

The Woonerf Concept

“Rethinking a Residential Street in Somerville”

Natalia Collarte

60 Wadsworth Street Apt 12H, Cambridge, MA 02142

(857) 312 1090

Master of Arts in Urban and Environmental Policy and Planning | Tufts University

Originally submitted December 7, 2012

Abstract

The European concept of a woonerf—which views the street as a social space, rather than just a channel for vehicular mobility—is becoming increasingly popular in the United States. However, most of the applications of this concept have been in commercial streets. This study analyzes the woonerf’s benefits and design principles to explore the feasibility of designing a woonerf on a residential street in Somerville, Massachusetts. The aim of this study is to illustrate how a residential street can be retrofitted with the woonerf concept, and to provide a cost estimate for its implementation. A segment of Hudson Street in Somerville is selected for this analysis. Two different options are proposed. The first option transforms the street completely into a woonerf by eliminating the continuous curb and incorporating traffic calming measures, while the second option provides traffic calming elements, but only converts one segment of the street into a shared-space (i.e., no continuous curb). Both options show that it is possible to re-think a residential street’s design using the woonerf’s principles. The study estimates that option one would cost \$915,431, while option two would cost around \$252,315. Since implementation costs are expensive, this study also suggests what should be considered and evaluated before retrofitting a residential street into a woonerf.

Introduction

In the past years, the urban landscape has been changing slowly with the introduction of the European concept of a woonerf—or shared space—in the neighborhoods of many American cities. However, most of these efforts have been in commercial areas, leaving residential streets with a traditional auto-centric paradigm. People have recognized that many residential streets are unattractive to live on as well as unsafe for children to play in because they are designed for little more than motor vehicle access and parking.

The woonerf concept has proven to be successful in many European cities, by reclaiming the streets as public spaces for people’s use. However, would a woonerf work in a traditional residential street in Somerville, Massachusetts? This project examines the woonerf’s design principles and explores the feasibility of designing a woonerf on a segment of Hudson Street in Somerville. To create a woonerf, this project studies two options for retrofitting the street that involve reconstructing the road to varying degrees. Implementation costs for each option are also estimated.

The City of Somerville has been selected for this study because it has a stated goal to increase the available public open space by 2030.¹ Implementing a woonerf could meet the City’s objective of providing high-quality and well-programmed community space. While Hudson Street has been chosen to introduce the woonerf concept, the goal of this project is to show schematically how a residential street could look in Somerville if woonerf design principles are applied. Therefore, this study can be used as an example of how other residential streets in Somerville—or elsewhere—could be retrofitted with the woonerf concept.

¹ “Somerville Vision Comprehensive Plan 2010-2013,” 16.

What is a Woonerf?

The concept of the *woonerf* was developed in the late 1960s in the city of Delft, Netherlands. Residents of a neighborhood were upset with cut-through traffic speeding through their neighborhood, making it unsafe. The residents took out their brick streets and replaced them with winding serpentine paths. This action initiated the woonerf—or “residential yard” in Dutch—a residential street in which the living environment predominates rather than vehicular infrastructure.² Through the physical alteration of the street, the woonerf provides space for cars while fully accommodating the needs of residents. The main goal of a woonerf is to change the way streets are used and to improve the quality of life in residential streets by designing them for people, not just for traffic.³

In a woonerf, the street is shared among pedestrians, bicyclists, and motor vehicles; however, pedestrians have priority over cars. The street is designed without a clear division between pedestrian and auto space (i.e., no continuous curb), so motorists are forced to slow down and travel with caution. Limiting vehicular speed not only improves residents’ feelings of safety, but also promotes greater use of the public space. This action allows more room for new features in the street such as street furniture (e.g., planters, street trees, benches) and areas for social interaction,⁴ bringing more people out on the streets to walk, bike, play, and interact with each other. In other words, a woonerf transforms the street into a livable and attractive environment for a variety of activities.

The woonerf concept in urban planning has proven to be successful in the Netherlands. As a result, it has become increasingly popular in many other countries in

² Appleyard and Cox, “At Home in the Zone,” 31.

³ Biddulph, *Home Zones*, 3; “What is a Home Zone.”

⁴ Biddulph, *Home Zones*, 3.

Europe as well as around the world.⁵ The term itself, "woonerf," varies from one country to another. For example, a woonerf is also known as a *home zone*. The home zone concept was developed from the woonerf concept in Britain in the late 1990s.⁶ According to Appleyard and Cox, there is a subtle difference between the two: a woonerf in the Netherlands emphasizes creating a sense of place, while a home zone in Britain focuses more on easing traffic and reducing accidents.⁷ However, both concepts incorporate formal and informal space for children's play and social activities.⁸ Another concept is the *shared street*, which is commonly used in the United States; however, this concept can be applied to residential streets as well as commercial ones. Since all these terms, as well as others, originated from the woonerf concept, they share similar principles and design characteristics, and thus they are often used interchangeably. This study focuses on transforming a residential street, so the term woonerf will be used.

Why a Woonerf?

Research on different case studies of woonerven⁹ in Europe has shown that they have a positive effect on the street environment as well as on residents' lives by:

- **Reducing driving speeds and increasing levels of safety:** By incorporating different traffic calming measures into the street, residents feel more confident

⁵ Appleyard and Cox, "At Home in the Zone," 32.

⁶ *Ibid.*

⁷ *Ibid.*

⁸ "Case Studies: Home Zones."

⁹ The plural of woonerf in Dutch.

using the streets for different activities. Research from the Netherlands indicates that vehicle speeds were reduced to an average of 8 to 15 mph.¹⁰

- **Creating more efficient use of space:** The street design balances the need of street space for vehicles with the provision of street space for other users and activities. Since the street does not make distinction between travel lanes, children play across the whole width of the environment,¹¹ turning the streets into a valued public space, and not just a channel for vehicular mobility.
- **Increasing socialization and activities:** Research has observed that people stay for longer periods of time in the streets and also engage in more verbal communication. In fact, Biddulph (2012) in his research “Street Design and Street Use” compares street activity in two very similar streets over exactly the same period using time lapse cameras; however, one is a home zone and the other a traffic-calmed street. He found that residents stayed in the home zone for longer periods, engaging in optional activities and also socializing. In contrast, the traffic-calmed street showed no significant change in the way that the street was being used.¹²
- **Creating a more attractive street:** A total of 70% of residents living in woonerven in the Netherlands, as well as 80% of residents living in home zones in the UK, find their living environment to be attractive or highly attractive.¹³ Furthermore, while residents appreciate low traffic volumes and the absence of cut-through traffic, they

¹⁰ Biddulph, *Home Zones*, 16; “Lesson 20: Traffic Calming,” 30.

¹¹ Biddulph, *Home Zones*, 18.

¹² Biddulph, “Street Design and Street Use,” 231.

¹³ Biddulph, *Home Zones*, 18.

considered the provision of larger play areas for children as well as the improvements to the street environment to be the most important benefits.¹⁴

Other benefits include:

- Increasing natural surveillance, which deters casual crime.¹⁵
- Enabling the elderly and others with limited mobility to have better access and mobility within in their own street environment.¹⁶
- Improving the environmental quality of urban streets, helping to increase the demand for urban living.¹⁷ However, this may increase property values, which can generate both positive and negative impacts.

While woonerven offer significant benefits, they are not without drawbacks or controversy. In the UK, it has been reported that home zone schemes have delayed the response rate of emergency services to the street.¹⁸ Other reports have described residents complaining about both the lack of parking spaces close to their homes and occasional traffic congestion caused by traffic calming measures. Additionally, some people fear accidents due to the mix of transportation modes.¹⁹

Design elements of a Woonerf

Most of the examples of woonerven are in the Netherlands, Germany and the United Kingdom, but the concept has spread through Europe as well as Japan, Australia and

¹⁴ "Lesson 20: Traffic Calming,"30.

¹⁵ "What is a Home Zone."

¹⁶ *Ibid.*

¹⁷ "Concept: What are Home Zones?"

¹⁸ *Ibid.*

¹⁹ Alan M. Voorhees Transportation Center. "Home Zone Concepts and New Jersey,"6.

Israel.²⁰ While each country has implemented the woonerf scheme, there is no cookie-cutter design for a woonerf. This means that each country—and place—has transferred the core concepts of a woonerf and created their own safe areas according to their needs and local culture. Each woonerf implementation requires a distinct approach to street design, so the woonerf core concepts are clear and adaptable; and they consist of the following guidelines:

- **Have a clear and distinct entrance:** A woonerf should be marked by some kind of entrance so people going into the street will know that this area is not a typical neighborhood. This can be achieved by incorporating gateway features such as trees and planters, curbs extensions to make the carriageway narrow, and a ramp up to the shared surface.²¹ Any of these approaches should be also accompanied by a sign indicating the woonerf status. Exits from the woonerf should therefore also include a sign indicating the end of the status.²²
- **Eliminate the continuous curb:** Pedestrian and auto space should be on the same level. Shared surfacing encourages drivers to travel more slowly and carefully since there is no clear definition of the travel lane. Using different colors or textures in pavement material is also important for guiding the users of the street within the carriageway (e.g., pedestrian vs. auto lanes). By eliminating the continuous curb, residents—especially children—can move freely across the entire space.²³

²⁰ Appleyard and Cox, "At Home in the Zone," 32.

²¹ Biddulph, *Home Zones*, 4.

²² *Ibid.*, 53.

²³ *Ibid.*, 52.

- **Use traffic calming measures:** The design of the street should add slight curves to break up the sightlines of a driver and also introduce physical and visual features that will encourage people to drive slowly and with greater caution.²⁴ These measures include chicanes, speed bumps and cushions, narrow travel lanes, small corner radii, different pavement treatments, as well as other elements such as street trees, bollards and furniture.²⁵ According to Biddulph (2001), these measures should be located less than 160 feet apart so there is no length that would allow drivers to think they have priority over pedestrians and bicyclists, but at the same time they should be designed so they do not represent a hazard if they are passed at an inappropriate speed.²⁶ Furthermore, these traffic calming measures cannot be an obstacle for emergency responders. It is recommended that planners and architects engage emergency responders in a collaborative approach to designing traffic-calming elements.²⁷
- **Provide on-street parking:** Parking should be provided intermittently rather than continuously so the car is not the predominant element in the street.²⁸ Areas in which parking is permitted should be indicated by physical elements (e.g., bollards) and/or different pavement material. Parking arrangements should also be used as a mechanism to calm traffic.²⁹ There are a few common strategies to arrange parking

²⁴ Appleyard and Cox, "At Home in the Zone," 32.

²⁵ Biddulph, *Home Zones*, 54.

²⁶ *Ibid.*, 54.

²⁷ Appleyard and Cox, "At Home in the Zone," 35.

²⁸ *Ibid.*, 32.

²⁹ Biddulph, *Home Zones*, 55.

(Figures 1 and 2); the strategy adopted will depend on the dimensions of the street as well as code allowance.

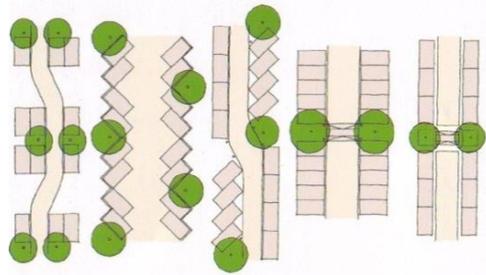


Figure 1: Parking strategies
 Biddulph 2001, 55

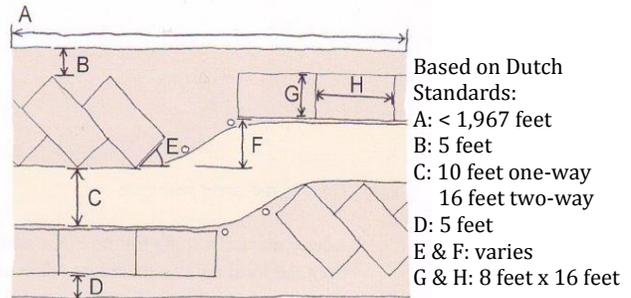


Figure 2: Typical angle and parallel parking strategy
 Biddulph 2001, 55

- **Incorporate outdoor furnishings and landscaping:** Street trees and planters make the street look more attractive as well as calm traffic. Tree planting should be carefully coordinated with existing or planned underground utilities to avoid conflict.³⁰ Seating also should be included to encourage people to use and stay in the street for other activities. Seating areas should be protected from cars, using bollards or other physical barriers.³¹

Appleyard and Cox summarize well the woonerf design principles in Figure 3.



Figure 3: Woonerf design elements | Source: Appleyard and Cox 2006, 31.

³⁰ Biddulph, *Home Zones*, 56-7.

³¹ *Ibid.*, 57.

According to Biddulph (2001), a woonerf works better in areas in where there is resident support as well as existing street activity such as children playing on the streets. It also works better if the street’s current traffic is considered dangerous by the residents, discouraging people from going out. Also, a woonerf would be more successful if there is little or no open spaces available close by.³² As a result, woonerf implementation should not be applied in isolation—instead, it should be part of a wider strategy such as an area-wide traffic calming initiative, a related safety initiative (e.g., Safer Route to School), or an expanded pedestrian and cyclist network, among other possibilities.³³

Research also suggests that streets need to be used by fewer than 100 vehicles per hour at peak times. In addition, the area treated should be less than 1,968 feet long (600 meters).³⁴ However, Appleyard and Cox (2006, 35) recommend a length of 300 to 500 feet. Even though there is no clear justification for determining the street limit, research suggests that shorter distances might reduce driver frustration at having to drive slowly through the woonerf.³⁵

The American Experience

Most of the woonerven implemented in the United States are *shared streets* in commercial areas. Good examples are found in Asheville, NC (Wall Street),³⁶ San Francisco, CA (Linden Street)³⁷ and Cambridge, MA (Palmer and Winthrop Street). However, woonerf implementation in residential areas is rare. Two known cases are The Cottages and

³² Biddulph, *Home Zones*, 15.

³³ Alan M. Voorhees Transportation Center. “Home Zone Concepts and New Jersey,” 17; Biddulph, *Home Zones*, 15.

³⁴ Biddulph, *Home Zones*, 15.

³⁵ *Ibid.*

³⁶ Alan M. Voorhees Transportation Center. “Home Zone Concepts and New Jersey,” 19.

³⁷ Langdon, “Shared-Space’ Streets cross the Atlantic.”

Bridgewalk in Boulder. Both projects were built based on the woonerf concept; however, both had some difficulties applying the concept. For example, in the case of Bridgewalk, houses already had backyards, porches, and other areas for people to congregate, so the shared street was used more by cars than people.³⁸

Another example is on Appleton Street in Boston, where the street and house typology are very similar to a European street. It was converted into a woonerf in the 1980s.³⁹ Appleton Street’s design includes a raised entrance (Figure 4), traffic calming measures, and angled and parallel on-street parking. While it does have different pavement materials, there is a continuous curb (Figure 5).



Figure 4: Entrance

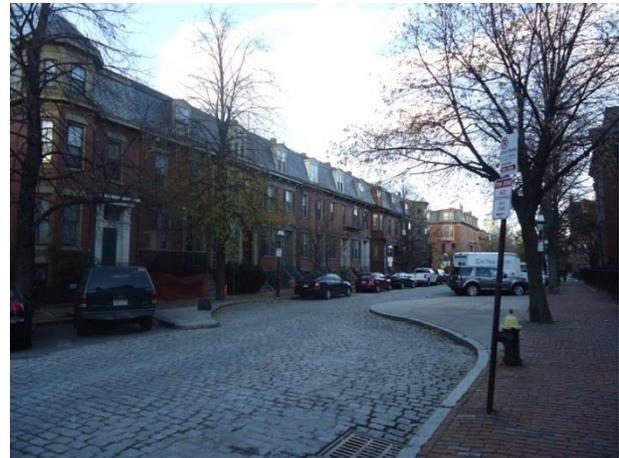


Figure 5: Traffic calming, parking and continuous curb

The most useful example is the Borderline Neighborhood Shared Streets Project in Santa Monica developed by Nelson\Nygaard Consulting Associates in collaboration with other consultants.⁴⁰ The project retrofitted four connected streets into a community front yard that promotes walkability, adds sustainable landscaping, and provides community gathering space. The project raised the roadbed to eliminate vertical curbs and used

³⁸ Alan M. Voorhees Transportation Center. “Home Zone Concepts and New Jersey,” 20-22.

³⁹ Whiston, *The Granite Garden: Urban Nature and Human Design*, 70.

⁴⁰ “Feature Projects: Borderline Neighborhood Shared Street Project.”

decorative pavers to delineate walking, driving, and socializing spaces (Figure 6). It also incorporates sustainable features such as urban runoff retention elements, permeable concrete and pavers and solar lighting.⁴¹ The project took nearly six years to be completed and cost \$2.1 million.⁴²



Figure 6: Borderline Neighborhood Shared Streets Project | Source: Blackbird Architects <http://www.bbird.com>

A Woonerf in Somerville, MA

Somerville is the most densely populated municipality in New England, but only 123 acres of the city’s 4.1 square miles are considered public open space.⁴³ Somerville’s Comprehensive Plan for 2010-2030 states they would like to increase the available public open space to 125 acres by 2030.⁴⁴ Two of their goals are to “design and maintain a healthy and attractive public realm” and to “create and program a network of vibrant

⁴¹ “Feature Projects: Borderline Neighborhood Shared Street Project.”

⁴² “Current News Items.”

⁴³ “Five Year Consolidated Plan 2008-2013: Section Four: Parks & Open Space,” 123.

⁴⁴ “Somerville Vision Comprehensive Plan 2010-2013,” 16.

public open spaces and shared use paths throughout the city."⁴⁵ A woonerf could be one strategy to accomplish the City's goal.

For this study, a segment of Hudson Street (660 feet long) between Cedar Street and Lowell Street was selected (Figure 7). The selection criteria were: (1) the street is a part of a "[Somerville Neighborways](#)" plan;⁴⁶ (2) the street is located two and a half blocks from the Somerville Community path; (3) the street has less than 100 vehicles per hour;⁴⁷ (4) residents perceive the cars on the street as driving too fast;⁴⁸ (5) most of the houses have driveways; and (6) has the potential for a design intervention.

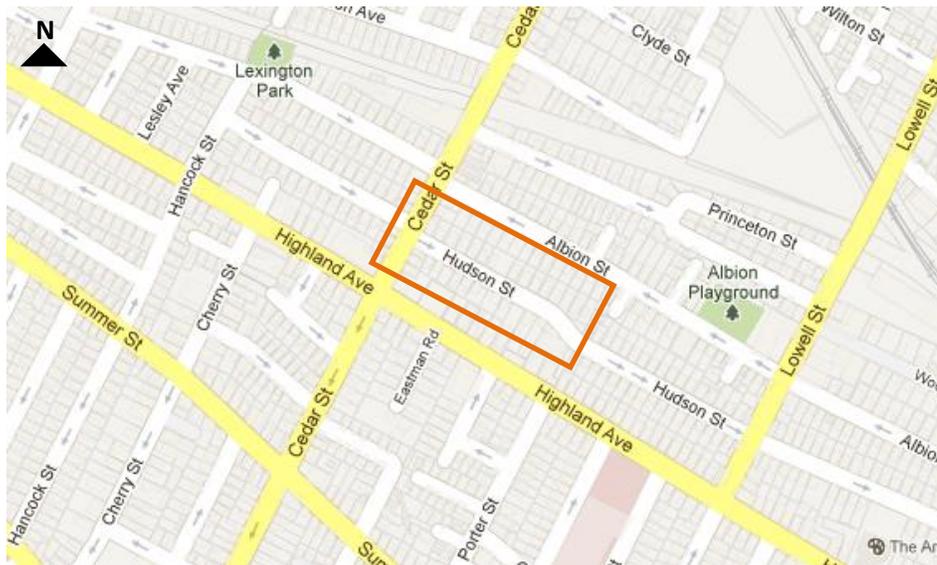


Figure 7: Street location | Source: Google maps

Hudson Street is a 30 feet wide, one-way street with parallel parking. On one street segment, the road is wider, having a triangular shape. There are 27 houses in this segment, of which only four houses do not have parking on their property. The street provides a total

⁴⁵ "Somerville Vision Comprehensive Plan 2010-2013," 20.

⁴⁶ The "Somerville Neighborways" plan was developed by Tufts students as part of Spring and Fall 2012 Transportation Planning class at Tufts University. Information about the plan and the "Hudson Street Pilot" can be found at: <http://sites.tufts.edu/neighborways/>.

⁴⁷ On Monday, November 5, 2012, 73 vehicles were counted from 18:30 to 19:30.

⁴⁸ Personal communication with Todd Easton, a resident of Hudson Street, Friday, October 26, 2012.

of 38 on-street parking spaces for its residents (Figure 8). The number of cars parked on the street was counted twice for this study. The total number of cars identified was 23 and 28 respectively.⁴⁹ For the purpose of this study, it is assumed that residents are willing to lose some on-street parking spaces in order to transform the street into a woonerf.

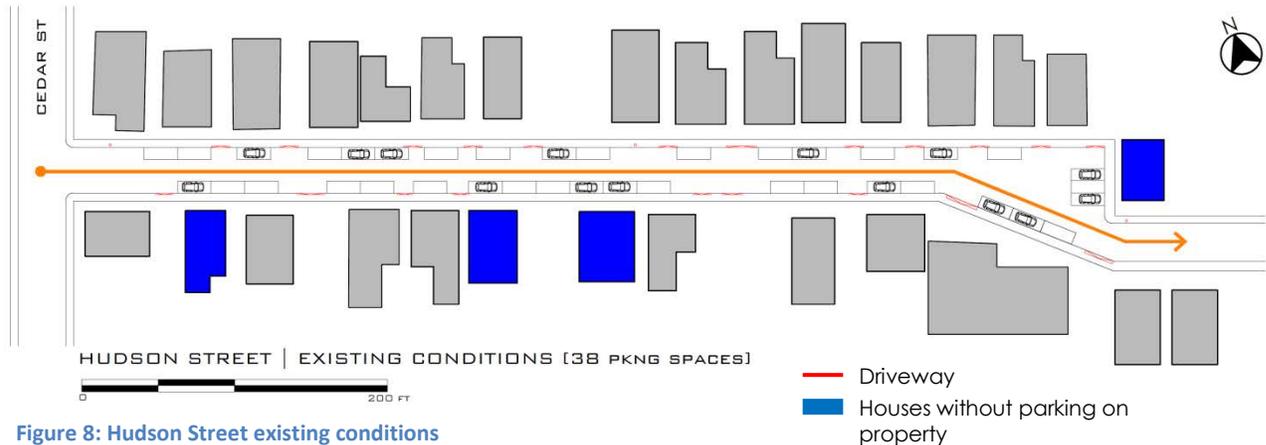


Figure 8: Hudson Street existing conditions

Schematic 1 | A woonerf

In this option, the continuous curb is eliminated by re-paving the street completely. A clear and distinctive entrance with a tight curb extension and ramp up to the shared surface is provided to alert drivers of the woonerf status. Parking was re-arranged, taking into account Somerville’s Zoning Ordinances.⁵⁰ Without blocking driveways and fire hydrants, the number of parking spaces is reduced to 23 on-street spaces. Based on the street width (30’), the parking strategy adopted is parallel parking (22’ x 8’) and 90° parking (18’ x 9’), reducing the street width to 12 feet. Parking is provided 30 feet from the intersection with Cedar Street to allow fire trucks to make the turn. Also, parking has been re-arranged in a

⁴⁹ First count was made on Monday, November 5, 2012 at 18:30. Second count was made on Sunday, November 25, 2012 at 22:00.

⁵⁰ While minimum dimensions were considered for parking spaces, travel lanes, and accessibility for fire trucks and larger vehicles (complying with Somerville’s Zoning Ordinances), it is important to note that redesigning the road must be done in collaboration with the City of Somerville, Traffic Engineers, the Fire Department, as well as other consultants.

way that works as a traffic calming measure by creating slight curves to break up the sightline of the driver to less than 160 feet. In those breaks, street trees and furniture—protected by bollards—were incorporated to create small areas for social interaction and activities within the street. The design also includes a larger emergency vehicle staging area in the middle of the street. Finally, in the wider area, a larger pedestrian area is incorporated for multiple uses (Figures 9 and 10).

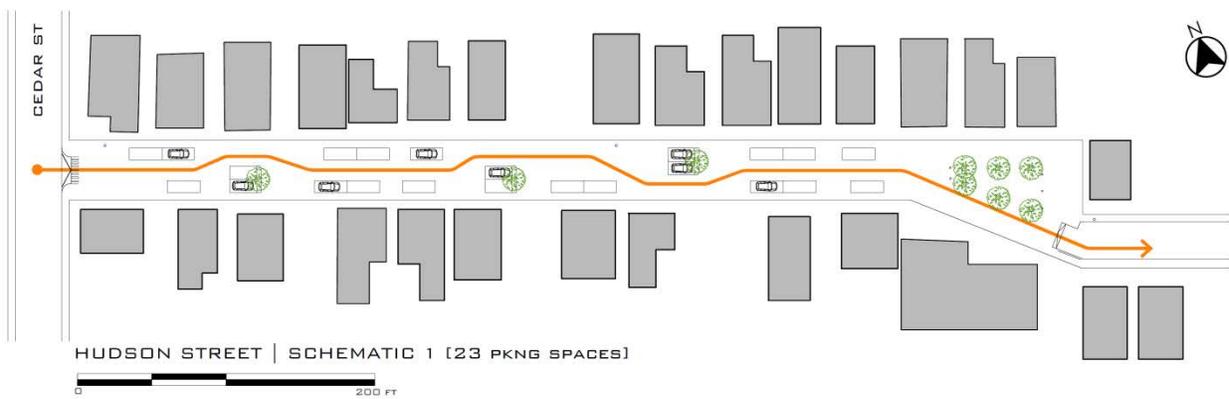


Figure 9: Schematic 1 - Plan

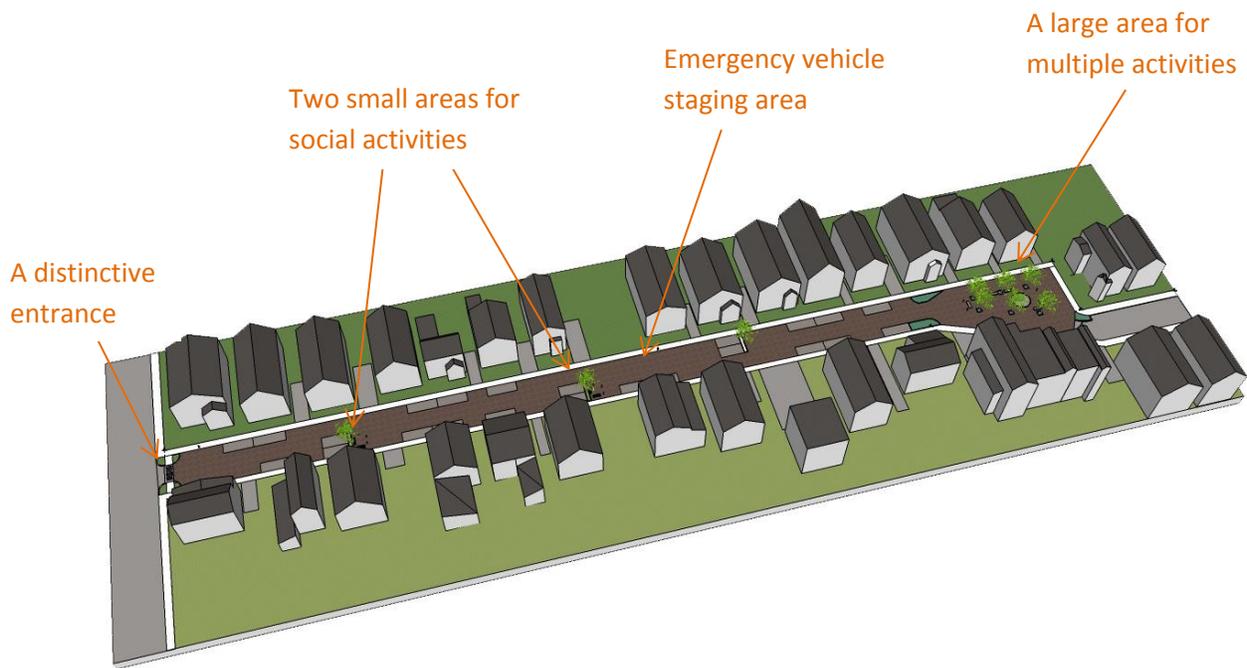


Figure 10: Schematic 1 - 3D Model

The Woonerf Concept
"Rethinking a Residential Street in Somerville"



Figure 11: Woonerf entrance



Figure 12: An area for social activities



Figure 13: Large area for multiple uses (vehicular circulation is limited to the sides)

Schematic 2 | One segment of the street is a shared space

In this option, only the large area is converted into a shared street by eliminating the continuous curb; the rest of the street maintains the division between pedestrian and auto lanes. However, on-street parking has the same amount and arrangement of spaces as in Schematic 1, thus calming traffic visually and physically as well as creating small areas for social activities within the street. A clear and distinctive entrance, including a speed table, is also incorporated to indicate to drivers the new status of the street (Figures 14 and 15).

The Woonerf Concept
"Rethinking a Residential Street in Somerville"

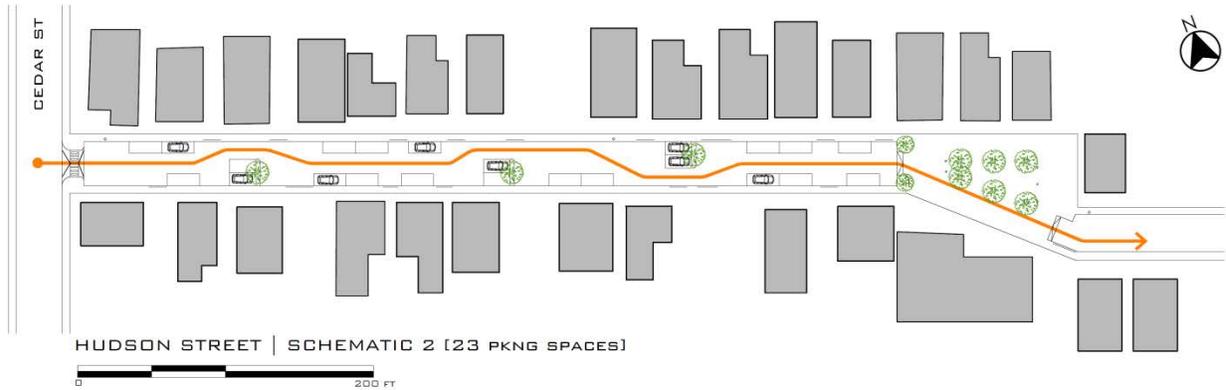


Figure 14: Schematic 2 - Plan

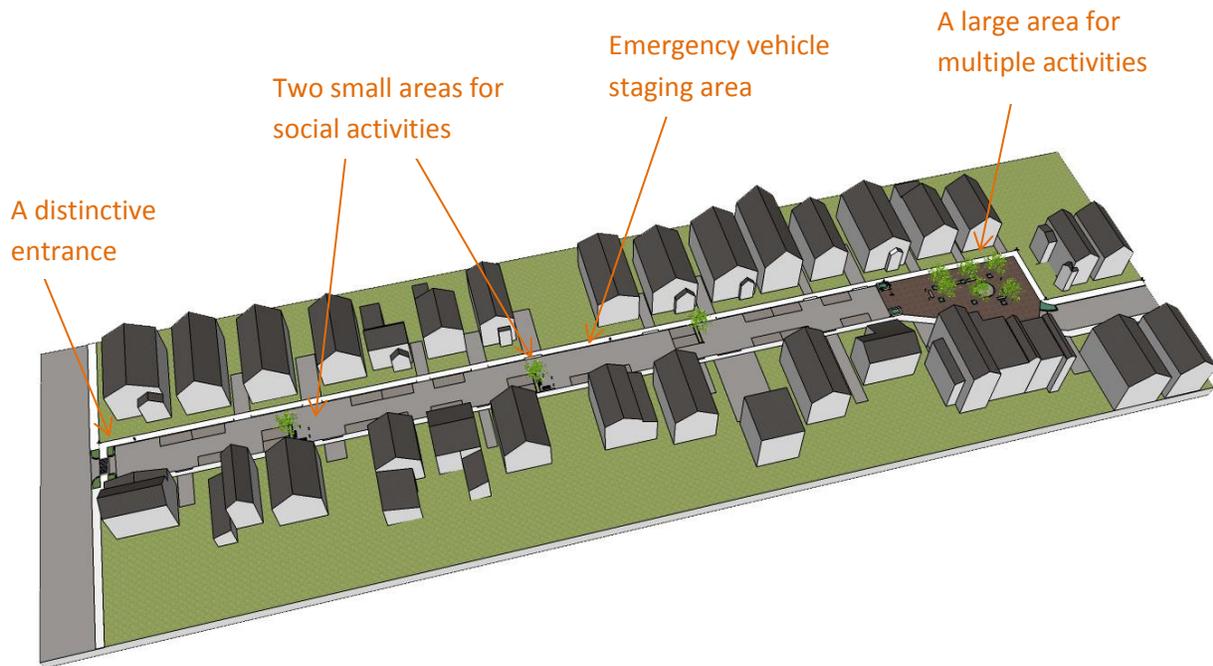


Figure 15: Schematic 2 – 3D Model

The Woonerf Concept
"Rethinking a Residential Street in Somerville"

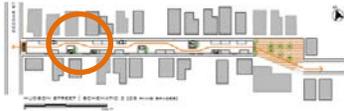


Figure 16: Entrance and a small area for social activities



Figure 17: Street and large area entrance beyond



Figure 18: Another perspective of the large area [this area remains the same as in schematic 1]

How much would it cost?

Using a typical section of Winthrop Street’s transformation into a woonerf in Harvard as an example for this calculation, and considering a few items related to the excavation and re-pavement only (the most expensive items), *Schematic 1* would cost approximately \$915,431, while *Schematic 2* would cost around \$252,315 (Table 1).⁵¹

Other items such as soil disposal, drainage/sanitary structure adjusted, labor, and other items were not considered because their cost varies according to the current conditions of the street, requiring a deeper technical study.

⁵¹ All calculations were made using mean prices and information from the “Construction Project Estimator” of The Massachusetts Department of Transportation Highway Division on Wednesday, December 5, 2012. Available at <http://www.mhd.state.ma.us/cpe/WeightedAverageCriteria.aspx>

Table 2: Cost of Implementation Schematics 1 and 2

Schematic 1 Implementation Costs (approx.)					
Item	Description	Units	Unit Price	Quantity	Cost
120.1	Unclassified Excavation (> 6")	Cubic Yard	\$ 22.04	4,884	\$ 107,643
NA	Precast Concrete Pavers (Unilock)	Square Yard	\$ 250.00	2,442	\$ 610,500
420.	Hot Mix Asphalt Base Course	TON	\$ 99.78	520	\$ 51,886
151.	Gravel Borrow	Cubic Yard	\$ 18.20	6,513	\$ 118,537
580.	Remove and Reset Granite Curb*	Feet	\$ 18.84	1,426	\$ 26,866
					<i>*If applicable</i>
Total Cost					\$ 915,431

Schematic 2 Implementation Costs (approx.)					
Item	Description	Units	Unit Price	Quantity	Cost
120.1	Unclassified Excavation (> 6")	Cubic Yard	\$ 24.92	1,255	\$ 31,275
NA	Precast Concrete Pavers (Unilock)	Square Yard	\$ 250.00	580	\$ 145,000
420.	Hot Mix Asphalt Base Course	TON	\$ 99.78	131	\$ 13,071
151.	Gravel Borrow	Cubic Yard	\$ 34.17	1,673	\$ 57,166
580.	Remove and Reset Granite Curb*	Feet	\$ 18.84	308	\$ 5,803
					<i>*If applicable</i>
Total Cost					\$ 252,315

Conclusions

This project has shown that retrofitting a residential street into a woonerf in Somerville is feasible. Both schematic options show that it is possible to re-think the way streets are designed using the core design principles of the woonerf concept. While a complete street transformation may not be the best option for some communities, strategically implementing shared space on certain parts of a street can provide similar benefits without requiring major road renovation and funding. However, wherever the concept is applied, it is important to incorporate most of the woonerf elements; otherwise, the street will end up with less vehicular traffic but not necessarily transformed into a place that promotes livability and sense of community.

Since the woonerf implementation costs are significant, it is important to first understand what the woonerf means and what can and cannot be accomplished with this concept. In other words, its benefits (e.g., community space) and disadvantages (e.g., parking removal) should be carefully evaluated. It is also imperative to consider that this is a European model, which might not work well in the American culture. Thus, days of woonerf simulation (i.e., painting the streets to see how the woonerf will work) and/or other less costly initiatives—like “Somerville Neighborways”—should be introduced first to evaluate how people will respond to this new way of thinking about the street.

Residents should be involved in all the processes with active participation to create the street in which they want to live, meet and play. Residents will also need to get support from City officials to make it a reality. Without official support, neither financial resources nor other permission will be available to design streets that work for people as well as cars. Therefore, it helps to see the woonerf concept as a part of larger initiatives such as traffic calming, safety, and/or open space programs to make it feasible. In other words, whether a woonerf becomes accepted in Somerville, or elsewhere, will depend on whether residents and political leaders want them or not.

Finally, the street should be studied carefully to understand how it works and to recognize which areas have more potential for redesigning. Aspects of traffic, landscape, utilities, activity, and ownership should be deeply analyzed. Furthermore, the street must be designed considering the needs of emergency services. It is vital to ensure that emergency vehicles can enter and exit, as well as maneuver through the street.

People increasingly seek an attractive and vibrant living environment with community space to meet and play in their own neighborhoods. Thus, it is time to rethink and reclaim the most valuable public space in the cities: our streets.

Bibliography

- Alan M. Voorhees Transportation Center. "Home Zone Concepts and New Jersey." November 2004. Accessed November 22, 2012. http://njbikeped.org/wp-content/uploads/2012/08/Home_Zones_NJ_Final_Report.pdf
- Appleyard, Bruce, and Lindsey Cox, "At Home in the Zone: Creating Livable Streets in the U.S." *Planning* 72.9 (2006): 30-35.
- Biddulph Mike. *Home Zones: A Planning and Design Handbook*. Bristol, UK, 2001.
- Biddulph, Mike. "Street Design and Street Use: Comparing Traffic Calmed and Home Zone Streets." *Journal of Urban Design*, 17:2 (2012): 213-232. Accessed November 22, 2012. doi:10.1080/13574809.2012.666206
- City of Santa Monica. "Current News Items." April 4, 2012. Accessed November 21, 2012. http://www.smgov.net/Main/News_Tab/City_Officials_and_Local_Residents_Celebrate_Completion_of_Borderline_Neighborhood_Shared_Streets_Project.aspx
- City of Somerville. "Five Year Consolidated Plan 2008-2013: Section Four: Parks & Open Space." February 2008. Accessed November 23, 2012, <http://www.somervillema.gov/sites/default/files/documents/E%20Parks%20%26%20Open%20Space%20Final.pdf>
- City of Somerville. "Somervision Comprehensive Plan 2010-2013." Accessed November 23, 2012. http://www.somervillema.gov/sites/default/files/SomervisionComprehensivePlan_WithAppendicesAdoptedApril-19-2012.pdf
- Department for Transport. "What is a Home Zone." Accessed November 22, 2012. http://www.homezones.org.uk/challenge/What_is_a_home_zone.htm
- Home Zones. "Concept: What are Home Zones?" Accessed November 22, 2012. <http://www.homezones.org/concept.html>
- Langdon, Philip. "Shared-Space' Streets cross the Atlantic," *Better! Cities & Towns*, October 1, 2008. Accessed November 23, 2012. <http://bettercities.net/article/%E2%80%98shared-space%E2%80%99-streets-cross-atlantic>
- Nelson/Nygaard. "Feature Projects: Borderline Neighborhood Shared Street Project." Accessed November 21, 2012. http://www.nelsonnygaard.com/Content/Featured_Projects/Santa-Monica-Borderline.htm

Streets Reconsidered. "Case Studies: Home Zones." Accessed November 22, 2012.

<http://demo-restreets.migcom.com/case-studies/home-zones/>

U.S. Department of Transportation. "Lesson 20: Traffic Calming." July 2006. 28-31. Accessed November 22, 2012.

<http://www.fhwa.dot.gov/publications/research/safety/pedbike/05085/pdf/lesson20lo.pdf>

Whiston, Anne. *The Granite Garden: Urban Nature and Human Design*. New York: Basic Books, 1984.

**All figures and tables by the author unless otherwise noted.*