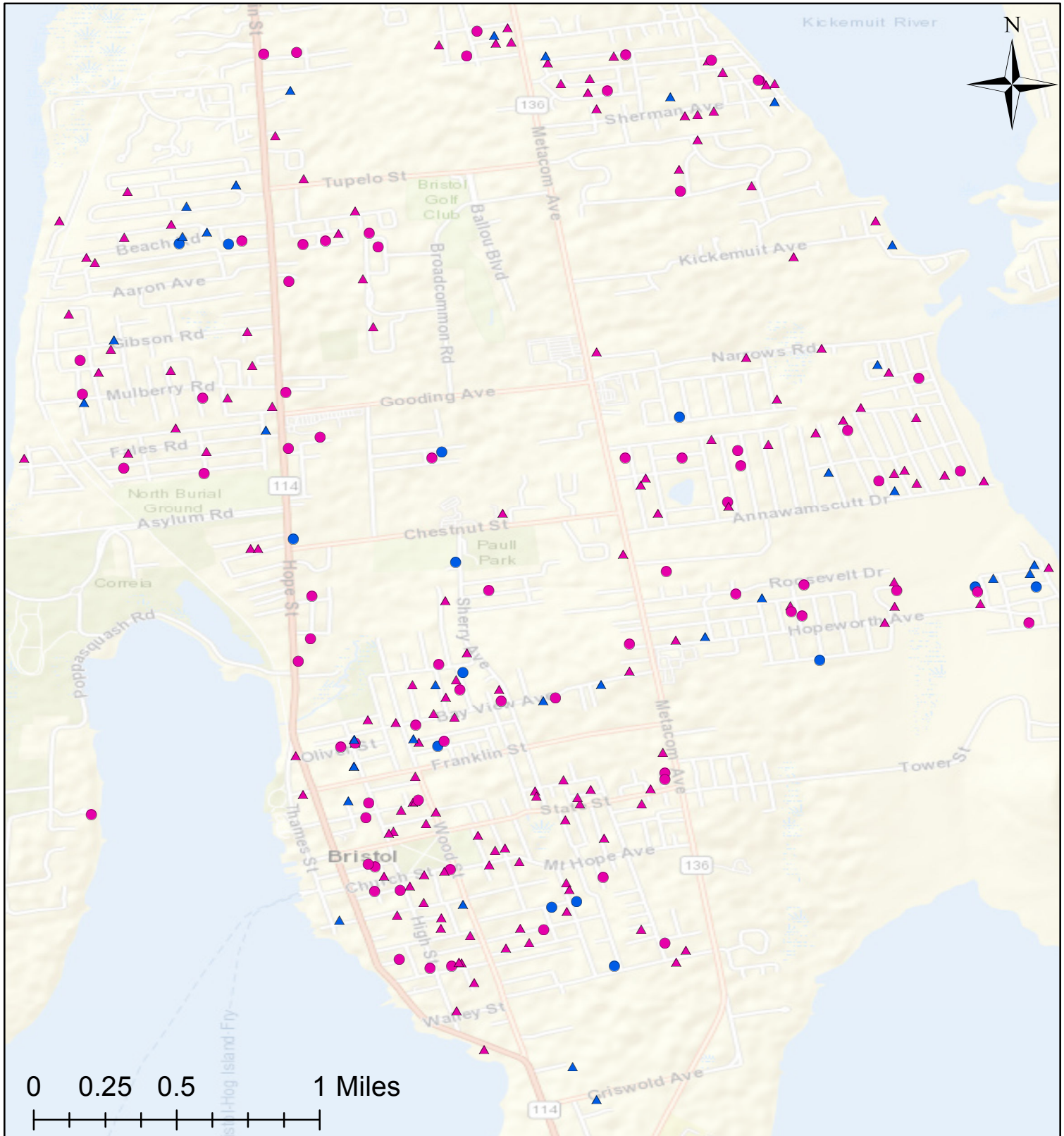
This map represents the amount of 16-gallon recycling bins that are being used compared to a 22-gallon recycling bin. Based on the data, Bristol residents are using the DPW issued 22-gallon bin.

Legend

- 16
- 22

Bin 1: Size and Capacity

Created by: Devina S. Thakur | URI Graduate Student



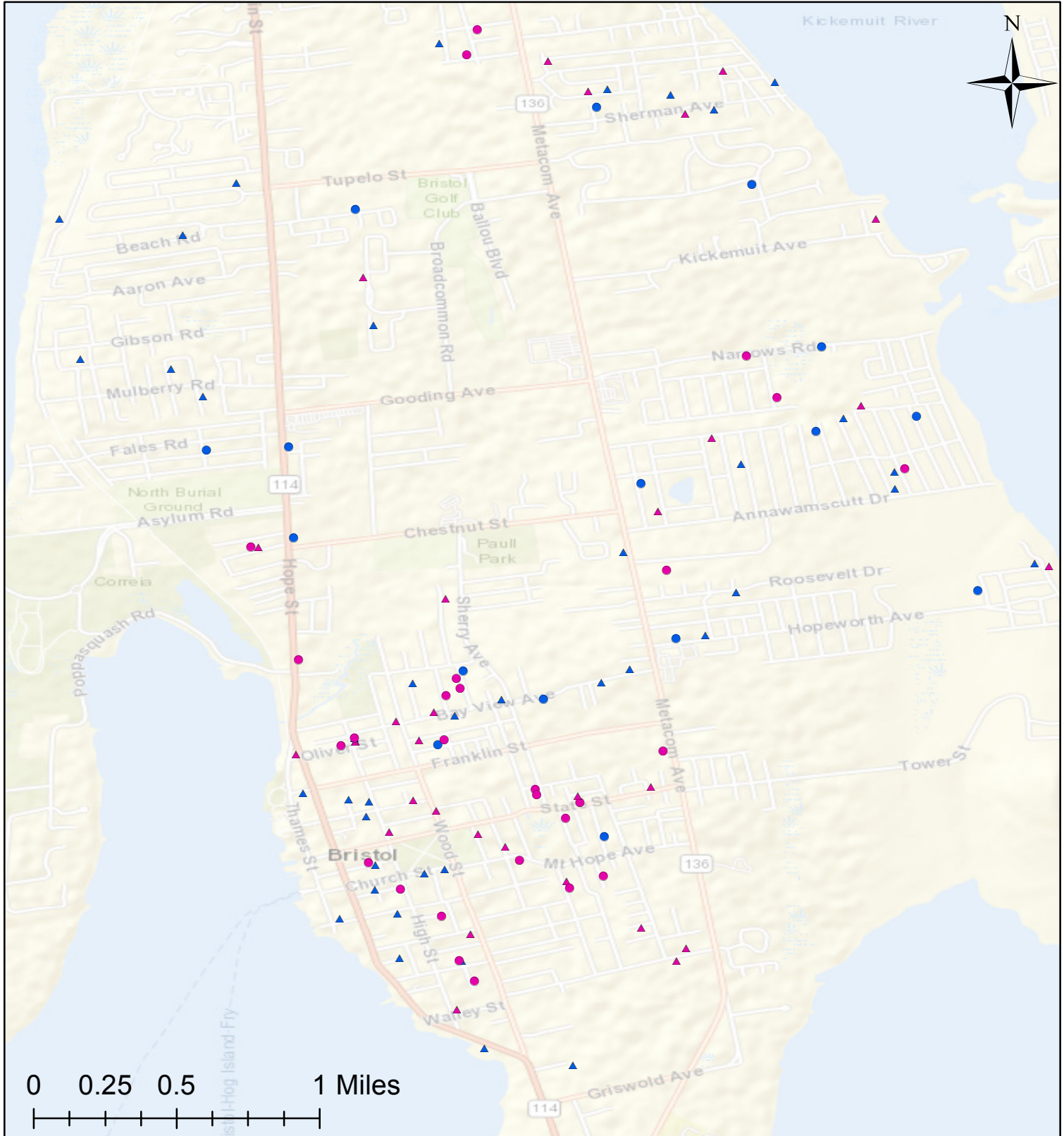
Legend

- ▲ 22, Full
- 22, Not Full
- 16, Not Full
- ▲ 16, Full

This map represents the summary of bin 1 in surveying the data. Represented is the size of the bin (22 vs. 16) as well as the bin capacity (not full vs. full).

Bin 2: Size and Capacity

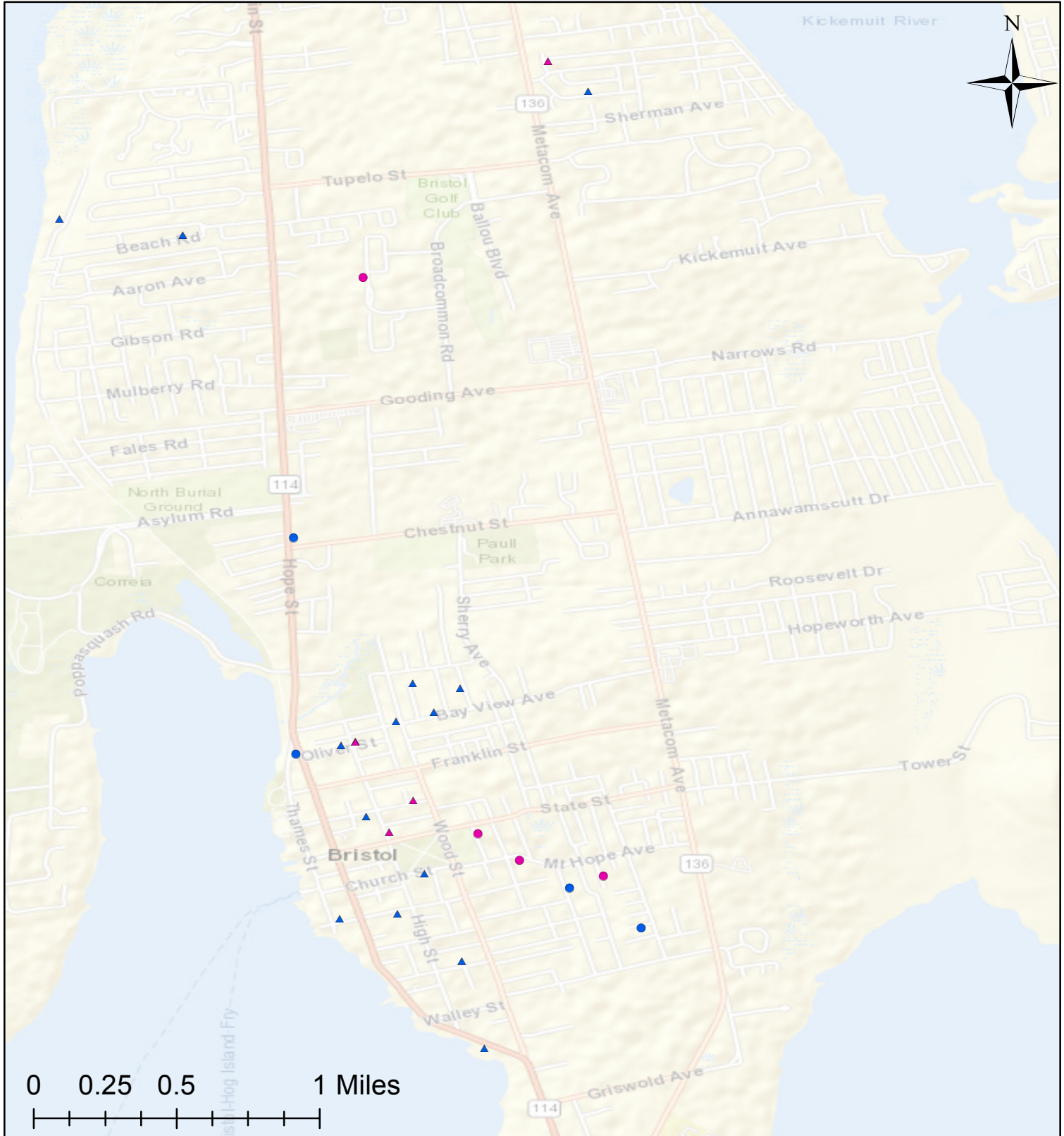
Created by: Devina S. Thakur | URI Graduate Student



This map represents the summary of bin 2 in surveying the data. Represented is the size of the bin (22 vs. 16) as well as the bin capacity (not full vs. full).

Bin 3: Size and Capacity

Created by: Devina S. Thakur | URI Graduate Student



Legend

- ▲ 22, Full
- 22, Not Full
- 16, Not Full
- ▲ 16, Full

This map represents the summary of bin 3 in surveying the data. Represented is the size of the bin (22 vs. 16) as well as the bin capacity (not full vs. full).

Bin 4: Size and Capacity

Created by: Devina S. Thakur | URI Graduate Student



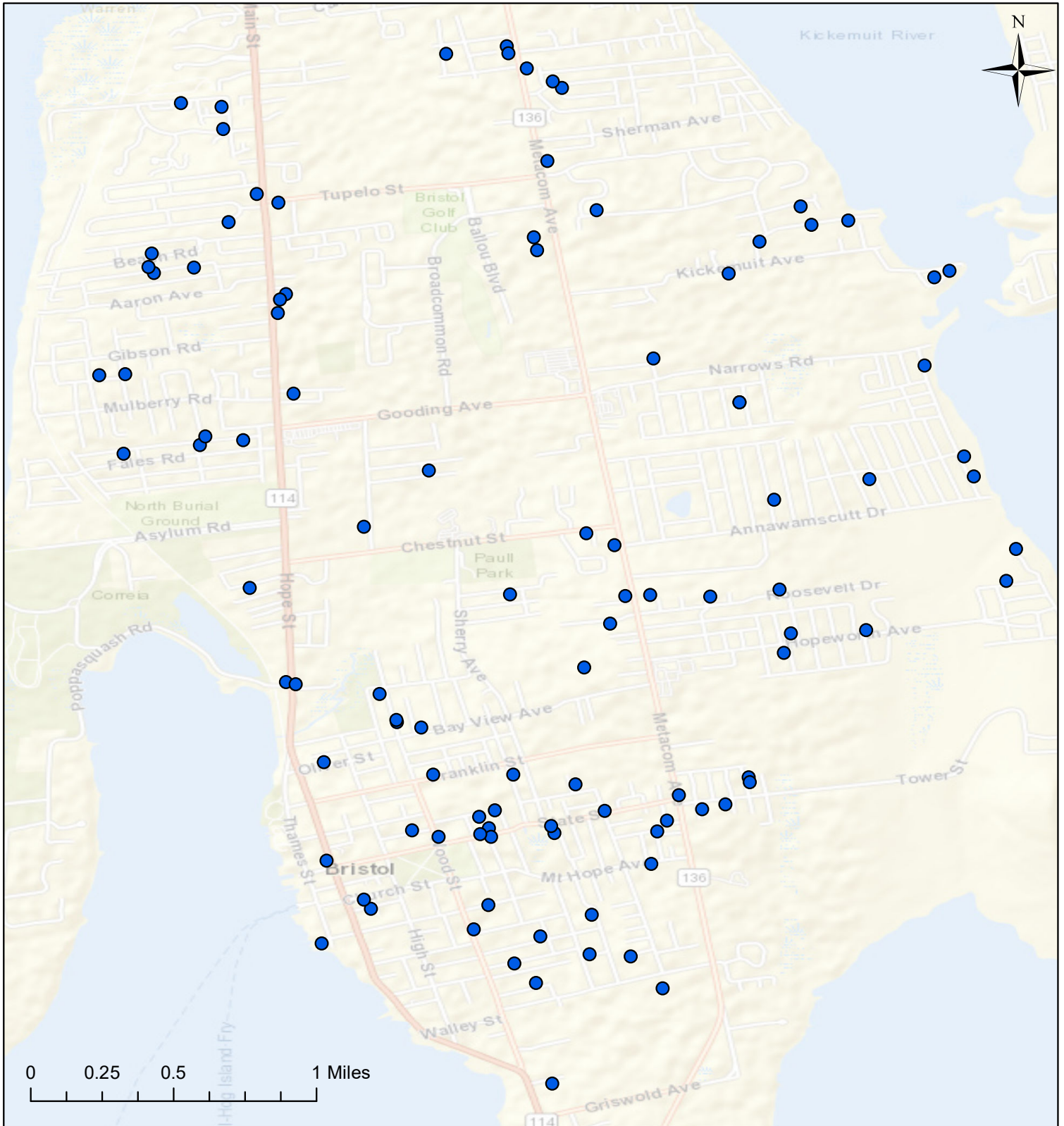
Legend

- ▲ 22, Full
- 22, Not Full
- 16, Not Full
- ▲ 16, Full

This map represents the summary of bin 4 in surveying the data. Represented is the size of the bin (22 vs. 16) as well as the bin capacity (not full vs. full).

No Curbside Recycling in Bristol, RI

Created by: Devina S. Thakur | URI Graduate Student



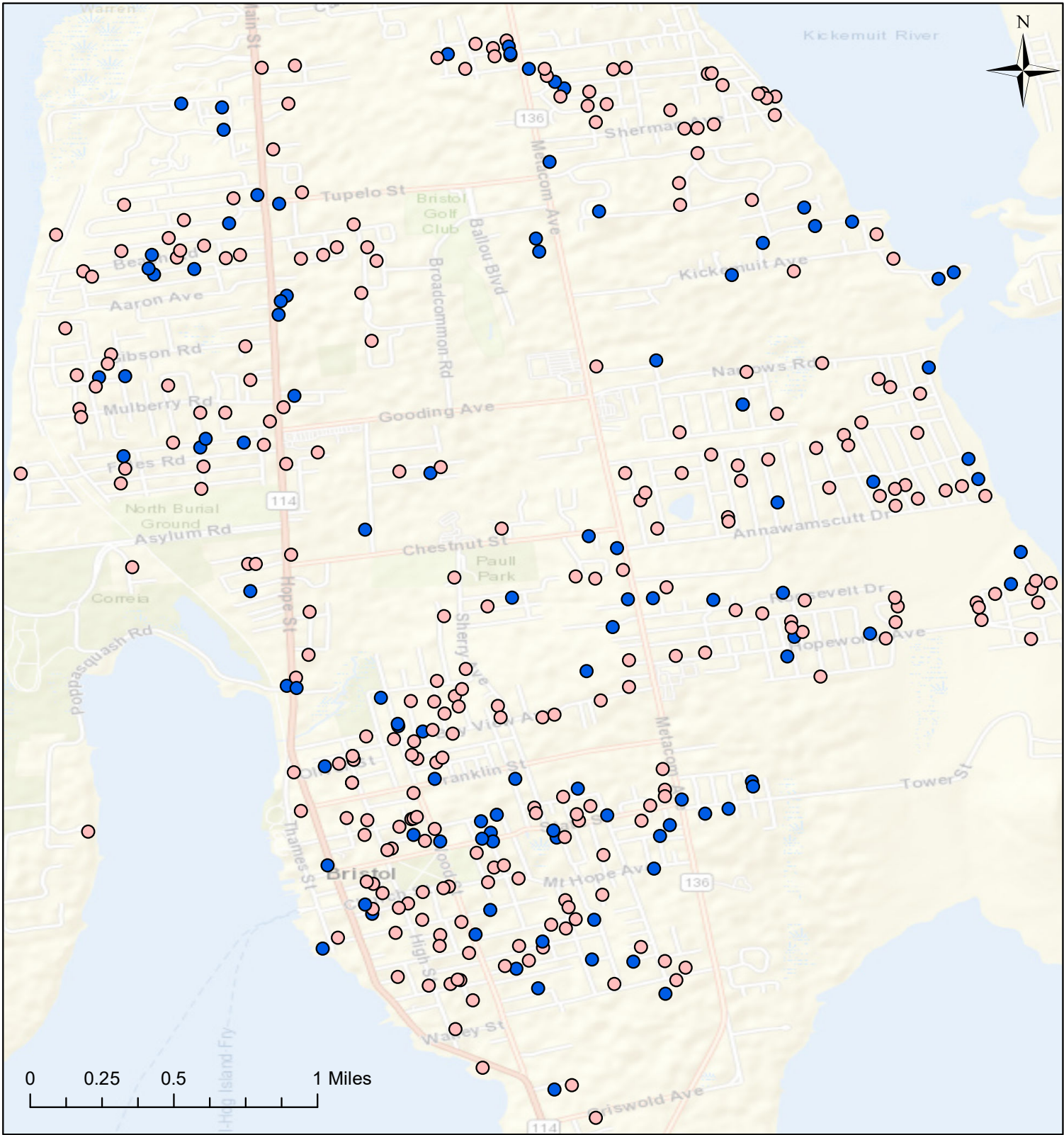
Legend

- No Curbside Recycling

This map represents no curbside recycling in the town of Bristol, Rhode Island. This is represented by whether or not recycling bins were surveyed and classified as no curbside recycling or yes curbside recycling.

Curbside Comparison of Recycling in Bristol, RI

Created by: Devina S. Thakur | URI Graduate Student



Legend

- No Curbside Recycling
- Yes Curbside Recycling

This map represents the total curbside recycling for each residence in the town of Bristol, Rhode Island. This is represented by whether or not recycling bins were surveyed and classified as no curbside recycling or yes curbside recycling.