

**Somerville's Green Infrastructure Project**  
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**Tufts University**  
**Tisch Scholar**

**Abstract**

The purpose of this report is to document the findings of Malek Al-Chalabi's Tisch College Scholar Project in collaboration with Groundwork Somerville. The purpose of his project was the following:

- 1) Research previous energy conserving initiatives in Somerville
- 2) Research "green" initiatives that have taken place domestically and internationally  
Note: We define "green" as a mechanism that decreases carbon demand or improves quality of life
- 3) Propose recommendations to City Hall to make Somerville a more energy efficient city based on what has worked in Somerville before and what has worked effectively in other areas

One important fact to consider is that members of City Hall, active members of the Somerville community, local residents, members of the Tufts faculty, and local non profits were all integral parts of the research. Their feedback was critical for the development of this project. After collaborating with these members, the research was focused on three areas, which was: air quality, open space, and storm water management. This report will highlight what Somerville has done in the past, what Somerville is currently doing, and recommend what Somerville could do in the future. Feedback from the community, the environmental impacts, the economical aspect, as well as the feasibility of the recommendations was an integral part of the project. The findings were to plant more trees, install green roofs, and install permeable pavements. If you have any questions on concerns, feel free to contact Malek Al-Chalabi at [malekalc@gmail.com](mailto:malekalc@gmail.com)

**Community Members interviewed (\*potential working group for Green Infrastructure planning)**

- Mayor Joseph A. Curtatone, City of Somerville
- Vanessa Rule, Somerville Climate Action\*
- Vithal Deshpande, Environmental Services, City of Somerville\*
- Peter Mills, previous Environmental Services Coordinator, City of Somerville
- Nancy Bernhard, GWS Board member\*
- Peter Kwass, GWS Board member
- Lisa Brukilacchio, Director Somerville Community Health Agenda\*
- Meridith Levy, Director of Organizing, Somerville Community Corporation
- Jeff Fullerton, Owner, Geothermal House\*
- Charlie O'Brien, Engineer, City of Somerville
- Jackie Rossetti, City of Somerville
- Mary Beth Duchant, Director, Mystic River Watershed Association
- Jennifer Lawrence, Director, GWS
- Ellin Reisner, President, Somerville Transportation Equity Partnership
- Wig Zamore, Consultant, transportation expert\*
- Steve Winslow, Senior Planner, City of Somerville

- Arn Franzen, Director, Parks and Open Space, City of Somerville
- Ellen Schneider, Parks and Open Space, City of Somerville

## Air Quality in Somerville

### Background

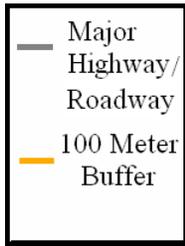
According to the Somerville Transportation Equity Partnership, Somerville has the “second greatest exposure to pollution and the least open space in Massachusetts” (“Did You Know?”). Somerville is also the most densely populated city in New England, as well as the sixth most densely populated city in the United States.

Somerville also has “the most excess lung cancer and heart attack deaths per square mile of any of Massachusetts' 350 cities and towns,” and there is growing concern about the quality of air in Somerville (“Did You Know?”). Studies have shown that living next to a highway may be detrimental to your health, and research studies support this. Wig Zamore, 2007 New England EPA Environmental Merit Award Winner and active member of the Somerville community, wrote “I believe that exposures within 1 kilometer, and especially those within several 100 meters of large sources, such as highways, *may* represent 50% of all PM related mortality in the US” (Zamore).

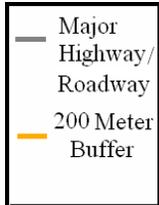
Where are all the highways/major road ways located in Somerville, and how far could the pollution potentially travel? Below is map that was created using Geographic Imaging Systems (GIS) to show where all the highways/major roadways are:



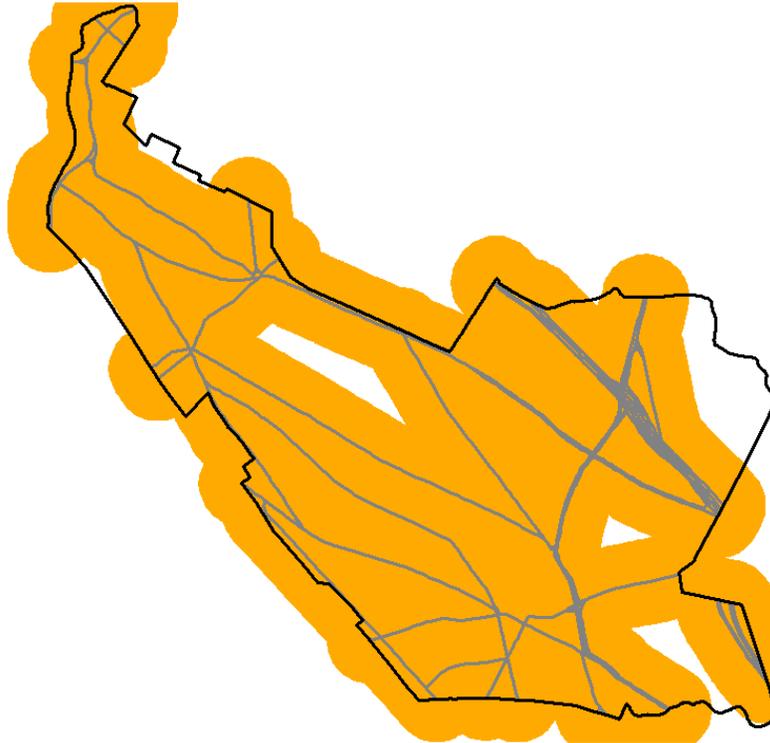
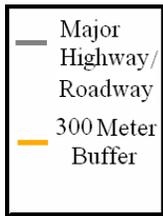
Then, a 100 meter buffer was created from all the highways/major roadways to see how far the air pollution could travel:



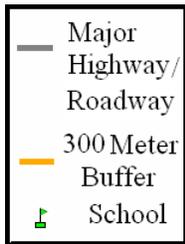
Next, a 200 meter buffer was created to see how far the air pollution could travel.



Finally, a 300 meter buffer was created to see how far the air pollution could travel.



As depicted above, most of Somerville is within a three hundred meter boundary of all highways/major road ways. Where are the schools in Somerville? The figure below depicts all the schools within the 300 meter buffer:



As depicted above, all of our schools are located within the three hundred meter buffer with the exception of one school, which is important to recognize.

### *Initiatives*

What methods can be used to improve the quality of air in Somerville? After conducting a local literature review trying to tackle this very question, three methods were constantly brought up. The first method was tree planting, and this was supported by the State Action Plan Database, the 2001 Greenhouse Gas Emission Inventory Report, and Sustainable Somerville. The second method was to enforce the anti-idling law, and this was supported by the Climate Action Plan, Sustainable Somerville, and the Greenhouse Gas Emissions Inventory Report. The final method was to promote the use of public transportation, and this was supported by the State Action Plan Database, the Climate Action Plan, and the Greenhouse Gas Emission Inventory Report. After collaborating with members of the community, the method that was chosen for this particular report was tree planting because of its importance, its feasibility, and its need in Somerville.

How effective are trees in combating air pollution, and what does the scientific literature state? One relevant study to this question is entitled “Effective Tree Species for Local Air Quality Management,” written by K.P. Beckett, P.H. Freer-Smith, and G. Taylor. The findings of the study found that “trees can capture significant quantities of health damaging particles from the atmosphere” (Beckett et al 18). Therefore, there is a public health incentive to plant more trees in Somerville to improve the air quality.

But have there been any studies that analyze the economic viability of having a large scale tree planting initiative to improve the air quality?

Santiago, Chile has the worst urban air pollution in Latin America. A study, entitled “Analyzing the cost effectiveness of Santiago, Chile's policy of using urban forests to improve air quality,” focused on the effectiveness of trees to improve air quality in Santiago Chile, and whether trees are an economically viable option. The findings were

“The results from this study indicate that in the case of Santiago, Chile urban forests are a cost-effective air quality improvement policy. That said, even if urban forests were not cost effective, urban trees can provide additional environmental benefits, for example, in their potential to sequester carbon and modify climate” (Escobedo 155).

The research shows that in the case of Santiago, Chile, trees are an effective method to counter the effects of air pollution. But can the same be stated about Somerville?

In “Developing an Innovative Model for Cost Effective Asset Management and Pollution Prevention in a Municipal Storm Water System,” the value of trees was found in terms of air pollution and storm water value. Below is a table from that study that shows the certain values (Page 21):

<b>Somerville Neighborhood</b>	<b>Acres</b>	<b>% Trees</b>	<b>% Impervious</b>	<b>Air Pollution lbs</b>	<b>Air Pollution Value (\$)</b>	<b>Retention Volume</b>	<b>Storm Water Value (\$)</b>	<b>Total Value (\$)</b>
Central Hill	58.1	25.6	66.1	1,345	3,305	95,170	190,339	199,856
Davis Square	201	22.1	70.3	4,009	9,854	307,916	615,832	923,748
East Somerville	471.8	10.6	71.4	10,172	24,998	652,545	1,305,089	1,957,634

Magoun, Albion	143.1	21.3	71.1	2,834	6,966	242,612	485,224	727,836
Powderhouse	118.6	23.6	67.4	2,522	6,198	194,161	388,322	582,483
Prospect Hill	123.2	21.9	70.4	2,443	6,003	188,718	377,437	566,155
Spring Hill	225.8	23.7	68	4,840	11,897	369,762	739,524	1,109,286
Ten Hills	231.5	19.7	69.3	3,627	11,897	367,307	734,613	1,101,920
Tufts	143.8	30.5	55	3,952	9,713	262,843	525,687	788,530
Ward2 Cobble Hill	571.6	9.6	85.7	5,045	12,400	790,565	1,581,130	2,371,695
West Somerville	224.7	25.3	66.4	5,163	12,689	367,983	735,965	1,103,948
Winter Hill	206.3	18.8	73.8	2,338	8,686	292,187	584,374	876,561
Somerville	2719.5	18	72.7	50,689	124,580	4,315,039	8,630,078	12,945,117

An interesting finding from the report was the following:

“The total computed benefit of trees in Somerville including both air pollution and storm water is \$12,945,117. This value is even higher than the amount the city pays the MWRA (Massachusetts Water Resource Authority) in annual water treatment (\$11.5 million)” (Deshpande 20).

Trees in Somerville play an important role in terms of storm water management and air pollution. They can effectively counter the negative effects of air pollution, and also improve the local storm water management. Planting more trees is a critical need for the community.

When more trees are planted in a community, then indirectly, there is a need for more open space. The next phase of this report focuses on the amount of open space in Somerville.

### **Open Space in Somerville**

According to the 2008-2013 Consolidate Plan, Somerville has 49 parks. In the fall of 2007, Somerville had two new parks, which were Allen Street Community Garden and Durrell Pocket Park and Community Garden, and there were improvements in Foss Park, which is Somerville’s largest park (Fox). It is important to note that members of City Hall continue to work hard to improve the amount of open space in Somerville.

However, because of the high population density, large amounts of concrete, and lack of open space, Somerville is prone to the “heat island effect,” where there are “higher temperatures experienced in urban areas compared with surrounding suburbs” (“Local Action Plan Recommendations: Somerville, Massachusetts”). When there are higher temperatures, more resources are being inputted to pay for the cooling of buildings.

What are other cities doing to counter balance the “heat island effect,” and what can Somerville do?

A study by Akhbari and other scientists entitled “Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas” noted that the city of Los Angeles has increased 2.5 Degrees Celsius (5 Degrees Fahrenheit) since 1920 (Akhbari). Because of this increased temperatures, “5-10% of current urban electricity demand is spent to cool buildings just to compensate for the increased...temperatures” (Akhbari). The “heat island effect” then causes cities to pay more for cooling. What are cities doing to counterbalance the “heat island effect?”

Locally, the Environmental Protection Agency (EPA) recommended for the city of Cambridge in Massachusetts to use “tree canopies” (“Local Action Plan Recommendations:

Cambridge, MA”). The use of tree canopies not only helps counter balance the “heat island effect,” but also “sequesters carbon, reduces gasoline evaporation from parked motor vehicles, and makes the city more visually attractive” (“Local Action Plan Recommendations: Cambridge, MA”).

In the city of Los Angeles, Akhbari and other scientists stated that an effective ways to reduce the “heat island effect” was to plant more trees, and another method was to have reflective roofs. When a roof has a light color, which reflects light/heat, it can reduce the impact of the “heat island effect” compared to a city that has a dark roof, which absorbs heat and increases the heat island effect. In the study, the scientists noted that “the direct effect of planting trees around a building... is to alter the energy balance and cooling requirements of that particular building” (Akhbari 296). Also, the scientists noted that “about 20% of the national cooling demand can be avoided through a large-scale implementation of heat-island mitigation measures [reflective roofs/trees]” (Akhbari 308). Therefore, their findings reinforce the idea that tree planting, along with reflective roofs, are effective measures to counter balance the heat island effect.

Internationally, there are similar findings. A study entitled “Energy Effects of Heat-Island Reduction Strategies in Toronto” found that planting trees in designated areas could substantially reduce cooling bills because of the shading. The important part of effective cooling is the location of the tree. The findings found that the city of Toronto could save up to 11 million dollars per year if trees were planted all over the city in designated locations (Konopacki).

Locally, nationally, and internationally, we have seen that the planting of trees in designated areas not only improves air quality, but also counterbalances the “heat island effect.” However, when calling for the planting of more trees, then one is calling for more open space. Are there any potential measures that could reduce the “heat island effect” and improve air quality without changing the current status of our infrastructure? The answer to that question is green roofs.

## **Green Roofs**

Green roofs are important because they help decrease heating and cooling within a building, they make a city more attractive, and are easy to maintain. Initiatives to build green roofs have been supported by the Climate Action Plan (page 41) and the EPA’s Location Action Plan Recommendations to the city of Somerville. However, many question the economic value of green roofs.

An international study in Singapore entitled “Life cycle cost analysis of rooftop gardens in Singapore” found that in the case of Singapore, green roofs were a viable option. The finding was that “it is observed that life cycle costs of extensive green roofs with or without consideration for energy costs, are lower than that of exposed flat roofs, despite its higher initial costs” (Wong 499).

Domestically, researchers from the University of Georgia and Ohio State found a different benefit for green roofs. Their findings were focused on the importance of green roofs with regard to storm water management. The authors noted that “green roofs can provide both private and public benefits and should be included as a potential tool in watershed management manuals for use in highly developed areas. Architects, storm water professionals and watershed planners can only benefit from having more options to alleviate the environmental impacts of urbanization” (Carter and Keeler 361).

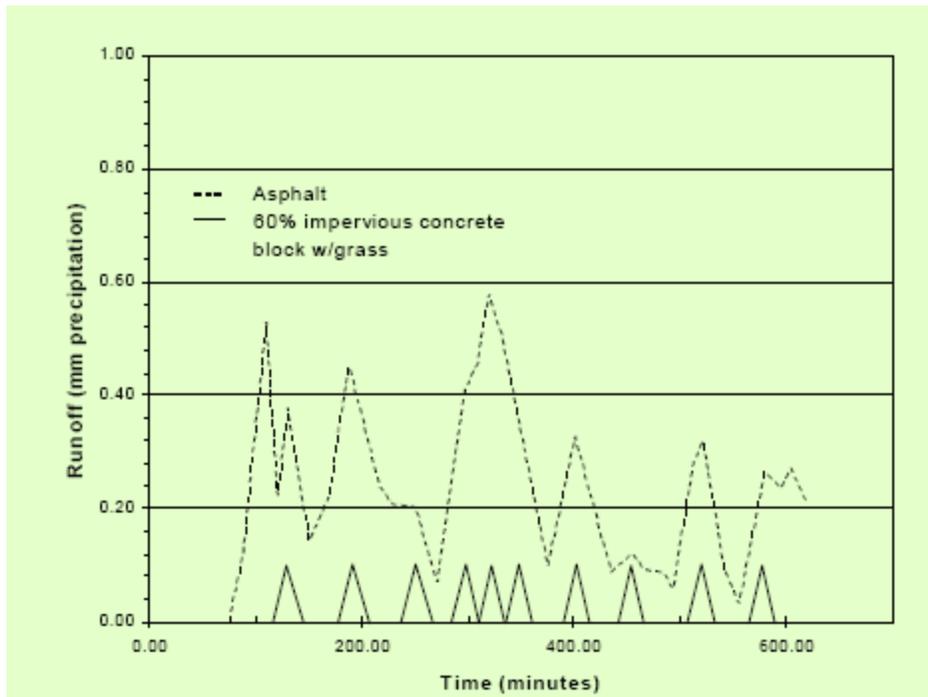
Green roofs are beneficial because they help counter balance the “heat island effect,” they do not require a major infrastructure change, they are economically viable, and can also improve local storm water management. After collaborating with the community, one area of concern in Somerville was storm water management, which is the final part of this report.

## **Storm Water Management**

The city of Somerville has done a tremendous amount of work to improve storm water management. There is the bold initiative to make the Mystic River Swimmable and Boat-able by 2010, which is noted in Sustainable Somerville. According to the Boston Globe, “Somerville has resolved to cancel its bottled water contracts, although it first must install the necessary plumbing to make water fountains available in city buildings” (Pfeiffer). Also, the Massachusetts Water Resource Authority actively continues to send water mailings to residents in the community regarding the quality of the water. However, what problems does Somerville face with regards to storm water management?

Desphande’s “Developing an Innovative Model for Cost Effective Asset Management and Pollution Prevention in a Municipal Storm Water System” highlights the storm water management problem of having a highly impervious city. As noted in the article, “impervious surfaces in urban areas prevent rainwater from infiltrating into the ground” (Desphande 14). This is an issue in Somerville because “due to the high percentage of impervious surfaces in urban areas, the rainwater cannot infiltrate and instead turns into surface runoff. Surface runoff picks up pollutants off the roads and other impervious surfaces” (Desphande 14). This is important in Somerville because “if the highly polluted storm water gets into surface waters without being treated this can have negative effects on water quality. This situation is especially critical in Somerville since one-third of the city sewers discharge storm water directly into the Mystic River and Alewife Brook without being treated” (Desphande 14). What are measures apart from planting trees and installing green roofs that could improve the storm water management in Somerville?

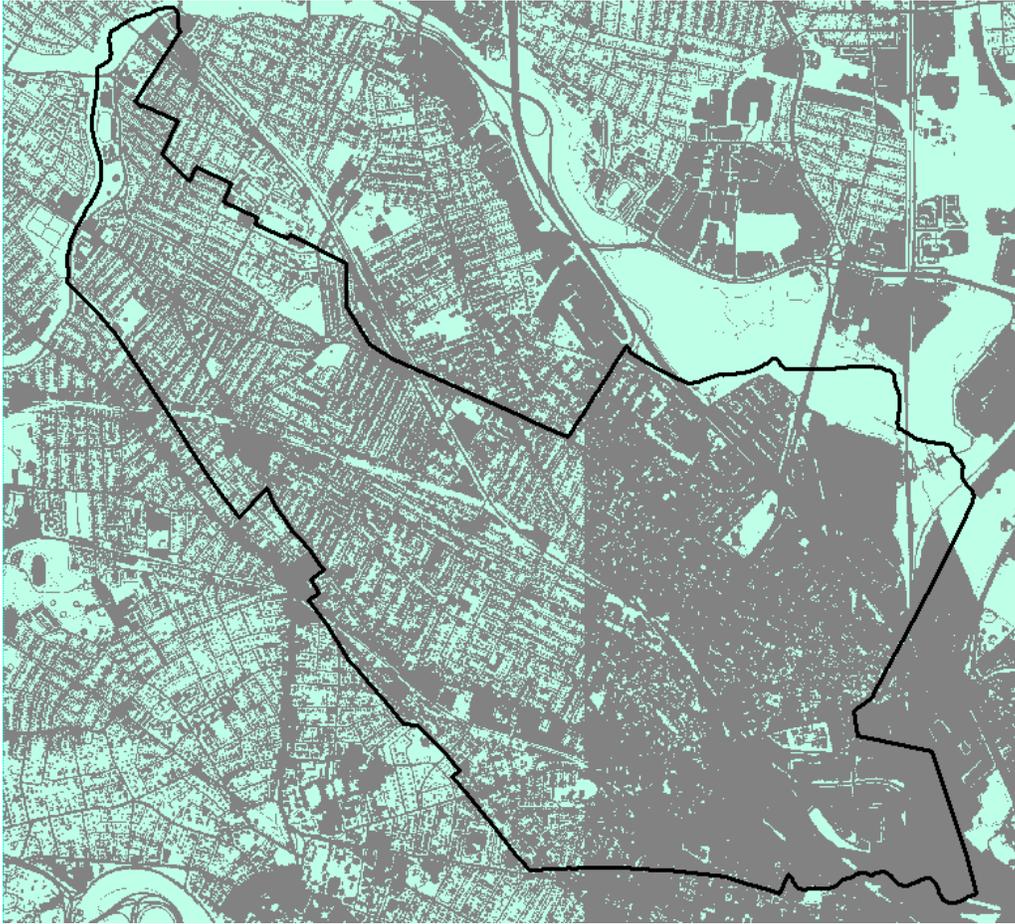
Permeable pavements have shown to be a viable solution. Permeable pavements are pavements that are porous. Permeable pavements have a variety of advantages. They filter the storm water so that it does not have a negative impact on the environment. They recharge the underground water table. Finally, they add less strain to the storm water system in Somerville because of the decreased amounts of storm water (“Permeable Paver Research Summary”). The graph below from the USA EPA Office in Washington DC depicts the decreased run off when a permeable pavement is installed.



One fundamental point to address is whether a permeable pavement can survive in a cold climate, where a lot of water is melted and frozen. Can a permeable pavement function effectively? In 1977, the EPA led a project to install a permeable pavement in Walden Pond, Concord, Massachusetts (Miller). The thirty year old pavement still works effectively today as it did thirty years ago despite being in a cold climate. In general, the only maintenance required of permeable pavements is to clean out the pollutants through a vacuum. The frequency of the clean up varies by location.

Many question the economic viability of permeable pavements. According to the US EPA Office in Washington DC, “Permeable pavement system types vary widely in cost and are more expensive than typical asphalt pavements. Cost comparisons between permeable pavement installations and conventional ponds or underground vaults are limited. However, the elimination of conventional systems and reduced life cycle and maintenance costs can result in significant cost savings over the long term” (“Field Evaluation of Permeable Pavements for Storm water Management”). In the long run, permeable pavements are an effective tool to improve storm water management.

Where could Somerville install the permeable pavements? Below is an image that depicts the impervious versus pervious layers of Somerville. The blue color is pervious, while the gray is impervious. The image was from Mass GIS.



## **Conclusion**

The findings of this research project are to plant more trees, install green roofs, and to install permeable pavements because of their economic viability, improvements to the environment, and applicability to Somerville. These solutions have shown to work well domestically, nationally, and internationally. It is recommended to have a “green roof initiative” and/or a “permeable pavement initiative,” where a certain percent of the city would have a certain amount of green roofs and/or permeable pavements by a certain time period. Finally, the City of Somerville could also encourage residents to install green roofs and/or permeable pavements, and could also assist residents to easily obtain permits for these jobs. In addition to these recommendations, it will be ideal to partner with the current “Sustainable Somerville” group. Instead of creating an additional working group, members of this research project will participate in the Sustainable Somerville conversations in order to ensure that green infrastructure is a part of the conversation from this point forward.

## **Community Partners**

- **Groundwork Somerville:** Tree planting and Green roof creation
- **City of Somerville:** improve ease of the permitting process for developers, organizations and landowners around permeable pavements and green roofs; create initiatives for landowners to create green roofs; use CDBG block grant money for organizations

planting trees around the community; have permeable pavement options in creation/renovation of parking lots and sidewalks.

- **Local businesses/landowners:** Create green roofs on flat roofs when re-roofing their buildings; partner with local non-profits to match trees planted (example, Home Depot will match the trees purchased by Groundwork Somerville this summer and plant along the busy Mystic Ave/ I-93).

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