WORCESTER POLYTECHNIC INSTITUTE

Assessing People's Perceptions of Urban Trees:
A Case Study in Worcester, Massachusetts

A Major Qualifying Project Report
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfillment of the requirements for the
Degree of Bachelor of Arts
by

Anna Costello

Jeffrey Robinson

Project Advisor: Robert Krueger

January 14, 2011

Table of Contents

Table of Tables 2
Table of Figures 4
Abstract 5
Introduction 6
Literature Review 7
Environmental Benefits of Trees 8
Health Benefits of Trees 10
Economic Benefits of Trees 11
Social Benefits of Trees 13
Methodology 15
Selecting the Concourse 15
Deriving Q Statements 16
The Condition of Instruction 16
Selecting Q Participants 17
Q Cards 17
Conduct the Q Sorts 18
Doing the Q Sort 18
Phase 1: Greendale/Burncoat Neighborhoods 18
Phase 2: Walnut Hill Neighborhoods 19
Record the data 19
Q Method Analysis 20
Factor Analysis and Social Narratives for Greendale/Burncoat and Walnut Hill 23
Comparison of Greendale/Burncoat and Walnut Hill Factors 1, 2, and 3: 29
Phase 1: Greendale and Burncoat Neighborhoods 31
Factor Analysis and Social Narratives for the Greendale and Burncoat Neighborhoods 32
Comparison of Greendale/Burncoat Factors 1, 2, and 3 38
Phase 2: Walnut Hill Neighborhood 40
Factor Analysis and Social Narratives for the Walnut Hill Neighborhood 41
Comparison of Walnut Hill Factors 1, 2, 3, and 4 49
Comparison of Greendale/Burncoat and Walnut Hill Neighborhoods 50
Conclusion 53
Works Cited 54
Appendix A- Consent Form 58
Appendix B- Q Protocol 62
Appendix C- Q Cards 63
Appendix D- Q Board 68

Table of Tables

Table 1. Improve air quality and sequester carbon 8
Table 2. Aesthetics 9
Table 3. Remove pollutants from air 9
Table 4. Control rainfall runoff and flooding therefore stabilizing soils and reducing erosion 9
Table 5. Phytoremediation 9
Table 6. Urban wildlife and biodiversity 9
Table 7. Reduce cancer risk 10
Table 8 Recovery and less pain 10
Table 9. Reduce human stress levels 10
Table 10. Moderate temperature and microclimates (carbon avoidance) 11
Table 11. More productive office workers 11
Table 12. Increased property Value 11
Table 13. Positive impact on shopping behavior and perception of shopping experience 12
Table 14. Reduce urban noise levels 13
Table 15. Improving learning and behavior by children in urban areas 13
Table 16. Cultivate attachment to place, emotional and spiritual 13
Table 17. Reduce negative psychosocial issues, fear, violence, aggressive behavior 14
Table 18. Non-Significant Statements 21
Table 19. Combined Data for Greendale/ Burncoat and Walnut Hill 22
Table 20. Distinguishing Statements of Greendale/Burncoat and Walnut Hill (GB/WH) 23
Table 21. Statements that rated low for GB/WH Factor 1 24
Table 22. Z-Scores using Defining Statements GB/WH Factor 1 24
Table 23. Distinguishing Statements of GB/WH Factor 2 25
Table 24. Statements that rated low for GB/WH Factor 2 25
Table 25. Z-Scores Using Defining Statements GB/WH Factor 2 26
Table 26. Distinguishing Statements of GB/WH Factor 3 27
Table 27. Z-Scores Using Defining Statements GB/WH Factor 3 27
Table 28. Statements that rated low for GB/WH Factor 3 28
Table 29. Statements whose Z-Scores were positive for factors 1, 2, and 3 29
Table 30. Statements whose Z-Scores were negative for factors 1, 2, and 3 29
Table 31. Statements whose Z-Scores were positive and negative for factors 1, 2, and 3 30
Table 32. Rank Statement Totals with Each Factor for Greendale and Burncoat Neighborhoods 31
Table 33. Distinguishing Statements GB Factor 1 32
Table 34. Statements that rated low for GB Factor 1 33
Table 35. Z-Scores using Defining Statements GB Factor 1 33
Table 36. Distinguishing Statements GB Factor 2 34
Table 37. Statements that rated low for Factor 2 35
Table 38. Z-Scores using Defining Statements GB Factor 2 35
Table 39. Distinguishing Statements GB Factor 3 36
Table 40. Statements that rated low for GB Factor 3 37
Table 41. Z-Scores using Defining Statements GB Factor 3 37
Table 42. Rank Statement Totals with Each Factor for Walnut Hill Neighborhood 40

Table 43. Distinguishing Statements for WH Factor 1 41
Table 44. Statements that rated low for WH Factor 1 42
Table 45. Z-Scores using Defining Statements WH Factor 1 42
Table 46. Distinguishing Statements for WH Factor 2 43
Table 47. Statements that rated low for WH Factor 2 43
Table 48. Z-Scores using Defining Statements WH Factor 2 44
Table 49. Distinguishing Statements for WH Factor 3 45
Table 50. Statements that rated low for WH Factor 3 45
Table 51. Z-Scores using Defining Statements WH Factor 3 46
Table 52. Distinguishing Statements for WH Factor 4 47
Table 53. Statements that rated low for WH Factor 4 48
Table 54. Z-Scores using Defining Statements WH Factor 4 48

Table of Figures

Figure 1. Q Board 19

Abstract

The Asian longhorned beetle (ALB) has decimated the forests of several cities along North America's east coast. The outbreak in Worcester, Massachusetts presented a unique opportunity to evaluate the public's perception of trees. The goal of this research is to communicate resident opinion to policy makers so that they may better manage and protect urban forests. This paper will use Q method to introduce, review, and analyze how residents understand and perceive urban trees.

Introduction

The tree removal associated with the Asian longhorned beetle infestation in Worcester, Massachusetts presented a unique opportunity to explore the perceptions residents have of their trees in a community that recently experienced considerable tree loss. The researchers felt this context would enable respondents to more easily communicate how they value and experience trees. This research is part of a collaborative multi-phase study between Worcester Polytechnic Institute's Worcester Community Project Center and the University of Massachusetts' Department of Natural Resources Conservation. The purpose of this study was to understand how residents value and experience trees, and communicate those conclusions to politicians and decision makers who may help better manage and protect urban forests.

The research reported here was collected in two phases over a one year study period in Worcester, Massachusetts. Phase one was piloted in the Greendale and Burncoat neighborhoods of Worcester, Massachusetts (Census Tract, 7303). This neighborhood recently lost over 25,000 trees in a two-mile radius as a result of the 2008 ice storm and the Asian longhorn beetle infestation. Four data collection methods were used in phase one including a content analysis on local (Worcester Telegram and Gazette), national, and Canadian (Toronto, Montreal) newspapers, two focus groups, 32 survey questionnaires, and 18 Q sorts. Phase two was conducted in area 7309.01 in the Walnut Hill neighborhood of Worcester, MA. The objective of phase two was to gather the opinions of residents living inside the quarantine zone, who have not had their trees cut. This phase consisted of 30 surveys and 14 Q sorts.

By observing the overall results and then comparing the neighborhoods against one another, we can determine if differences exist in peoples' perception of trees based on whether they were removed or not. Phase three (September-November 2010) further explored the neighborhoods outside the quarantine zone in the Sixteen Acres neighborhoods of Springfield, Massachusetts.

Literature Review

Forestry and academic literature has revealed a host of benefits associated with urban trees, but estimating their value to the community can be extremely difficult. The benefits described by experts can by expressed in four categories: economic, environmental, social, and health-related. The sections below will describe how each of the benefits was analyzed in this study.

Environmental benefits emphasize how the presence of trees enhances a community from an ecological standpoint, as well as a humanistic viewpoint. These benefits include a tree's ability to improve air quality, control rainfall runoff and flooding (therefore stabilizing soils and reducing erosion), contribute to phytoremediation, enhance urban wildlife and biodiversity, and embody aesthetic value to a community.

The economic benefits are built around the services that community trees provide at no cost, and the avoided costs they represent. These benefits include: a tree's ability to moderate temperatures and microclimates, increase property value, and have a positive impact on shopping behavior and perception of shopping experience. Academia describes the economic value of trees purely scientifically; this research looks to broaden this perspective to include public input, revealing real economic costs that residents experience in everyday life.

The social benefits of urban trees have been extensively documented by experts. These benefits are supported through trees ability to impact a community and its residents directly. They include: improved learning and behavior by children in urban areas, reduced urban noise levels, a cultivate attachment to place emotionally and spiritually, and a reduction of negative psychosocial issues such as fear violence, and aggressive behavior. Contrary to the researchers' expectations, some of the more seemingly obvious social benefits that residents revealed such as privacy and protection, and the emotional attachment those residents have both historically and memory oriented values, were understated.

The fourth category is the health-related benefits, both physical and psychological, which include: trees ability to reduce skin cancer, lead to recovery and less pain, reduce human stress levels, and increase oxygen levels.

Q method takes these benefits, and through an extensive methodology, reveals the different social perspectives that exist on the topic.

A steady migration of inhabitants from the suburbs to cities has resulted in an overall increased usage of energy and natural resources. Presently, forty-three percent of Americans live in cities of at least 25,000 people (Birch, 2009). As urban areas become overcrowded, green infrastructure is transformed to streets and buildings, and it becomes extremely difficult for the public to experience nature.

Although trees have always been a valued amenity in American cities; academics, policy makers, and politicians are becoming more aware of how trees benefit residents living in urban ecosystems and the services trees provide (Wolf, 2004). Scholars in ecological economics have

attempted to identify and quantify the value of the natural services earth provides. In 1997, environmental economist and chief authority on the value of earth's ecosystems, Robert Costanza, published an article in the British journal *Nature* estimating the total value of U.S ecosystem services at 33 trillion dollars annually in economic value (Costanza, 1997). Scientific studies have evaluated the economic value trees represent. However, these opinions are often times completely scientific and lack resident credibility. This study looks to strengthen these opinions and expand them through an extensive Q study with residents living in Worcester, Massachusetts. By combining scientific research with resident opinions, the researchers hope to gather the entire spectrum of opinions around the benefits of urban trees. For example, Wolf (1998) reported that a twenty-five foot tree has the capability of reducing annual heating and cooling costs by eight to twelve percent in households. An interesting statement, but exclusively scientific; this research will provide evidence to show how residents experience the shade that trees provide and the economic value they represent. Another example, Benedict and McMahon, 2002, mention a 1990's study in New York which concluded that by purchasing and protecting watershed land in the Catskill Mountains, the city saved approximately 5 billion dollars on filtration and treatment plants. In this study, the researchers will not only understand how residents value the trees in their neighborhoods, but more specifically how residents communicate some of the benefits described in expert literature and the social, environmental, economic, and health impacts they have within a community.

By compiling forestry and academic literature, along with a set of newspaper articles from cities that experienced the ALB infestation, the team developed a Q study that would allow the public to rate how strongly they felt about the benefits expressed by experts and discussed in newspaper articles. The first major step in this research was to gather forestry and academic literature on the benefits of urban trees documented by experts. This information can be seen in Tables 1 through 17 below.

Environmental Benefits of Trees

Table 1. **Improve air quality and sequester carbon**

Author , Year	**Source**	**Notes**
Nowak 1993, 1994	Atmospheric Carbon Reduction by Urban Trees Journal of Environ Manage	Bigger trees remove more carbon than small ones
Nowak and McPherson 1993	Quantifying the Impact of Trees: The Chicago Urban Forest Climate Project.	Improve air, sequester carbon.
Nowak and Crane 2002	Carbon Storage and Sequestration by Urban Trees in the USA Environmental Pollution	Less carbon sequestering in urban forests than forest stands
Rowntree and Nowak 1993	Measuring and analyzing urban tree cover. Landscape Urban Planning	Improve air, sequester carbon
McPherson 1997	Modeling Residential Landscape Water and Energy Use to Evaluate Water Conservation Policies. Landscape Journal	Chicago gets $9mil worth of air quality in 1 year Long term benefits of trees are 2x value of costs

Table 2. **Aesthetics**

Author, Year(s)	Source(s)	Notes
Schroeder 1989	Environment, Behavior, and Design Research on Urban Forests Advances in Environment, Behavior and Design-Book	Residents credit trees as most important feature to aesthetic quality of community, more appealing so increase value of property

Table 3. **Remove pollutants from air**

Author, Year(s)	Source(s)	Notes
Nowak 1994, 1995	"Trees Pollute? A "TREE" Explains it all"	TREE, removal of air pollutants
Smith 1990	Air Pollution and Forests- book	Vegetation temporarily retains pollutants, then washed off by rain or dropped with leaves

Table 4. **Control rainfall runoff and flooding therefore stabilizing soils and reducing erosion**

Author, Year(s)	Source(s)	Notes
Sanders 1986	Urban Vegetation Impacts on the Urban Hydrology of Dayton Ohio Urban Ecology	Ohio 22% canopy coverage to 29% coverage reduce runoff from 7-12% Reduces money spent on process, improve groundwater recharge Through controlling rainfall and flooding, stabilize soils, reduce erosion
Haughton and Hunter 1994	Sustainable Cities, Regional Policy and Development, book	Rain becomes surface water runoff and degrades water, pick up urban street pollutants

Table 5. **Phytoremediation**

Author, Year(s)	Source(s)	Notes
Westphal and Isebrands 1989	Phytoremediation of Chicago's Brownfields: Consideration of Ecological Approaches to Social Issues Conference proceedings	Absorbing, transforming, containing contaminants

Table 6. **Urban wildlife and biodiversity**

Author, Year(s)	Source(s)	Notes
Van Druff et al 1995		Economic benefit (birdfeeder industry), biological indicator of area health
Johnson 1988	Planning for Avian Wildlife in Urbanizing Areas in America Desert/Mountain Valley Environments. Landscape Urban Planning	Provide habitat that improves biodiversity
Brown 1979	Interests and Attitudes of Metropolitan New York Residents About Wildlife Conference proceedings	Feelings of personal satisfaction when attracting wildlife

Health Benefits of Trees

Table 7. **Reduce cancer risk**

Author, Year	Source	Notes
Heisler et al 1995	Urban forests' Cooling our Communities? Conference proceedings	Shade reduces UV radiation, cancer and cataracts

Table 8 **Recovery and less pain**

Author, Year(s)	Source(s)	Notes
Ulrich 1984	View Through A Window May Influence Recovery From Surgery Science	View of trees in hospital window reduce recovery time, use less medicine, better mood through stay

Table 9. **Reduce human stress levels**

Author, Year(s)	Source(s)	Notes
Ulrich 1984, 1991	View Through a Window May Influence Recovery From Surgery Science Stress Recovery During Exposure to Natural and Urban Environments, Journal of Environmental Psychology	Exposure to urban environments increase stress, exposure to green spaces reduce stress
Hull 1992;Kaplan and Kaplan, 1989	How the Public Values Urban Forests Journal of Arboriculture	Urban parks reduce stress
Cackowski and Nasar 2003	The Restorative Effects of Nature: Implications for Driver Anger and Frustration, Environmental behavior	Reduce driver aggression

Economic Benefits of Trees

Table 10. **Moderate temperature and microclimates (carbon avoidance)**

Author, Year(s)	Source(s)	Notes
Heisler 1986, 1990, 1995	Energy Savings with Trees Tree Plantings that Save Energy Effects of Individual Trees on the Solar Radiation Climate of Small Building Urban Ecology	Alter wind speed and direction, reduce solar radiation by 90%, transpiration (all work together) Shade reduces summer energy use, 20-25%
McPherson 1990, 1997	Modeling Residential Landscape Water and Energy Use to Evaluate Water Conservation Policies. Landscape Journal	Reduce need for AC, carbon avoidance
Akabari 1988, 1992, 1995, 2002	"The Impact Of Summer Heat Islands On Cooling Energy Consumption And CO2 Emissions" Cooling Our Communities: A Guidebook on Tree Planting and Light-colored Surfacing Shade Trees Reduce Building Energy Use and CO_2 Emissions from Power Plants	5 degree C reduction of city temp, transpirational cooling, reduce solar heating of dark surfaces $2 billion annual reduced energy cost with 100 mil residential trees Urban tree planting can account for 25% reduction in net cooling and heating energy usage in urban landscape
Nowak, 1995	"Trees Pollute? A "TREE" Explains it All"	TREE, Temperature, Removal of pollutants, Emission of VOC's, Energy conservation
Haughton and Hunter 1994	Sustainable Cities, Regional Policy and Development, book	Wind speed lowered 10-30%, solar radiation reduced up to 20%
Scott et al 1999	Effects of Tree Cover on Parking Lot Micro-Climate and Vehicle Emissions Journal of Arboriculture	Shading in parking lots reduces VOC emission of cars

Table 11. **More productive office workers**

Author, Year(s)	Source(s)	Notes
Kaplan 1992, 1993	The Role of Nature in the Context of the Workplace. Landscape Urban Planning	View of trees at office provides psycho benefits to affect job satisfaction, more productive, fewer illnesses, higher job satisfaction

Table 12. **Increased property Value**

Author, Year(s)	Source(s)	Notes
Rodriguez and Sirmans 1994	Quantifying the Value of a View in Single-Family Housing Markets.	Good view of park increases single-family home value by 8%

	Appraisals Journal	
Anderson and Cordell 1985, 1988	Influence of Trees on Residential Property Values in Athens, GA Landscape Urban Planning Residential Property Values Improve by Landscaping with Trees Journal of Applied Forestry	Athens, GA, increased value of 3.5-4.5% higher with trees
Crompton 2001 2004	The Proximate Principle: The Impact of Parks, Open Space and Water Features on Residential Property Values and the Property Tax Base, Nat'l Rec and Park Assoc	Near a park increases home value (8-20%), ripple effect of being near green space 7% increase in rental commercial rates near landscaped property
Dombrow et al 2000	The Market Value of Mature Trees in Single Family Housing Markets Appraisals Journal	LA 2% increase home value
Sydor et al 2005	Valuing Trees in a Residential Setting: Revisiting Athens Draft paper	Athens, GA, $296 increase in residential value
Thompson et al 1999	Valuation of Tree Aesthetics on Small Urban-Interface Properties Journal of Arboriculture	5-20% increase depending on health of forest nearby

Table 13. **Positive impact on shopping behavior and perception of shopping experience**

Author, Year(s)	**Source(s)**	**Notes**	**Notes 2**
Wolf 2004, 2005	Freeway Roadside Management: The Urban Forest Beyond the White Line Trees and Business District Preferences: A Case Study of Athens, Georgia US Business District Streetscapes, Trees, and Consumer Response Journal of Arboriculture	Consumer behavior, spend longer shopping, pay to park, spend more, consumers like tree screen from commercial areas Spend more	Nesting sampling Survey method, mailed Preference rating exercise, 30 images, varying green space, then a shopping scenario to project behavior, rating scales, then questions on urban tree perception and demographics
Wolf 2003	Public Response to the Urban Forest in Inner-City Business Districts Journal of Arboriculture		Respond to visual hypothetical situations, perception, then behavior, then WTP (willingness to pay) Last demographics and socioeconomic situation Mailed surveys
Crompton 2001	Parks and Economic Development. American Planning Association		Customer service, merchant helpfulness, product quality are better in places with trees
Dwyer et al 1992	Assessing the Benefits and Costs of the Urban Forest Journal of Arboriculture		Urbanites that use parks pay more for trees and forests in recreational areas

Social Benefits of Trees

Table 14. **Reduce urban noise levels**

Author, Year	Source	Notes
Cook 1978	Trees, Solid Barriers, and Combinations: Alternatives for Noise Control Conference Proceedings	30m wide belt of tall dense trees + soft ground reduces sound 50%
Reethof and McDaniel 1978	Acoustics and the Urban Forest Conference Proceedings	3-5 decibel reduction with row of shrub and row of trees behind
Bolund and Hunhammer 1999	Ecosystem Services in Urban Areas	Evergreens preferred for noise reduction, but soft ground and vegetation decrease noise
Aylor 1972	Noise Reduction by Vegetation and Ground Journal of Acoustics	Leaves and stems scatter sound (ground absorbs it)

Table 15. **Improving learning and behavior by children in urban areas**

Author, Year	Source	Notes	Notes 2
Taylor, Kuo and Sullivan 2001	Views of Nature and Self-Discipline: Evidence from Inner-City Children Journal of Arboriculture	Because reduced stress and physical fitness increases learning and better behavior by children	Observed use of outside space, near trees or not near trees

Table 16. **Cultivate attachment to place, emotional and spiritual**

Author, Year(s)	Source(s)	Notes	Notes 2
Chenoweth and Gobster 1990	The Nature and Ecology of Aesthetic Experiences In the Landscape. Landscape Journal		Provide experience (emotional and spiritual) and foster strong attachment to community, positive meanings and values
Barro, Gobster, Schroeder and Bartram 1997	What Makes a Big Tree Special? Trees Program	Emotional ties to trees and connection to community	Qualitative analysis of comments made by residents about specimen trees in area, key word/coding
Dwyer et al 1991			Attachment to places and trees
Schroeder 1991, 2002, 2004	Preference and Meaning of Arboretum Landscapes: Combining Quantitative and Qualitative Data Journal of Environmental Psychology Experiencing Nature in Special Places Journal of Arboriculture Special Places in the Lake Calumet Area USDA report		Provide experience that foster spiritual and cultural attachment
Westphal 1999, 2003	Empowering People Through Urban Greening Projects: Does it Happen? Conference Proceedings Urban Greening and Social Benefits: A Study of Empowerment Outcomes	Volunteer tree planting provides more connection Strengthens sense of community	Photoelicitation and semi-structured interview, both data analyzed Single use camera to take 10 pictures of changes in

	Journal of Arboriculture		environment, door to door canvassing
Feldman and Westphal 1999		Active in community tree care increases connection	

Table 17. **Reduce negative psychosocial issues, fear, violence, aggressive behavior**

Author, Year(s)	Source(s)	Notes	Notes 2
Kuo, 1996 1998	Fertile Ground for Community: Inner-City Neighborhood Common Spaces and the Social Integration of Inner-City Adults.	Stronger ties to neighbors, sense of safety and adjustment, more children supervision, healthy pattern of play, use of neighborhood common space, few incivilities, fewer property crimes, fewer violent crimes better coping skills Less graffiti near green areas of neighborhood	Watching residents and their behavior outside, spending time outside, focused on spaces near trees. 145 randomly assigned residents in public housing units (2 types, w/ trees and w/o) studied "How safe do you feel here?" Then 90 residents asked to report incivilities, graffiti, etc
Dwyer et al 1992	Assessing the Benefits of and Costs of Urban Forests		Chicago research, alleviate hardships of inner-city life
Kuo and Sullivan 2001	Environment and Crime in Inner-City: Does Vegetation Reduce Crime?	Less crime in buildings with more trees and green space	Collect 2 years of police reports for 98 apt buildings and correlate that w/ green cover
Kuo 2003	The Role of Arboriculture in a Healthy Social Ecology Journal of Arboriculture	In poor inner-city neighbors more green space means enhanced resident territoriality, healthier patterns of interrelation, shared resources	100 Chicago residents asked to respond to images, one with trees, one without
Schroeder and Anderson 1984			Reduce the fear of crime

It is valuable to know what experts have concluded about the benefits of trees, but what about the public? Expert opinion provides an excellent baseline for this study because it essentially frames urban tree policy; but linking this to public perception will provide experts with insight into how the public might receive and process messages about the value of urban trees. Understanding and communicating how residents experience and value their trees will, first, educate politicians and policy makers on the concerns and feelings of residents, and second, broaden the range of benefits by expressing those benefits residents can convey more easily than experts can articulate scientifically. This study presents an opportunity to evaluate the similarities and differences amongst expert and resident opinion and develop an understanding of which benefits the public has the strongest opinions on.

Methodology

The goal of this multi-phase research is to understand how residents value and experience trees, and communicate those conclusions to politicians and decision makers who may help better manage and protect urban forests. Forestry and academic literature has revealed a host of benefits connected to urban trees; however, the researchers felt that more could be done to defend and support these benefits with the input of residents. Experts express the benefits of trees primarily through a scientific viewpoint, but resident opinion in collaboration with expert opinion will help construct more credible data. There are several methods of data collection that can be used to generate the type of information desired, these include: surveys, questionnaires, focus groups, and content analysis. All of the methods above were utilized in some phase of this study, however, in phase two, the focus of this paper; the researchers selected a unique social science research method called Q methodology. In Q methodology, it is essential to first understand the Q language or Q jargon used in the methodology. Some of the terminology will be listed here, and the rest will be described prior to the analysis section of the paper:

Concourse: A body of literature about the topic, usually consists of text, (newspaper articles relevant to the topic of interest)

Q statements: Strategically selected statement that is an expression of an individual opinion.

Q participants: People with clearly different opinions who are asked to express opinions about the Q statements by sorting them, i.e. "doing a Q sort."

(Webler, Danielson, Tuler, 2009)

To begin, the researchers used a Q sort to collect raw data from a defined group of individuals in the target population. A Q sort statistically reveals a respondent's subjectivity on a set of Q statements. Once the Q sorts were completed by residents, they were input into pqMethod, which generated statistical analysis in the form of factor analysis, Z score, etc. This data was then interpreted by the researchers and expressed through qualitative social narratives to describe the different social perspectives that exist on the topic. This section of the paper will introduce, review, and analyze the Q research method to explore how residents understand and value urban trees.

Selecting the Concourse

The concourse is intended to enclose the entire range of perspectives on the topic. The concourse of text for this research included newspaper articles published in areas where the Asian longhorn beetle had been identified. Expert literature was used to help source benefits that residents described. The team also conducted focus groups to ensure all categories of concern were covered. The newspaper articles expressed public opinion, yielding valuable statements that could be isolated and used as Q statements. To ensure that the final Q sample represented the concourse effectively, the research team divided the concourse into four categories that would cover a full range of benefits on urban trees. The categories represented were environmental,

social, economic, and health related benefits previously mentioned in the literature review section.

Deriving Q Statements

The Q statements were selected through a methodical content analysis of local, national, and Canadian newspapers covering the ALB infestation. The articles of interest specifically explore the public perception of urban trees and the benefits of urban trees more so than the beetle itself, however all issues were considered in the initial development of the concourse. The articles were obtained online via WPI's Gordon Library search engine that extracted relevant articles from: *Worcester Telegram and Gazette, The New York Times, The New Yorker, The Star-Ledger, Chicago Tribune, Chicago Sun Times, Toronto Sun, Montreal Gazette*. The team analyzed over 500 articles, and after an initial selection based on relevancy, a set of 129 potential statements remained. These 129 statements were presented to Robert Krueger, Ph.D., an advanced Q researcher, for further analysis. Each statement was examined alone and beside the four categories (environmental, social, health, economics). From there, each was critiqued and placed into a specific category to attain a broad range of perspective that would be most appropriate for our concourse.

Once each of the 129 statements was placed in a category, the researchers discussed the strengths and weaknesses of each statement. Each category was then reduced to about 16 to 18 Q statements. They were then observed to ensure all important aspects of the concourse were included in the 66 statement sample. The final step in the Q statement selection process was a final review of the statements in which they were systematically critiqued to yield a set of 42 unique statements most appropriate for the study. These final Q statements can be viewed in Appendix C- Q Cards.

An interesting benefit of Q methodology is its ability to accurately represent people's natural statements, or perceptions on a topic (Robbins and Krueger 2000). A portion of our Q statements directly reflect quotes from residents taken from newspaper articles. Brown (1970) explained that a good Q statement represents an expression of an individual that residents can easily relate to, and that having a mix of positively and negatively worded statements is most effective in the Q statements selection.

In this Q design, a forced normal distribution was used to assure that the participant ranked each individual statement against one another. In the end, the strongest opinions arranged themselves toward the +6 column, the most neutral statements in the zero column, and the statement the participant least agreed with in the -6 column (Webler, Danielson, Tuler, 2009).

The Condition of Instruction

The "condition of instruction" is Q terminology for the researcher's instruction on how to sort the cards. The condition of instruction should be developed around the question or goal of the study and the data desired (Webler, Danielson, Tuler, 2009). It is a neutral sentence that precedes the Q statements in which all statements, positive or negative, follow smoothly. The 42 statements selected were edited so that they would flow smoothly along with the condition of

instruction “trees in my neighborhood...” For example ‘trees in my neighborhood…protect my kids from the sun’.

Selecting Q Participants

The individuals who perform the Q sorts are called Q participants (Webler, Danielson, Tuler, 2009). In a Q study, the researchers select participants to capture the range of opinions within a concourse. Typically, one to three dozen people are sufficient for a Q study; this study had 32 participants (Webler, Danielson, Tuler, 2009). The Q participants in this study represent a population of residents living in Worcester, Massachusetts, whom either witnessed or experienced significant tree loss in their neighborhoods.

Unlike most Q studies that rely on expert judgment, this specific study put no emphasis on selecting residents with expert knowledge of urban forestry, arboriculture, agriculture or any other related field. No specific level of education was required; instead residents living in the restricted areas were randomly selected, and if willing to participate, became participants in the study.

The recommended number of Q participants for a study is a 1:3 ratio of participants to statements (Webler, Danielson, Tuler, 2009). Thus the number of participants is dependent on the number of Q statements in the concourse. In this study, there are 42 Q statements and 32 Q participants. However, the data was collected in two separate phases and in two separate neighborhoods. Phase one consisted of 18 Q sorts from an area (Greendale/Burncoat) that lost its trees as a result of the ALB. In phase two, 14 Q sorts were gathered in the Walnut Hill neighborhood, an area in the quarantine zone that did not have trees cut. Therefore the ratio of statements to participants in each of the neighborhoods, if approached separately, was about 1:3.

Q Cards

The statements were printed out on cards approximately the size of business cards and are shown in Appendix C- Q Cards. Each statement was given a random identifying number to facilitate data recording. The number was written on the front of the card to be easily recorded. Each time the research team went out to collect data, two copies of Q cards were kept on hand in case a card became lost or damaged (Webler, Danielson, Tuler, 2009).

The statements should be placed on the Q board from left to right in order of importance to the participant. While the distribution table ranges from -6 to +6, it is essential for the participant to understand that the purpose of a forced normal distribution is to compare how a participant rates one statement from another (Webler, Danielson, Tuler, 2009). Thus, the participant must be instructed not to sort the statements from disagree to agree, but rather from those they most agree with to those they least agree with (Brown, Durning, Shelden 2007). Additionally, the midpoint in the Q sort has zero pull on the data represented. The participant may agree or disagree with all the statements; allowing the research team to measure the benefits of trees in relation to one another (how strongly someone feels about a particular statement over another statement).

Conduct the Q Sorts

Preceding each Q sort, the sorting instructions, along with the goals of the study was explained to the participant. It was effective to show the participant the cards and the distribution chart when explaining the study to familiarize them with the methodology. It was emphasized to participants that there is no right or wrong answer. Prior to performing the Q sort, they were asked to sign a consent form that was pre-approved by Robert Krueger and the Institutional Review Board (IRB). See Appendix A- Consent Form. The consent form was intended to assure the participant that personal and identifying information would be kept private. It is always good practice to keep the results of Q studies anonymous, and locked in a filing cabinet with research access only (See Appendix for consent form) (Webler, Danielson, Tuler, 2009).

Doing the Q Sort

The Q board is displayed below in

. There are exactly forty-two spaces in which to place the cards. The board is designed in such a way that forces the participant to prioritize which statements hold the least and most importance to them (Webler, Danielson, Tuler, 2009). The general procedure for carrying out a Q sort is as follows: The participant was asked to read through the statements and then sort them into three piles – a "most like how I think" pile, a "sort of like how I think" pile, and a "less like how I think" pile (Webler, Danielson, Tuler, 2009). Once these piles were established the participants were asked to begin placing the Q cards onto the distribution board. The participants were reminded that the vertical rows or y- axis hold no significance, nor do the numbering on the cards that are simply for recording purposes. The participants were also reminded that they are free to move cards around in the sort at any time. It was emphasized that one of the points of Q methodology is to force them to prioritize and that the normalized distribution is not intended to force the participants to rate statements negatively, it is strictly to rate the statements relative to each other using the statement *least like how I think* to *most like how I think* (Webler, Danielson, Tuler, 2009). All participants with whom we worked either preferred to conduct the sort in their own home, or on a porch outside their home. The researchers emphasized doing the Q sorts in the most comfortable environment with adequate privacy and free from distractions.

The sorting instructions are explained in further detail in Appendix B- Q Protocol.

Phase 1: Greendale/Burncoat Neighborhoods

The researches held two focus groups in the Greendale and Burncoat neighborhoods of Worcester, Massachusetts. All residents who participated in either of our two focus groups were asked, and all agreed, to participate in a Q sort before the focus group conversation began. Focus groups, surveys, and Q sorts were done simultaneously in this phase; as a result, it was effective to use the formal setting as an opportunity to conduct Q sorts. From these two groups, eleven participants completed a Q sort. The remaining 7 Q sorts in these neighborhoods were gathered through an informal, door to door, method. The researchers randomly selected a group of houses to target for collecting surveys and Q sorts. Each house was visited three times before a new set of addresses were randomly assembled. This process continued until 32 surveys and 18 Q sorts

were completed. It was necessary to construct multiple Q boards because such a large number of Q sorts were done in a single sitting,

Phase 2: Walnut Hill Neighborhoods

A random sampling method was used to gather Q sort participants in the Walnut Hill neighborhoods. Because Q sorts were done simultaneously with surveys, the same random sampling strategy was used for each method. The researchers began with the assumption that every participant selected would complete the Q sort and the survey; therefore the first target group included 30 addresses. Once the participants were identified, they were contacted through a door to door method and asked if they had 15 minutes to help with the study. If they were not available to do the sort at that time they were politely asked to schedule a time that would be more convenient for them. Each house targeted was visited three times before the team developed a new set of addresses. After each of the first 14 selected residences was contacted, the number of completed surveys was calculated, and depending on the number, another group of addresses were randomly selected. This process continued until 14 Q sorts were completed. The Q sorts were all held at the residence of the participant, the comfort of the participant was a main concern in choosing the setting.

Record the data

When the participants were satisfied with their sort, it was recorded on a data record page by filing in the number on the front of the card in the space on the empty sheet which is identical to the Q sort board.

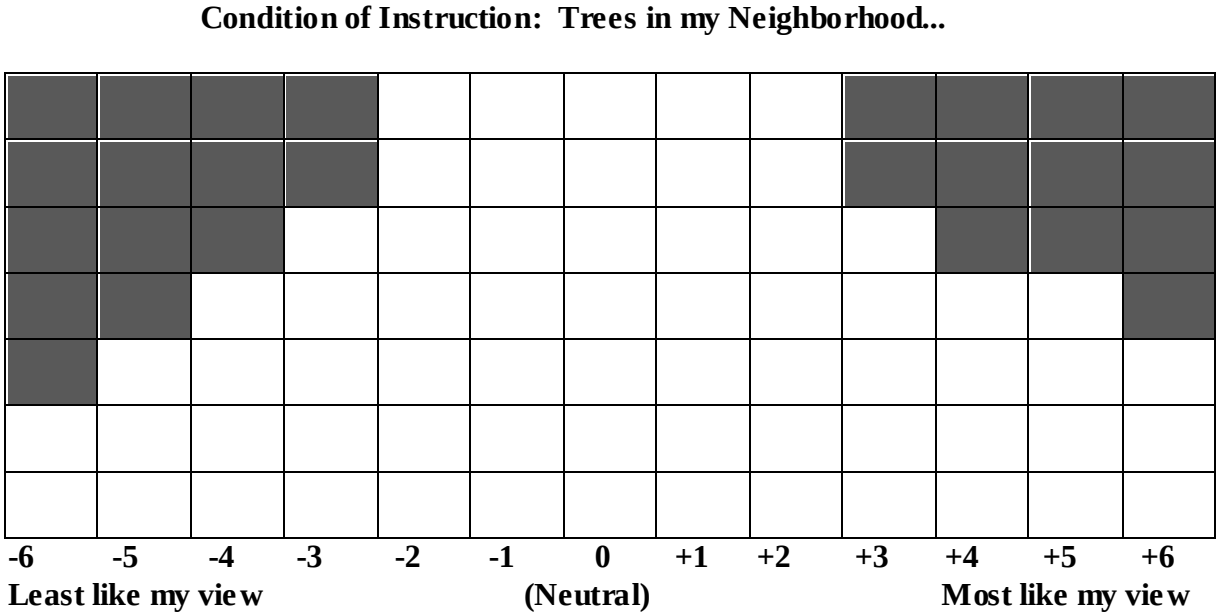


Figure 1. Q Board

Q Method Analysis

The researchers used PQmethod, a factor analysis program developed by Peter Schmolck, to reveal statistical evidence supporting the benefits of urban trees in expert literature and expressed in the newspapers. The results of this study are expressed in this paper both qualitatively, through social narratives, and quantitatively, through factor analysis, Z-scores, factor loading, and statement factor scores. To begin, it is essential for the reader to understand the Q jargon that is used in Q sort analysis.

The 'subjects' are the Q statements; the term 'variable' is used to describe a Q sort done by a Q participant and the 'concourse' is all the possible perspectives on a topic. In Q, the goal of the researcher is to find patterns where Q statements appear in different Q sorts (Webler, Danielson, Tuler, 2009).

Factor analysis is a mathematical technique that reveals underlying explanations for patterns in a large set of data (Webler, Danielson, Tuler, 2009). Q method integrates the use of social science research to develop a collection of data that is analyzed through quantitative statistical analysis to reveal qualitative social perspectives or social narratives. Using the PQmethod, the researcher first performs a factor analysis test. Next, the researchers can "rotate" factors while creating the factor solution. Rotating the factors can make individual factors more definitive, relevant, and meaningful. The researchers rotated the factors using computer-automated rotation called "varimax." Varimax produces the factor solution that displays the maximum amount of variance within the data, explained with as few factors as possible. The researcher is in charge of selecting how many factors they wish to produce, and after looking at data from different factors, they may decide which data is most definitive. After selecting and rotating factor, the program flagged the statements that define the factor, and produced an extensive report with a variety of tables on factor loadings, statement factor scores, discriminating statements for each of the factors as well as consensus statements across factors. (Webler, Danielson, Tuler, 2009).

PQmethod mathematically invented a few new 'factors' used to describe statistical patterns in the data. Normally a Q study will reveal 2-5 factors or perspectives; in this study we analyzed 2, 3, and 4 social perspectives. Typically, there should be at least three people loading highly on a perspective for it to be considered significant (Webler, Danielson, Tuler, 2009). Through a collaborative effort, the social perspectives were extracted from the raw data by the researchers. The researcher should then examine the perspectives for similarity and that will assure that each factor is clearly defined and distinct (Webler, Danielson, Tuler, 2009).The job of the researcher is to interpret the data, identify patterns, and eventually write a narrative describing each factor; this factor description is called a social narrative. Social narratives represent the qualitative meaning behind these 'factors' expressed through quantitative statistical data. Factor analysis can involve a great deal of judgment and there are several possible solutions to the factor analysis, thus determining which is "best" is a matter of interpretation (Webler, Danielson, Tuler, 2009). The PQ Method computed 2, 3 and 4 factors, and comparatively analyzed these results to identify which results were most convincing.

In analyzing the data, there are a few guidelines the researcher can use to help establish the strength of each factor. For example, factors with values >1.0 or <-1 are probably significant unless multiple factors rate extremely high or low on the same statement (Webler, Danielson, Tuler, 2009). Also, the PQMethod output file provides a list of distinguishing statements, statements that were significantly different among the factors, and should be a focal point in the analysis stage (Webler, Danielson, Tuler, 2009). In the end, the researcher must be able to defend his or her factors with a convincing explanation that their Q sorts were closer to the social perspective than other people. The degree of this similarity can be computed into what are called 'factor loadings'. Loadings in this study range from 3 (complete agreement) through 0 (no agreement) to -3 (complete disagreement). Ideally, each Q participant loads highly on one factor, but this is not always the case. A solution where no Q participant loads highly on any factor is considered a poor solution and demands that either the number of factors be adjusted or the particular factor is insignificant (Webler, Danielson, Tuler, 2009). People with the highest and most definitive factor loading for a given perspective, are said to "define" that perspective (Webler, Danielson, Tuler, 2009). Sometime within the data there will be statements that are listed as Non-Significant at P>.01. This study yielded a group of five statements that fit into this category shown below in Table 18(Webler, Danielson, Tuler, 2009).

Table 18. **Non-Significant Statements**

No.	**Statement**	**Factor 1**		**Factor 2**		**Factor 3**		
4	Increase my property values	4	1.12	7	1.34	4	1.44	5
23	Can make any collection of buildings	23	.87	11	0.90	9	0.67	10
24	Need my attention if their going...	24	.11	21	-0.11	23	-0.29	25
25	Protect us from the noisy highway	25	-0.60	29	-0.60	29	-0.80	32
34	Should be biodiverse...	34	0.17	20	-0.08	22	0.42	15

After analyzing the results of each factor, it was evident that the introduction of 3 factors revealed the strongest and most definitive perspectives for the combined Greendale/Burncoat and Walnut Hill data. The research team then analyzed the 3 factor analysis data generated by PQmethod to identify social narratives to define each perspective. Once the factor is described in the language of the Q statements it becomes a social perspective and the product of the Q study (Webler, Danielson, Tuler, 2009). Stephenson (1965) wrote that "the Q sorts are *individual* perspectives, the factor analysis solutions reflect deeper organizing principles, and hence they are called *social* narratives."

Greendale/Burncoat and Walnut Hill

Table 19 below shows how the process by which the researchers selected distinguishing statements from the data. GREEN means that the statement rated highly and RED meant the statement rates low. By identifying these distinguishing statements and then observing the group of statements within a factor together, the researcher began to identify the type of individual this factor represented.

Greendale/Burncoat and Walnut Hill

Table 19. **Combined Data for Greendale/ Burncoat and Walnut Hill**

PQMethod2.11 Trees in my neighborhood… Factors and statement #

No.	Statement	No.	1	#	2	#	3	#
1	Reduce the cost of air conditioning.	1	0.09	22	0.83	10	-0.90	35
2	Have roots that bust my pipes.	2	-1.38	37	-0.70	31	-0.88	33
3	Clog the gutter	3	-1.14	34	-0.01	21	-1.43	39
4	Increase my property values	4	1.12	7	1.34	4	1.44	5
5	Require professional care beyond...	5	-1.59	41	-1.60	42	0.01	23
6	Are a hazard if their limbs fall.	6	-1.23	35	.41	16	.86	8
7	Reduce my electric bills	7	-0.41	27	.77	12	-0.61	29
8	Damage our sidewalks	8	-1.40	39	-0.4	26	1.54	3
9	Are expensive to plant and maintain	9	-1.38	38	-1.40	38	-.45	26
10	Protect my kids from the sun	10	0.41	19	-0.60	28	-2.05	42
11	Are a reason we bought this house	11	1.39	1	-1.54	40	0.37	16
12	Damage my fence	12	-2.02	42	-1.06	36	-0.71	30
13	Create lush canopies during the summer	13	1.38	2	1.13	7	1.89	1
14	Are a legacy from previous generations	14	.86	12	-0.32	24	0.54	14
15	Reduce basement flooding	15	-.68	31	0.23	18	-0.89	34
16	Connect people to their land	16	1.21	5	-1.08	37	0.34	17
17	Have become 'part of the family'	17	.82	14	-1.42	39	0.21	20
18	Having a calming effect that enhances...	18	1.00	9	0.06	19	-0.06	24
19	Are worth defending and provide	19	1.23	4	0.02	20	0.59	13
20	Provide a place for people to talk	20	-0.01	24	-0.95	35	-1.00	37
21	Are an important political issue	21	-0.33	26	-0.59	27	-1.45	40
22	Cause me to do a lot of raking	22	-1.14	33	0.61	14	0.65	11
23	Can make any collection of buildings feel like	23	.87	11	0.90	9	0.67	10
24	Need my attention if they're going to survive	24	.11	21	-0.11	23	-0.29	25
25	Protect us from the noisy highway	25	-0.60	29	-0.60	29	-0.80	32
26	Seem to be neglected by the general public	26	-0.61	30	-0.85	33	0.11	22
27	Prevent my community from becoming an…	27	.52	17	0.36	17	1.33	6
28	Are connected to so many memories	28	0.63	15	-0.81	32	-1.42	38
29	Give me a sense of privacy from my neighbors.	29	1.02	8	1.51	3	0.65	12
30	Help lead to much healthier lives...	30	0.61	16	0.78	11	-0.51	27
31	Improve air quality	31	1.25	3	1.83	2	0.17	21
32	Provide oxygen for all residents	32	0.48	18	1.27	5	0.80	9
33	Help landscape my property	33	0.83	13	1.23	6	1.71	2
34	Should be biodiverse	34	0.17	20	-0.08	22	0.42	15
35	Contribute to community safety...	35	0.09	23	-0.89	34	-1.74	41
36	Keep my yard from becoming mud.	36	-0.69	32	0.65	13	-0.60	28
37	Keep my house shaded and cool	37	1.18	6	2.17	1	1.26	7
38	Make my garden too dry and shady.	38	-1.29	36	-0.66	30	0.24	18
39	Make my nose run and my eyes itch.	39	-1.50	40	-1.59	41	-0.72	31
40	Prevent water runoff problems for many	40	-0.25	25	1.04	8	-0.97	36
41	Provide a habitat for wildlife	41	0.95	10	0.54	15	1.45	4
42	Can be decorative if small, but...	42	-0.54	28	-0.37	25	0.23	19

Factor Analysis and Social Narratives for Greendale/Burncoat and Walnut Hill

Factor 1: The Environmentalist

Factor 1 is representative of an environmentalist; someone spiritually, emotionally, and historically attached to their trees, sometimes labeled a 'tree hugger'. It appears this individual is very in tune with nature, and ecological ethics. They address trees ability to provide a habitat for wildlife and recognize the importance of trees in the landscape of a neighborhood (41, 33). They seem to cherish the beauty of nature, and also understand how trees improve air quality (31). They associate the presence of trees with overall happiness, rating highly on statements like "Are a reason we bought this house". This type also demonstrates an emotional attachment to trees and values the memories and historical value "have become 'part of the family'", "are connected with so many memories", "are a legacy form previous generations", "connect people to their land". This individual ranked highly on most all positive attributes of trees and tended to see past small burdens that trees sometimes cause. It is safe to suggest that individuals with this perspective are very connected to their trees and would be very resistant to their removal. This is demonstrated by a strong agreement with statements like "are worth defending and provide a sense of place". Interestingly, there is an absence of economic statements in this social perspective, which suggests they are not very concerned with or aware of the economic value that trees represent.

Table 20. **Distinguishing Statements of Greendale/Burncoat and Walnut Hill (GB/WH)**

Factor 1

11	Are a reason we bought this house	11	1.39	1	-1.54	40	0.37	16
31	Improve air quality...	31	1.25	3	1.83	2	0.17	21
19	Are worth defending and provide a sense of...	19	1.23	4	0.02	20	0.59	13
16	Connect people to their land	16	1.21	5	-1.08	37	0.34	17
18	Having a calming effect that enhances community...	18	1.00	9	0.06	19	-0.06	24
28	Are connected to so many memories	28	0.63	15	-0.81	32	-1.42	38
41	Provide a habitat for wildlife	41	0.95	10	0.54	15	1.45	4
33	Help landscape my property...	33	0.83	13	1.23	6	1.71	2
17	Have become 'part of the family'	17	.82	14	-1.42	39	0.21	20
14	Are a legacy from previous generations	14	.86	12	-0.32	24	0.54	14

Statements 'flagged' by PQmethod

+are a reason we bought this house 1.39
+improve air quality1.25
+are worth defending and provide a sense of place 1.23
+connect people to their land 1.21
+have a calming effect that enhances community safety 1.00
+ are connected to so many memories .63

Statements that rate low are often helpful in describing a perspective.

Table 21. **Statements that rated low for GB/WH Factor 1**

2	Have roots that bust my pipes.	2	-1.38	37	-0.70	31	-0.88	33
6	Are a hazard if their limbs fall.	6	-1.23	35	.41	16	.86	8
12	Damage my fence	12	-2.02	42	-1.06	36	-0.71	30
22	Cause me to do a lot of raking	22	-1.14	33	0.61	14	0.65	11
38	Make my garden to dry and shady...	38	-1.29	36	-0.66	30	0.24	18

Table 22. **Z-Scores using Defining Statements GB/WH Factor 1**

Statement #	Statement	Z-Score
11	Are a reason we bought this house	1.388
13	Create lush canopies during the summer	1.379
31	Improve air quality	1.245
19	Are worth defending and provide a sense of place	1.232
16	Connect people to their land	1.212
37	Keep my hose shaded and cool	1.176
4	Increase my property value	1.122
29	Give me a sense of privacy from my neighbors	1.017

Factor 2: The Utilitarian

This view is an extremely definitive and unique perspective, representative of a utilitarian. It is safe to say that this perspective connects the existence of trees to economic value and attributes shade trees to reduction in the cost of air conditioning and electricity "reduce the cost of air conditioning", "reduce my electric bills", "improve air quality", and "keep my house shaded and cool". This perspective also understands a tree's natural ability to improve landscaping by reducing water runoff and stabilizing soils "keep my yard from becoming mud", "prevent water runoff problems for many", "reduce basement flooding", and it appears they are aware of the avoided costs due to flooding and erosion. Statements like "give me a sense of privacy from my neighbors" also exhibit awareness of the additional costs involved in accounting for the services that trees once provided to the neighborhood. They recognize that the screening trees provide is a valuable amenity that otherwise involves additional expenses to account for that lost privacy.

Table 23**. Distinguishing Statements of GB/WH Factor 2**

37	Keep my house shaded and cool	37	1.18	6	2.17	1	1.26	7
31	Improve air quality...	31	1.25	3	1.83	2	0.17	21
40	Prevent water runoff problems for many	40	-0.25	25	1.04	8	-0.97	36
1	Reduce the cost of air conditioning.	1	0.09	22	0.83	10	-0.90	35
7	Reduce my electric bills	7	-0.41	27	.77	12	-0.61	29
36	Keep my yard from becoming mud.	36	-0.69	32	0.65	13	-0.60	28
15	Reduce basement flooding	15	-.68	31	0.23	18	-0.89	34
29	Give me a sense of privacy...	29	1.02	8	1.51	3	0.65	12
41	Provide a habitat for wildlife	41	0.95	10	0.54	15	1.45	4

Statements 'flagged' by PQmethod
+keep my house shaded and cool 2.17
+improve air quality 1.83
+prevent water runoff problems for many 1.04
+reduce the cost of air conditioning .83
+reduce my electric bills .77
+ keep my yard from becoming mud .65
+reduce basement flooding .23

Table 24**. Statements that rated low for GB/WH Factor 2**

11	Are a reason we bought this house	11	1.39	1	-1.54	40	0.37	16
16	Connect people to their land	16	1.21	5	-1.08	37	0.34	17
17	Have become 'part of the family'	17	.82	14	-1.42	39	0.21	20
19	Are worth defending and provide	19	1.23	4	0.02	20	0.59	13

Table 25**. Z-Scores Using Defining Statements GB/WH Factor 2**

Statement #	Statement	Z-Score
37	Keep my house shaded and cool	2.172
31	Improve air quality	1.834
29	Give me a sense of privacy from my neighbors	1.506
4	Increase my property value	1.336
32	Provide oxygen for all the residents	1.268
33	Help landscape my property	1.235
13	Create lush canopies during the summer	1.129
40	Prevent water runoff problems for many	1.040

Factor 3: The Communitarian

This perspective appears less concerned with the trees themselves, and more aware of what they are a part of and what they add to an environment. A communitarian, concerned with community, property, neighborhood, and aesthetics. They recognize the importance of trees in neighborhood character rating highly on statements like "create lush canopies during the summer", "prevent my community from becoming an empty, windy, dusty place" and value aesthetics or how trees enhance the beauty of the neighborhood. This individual is invested in their local environment, demonstrated by their agreement with the statement "help landscape my property". This type feels that trees "are worth defending and provide a sense of place", "are a reason we bought this house", and, "connect people to their land". An interesting statement that rated highly with this perspective and one which truly distinguishes this factor is "damage our sidewalks". This statement demonstrates the viewpoint's recognition of how trees may negatively affect their neighborhood character as they sometimes consider trees to be a nuisance.

Table 26. **Distinguishing Statements of GB/WH Factor 3**

8	Damage our sidewalks	8	-1.40	39	-0.4	26	1.54	3
13	Create lush canopies during the summer	13	1.38	2	1.13	7	1.89	1
27	Prevent my community from becoming…	27	.52	17	0.36	17	1.33	6
33	Help landscape my property...	33	0.83	13	1.23	6	1.71	2
41	Provide a habitat for wildlife	41	0.95	10	0.54	15	1.45	4

Statements 'flagged' by PQmethod
+damage our sidewalks 1.54
+prevent my neighborhood from becoming an empty windy dusty place 1.33
+are a reason we bought this house .37
+connect people to their land .34
+make my garden to dry and shady .24

Table 27. **Z-Scores Using Defining Statements GB/WH Factor 3**

Statement #	Statement	Z-Score
13	Create lush canopies during the summer	1.891
33	Help landscape my property	1.714
8	Damage our sidewalks	1.543
41	Provide a habitat for wildlife	1.454
4	Increase my property value	1.437
27	Prevent my community from becoming an empty windy dusty place	1.328
37	Keep my house shaded and cool	1.258

Table 28. **Statements that rated low for GB/WH Factor 3**

10	Protect my kids from the sun	10	0.41	19	-0.60	28	-2.05	42
15	Reduce basement flooding	15	-.68	31	0.23	18	-0.89	34
20	Provide a place for people to talk	20	-0.01	24	-0.95	35	-1.00	37
21	Are an important political issue	21	-0.33	26	-0.59	27	-1.45	40
28	Are connected to so many memories	28	0.63	15	-0.81	32	-1.42	38
35	Contribute to community safety...	35	0.09	23	-0.89	34	-1.74	41

Comparison of Greendale/Burncoat and Walnut Hill Factors 1, 2, and 3:

Tables 29-31 below show the statements ranked with either a positive or negative z-score by all three factors or had a mix of positive and negative z-scores between the three factors.

Table 29. **Statements whose Z-Scores were positive for factors 1, 2, and 3**

4	Increase my property values	4	1.12	7	1.34	4	1.44	5
13	Create lush canopies during the summer	13	1.38	2	1.13	7	1.89	1
23	Can make any collection of buildings	23	.87	11	0.90	9	0.67	10
27	Prevent my community from becoming…	27	.52	17	0.36	17	1.33	6
29	Give me a sense of privacy…	29	1.02	8	1.51	3	0.65	12
31	Improve air quality…	31	1.25	3	1.83	2	0.17	21
32	Provide oxygen for all residents…	32	0.48	18	1.27	5	0.80	9
33	Help landscape my property…	33	0.83	13	1.23	6	1.71	2
37	Keep my house shaded and cool	37	1.18	6	2.17	1	1.26	7
41	Provide a habitat for wildlife	41	0.95	10	0.54	15	1.45	4

These statements are what all three perspectives agree are on the "most like me" side of the spectrum.

Table 30. **Statements whose Z-Scores were negative for factors 1, 2, and 3**

2	Have roots that bust my pipes.	2	-1.38	37	-0.70	31	-0.88	33
3	Clog the gutter	3	-1.14	34	-0.01	21	-1.43	39
9	Are expensive to plant and maintain	9	-1.38	38	-1.40	38	-.45	26
12	Damage my fence	12	-2.02	42	-1.06	36	-0.71	30
20	Provide a place for people to talk	20	-0.01	24	-0.95	35	-1.00	37
21	Are an important political issue	21	-0.33	26	-0.59	27	-1.45	40
25	Protect us from the noisy highway	25	-0.60	29	-0.60	29	-0.80	32
39	Make my nose run and my eyes itch…	39	-1.50	40	-1.59	41	-0.72	31

The majority of the statements ranked three times with a negative z-score are statements about the negative characteristics of trees (statements 2, 3, 9, 12, and 39). All three perspectives agree that these statements are on the "least like me" side of the spectrum, to varying degrees.

Table 31. **Statements whose Z-Scores were positive and negative for factors 1, 2, and 3**

1	Reduce the cost of air conditioning.	1	0.09	22	0.83	10	-0.90	35
5	Require professional care beyond...	5	-1.59	41	-1.60	42	0.01	23
6	Are a hazard if their limbs fall.	6	-1.23	35	.41	16	.86	8
7	Reduce my electric bills	7	-0.41	27	.77	12	-0.61	29
8	Damage our sidewalks	8	-1.40	39	-0.4	26	1.54	3
10	Protect my kids from the sun	10	0.41	19	-0.60	28	-2.05	42
11	Are a reason we bought this house	11	1.39	1	-1.54	40	0.37	16
14	Are a legacy from previous generations	14	.86	12	-0.32	24	0.54	14
15	Reduce basement flooding	15	-.68	31	0.23	18	-0.89	34
16	Connect people to their land	16	1.21	5	-1.08	37	0.34	17
17	Have become 'part of the family'	17	.82	14	-1.42	39	0.21	20
18	Having a calming effect that enhances...	18	1.00	9	0.06	19	-0.06	24
19	Are worth defending and provide	19	1.23	4	0.02	20	0.59	13
22	Cause me to do a lot of raking	22	-1.14	33	0.61	14	0.65	11
24	Need my attention if they're going...	24	.11	21	-0.11	23	-0.29	25
26	Seem to be neglected by the ...	26	-0.61	30	-0.85	33	0.11	22
28	Are connected to so many memories	28	0.63	15	-0.81	32	-1.42	38
30	Help lead to much healthier lives...	30	0.61	16	0.78	11	-0.51	27
34	Should be biodiverse...	34	0.17	20	-0.08	22	0.42	15
35	Contribute to community safety...	35	0.09	23	-0.89	34	-1.74	41
36	Keep my yard from becoming mud.	36	-0.69	32	0.65	13	-0.60	28
38	Make my garden too dry and shady...	38	-1.29	36	-0.66	30	0.24	18
40	Prevent water runoff problems for many	40	-0.25	25	1.04	8	-0.97	36
42	Can be decorative if small, but...	42	-0.54	28	-0.37	25	0.23	19

There are many factors whose z-scores vary from negative to positive values. Some of these statements are ranked with both positive and negative values but are concentrated close to zero, such as statement 24 "need my attention if they're going to survive" whose z-scores are 0.11, -0.11, and -0.29, or 34 "should be biodiverse" whose z-scores are 0.17, -0.08, and 0.42 . Since they are all relatively close to zero, we can infer that all three factors agree that this statement is neither "most like me" or "least like me" and it doesn't apply very strongly to them. The other statements, whose z-scores vary greatly from each other, are the contrasting statements that cause the factors to differ from one another.

Phase 1: Greendale and Burncoat Neighborhoods

The same methods that were used to analyze the combined Phase 1 and Phase 2 neighborhoods were used to analyze the neighborhoods separately.

Table 32. **Rank Statement Totals with Each Factor for Greendale and Burncoat Neighborhoods**

PQMethod2.11 Trees in my neighborhood... Factors and statement #

No.	Statement	No.	1	#	2	#	3	#
1	Reduce the cost of air conditioning.	1	-0.57	27	-0.71	31	0.03	21
2	Have roots that bust my pipes.	2	-1.24	37	-1.36	39	-0.45	28
3	Clog the gutter	3	-0.71	29	-0.15	24	-1.68	39
4	Increase my property values	4	1.17	6	1.30	5	1.49	5
5	Require professional care beyond what I can provide.	5	-1.47	41	-1.74	42	-0.50	30
6	Are a hazard if their limbs fall.	6	-1.20	36	-0.15	23	0.14	18
7	Reduce my electric bills	7	-0.90	34	-0.32	26	0.01	22
8	Damage our sidewalks	8	-1.26	39	-0.45	29	0.19	16
9	Are expensive to plant and maintain	9	-1.46	40	-1.58	41	-0.73	35
10	Protect my kids from the sun	10	0.85	12	-1.02	32	-1.75	41
11	Are a reason we bought this house	11	1.69	1	-1.02	33	0.03	20
12	Damage my fence	12	-1.83	42	-0.40	28	-1.61	38
13	Create lush canopies during the summer	13	1.59	2	1.06	9	1.68	2
14	Are a legacy from previous generations	14	0.96	11	-0.50	30	0.84	10
15	Reduce basement flooding	15	-0.68	28	0.58	14	-0.41	26
16	Connect people to their land	16	1.22	5	-1.34	38	0.57	13
17	Have become 'part of the family'	17	0.83	13	-1.13	36	0.49	14
18	Having a calming effect that enhances community safety	18	1.04	10	-0.11	22	-0.12	23
19	Are worth defending and provide a sense of place	19	1.38	3	0.96	12	1.12	7
20	Provide a place for people to talk	20	-0.04	20	-1.37	40	-1.04	36
21	Are an important political issue, one that candidates...	21	-0.35	25	-0.39	27	-1.09	37
22	Cause me to do a lot of raking	22	-0.79	31	1.03	11	-0.43	27
23	Can make any collection of buildings and roads feel part...	23	1.13	8	1.18	8	1.57	4
24	Need my attention if they're going to survive	24	0.13	19	0.24	16	-0.33	25
25	Protect us from the noisy highway	25	-0.71	30	-0.30	25	0.94	8
26	Seem to be neglected by the general public	26	-0.82	32	-0.10	21	-0.66	33
27	Prevent my community from becoming an empty,...	27	0.70	15	-0.07	20	1.31	6
28	Are connected to so many memories	28	0.42	18	0.16	17	-1.69	40
29	Give me a sense of privacy from my neighbors	29	1.26	4	1.21	7	0.65	12
30	Help lead to much healthier lives.	30	0.45	17	1.03	10	-0.57	32
31	Improve air quality...	31	0.73	14	2.09	1	0.08	19
32	Provide oxygen for all residents.	32	-0.05	21	0.67	13	0.71	11
33	Help landscape my property.	33	1.17	7	1.34	4	1.84	1
34	Should be biodiverse.	34	-0.24	23	0.12	18	0.91	9
35	Contribute to community safety.	35	-0.31	24	-1.06	34	-0.57	31
36	Keep my yard from becoming mud.	36	-0.83	33	0.45	15	-0.50	29
37	Keep my house shaded and cool	37	0.65	16	1.38	3	1.60	3
38	Make my garden to dry and shady...	38	-1.25	38	-1.17	37	0.17	17
39	Make my nose run and my eyes itch...	39	-1.09	35	-1.06	35	-1.86	42
40	Prevent water runoff problems for many	40	-0.55	26	1.27	6	-0.70	34
41	Provide a habitat for wildlife	41	1.12	9	1.41	2	0.48	15
42	Can be decorative if small, but won't provide the same...	42	-0.14	22	0.03	19	-0.15	24

Factor Analysis and Social Narratives for the Greendale and Burncoat Neighborhoods

Factor 1: Environmentalist

An individual with this perspective has a very spiritual and historical connection to their trees. An environmentalist, sometimes considered a 'tree hugger', they hold a strong attachment to their trees and view them as something special. They also feel that trees create a sense of place.

This view of trees is full of a deeper and stronger connection with trees than most of the other views. Individuals with this perspective hold a spiritual connection that makes them feel more connected to their land and its history (14, 16). This deeper relationship causes them to be more attached and defensive of their trees (19).

They enjoy the type of atmosphere that trees create around them very much. This individual values the "lush canopies" trees have in the summer and the sense of privacy that they provide from neighbors (13, 29). These characteristics are so important to them that they attribute the presence of trees as a deciding factor when choosing a house to buy (11).

The statements that this view does not associate itself with only strengthen this narrative. They do not feel trees to be a nuisance that they have to deal with; rating statements such as, "are a hazard if their limbs fall", "require professional care beyond what I can provide", "damage our sidewalks", "are expensive to plant and maintain", and "damage my fence", as "least like them".

Table 33. **Distinguishing Statements GB Factor 1**

No.	Statement	No.	1	#	2	#	3	#
11	Are a reason we bought this house	11	1.69	1	-1.02	33	0.03	20
13	Create lush canopies during the summer	13	1.59	2	1.06	9	1.68	2
14	Are a legacy from previous generations	14	0.96	11	-0.50	30	0.84	10
16	Connect people to their land	16	1.22	5	-1.34	38	0.57	13
19	Are worth defending and provide a sense of place	19	1.38	3	0.96	12	1.12	7
29	Give me a sense of privacy from my neighbors	29	1.26	4	1.21	7	0.65	12

Statements 'flagged' by PQmethod

+ Are a reason we bought this house 1.69
+ Have a calming effect that enhances community safety 1.04
+ Protect my kids from the sun 0.85
- Provide a place for people to talk -0.04
- Are a hazard if their limbs fall. -1.20
- Damage our sidewalks -1.26

Table 34. **Statements that rated low for GB Factor 1**

No.	Statement	No.	1	#	2	#	3	#
5	Require professional care beyond what I can provide.	5	-1.47	41	-1.74	42	-0.50	30
6	Are a hazard if their limbs fall.	6	-1.20	36	-0.15	23	0.14	18
8	Damage our sidewalks	8	-1.26	39	-0.45	29	0.19	16
9	Are expensive to plant and maintain	9	-1.46	40	-1.58	41	-0.73	35
12	Damage my fence	12	-1.83	42	-0.40	28	-1.61	38

Table 35. **Z-Scores using Defining Statements GB Factor 1**

Statement #	Statement	Z-Score
11	Are a reason we bought this house	1.685
13	Create lush canopies during the summer	1.591
19	Are worth defending and provide a sense of place	1.375
29	Give me a sense of privacy from my neighbors	1.256
16	Connect people to their land	1.215
14	Are a legacy from previous generations	0.956

Factor 2: Utilitarian

An individual with this perspective recognizes and values a variety of benefits from trees and leans toward having a utilitarian outlook. This utilitarian outlook is not fixated on solely economic benefits however.

The most obvious of these utilitarian benefits that this perspective strongly recognizes, is that trees can keep a house shaded and cool which leads to a lower cost in air conditioning and electric (37). This perspective is also conscious of the way trees positively affect the aesthetics of an area, making it more valuable (4) as well as. We can also assume that this perspective is aware of landscaping and how trees can sequester water, preventing water runoff (40).

An individual with this perspective has an understanding of the ecosystem around them. They recognize that the trees provide a habitat for wildlife and value the fresh air that trees provide to their community (31, 41).

There is no spiritual or historical connection to trees present in this perspective. Statements such as, "connect people to their land", "have become 'part of the family'", and "are a legacy from previous generations" rated far to the "less like me" side of the spectrum.

Table 36. **Distinguishing Statements GB Factor 2**

No.	Statement	No.	1	#	2	#	3	#
4	Increase my property values	4	1.17	6	1.30	5	1.49	5
31	Improve air quality...	31	0.73	14	2.09	1	0.08	19
37	Keep my house shaded and cool	37	0.65	16	1.38	3	1.60	3
40	Prevent water runoff problems for many	40	-0.55	26	1.27	6	-0.70	34
41	Provide a habitat for wildlife	41	1.12	9	1.41	2	0.48	15

Statements 'flagged' by PQmethod with their Normalized Score

+improve air quality (31) 2.09
+prevent water runoff problems for many (40) 1.27
+cause me to do a lot of raking (22) 1.03
+reduce basement flooding (15) 0.58
+keep my yard from becoming mud (36) 0.45
-damage my fence (12) -0.40
-are a legacy from previous generations (14) -0.50
-are a reason we bought this house (11) -1.02
-have become part of the family (17) -1.13
-connect people to their land (16) -1.34

Table 37. **Statements that rated low for Factor 2**

No.	Statement	No.	1	#	2	#	3	#
5	Require professional care beyond what I can provide.	5	-1.47	41	-1.74	42	-0.50	30
9	Are expensive to plant and maintain	9	-1.46	40	-1.58	41	-0.73	35
16	Connect people to their land	16	1.22	5	-1.34	38	0.57	13
17	Have become 'part of the family'	17	0.83	13	-1.13	36	0.49	14
20	Provide a place for people to talk	20	-0.04	20	-1.37	40	-1.04	36

Table 38. **Z-Scores using Defining Statements GB Factor 2**

Statement #	Statement	Z-Score
31	Improve air quality.	2.091
41	Provide a habitat for wildlife	1.408
37	Keep my house shaded and cool	1.376
4	Increase my property values	1.298
40	Prevent water runoff problems for many	1.267

Factor 3: Communitarian

Someone with this perspective views trees as objects that create an enjoyable place for them to live. They believe trees enhance the quality of their community as well as their personal property. They also have a very slight spiritual connection to their trees.

The main things that an individual with this type of view values is what trees do for their property. They provide landscaping and create a comfortable, shaded area in the summer months (33, 13, 37). In the eyes of the resident, this creates a more enjoyable living space for them. However, it is interesting to note that despite these points, they barely considered trees a reason for buying their house (11).

Along with the focus on enhancing personal property, this perspective values the benefits trees can provide to a whole community. They agree with statements such as "can make any collection of buildings and roads feel part of a community" and "prevent my community from becoming an empty, windy, dusty place".

A secondary idea this person would agree with is that their trees are a legacy from previous generations and are worth defending (14, 19). Trees give them a sense of connection to previous generations.

Based on the distinguishing factors, an individual with this perspective may have liked their trees before they were removed but probably did not realize the mentioned benefits until they were gone.

Table 39. **Distinguishing Statements GB Factor 3**

No.	Statement	No.	1	#	2	#	3	#
4	Increase my property values	4	1.17	6	1.30	5	1.49	5
13	Create lush canopies during the summer	13	1.59	2	1.06	9	1.68	2
23	Can make any collection of buildings and roads feel part...	23	1.13	8	1.18	8	1.57	4
27	Prevent my community from becoming an empty,...	27	0.70	15	-0.07	20	1.31	6
33	Help landscape my property	33	1.17	7	1.34	4	1.84	1
37	Keep my house shaded and cool	37	0.65	16	1.38	3	1.60	3

Statements 'flagged' by PQMethod with their Normalized Score

+protect us from the noisy highway (25) 0.94
+make my garden too dry and shady (38) 0.17
+are a reason we bought this house (11) 0.03
-have roots that bust my pipes (2) -0.45
-require professional care beyond what I can provide (5) -0.50
-lead to much healthier lives (30) -0.57
-clog the gutter (3) -1.68
- are connected to so many memories (28) -1.69

Table 40. **Statements that rated low for GB Factor 3**

No.	Statement	No.	1	#	2	#	3	#
3	Clog the gutter	3	-0.71	29	-0.15	24	-1.68	39
10	Protect my kids from the sun	10	0.85	12	-1.02	32	-1.75	41
28	Are connected to so many memories	28	0.42	18	0.16	17	-1.69	40
39	Make my nose run and my eyes itch	39	-1.09	35	-1.06	35	-1.86	42

Table 41. **Z-Scores using Defining Statements GB Factor 3**

Statement #	Statement	Z-Score
33	Help landscape my property	1.843
13	Create lush canopies during the summer	1.681
37	Keep my house shaded and cool	1.596
23	Can make any collection of buildings and roads feel part...	1.569
4	Increase my property values	1.493
27	Prevent my community from becoming an empty, windy, dusty place	1.309

Comparison of Greendale/Burncoat Factors 1, 2, and 3

Consensus Points

All three perspectives placed strong emphasis on the importance of trees to the area around them. They all agree that trees are worth defending and make an area feel more welcoming and more like a connected community (19, 23). Associated with this were the strongly supported ideas that trees help landscape an area and decorate it with lush canopies in the summer (33, 13). This makes sense because these statements are characteristics of trees people would miss very immediately after trees were removed, which was the case in Greendale and Burncoat. The idea that trees increase a property's value received the highest level of consensus among the perspectives (4). Based on the high scores given by all three perspectives, these statements should be taken into consideration when planning anything involving an extensive tree removal in a suburban area and how to communicate with residents in the area.

There were other statements that received all positive scores from all three statements that should be noticed. Participants all gave some level of agreement to the following statements: Trees in my neighborhood…

- Give me a sense of privacy from my neighbors (29)
- Improve air quality (31)
- Keep my house shaded and cool (37)
- Provide a habitat for wildlife (41)

There were also many statements on which all three perspectives did not view as representative of what they would think. Allergy symptoms caused by trees was strongly regarded as not an issue for any of the perspectives (39). There was a similar lack of concern towards the damage that could be caused by trees to personal property, such as pipes or fences, or clogged gutters (2, 3, 12). Despite agreeing that trees are worth defending, the Greendale and Burncoat perspectives did not consider them significant enough to be an important political issue (21). The cost and skill to maintain trees was not regarded as unfeasible to participants (5, 9). Trees were not seen as a social gathering area (20). They were also not greatly credited for contributing to community safety (35). There is a lack of focus on the economic benefits that trees provide from Burncoat and Greendale participants.

Points of Disagreement

There were many statements which the three perspectives disagreed on. The statement that proposed trees to be a deciding factor in purchasing a home resulted in the greatest disagreement among perspectives (11). Factor 1, which represented more Q-Sorts than Factors 2 and 3, agreed very strongly with this statement. This is because Factor 1 has the deepest connection with trees and values the way trees make them feel, as opposed to Factor 2 which has a more utilitarian view of trees and lacks any spiritual or historical connection. Factor 3 was neutral on this statement.

The next greatest disagreement was over the statement "Trees in my neighborhood protect my kids from the sun" (10). As seen in **Table 32**, Factor 1 was the only perspective which agreed with this statement. Factor 2 disagreed to approximately the same level that Factor 1 agreed with the statement, and Factor 3 disagreed strongly with it.

There was also disagreement that trees prevent water runoff problems for many (40). It makes sense that the utilitarian perspective (Factor 2) agreed with this. This could be attributed to the fact that participants were located in areas of different geographic characteristics.

The last disagreement was over the connection of trees to memories (28). Factor 1 agrees that trees are connected to memories because they have the strongest historical connection to trees. Factor 2 only slightly agrees with the statement. It is interesting to note that Factor 3 disagrees strongly with this statement, despite agreeing that trees connect them to previous generations (14).

Phase 2: Walnut Hill Neighborhood

Phase 2 of our research focused on the Walnut Hill neighborhood in Worcester, Massachusetts. This area is inside the Asian Longhorn Beetle quarantine zone, so trees here are threatened, but none have been removed. It was more difficult to determine the social perspectives of this area. There was a larger variation in this data so it was decided to break it up into four social perspectives, to represent the many different views.

Table 42. **Rank Statement Totals with Each Factor for Walnut Hill Neighborhood**

PQMethod2.11 Trees in my neighborhood… Factors

No.	Statement	No.	1	#	2	#	3	#	4	#
1	Reduce the cost of air conditioning	1	1.19	4	-0.87	34	1.57	3	0.24	18
2	Have roots that bust my pipes	2	-1.73	40	-0.59	29	0.05	20	-0.16	25
3	Clog the gutter	3	-1.64	39	-0.81	33	0.44	12	-00.72	32
4	Increase my property values	4	0.81	9	0.86	8	1.48	4	-0.63	31
5	Require professional care beyond what I can provide	5	-1.34	37	0.06	19	-1.42	40	-1.63	41
6	Are a hazard if their limbs fall	6	0.04	23	1.26	6	0.23	16	-1.08	36
7	Reduce my electric bills	7	1.16	5	-0.96	36	1.34	5	-0.83	33
8	Damage our sidewalks	8	-0.93	35	1.70	4	-0.03	23	-0.52	30
9	Are expensive to plant and maintain	9	-0.44	30	-0.39	25	-1.25	38	-1.99	42
10	Protect my kids from the sun	10	0.05	22	-1.38	39	0.00	22	-0.16	25
11	Are a reason we bought this house	11	1.68	2	-0.89	35	-1.35	39	0.04	23
12	Damage my fence	12	-2.04	42	-1.08	37	-0.89	34	-0.88	34
13	Create lush canopies during the summer	13	0.37	20	1.49	5	0.87	10	0.52	12
14	Are a legacy from previous generations	14	-0.43	28	0.09	18	-0.24	25	0.16	22
15	Reduce basement flooding	15	-1.38	38	-1.52	40	0.01	21	0.60	10
16	Connect people to their land	16	0.58	14	-0.26	24	-0.86	31	0.32	17
17	Have become 'part of the family'	17	0.58	15	-0.15	22	-1.67	42	0.16	22
18	Having a calming effect that enhances community safety	18	0.94	8	0.35	15	0.09	18	0.40	15
19	Are worth defending and provide a sense of place	19	0.72	11	0.50	14	-0.80	30	0.32	17
20	Provide a place for people to talk	20	0.75	10	-0.39	26	-0.89	35	0.20	20
21	Are an important political issue, one that candidates…	21	0.65	13	-1.13	38	-0.88	33	-1.43	39
22	Cause me to do a lot of raking	22	-0.82	33	2.12	1	0.38	14	-1.56	40
23	Can make any collection of buildings and roads feel part…	23	-0.23	25	0.10	17	0.21	17	0.76	9
24	Need my attention if they're going to survive	24	-0.41	27	0.04	20	-0.50	28	-0.36	27
25	Protect us from the noisy highway	25	-0.34	26	-1.52	41	-0.43	26	-0.52	30
26	Seem to be neglected by the general public	26	0.27	21	-0.24	23	-0.87	32	-1.08	36
27	Prevent my community from becoming an empty…	27	-0.74	32	0.84	9	0.36	15	1.04	8
28	Are connected to so many memories	28	0.65	12	-0.63	31	-1.16	37	-0.36	27
29	Give me a sense of privacy from my neighbors	29	-0.43	29	0.23	16	2.00	2	-0.40	15
30	Help lead to much healthier lives	30	1.04	6	-0.08	21	0.41	13	1.47	4
31	Improve air quality	31	1.35	3	0.93	7	1.29	6	1.63	2
32	Provide oxygen for all residents	32	0.45	17	1.73	3	1.14	7	2.15	1
33	Help landscape my property	33	0.38	19	0.80	11	1.04	9	0.20	20
34	Should be biodiverse	34	0.99	7	0.57	13	-0.44	27	1.27	7
35	Contribute to community safety	35	0.43	18	-1.82	42	-0.76	29	0.40	15
36	Keep my yard from becoming mud	36	-1.13	36	-0.54	28	0.84	11	0.52	12
37	Keep my house shaded and cool	37	1.91	1	0.81	10	2.14	1	1.40	5
38	Make my garden to dry and shady	38	-0.69	31	-0.75	32	0.09	19	-0.52	30
39	Make my nose run and my eyes itch	39	-1.91	41	-0.53	27	-1.46	41	-1.43	39
40	Prevent water runoff problems for many	40	-0.05	24	-0.63	30	1.09	8	1.27	7

41	Provide a habitat for wildlife	41	0.57	16	1.94	2	-0.11	24	1.59	3
42	Can be decorative if small, but won't provide the same…	42	-0.86	34	0.74	12	-1.05	36	-1.20	37

Factor Analysis and Social Narratives for the Walnut Hill Neighborhood

Factor 1: "Well- Rounded" Perspective

An individual with this viewpoint is someone who recognizes the utilitarian benefits trees provide, but also values historical and spiritual aspects. They look at trees primarily as something that is useful rather than aesthetically pleasing. However, that is not to say that they lack a connectedness to their trees.

This view primarily associates trees with providing a shaded and cool environment and clean air (37, 31). These characteristics are so important to them that they were a consideration when purchasing a house (11). Interestingly, this perspective took trees into consideration much more than any other perspective when looking for a house. They value living in a home that is protected by the shade of trees and recognize that this results in economic benefits such as lower electric bills (37, 1, 7). They also recognize, to a lesser degree, that trees add to their property values (4).

There is reason to believe that a secondary part of this perspective is one which connects trees to historical and spiritual/personal value. Statements such as, "have a calming effect that enhances community safety" and, "are connected to so many memories" were also rated on the "more like how I think" side of the spectrum. This perspective also feels a slight spiritual connection to trees (16, 17).

Trees are important to this group of people. They value them a great deal, believing that they are an important issue worth defending (19, 21).

This perspective places much more emphasis on positive benefits of trees and is not bothered by the negative effects that can occur, rating statements such as, "clog the gutter", "have roots that bust my pipes", and "damage my fence" far to the left, "less like me" end of the spectrum.

Table 43. **Distinguishing Statements for WH Factor 1**

No.	Statement	No.	1	#	2	#	3	#	4	#
11	Are a reason we bought this house	11	1.68	2	-0.89	35	-1.35	39	0.04	23
31	Improve air quality	31	1.35	3	0.93	7	1.29	6	1.63	2
37	Keep my house shaded and cool	37	1.91	1	0.81	10	2.14	1	1.40	5

Statements 'flagged' by PQmethod with their Normalized Score

+are a reason we bought this house. (11) 1.16
+are an important political issue, one that candidates must… (21) 0.65
-prevent my community from becoming an empty, windy, dusty place. (27) -0.74
-have roots that bust my pipes. (2) -1.73

Table 44. Statements that rated low for WH Factor 1

No.	Statement	No.	1	#	2	#	3	#	4	#
2	Have roots that bust my pipes.	2	-1.73	40	-0.59	29	0.05	20	-0.16	25
3	Clog the gutter	3	-1.64	39	-0.81	33	0.44	12	-00.72	32
12	Damage my fence	12	-2.04	42	-1.08	37	-0.89	34	-0.88	34
15	Reduce basement flooding	15	-1.38	38	-1.52	40	0.01	21	0.60	10
36	Keep my yard from becoming mud.	36	-1.13	36	-0.54	28	0.84	11	0.52	12
39	Make my nose run and my eyes itch...	39	-1.91	41	-0.53	27	-1.46	41	-1.43	39

Table 45. **Z-Scores using Defining Statements WH Factor 1**

Statement #	Statement	Z-Score
11	Are a reason we bought this house	1.685
31	Improve air quality	1.349
37	Keep my house shaded and cool	1.907

Factor 2: "Trees have negative effects"
This perspective places a lot of emphasis on the statements that illustrate the very visible and often negative effects of trees. An individual with this view does not have a lot of background knowledge about the benefits of trees. They observe what happens outside their door, such as a damaged sidewalk from tree roots (8), lush canopies in the summer (13), a lot of leaves to rake (22), and a place that animals live (41), but do not seem internally connected.

It is probable that an individual in this category has many large trees on their property which cause them to do a lot of raking (22), have large roots that damage their sidewalk (8), and cause them to worry about the effects of limbs falling (6).

Despite the negative focus of this perspective, it also recognizes some positive benefits. A person with this view realizes that trees create lush canopies in the summer (13), provide a habitat for wildlife (41), and provide oxygen to residents (32).

This perspective is not fully aware of the economic and community benefits trees provide because statements such as "reduces the cost of air conditioning", "reduce my electric bills", and "contribute to community safety" were ranked closer to the "least like me" side.

Table 46. **Distinguishing Statements for WH Factor 2**

No.	Statement	No.	1	#	2	#	3	#	4	#
6	Are a hazard if their limbs fall.	6	0.04	23	1.26	6	0.23	16	-1.08	36
8	Damage our sidewalks	8	-0.93	35	1.70	4	-0.03	23	-0.52	30
13	Create lush canopies during the summer	13	0.37	20	1.49	5	0.87	10	0.52	12
22	Cause me to do a lot of raking	22	-0.82	33	2.12	1	0.38	14	-1.56	40
32	Provide oxygen for all residents	32	0.45	17	1.73	3	1.14	7	2.15	1
41	Provide a habitat for wildlife	41	0.57	16	1.94	2	-0.11	24	1.59	3

Statements 'flagged' by PQmethod with their Normalized Score

+cause me to do a lot of raking. (22) 2.12
+damage our sidewalks. (8) 1.70
+are a hazard if their limbs fall. (6) 1.26
+can be decorative if small but won't provide the same shade… (42) 0.74
+require professional care beyond what I can provide. (5) 0.06
-protect my kids from the sun. (10) -1.38
- contribute to community safety. (35) -1.82

Table 47. **Statements that rated low for WH Factor 2**

No.	Statement	No.	1	#	2	#	3	#	4	#
10	Protect my kids from the sun	10	0.05	22	-1.38	39	0.00	22	-0.16	25
15	Reduce basement flooding	15	-1.38	38	-1.52	40	0.01	21	0.60	10
25	Protect us from the noisy highway	25	-0.34	26	-1.52	41	-0.43	26	-0.52	30
35	Contribute to community safety	35	0.43	18	-1.82	42	-0.76	29	0.40	15

Table 48. **Z-Scores using Defining Statements WH Factor 2**

Statement #	Statement	Z-Score
22	Cause me to do a lot of raking	2.120
41	Provide a habitat for wildlife	1.939
32	Provide oxygen for all residents	1.728
8	Damage our sidewalks	1.699
13	Create lush canopies during the summer	1.489
6	Are a hazard if their limbs fall.	1.263

Factor 3: Utilitarian

This perspective places a lot of attention on the utilitarian benefits that trees provide. Many of these benefits are economic services that the trees provide but there are also other benefits that are not in this category. A person with this view does not seem to hold any spiritual or historical connection to the trees in their neighborhoods.

An individual with this viewpoint values the shade trees provide and the privacy they provide from neighbors (29, 37). This view recognizes that trees, when placed in the correct places, will aid in reducing electric and air conditioning bills (1, 37). They also realize that trees increase the property's value and help to landscape their area (4, 7).

It is also clear, by looking at the statements that rated low for Factor 3 below (**Table 50**), that this viewpoint has no personal attachment to the trees.

Table 49. **Distinguishing Statements for WH Factor 3**

No.	Statement	No.	1	#	2	#	3	#	4	#
1	Reduce the cost of air conditioning.	1	1.19	4	-0.87	34	1.57	3	0.24	18
4	Increase my property values	4	0.81	9	0.86	8	1.48	4	-0.63	31
7	Reduce my electric bills	7	1.16	5	-0.96	36	1.34	5	-0.83	33
29	Give me a sense of privacy from my neighbors	29	-0.43	29	0.23	16	2.00	2	-0.40	15
33	Help landscape my property	33	0.38	19	0.80	11	1.04	9	0.20	20
37	Keep my house shaded and cool	37	1.91	1	0.81	10	2.14	1	1.40	5

Statements 'flagged' by PQMethod with their Normalized Score

+ give me a sense of privacy from my neighbors. (29) 2.00
+ clog the gutter. (3) 0.44
+ cause me to do a lot of raking. (22) 0.38
-should be biodiverse. (34) -0.44
-contribute to community safety. (35) -0.76
-are worth defending and provide a sense of place. (19) -0.80
-have become "part of the family." (17) -1.67

Table 50. **Statements that rated low for WH Factor 3**

No.	Statement	No.	1	#	2	#	3	#	4	#
11	Are a reason we bought this house	11	1.68	2	-0.89	35	-1.35	39	0.04	23
17	Have become 'part of the family'	17	0.58	15	-0.15	22	-1.67	42	0.16	22
28	Are connected to so many memories	28	0.65	12	-0.63	31	-1.16	37	-0.36	27
39	Make my nose run and my eyes itch	39	-1.91	41	-0.53	27	-1.46	41	-1.43	39

Table 51. **Z-Scores using Defining Statements WH Factor 3**

Statement #	Statement	Z-Score
37	Keep my house shaded and cool	2.142
29	Give me a sense of privacy from my neighbors	2.005
1	Reduce the cost of air conditioning.	1.566
4	Increase my property values	1.476
7	Reduce my electric bills	1.343
33	Help landscape my property	1.039

Factor 4: "Trees make me and my community healthy"

This perspective seems particularly focused on the health benefits that trees produce for humans, as well as the health and condition of the neighborhood itself. It also shows signs of an underlying communitarian attitude about trees.

An individual in this group primarily associates trees in their neighborhood with a cleaner atmosphere to live in. They are all very aware that trees are a major source of oxygen (32). They believe that trees "improve air quality" and "help lead to much healthier lives".

A secondary focus of this view is the condition of their neighborhood. Individuals recognize that a diversity of tree species should exist in their neighborhood to prevent a rapid deterioration, should a disease or infestation that targets a specific species occur (34). They also recognize and value that trees prevent water runoff problems, and prevent their neighborhood from becoming an empty, windy, dusty place (40, 27).

There is another weaker, but still present, theme to this perspective. It draws a connection between trees and a sense of "community". Residents with this viewpoint believe trees can make any collection of roads and buildings feel like a community (23). They also feel that trees "have a calming effect that enhances community safety" and "provide a sense of place" (18, 35)

Table 52. **Distinguishing Statements for WH Factor 4**

No.	Statement	No.	1	#	2	#	3	#	4	#
27	Prevent my community from becoming an empty,...	27	-0.74	32	0.84	9	0.36	15	1.04	8
30	Help lead to much healthier lives	30	1.04	6	-0.08	21	0.41	13	1.47	4
31	Improve air quality	31	1.35	3	0.93	7	1.29	6	1.63	2
32	Provide oxygen for all residents	32	0.45	17	1.73	3	1.14	7	2.15	1
34	Should be biodiverse	34	0.99	7	0.57	13	-0.44	27	1.27	7
40	Prevent water runoff problems for many	40	-0.05	24	-0.63	30	1.09	8	1.27	7

Statements 'flagged' by PQmethod with their Normalized Score

-increase my property values. (4) -0.63

Table 53. **Statements that rated low for WH Factor 4**

No.	Statement	No.	1	#	2	#	3	#	4	#
5	Require professional care beyond what I can provide	5	-1.34	37	0.06	19	-1.42	40	-1.63	41
9	Are expensive to plant and maintain	9	-0.44	30	-0.39	25	-1.25	38	-1.99	42
21	Are an important political issue, one that candidates…	21	0.65	13	-1.13	38	-0.88	33	-1.43	39
22	Cause me to do a lot of raking	22	-0.82	33	2.12	1	0.38	14	-1.56	40
26	Seem to be neglected by the general public	26	0.27	21	-0.24	23	-0.87	32	-1.08	36
42	Can be decorative if small, but won't provide the same…	42	-0.86	34	0.74	12	-1.05	36	-1.20	37

Table 54. **Z-Scores using Defining Statements WH Factor 4**

Statement #	Statement	Z-Score
32	Provide oxygen for all residents	2.151
31	Improve air quality	1.633
30	Help lead to much healthier lives	1.473
34	Should be biodiverse	1.274
40	Prevent water runoff problems for many	1.274
27	Prevent my community from becoming an empty, windy, dusty place	1.037

Comparison of Walnut Hill Factors 1, 2, 3, and 4

Consensus Points

All four perspectives in the Walnut Hill area strongly believe that trees improve the quality of air around them, in addition to providing oxygen (31, 32). They also strongly recognize that trees provide shade and cooling to their homes (37). There was a consensus that they slightly believe trees to have a calming effect that enhances their community's safety (18).

All perspectives agreed with the following statements about trees to varying degrees:
Trees in my neighborhood…

- Create lush canopies during the summer (13)
- Provide oxygen for all residents. (32)
- Help landscape my property. (33)

There were also a few ideas which all four perspectives agreed were "less like them". The statement, "protect us from the noisy highway" was irrelevant because the Walnut Hill neighborhood is not located near a noisy highway (25). All perspectives agreed that allergy symptoms caused by trees was not something that affected them (39). Participating residents did not feel that the expense to plant and maintain a tree was very significant (9). They also did not regard trees causing damage to a fence as significant to them (12).

Points of Disagreement

There were many statements that had mixed positive and negative ratings from the four perspectives. For the full list please refer to Table in the Appendix. There were a number of statements that were strongly disagreed upon. One of the strongest was whether residents regarded trees in the neighborhood as a reason for purchasing their home (11). Another statement of strong disagreement was over whether or not trees caused residents to rake a lot (22). There were mixed feelings over trees contributing to community safety (35), providing privacy (29), and reducing electric bills (7) as well as negative aspects such as damaging sidewalks (8), and falling limbs (6).

Comparison of Greendale/Burncoat and Walnut Hill Neighborhoods

Based on our data and analysis, perspectives in Greendale and Burncoat are more specific and focused than those of Walnut Hill. There is also a greater variety of perspectives in Walnut Hill. Some of these perspectives are not as present in the Greendale and Burncoat communities. There is a stronger recognition of the negative aspects of trees in the Walnut Hill area. Some residents in Walnut Hill also focus on the health benefits of trees. On the other hand, Walnut Hill lacks a perspective that is mainly spiritual.

People's perspectives of trees in Greendale and Burncoat were more specific than those of Walnut Hill. The data from the Q Sort analysis revealed that a many of the statements that both neighborhoods agreed received higher values in Greendale/Burncoat than Walnut Hill. This points to the suggestion that residents of Greendale and Burncoat feel more strongly about their trees than Walnut Hill residents, likely a result of watching their trees cut. This analysis is explained more in depth in the "Comparison of Specific Statements" under "Consensus Points" on the following page.

The views gathered from the Walnut Hill neighborhood contained a larger spread of ideas and values about trees than Greendale and Burncoat. The most obvious example of this is that the Walnut Hill data needed to be broken up into four separate perspectives to accurately describe the views of the residents; instead of three, as the Greendale and Burncoat data was. The three perspectives that make up the residents of Greendale and Burncoat were, "Environmentalist", "Utilitarian", and "Communitarian". Walnut Hill was broken up into the following four views: "Well Rounded", "Trees have negative effects", "Utilitarian", and "Trees make my community and me healthy". Even after being divided into four factors, some of the Walnut Hill perspectives are still multi-faceted. Factor 1 of Walnut Hill is a perfect example of this because it values utilitarian benefits of trees but also holds a historical and spiritual connection to trees.
There are also views heavily present in Walnut Hill that do not seem as important to residents of Greendale and Burncoat. In Walnut Hill, one of the perspectives focuses on negative effects of trees. In Greendale and Burncoat, many of the negative statements about trees were rated negative by all three perspectives. Another perspective focuses on the health benefits that trees provide to residents and the community. The focus on health is not nearly as great in Greendale and Burncoat, but some of the ideas are spread throughout the perspectives.

Similarly, there are views present in Greendale and Burncoat that are not as emphasized in Walnut Hill. The first perspective in Greendale and Burncoat focuses heavily on a spiritual and historical connection to their trees. This type of connection is not as strong in Walnut Hill. It exists, but it is mixed in with other views.

By comparing the perspectives of trees from the Greendale and Burncoat neighborhoods to those from the Walnut Hill neighborhood it can be seen if a large scale removal of trees from a neighborhood, like what happened in Greendale and Burncoat, changes how people perceive trees. It is evident that an event like this does change the way people think about trees in their

neighborhood. It does not make affected residents all realize the same things about trees. It sharpens their feelings and thoughts about trees to emphasize what is the most important to them.

Comparison of Specific Statements

Consensus Points

There were some statements that both test areas felt similarly about. Comparing the positively rated statements of Greendale and Burncoat and Walnut Hill revealed that both groups realize that trees create lush leaf canopies in the summer (13), improve air quality (31), add landscaping to their property (33), and keep their houses shaded and cool (37).

While both test areas rated these statements positively, it is interesting to note that most of them are rated higher in Greendale and Burncoat than in Walnut Hill. Statement 31 was the only one of these statements that rated higher overall in Walnut Hill than in Burncoat and Greendale. Residents of Greendale and Burncoat valued the "lush canopies" more than those in Walnut Hill (13). They also have a higher realization that trees landscape their property (33) and that they keep their houses shaded and cool in the summer time (37). This supports the conclusion that residents of Greendale and Burncoat have more specific views about trees in their neighborhoods.
There were also a few statements that both neighborhoods disagreed with. All the social perspectives in both test areas did not feel that trees are expensive to plant and maintain (9), nor did they feel that trees damaged their fences (12). There was also a strong consensus among the groups that trees did not present an allergy problem (39)

Points of Disagreement

There were no statements that were drastically disagreed on between the Phase 1 and Phase 2 neighborhoods; however, there were a number of statements that were rated higher in Burncoat and Greendale than in Walnut Hill, as discussed in the previous section.

Important points to Phase 1 neighborhoods (non-consensual and non-confrontational)

There are a number of statements which are important to the Greendale and Burncoat neighborhoods that do not appear as strongly in Walnut Hill. These points show what aspects of trees the community realizes are important to them after trees have been removed. This is helpful because it suggests how a community's perspective of trees might change after a large scale removal of trees from their neighborhood occurs.

The people in this neighborhood feel like less of a community now that a majority of their trees are gone (23). They feel more strongly that trees are worth defending and provide a sense of place (19). There are more people here that realize the privacy trees provide from neighbors now that they were removed (29). More people feel that trees increase property values (4). There was also a slight increase in awareness of the amount of wildlife that use trees as a habitat.

Important points to Phase 2 neighborhood (non-consensual and non-confrontational)

There are significantly fewer statements that Walnut Hill feels strongly about and Greendale and Burncoat do not. The Walnut Hill neighborhood feels more strongly than the Greendale/Burncoat neighborhood that trees provide oxygen to residents (32). Some residents of Greendale and Burncoat could have rated this lower because they had other concerns that they felt more strongly about or felt were more important to them. There are also more residents of Walnut Hill that agree that trees have a calming effect that enhances community safety (18).

Conclusion

This research is a collaborative study between Worcester Community Project Center and the University of Massachusetts' Department of Natural Resources Conservation. The purpose of this study was to better understand how residents value the trees in their neighborhoods, and communicate those conclusions to politicians and decision makers in an effort to better manage and protect urban forests.

The introduction of the Asian longhorned beetle in Worcester, Massachusetts presented the researchers with a unique opportunity to explore the opinions of residents in a community that recently experienced considerable tree loss. Trees were only removed in a specific area in Worcester; this allowed for a comparative study which would evaluate the difference in opinion between residents in the cut zone, and those in the quarantine zone. Using four data collection methods: content analysis, two focus groups, survey questionnaires, and Q sorts; the researchers conducted an extensive study to evaluate the range of opinion of residents in the city of Worcester, Massachusetts.

Q methodology was used in this study to evaluate how strongly residents rated specific benefits associated with urban trees. PQ method revealed quantitative data that was then analyzed and developed into qualitative social narratives to describe the different perspectives.

The third phase of this study was conducted in the Sixteen Acres neighborhoods of Springfield, Massachusetts from September 2010 to November 2010. This study will be analyzed in a future dissertation from fellow researcher Gretchen Folk.

Works Cited

Akbari and H. Taha (1992).The impact of trees and white surfaces on residential heating and cooling energy use in four Canadian cities. Energy 17 2, pp. 141–149.

Akbari, H., 2002. Shade trees reduce building energy use and CO2 emissions from power plants. Environmental Pollution 116 (Suppl. 1), S119-S126.

Akbari, H., J. Huang, P. Martien, L. Rainer, A. Rosenfeld, and H. Taha. 1988. The impact of summer heat islands on cooling energy consumption and CO2 emissions. Paper presented at the American Council for an Energy Efficient Economy Summer Study on Energy Efficiency in Buildings, Asilomar, CA, August 1988. Lawrence Berkeley Laboratory publication LBL-25179, Berkeley, CA.

Akbari, H., S. Davis, S. Dorsano, J. Huang and S. Winnett (eds) (1992). Cooling Our Communities: A Guidebook on Tree Planting and Light-colored Surfacing, US Environmental Protection Agency, Office of Policy Analysis, Climate Change Division.

Anderson, L.M. and H.K. Cordell (1988). Influence of Trees on Residential Property Values in Athens, Georgia (U.S.A.): A Survey based on Actual Sales Prices. Landscape and Urban Planning, 15:153-164.

Anderson, Linda M. and H. Ken Cordell. (1985). Residential Property Values Improved by Landscaping with Trees.Southern Journal of Applied Forestry, 9(3):162-166.

Barro, S.C., P.H. Gobster, H.W. Schroeder, and S.M. Bartram. 1997. What makes a big tree special? Insights from the Chicagoland Treemendous Trees program. J. Arboric. 23:239–249.

Brown, S. R. 1970. On the use of variance designs in Q methodology. Psychological Record (20): 179-189

Brown, S. R., D. W. Durning, and S. C. Shelden. 2007. Q Methodology. In: Miller (Editor) Handbook of research methods in public administration. Boca Raton, FL: Auerbach Publications.

Brown, T. L., C. P. Dawson and R. L. Miller. 1979. Interest and attitudes of metropolitan New York residents about wildlife. Trans. North. Amer. Wild. Conf. 44: 289-297

Chenoweth, Richard E. and Paul H. Gobster. 1990. "The Nature and Ecology of Aesthetic Experiences in the Landscape." Landscape Journal 9(1): 1-8.

Crompton, John L. (2004). The proximate principle: The impact of parks, open space and water features on residential property values and the property tax base. Ashburn, Virginia: National Recreation and Park Association.

Crompton, J.L., 2001. Parks and Economic Development. American Planning Association, Chicago, IL.

Faber Taylor, A., F.E. Kuo, and W.C. Sullivan. 2002. Views of nature and self-discipline: Evidence from inner-city children. J. Environ. Psychol., Special Issue: Environment and Children 22:49–63.

Heisler, G. M., (1986) Energy savings with trees. J. Arboricult. 12, 113-25

Heisler, G. M., (1986): Effects of individual trees on the solar radiation climate of small buildings. Urban Ecology, 9, 337-359.

Heisler, G.M., 1990. Tree plantings that save energy. Proceedings of the Fourth Urban Forestry Conference, St. Louis, MO, October 15-19, 1989. American Forestry Association, Washington, DC, pp. 58-62.

Heisler, G.M.; Grant, R.H.; Grimmond, S.; Souch, C. 1995. Urban forests—cooling our communities? In: Kollin, C.; Barratt, M., eds. Proceedings: 7th national urban forest conference. Washington, DC: American Forests: 31-34.

Haughton and Hunter, 1994. Sustainable Cities: Regional Policy and Development

Hull, R.B. 1992. How the Public Values Urban Forests. Journal of Arboriculture, 18, 2:98-101. Kaplan, R., and S.

Kaplan, R. (1993). The role of nature in the context of the workplace. Landscape and Urban Planning, 26, 193-201.

Kaplan. 1989. The Experience of Nature: A Psychological Perspective. Cambridge University Press, Cambridge.

Kuo, F. 2003. The role of arboriculture in a healthy social ecology. J. Arboric. 29(3):148–155.

Kuo, F.E., W.C. Sullivan, R.L. Coley, and L. Brunson. 1998. Fertile ground for community: Inner-city neighborhood common spaces. Am. J. Community Psychol. 266:823–851.

Kuo, F. E. and Sullivan, W. C. (2001) Environment and crime in the inner city: does vegetation reduce crime? Environment and Behavior, 33, 343–367.

McPherson, E.G. (1990) Modeling residential landscape water and energy use to evaluate water conservation policies. Journal of Landscape 9, 122–134.

McPherson, E.G.; Nowak, D.J.; Sacamano, P.L.; Prichard, S.E.; Makra, E.M. 1993. Chicago's evolving urban forest: initial report of the Chicago Urban Forest Climate Project. Gen. Tech. Rep. NE-169. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 55 p.

Nowak, D.J. and Crane, D.E. 2002. Carbon storage and sequestration by urban trees in the USA.

Environmental Pollution 116: 381-389.

Nowak, D.J.. 1995. Trees pollute? A "TREE" explains it all, in: Proc. 7th Natl. Urban For. Conf., (C. Kollin And M. Barratt, eds.), American Forests, Washington, DC, pp. 28-30.

Nowak, D.J.; Rowntree, R.A.; McPherson, E.G.; Sisinni, S.M.; Kerkmann, E.; Stevens, J.C. 1996. Measuring and analyzing urban tree cover. Landscape and Urban Planning. 36: 49-57.

Nowak, David J. 1993. Atmospheric carbon reduction by urban trees. Journal of Environmental Management. 37:207-217

Richard Thompson, Richard Hanna, Jay Noel, and Douglas D. Piirto. "Valuation of Tree Aesthetics on Small Urban-Interface Properties"Journal of Arboriculture 25.5 (1999): 225-234.

Robbins, P. and R. Krueger. 2000. Beyond Bias? The Promise and Limits of Q Method in Human Geography. The Professional Geographer 52 (4): 636–648.

Rodriguez, M., Sirmans, C.F. (1994), "Quantifying the value of a view in single-family housing markets", The Appraisal Journal, Vol. LXII No.4, pp.600-3

Sanders, R.A. 1986. Urban vegetation impacts on the hydrology of Dayton, Ohio. Urban Ecology 9: 361–

Schroeder, H. W. (1989). Environment, behavior and design research on urban forests. In E. H. Zube & G. T. Moore (Eds.), Advances in environment, behavior and design (pp. 87-117). New York: Plenum.

Schroeder, H.W. 1991. "Preference and Meaning of Arboretum Landscapes: Combining Quantitative and Qualitative Data." Journal of Environmental Psychology 11: 231-248.

Schroeder, H.W. 2002. Experiencing nature in special places. Journal of Forestry. 100(5): 8-14.

Schroeder, H.W. 2004. Special places in the Lake Calumet area. Gen. Tech. Rep. NC-249. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 23 p

Scott, K.I., Simpson, J.R., and E.G. McPherson. 1999. Effects of tree cover on parking lot microclimate and vehicle emissions. Journal of Arboriculture 25(3): 129-142.

Smith 1990, Air Pollution and Forests.

Sydor 2005, Valuing Trees ina Residential Setting: Revisiting Athens.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. Science, 224,4647: 420-21.

Webler, T., Danielson, S., & Tuler, S. (2009). Using Q method to reveal social perspectives

in environmental research. Greenfield MA: Social and Environmental Research Institute. Downloaded from: www.serius.org/pubs/Qprimer.pdf

Westphal and Isebrands, 1989. Phytoremediation of Chicago's Browsfields: Consideration of ecological approaches to social issues Johnson, C.W. 1988. Planning for avian wildlife in urbanizing areas in America desert/mountain valley environments. Landscape and Urban Planning 16:245–252.

Westphal, L.M. 2003. Urban greening and social benefits: A study of empowerment outcomes. Journal of Arboriculture 29:137–147.

Westphal, Lynne M. "Empowering People Through Urban Greening Projects: Does It Happen?" Building Cities of Green: Proceedings of the 1999 National Urban Forest Conference. Cheryl Kollin, ed. Washington, D.C.: American Forests, 1999. 60-63.

Wolf, K.L., 2003a. Freeway roadside management: the urban forest beyond the white line. J. Arboric. 29 (3), 127–136.

Wolf, K.L., 2003b. Public response to the urban forest in inner-city business districts. J. Arboric. 29 (3), 117–126.

Wolf, K.L. 2004b. Trees and business district preferences: A case study of Athens, Georgia, U.S. J. Arboricult. 30(6):336–346.

Wolf, K.L., 2005. Business district streetscapes, trees and consumer response. J. Forest. 103 (8), 396–400.

Appendix A- Consent Form

Consent Form
Summer 2010

Valuing Urban Trees
Informed Consent Agreement for Participation in a Research Study
Investigator: Rob Krueger, Gretchen Folk, Jeffrey Robinson, Anna Costello
Contact Information:
Rob Krueger: 1-508-831-5110 (Krueger@wpi.edu)
Gretchen Folk: 1-774-238-6614 (gfolk@nrc.umass.edu)
Jeffrey Robinson: 1-860-306-9407 (jrobinson@wpi.edu)

Anna Costello: 1-315-436-2135 (ascostello@wpi.edu)

Title of Research Study: Valuing Urban Trees: A case study of the Asian Longhorn Beetle infestation and tree loss in Massachusetts.

Sponsor: Rob Krueger
Purpose of the Study:
This project explores the public perception of the urban forestry in Worcester, Massachusetts. Four research methods will be used: content analysis, questionnaires, focus groups, and Q-methodology to gather a broad collection of perceived economic, environmental, social, and health benefits associated with urban forests. This case study focuses on residents of the Greendale, Burncoat, and Walnut Hill neighborhoods of Worcester, MA. Two of these areas (Greendale and Burncoat) were infested and eventually deforested as a result of the Asian Longhorn Beetle.
Risks to Study Participants: There are no foreseeable risks involved with this study. All participation is voluntary, and the participant is free to leave or refuse to answer any question.
Benefits to Research Participants and Others: Benefits to the research participants include an opportunity to express feelings, attitudes, and behaviors associated with recent tree loss in their neighborhoods.
Record Keeping and Confidentiality: The information collected in the focus groups will be recorded with a digital voice recorder which will be used for the sole purpose of documenting the conversation. Recordings of participants in this study will be held confidential as permitted by law. However, the study investigators, the sponsor or it's designee and, under certain circumstances, the Worcester Polytechnic Institute Institutional Review Board (WPI IRB) will be able to inspect and have access to confidential data that will identify participants by name. The final study and results will be available on the internet. However, any publication or presentation of the data will not identify any participant.
Compensation: There is no compensation for participation in this study.

Compensation or Treatment in the Event of Injury: There are no foreseeable risks involved with this study. The participant does not give up any legal rights by signing this statement.

For More Information about this Research or About the Rights of Research Participants, or in Case of Research-Related Injury, Contact:

Rob Krueger: 1-508-831-5110 (Krueger@wpi.edu)
Gretchen Folk: 1-774-238-6614 (gfolk@nrc.umass.edu)
Jeffrey Robinson: 1-860-306-9407 (jrobinson@wpi.edu)
Anna Costello: 315 436 2135 (ascostello@wpi.edu)
IRB Chair (Professor Kent Rissmiller, Tel. 508-831-5019, Email: kjr@wpi.edu) University Compliance Officer (Michael J. Curley, Tel. 508-831-6919, Email: mjcurley@wpi.edu).

Your Participation in This Research is Voluntary. Your refusal to participate in this study will not result in any penalty to you or any loss of benefits to which you may otherwise be entitled. You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time they see fit. The information gathered in this study will be used in a Major Qualifying Project (MQP) and as part of a master's dissertation at UMASS Amherst. The study will be available on the internet; however, your identity and personal information, as well as your responses will be protected and kept locked in a filing cabinet. The digital voice recorder will record focus groups for the sole purpose of documenting the conversation.

By signing below, you acknowledge that you have been informed and give consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.

_____ Date: _____
Study Participant Signature

_____
Study Participant Name (Please print)

_____ Date: _____
Signature of Person who Explained this Study

Please tell us something about yourself.

In what year were you born? 19_____

Are you male or female (circle one)?

Do you consider yourself (circle all that apply)

White
Black or African American
American Indian or Alaskan Native
Native Hawaiian or other Pacific Islander
Hispanic or Latino
Other (please indicate) _____

What is the highest level of education you have completed (circle one)?

Less than high school
Some high school
High School or GED
Technical or Trade School
Some college
College graduate
Graduate school or Masters
Doctorate degree

What is your income range?

< 10,000
10,000-30,000
30,000-49,999
50,000-79,999
80,000-99,999
100,000 +

Do you rent or own your house? Y/N

How many members are in your household?

1-3
4-6
7+

Valuing Urban Trees
Q-Sort

Dear Respondent,
Thank you for participating in this important collaborative study between Worcester Polytechnic Institute's Worcester Community Project and the University of Massachusetts' Department of Natural Resources Conservation. The Asian Longhorned Beetle infestation in the Greendale and Burncoat neighborhoods has created a number of challenges for residents, local officials, and our government.
The goal of this project is to better understand how your trees affect your quality of life in social, health-related, environmental and economic terms—whether positively or negatively. This interview and other data collection techniques will help us provide various government agencies with information on how they might better manage urban trees and forests.
This is the first study of its kind and your participation is critical to the success of the project. The interview should only take about 30 minutes to complete. The data collection method we are going to use is called a Q-sort. It's an innovative method and operates much like a game.
Regardless, of your level of participation your answers will remain strictly confidential. You name will not be linked to this project, to any data, or results we find.
If you have any questions about this collaboration please contact Professor Rob Krueger at Worcester Polytechnic Institute (508) 831-5110 or Krueger@wpi.edu.
We appreciate your help in this project.
Sincerely,

Rob Krueger
Director, Worcester Community Project Center, WPI

Brian Kane
University of Massachusetts-Amherst, Department of Forestry and Natural Resources

Appendix B- Q Protocol

Walk in:

Introduce yourself. Thank them for their time. Try to put them at ease with banter; the weather, their house, etc.

Explain the Project:

This is an important collaborative study between Worcester Polytechnic Institute's Worcester Community Project and the University of Massachusetts' Department of Natural Resources Conservation. The goal of this project is to better understand how your trees affect your quality of life in social, health-related, environmental and economic terms—whether positively or negatively.

The data collection method we are going to use is called a Q-sort. It's an innovative method and operates much like a game. Don't worry. I'll walk you through it. The Q-sort will take about 30 minutes.

Your answers will remain strictly confidential. You name will not be linked to this project, to any data, or results we find.

A funny method of interviewing…

The type of method I am going to use today is like an interview but it involves a game board and 41 pieces. This type of procedure allows us to collect very subjective information about our respondents while enabling us to quantify it.

Steps…

1. Place form board in front of them. Pull out card pile.
2. Explain that there are 42 responses to the question above the columns.
3. Have them start by developing three piles. **Pile one** is their most favorable responses to the question. It should go on the respondent's right. The **second pile** comprises those answers that are neutral, that the respondent cares little about one way or the other. **Pile three** are those responses that they disagree with.

Once they have developed these three piles have them start from the positive (+) end of the row and start filling in the cells. There can be only one card per cell. All cells must be filled. Vertical alignment doesn't matter, only the horizontal placement of the card does.

Ask them if they found the list comprehensive. Is there a statement that they would like to add?

They may not want to plug in negative statements to a positive column. Remind them that this is a "relational" approach. That a statement's location is relative to that of others.

Further, you can inform them that they will have a chance to explain their sorting approach at the end of the process. Sometimes it's also useful to tell them that tomorrow they might have another sort; this sort is a snap shot of them today.

Once they have completed the sort, ask them to explain it. Not card by card, but an impressionistic explanation. What general story are they trying to tell through their placement of the cards?

Once completed:

Make sure they have privacy/confidentiality form signed by both of you. Make sure they have my contact information so they can ask questions.

Leave them a copy of the cover letter and a copy of the confidentiality statement.

Appendix C- Q Cards

reduce the cost of air conditioning. 1	are a hazard if their limbs fall. 6	reduce my electricity bills. 7
have roots that bust my pipes. 2	require professional care beyond what I can provide. 5	damage our sidewalks. 8
clog the gutter. 3	increase my property value. 4	are expensive to plant and maintain. 9

protect my kids from the sun. **10**	**create lush canopies during the summer.** **13**	**connect people to their land.** **16**
are a reason we bought this house. **11**	**are a legacy from previous generations.** **14**	**have become “part of our family.”** **17**
damage my fence. **12**	**reduce basement flooding.** **15**	**have a calming effect that enhances community safety.** **18**

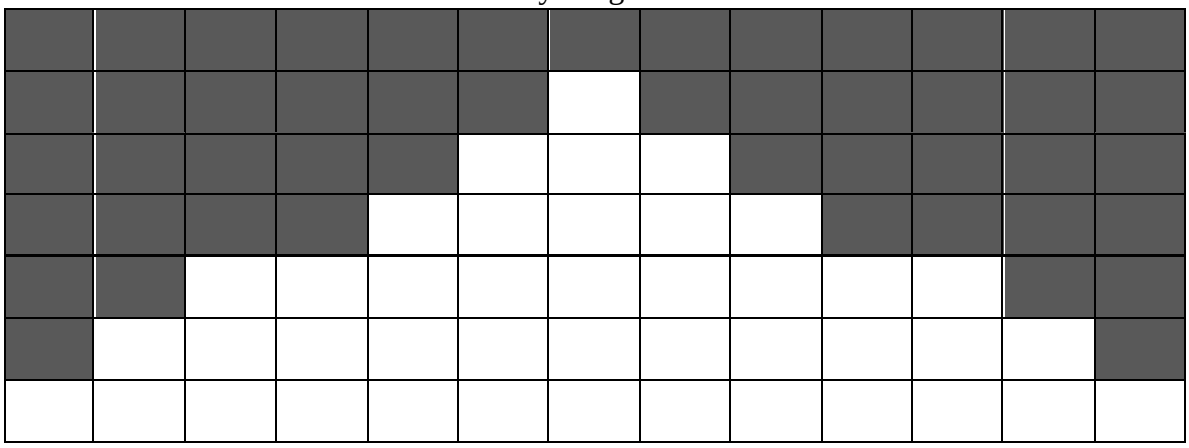
are worth defending and provide a sense of place. **19**	**cause me to do a lot of raking.** **22**	**protect us from the noisy highway.** **25**
provide a place for people talk. **20**	**can make any collection of buildings and roads feel part of a community; they create community character.** **23**	**seem to be neglected by the general public.** **26**
are an important political issue; one that candidates must be aware of. **21**	**need my attention if they're going to survive.** **24**	**prevent my community from becoming an empty, windy, dusty place.** **27**

are connected to so many memories. **28**	**improve air quality.** **31**	**should be biodiverse.** **34**
give me a sense of privacy from my neighbors. **29**	**provide oxygen for all the residents.** **32**	**contribute to community safety.** **35**
help lead to much healthier lives. **30**	**help landscape my property.** **33**	**keep my yard from becoming mud.** **36**

keep my house shaded and cool. **37**	**prevent water runoff problems for many.** **40**
make my garden too dry and shady. **38**	**provide a habitat for wildlife.** **41**
make my nose run and my eyes itch. **39**	**can be decorative if small but won’t provide the same shade, shelter, or visual relief.** **42**

Appendix D- Q Board

Conditions of Instruction: Trees in my neighborhood...
Trees in my Neighborhood...



-6 -5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5 +6

Least like my view Most like my view

N=42