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TITLE: Mapping Alternatives: Facilitating Citizen Participation in Development Planning and Environmental Decision Making

PRESENTED BY: Shalini P. Vajjhala

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______________________________ Major Professor ________________ Date

______________________________ Department Head ________________ Date

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______________________________ Dean ________________ Date

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ABSTRACT

MAPPING ALTERNATIVES: FACILITATING CITIZEN PARTICIPATION IN DEVELOPMENT PLANNING AND ENVIRONMENTAL DECISION MAKING

by Shalini P. Vajjhala

Chairperson of the Supervisory Committee: Professor Paul S. Fischbeck
Departments of Engineering and Public Policy and Social and Decision Sciences

Recent decades have seen a growing international awareness of the need for major development projects in tandem with a call for more environmentally sensitive decision making; however, many technical infrastructure projects currently face widespread difficulty associated with facilities siting. This rising difficulty is due to a variety of causes, including public opposition and not-in-my-backyard (NIMBY) protests. Efforts to mitigate public opposition have focused on improving citizen participation, but many participatory programs have still resulted in opposition and project delays. Taken as a whole, there is a growing need for 1) better characterizations of siting difficulty and the relative role of public opposition and 2) new strategies for facilitating timely, inclusive, and effective public participation.

The five main chapters of this dissertation bring together these interrelated problems. Each chapter consists of a stand-alone paper that together offer an integrated view of participatory development planning and environmental decision-making. Chapter 1 presents an introduction that connects the fields of planning and participation. Chapters 2 and 3 develop a policy-level quantitative evaluation of facilities siting difficulty and its major causes, including public opposition, based on a case study of electric transmission line siting. Next Chapter 4 proposes a conceptual framework of the basic components of participatory processes to link these agency-level analyses on siting difficulty and public opposition to local-level participation. Chapters 5 and 6 then provide a counterpart to this top-down view through a series of community-level mapping studies to understand local priorities, perceptions, and preferences for "the backyard." These studies further evaluate a combination of community mapping and Geographic Information Systems (GIS) as a new tool for facilitating participation. Finally, Chapter 7 concludes with a discussion of additional applications of the proposed mapping methods and avenues for future research.

Major results from all chapters include a state-level quantitative model for predicting siting difficulty and its dominant causes across the U.S. Results of siting analyses in Chapter 2 and 3 reveal large variations in state-level transmission line siting difficulty and demand. These variations have the potential to negatively impact the long-term success of current policy proposals such as Regional Transmission Organizations (RTOs) and federal eminent domain authority. Furthermore, perceptions of siting difficulty and siting constraints, including public opposition, vary significantly among stakeholders associated with different phases of project timelines. In spite of these variations, public opposition is identified as the dominant constraint on transmission siting from both qualitative survey results and related quantitative assessments.

These results bring the focus to the role of citizen participation as a means of addressing public concerns and improving siting decisions. Toward this end, the studies in Chapters 5 and 6 offer a complement to these agency-level findings. The results from these chapters provide strong support for the proposed combination of participatory mapping and GIS as an effective tool for 1) facilitating project information exchange, 2) enabling broader feedback and stakeholder communication, and 3) supporting participatory decision-making in development planning. Finally, Chapter 7 extends the proposed methods and findings to an ongoing transport planning project in Lesotho, Southern Africa.

Taken as a whole, this dissertation examines a sequence of important and interconnected issues: the need for new infrastructures, the causes of siting difficulty, the related call for participation, and strategies for improving public involvement. The integration of the top-down and bottom-up evaluations within this research provides a necessary transition from designing and informing effective policies to coordinating and implementing locally relevant solutions.

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Chapter 1

INTRODUCTION

In the modern world the intelligence of public opinion is the one indispensable condition for social progress. –Charles W. Eliot

Recent decades have seen significant changes in both local and global development planning efforts. Community-based organizations and advocacy groups around the world have advanced the concept of "environmental justice" and issued calls for more inclusive dialogues among planners and local stakeholders (Fiorino 1990; Renn, Webler et al. 1995; Sexton, Marcus et al. 1999). At the same time, research on sustainable practices has emphasized the importance of "resident experts" in implementing environmentally sound development decisions (Chambers 1983; Chambers 1997; Coenen, Huitema et al. 1998; World Bank 1996; Fischer 2000). In response to this concurrent international emphasis on stakeholder consensus and indigenous knowledge, development and environmental issues have become tightly coupled. At the same time, priorities for environmental management and civic involvement in both developed and developing nations have also grown inextricably intertwined. Consequently, public and community participation have moved to the forefront of both large- and small-scale development and environmental agendas (Stiglitz 2002). This shift in thinking has dramatically increased worldwide efforts to communicate with the public, to understand local responses to specific projects and risks, and perhaps most critically, to gain public acceptance to counter rising opposition and promote sustainable decision making (Beierle and Cayford 2002). This transformation of development priorities and practices has particularly affected large-scale technical projects and infrastructures.

Major development projects have brought a host of increasingly complex engineered systems, such as hydroelectric dams, electric power lines, transportation facilities, natural gas terminals, and other major infrastructures, into the public sphere. The growing demand for these key infrastructures has generated widespread awareness of the difficulty associated with facilities siting (Casper and Wellstone 1981; Hunter and Leyden 1995; Walsh, Warland et al. 1997; Halvorsen 1999; Henshaw 2001). Because of their large scales and technical complexity, many of these projects involve disparate risks, costs, and benefits for a variety of involved stakeholders, affected populations, and neighboring environments. This fundamentally inequitable distribution of project impacts has often fueled intense local opposition. Acronyms such as NIMBY (not in my backyard), NOPE (not on planet earth), LULU (locally unwanted land use), and even BANANA (build absolutely nothing anywhere near anything) are now common descriptors of public opposition in the US and around the world (Freudenberg and Pastor 1992; Mazmanian and Morell 1993; Inhaber 1998).

On the whole, the failure of traditional decide-announce-defend approaches to facilities siting has drawn even greater attention to the growing divide between agency agendas and local priorities. Although citizen participation is broadly viewed as a method of 1) building consensus among stakeholders, 2) improving the overall quality of decisions, 3) reducing uncertainty in implementation, and 4) allowing affected stakeholders to adapt and develop risk-mitigating strategies, many participatory efforts have still resulted in extreme opposition and greater uncertainty of project completion (Fischer 1980; Fiorino 1990; Renn, Webler et al. 1995; Fischer 2000; Beierle and Cayford, 2002). Overall, the related problems of siting major infrastructures, aligning stakeholder agendas, addressing project opposition, and facilitating effective public participation are complicated by the fragmented and project-specific nature of current research and practice in each of these areas (Rabe 1994, Chess and Purcell 1999).

This dissertation brings together these interrelated problems in a sequence of five major chapters that together present an integrated view of participatory development planning and environmental decision-making. The first half of the dissertation is based on a case study of electric transmission line siting, and develops a policy-level quantitative evaluation of the problem of facilities siting difficulty and its major causes, including public opposition. The second half of the dissertation provides a counterpart to this top-down view with a series of community-level mapping studies. These studies evaluate a combination of participatory mapping and Geographic Information Systems (GIS) technology as a new tool for facilitating participation. Overall, the integration of the top-down and bottom-up evaluations in this dissertation provides a necessary transition from developing effective large-scale development and environmental policies to coordinating and implementing locally relevant solutions. Toward this end, each chapter and its primary research objectives are outlined in detail below.

The first two main chapters of this dissertation focus on the specific case of transmission line siting as an example of major infrastructure development projects. Recent events in the electricity industry have focused national attention on the growing demand for electricity in the United States and the simultaneously lagging development of electricity transmission infrastructure. In spite of recurring examples of the nation's ailing transmission grid and the widespread call for new construction, transmission line siting is universally described as a difficult and time-consuming process, often resulting in construction delays or cancellations. Moreover, the problems associated with understanding impediments to expanding the transmission grid are compounded by a lack of quantitative data on siting issues. Chapter 2 develops a general framework and model for characterizing and evaluating state-level siting difficulty and the need for additional transmission capacity based on four unique quantitative indicators. This chapter establishes a structure to answer the fundamental questions: *How difficult is siting? And how much does siting difficulty contribute to the overall problem of infrastructure under-investment?* Results of this chapter provide a baseline assessment of siting difficulty at a policy-relevant scale and focus on informing current energy policy-making and grid-level planning.

Chapter 3 builds on the quantitative results from Chapter 2 to examine major siting constraints. This chapter addresses the question: *What makes siting difficult?* As transmission line siting projects have become increasingly complex, the interactions among stakeholders have also become more intricate, to the point where stakeholder perceptions of project constraints play a significant role in the general success of a project. This chapter presents a nationwide survey of transmission line siting professionals and analyzes variations in expert perceptions of state-level difficulty and siting constraints. The data from this survey also form the basis for a regression model that defines the relative importance of specific constraints, including public opposition, within the larger problem of siting difficulty. This chapter not only provides a reference level for understanding causes of siting difficulty, but it also presents a method for evaluating siting constraints and predicting siting difficulty within specific regions or along prospective routes. Overall, the results of these first two chapters illustrate the escalating impact of public opposition on transmission planning and policy and highlight the growing focus on participation as an answer to public opposition.

In spite of the global attention to participation and the undisputed demand for timely, inclusive, and effective public involvement, participatory studies are often scattered across a variety of projects, fields, and disciplines. As a result, the various tools and methods for facilitating participation are difficult to evaluate, and measures of success are often project- or outcome-specific. Chapter 4 focuses on bridging this gap and develops a unique framework for understanding and evaluating participatory processes. This chapter breaks participation down into three fundamental 'building blocks': information gathering and dissemination, communication, and decision-making. Because most studies focus on specific case studies of participation, this new framework first defines the general components of participation and then presents a proposal for a new mapping tool to facilitate public involvement.

Although a host of participatory methodologies for collecting and compiling local information currently exist, many of these techniques are limited in their usefulness. Often the process of data collection is time-consuming and difficult, and the resulting information is difficult to compile and unwieldy for effective use by decision makers. Because the majority of development planning and environmental decision-making projects have a common basis in spatial information, this proposal integrates two widely-used media for participation, GIS and participatory mapping, to create a unique tool: digital participatory mapping. The value of this new approach and its associated maps are assessed in the final chapters for each of the three respective building blocks of participation: information integration (Chapter 5), stakeholder communication (Chapter 6), and participatory decision making (Chapter 7). Overall, the framework in this chapter provides the structure for the chapters to follow.

From the initial transition to participation in Chapter 4, the next two chapters of this dissertation complete the shift from the large-scale focus on policy-making to the small-scale synergies that define community participation. Both Chapters 5 and 6 use a series of participatory mapping surveys and interviews to elicit local representations of 'the backyard.' As the NIMBY phenomenon gathers momentum, it is increasingly important to understand what defines a backyard. To address this question Chapter 5 draws on a three-part study including a survey, a mapping interview, and a follow-up interview with residents of several Pittsburgh communities. The results of these surveys and interviews not only present important data about individuals' priorities, perceptions, and preferences for their own neighborhoods and backyards, but they also provide a medium for evaluating the proposed maps as tools for facilitating participation. Overall, this study assesses the value of this new approach for 1) information gathering using traditional participatory mapping techniques, 2) information integration of the elicited participatory maps into GIS, and finally 3) information dissemination using the resulting digital participatory maps.

The maps collected from the study in Chapter 5 also form the basis for a follow-on survey in Chapter 6. This survey, conducted with community groups in the Mon Valley region of Pittsburgh, evaluates the effectiveness and the relevance of participatory maps for communicating with a broader audience. Participatory tools and methods often have limited value for outreach; therefore, this study focuses on the potential for extending the benefits of participation and the associated participatory information to the wider public. Results of this chapter compare original participatory map-makers' evaluations from Chapter 5 with those of unfamiliar audiences. This particular 'communication building block' is an essential step toward overcoming opposition from excluded groups and successfully implementing collective decisions among non-participating stakeholders.

Finally, Chapter 7 returns to the big picture and expands the discussion of digital participatory mapping to the final building block, stakeholder decision making. This chapter first describes a real-world application of the proposed digital maps for participatory transportation planning and impact assessment within an ongoing World Bank development program in Lesotho, southern Africa. It then presents an overview of the anticipated strengths and weaknesses of the method for a range of different development planning and environmental management efforts. Overall, this final chapter brings together the two halves of the dissertation to unite large-scale development planning problems and local-level implementation issues as they relate to public participation. In summary, the major research objectives of this dissertation are as follows:

- Quantitatively characterize siting difficulty and the need for new infrastructure for the case of electric transmission lines to inform U.S. grid policy and transmission planning. (Chapter 2)
- Develop a method to place public opposition in the context of other siting constraints and evaluate strategies to mitigate siting difficulty using participation; Specifically, illustrate the relative contribution of these constraints to overall transmission line siting difficulty. (Chapter 3)
- Establish a conceptual framework to evaluate a range of participatory tools and methods using three fundamental 'building blocks' of participation. (Chapter 4)
- Propose a new approach to facilitate participatory development planning and environmental decision making using a combination of participatory mapping and GIS. (Chapter 4)

- Evaluate the proposed digital participatory mapping tool for information gathering, integration, and dissemination using a series of mapping surveys and interviews in the Pittsburgh area; build an preliminary framework for characterizing 'the backyard.' (Chapter 5)
- Evaluate the comparative effectiveness of the new maps for communication, information exchange, and outreach through a larger survey in the greater Pittsburgh region. (Chapter 6)
- Assess the overall strengths and weaknesses of the digital mapping proposal based on a real-world pilot study for community transport planning and decision making in Lesotho. (Chapter 7)

On the whole, the chapters described above serve as a collection of stand-alone papers. Because the topics covered in each of the different chapters draw on a wide-variety of disciplines and domains, each individual chapter contains a brief review of the relevant literature. This introduction simply highlights the connections among chapters to organize the variety of studies and results within the dissertation as a whole. Overall, the final chapter (Chapter 7) presents a review of the major findings and their implications for implementing participation programs in a variety of development planning and environmental management projects. To conclude, this dissertation closes with a discussion of broader applications of the proposed tools and methods and some suggested areas for further research.

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Chapter 2

BUILDING NEW INFRASTRUCTURES

The machine does not isolate man from the great problems of nature but plunges him more deeply into them. – Antoine de Saint-Exupery

Recent decades have seen a growing worldwide demand for new energy infrastructures, including power plants, wind farms, electric transmission lines, liquefied natural gas (LNG) terminals, petroleum refineries, and other major projects. In spite of the widespread attention to energy issues today, siting many energy facilities has become increasingly difficult (Casper and Wellstone, 1981; Halvorsen, 1999; Inhaber, 1998). Because of their large scales and technical complexity, many projects involve disparate risks, costs, and benefits for a variety of involved stakeholders, affected populations, and surrounding environments (Keeney, 1980). This inequitable distribution of project impacts has often fueled intense local opposition, and further compounded already complex engineering and economic siting considerations and project constraints.

Siting difficulty is now frequently associated with familiar acronyms such as NIMBY (not in my backyard) or even more extreme acronyms like BANANA (build absolutely nothing anywhere near anything) (Fialka, 2001; Halvorsen, 1999; Maize and McCaughey, 1992). The term siting difficulty, as it is used here, is defined broadly as any combination of obstacles in facilities planning and siting processes, including but not limited to public opposition; environmental, topographic, and geographic constraints; inter-agency coordination problems; and local, state, and federal regulatory barriers to permitting, investment, and/or construction. As the scope of this definition illustrates, siting difficulty is a broad and complex problem, where potential solutions are not obvious or well-understood. Furthermore, the obstacles associated with understanding impediments to facilities siting are compounded by the lack of substantial data on siting problems. Although, siting difficulty is a widespread phenomenon, the majority of related literature and energy industry publication focuses either on overcoming individual *causes* of siting difficulty, such as public opposition, or characterizing localized *effects*, such as transmission grid congestion. These analyses are advanced in the absence of any clear empirical reference level for siting difficulty as a whole; and, as a result, many of these studies have limited siting applications and policy relevance. To bridge this gap, this paper presents a robust framework for characterizing and quantifying siting difficulty based on the unique concept of *siting indicators*.

This approach is fundamentally different from other siting research because each indicator of siting difficulty is 1) separate from the local causes and effects of siting problems and 2) large-scale to avoid results that are driven by individual case studies. These are crucial distinctions for two reasons. First, because of the numerous feedback loops and interactions among the causes of siting difficulty, it is necessary to develop an empirical characterization of overall difficulty before advancing effective strategies for mitigating individual siting constraints and impacts. Second, no single effect provides an adequate representation of the overall problem of siting difficulty. For example, one possible measure of siting difficulty for the case of transmission line siting is the difference between annual generation capacity and transmission capacity additions; however, this metric could conceivably mask underinvestment in both generation and transmission caused by siting constraints. As a result, siting difficulty needs to be quantified based on a careful evaluation and aggregation of multiple impacts.

Figure 2.1 describes this framework as a whole and highlights the general relationships among the selected siting indicators and the typical causes and effects of siting problems. This diagram illustrates how multiple causes of siting difficulty such as public opposition, environmental barriers, and regulatory roadblocks could collectively lead to an underinvestment in infrastructure. The resulting lack of necessary capacity then manifests a host of industry-level economic, physical, and perceptual impacts. For the case of transmission line siting, these impacts include variations in the cost of electricity generation and changes in capacity additions, among others. It is based on these types of large-scale impacts that the indicators in this paper are constructed.

The next sections of this paper apply this framework to the specific case of U.S. transmission line siting. Section 2 begins with a general characterization of the transmission problem. This section includes a basic transmission benefit-cost analysis to place the costs of siting in the context of other financial barriers to transmission investment and to demonstrate the need for a quantitative measure of siting difficulty. Section 3 then presents in detail the four indicators of siting difficulty: an economic indicator, a geographic indicator, a construction indicator, and a perception indicator. These indicators are combined in Section 4 using a series of statistical analyses to create a single quantified measure of siting difficulty. Section 5 then highlights the specific policy implications of this measure for U.S. transmission planning and regional grid management. Finally, Section 6 returns to the discussion of facilities siting difficulty in general and illustrates how this quantitative measure of siting can inform analyses of investment incentive and other related policy decisions for a variety of affected energy infrastructures. Overall, this paper makes an important first step toward answering the fundamental questions "How difficult is siting?" and "How can this quantitative measure of siting difficulty contribute to our understanding of the broader problems of infrastructure planning and underinvestment?"

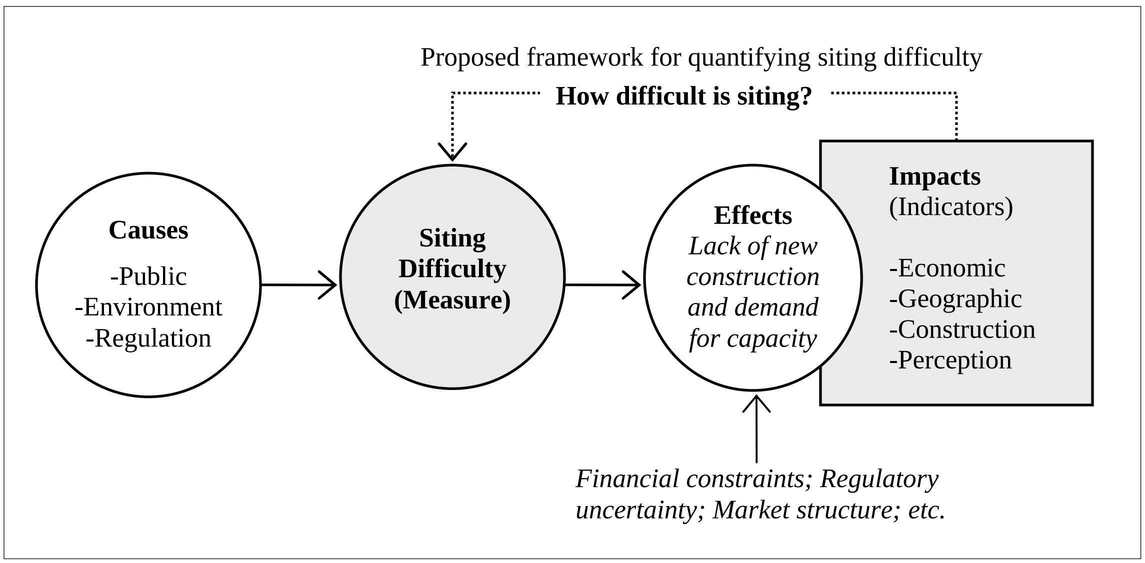

Figure 2.1 Diagram of causes, effects, impacts and indicators of siting difficulty.

Characterizing the Transmission Problem

Transmission line siting is one of the most extreme examples of siting difficulty today (Casper and Wellstone, 1981; Henshaw, 2001; Pierobon, 1995). Although the United States has one of the most reliable electricity systems in the world, electricity transmission expansion has not matched growing demand (CECA/RF, 1990; DOE, 2002; EEI, 2002; Hirst and Kirby, 2001). In August 2001, Spencer Abraham, U.S. Secretary of Energy, noted that, "The shortage of transmission lines is nationwide and will worsen as the demand for electricity grows if corrective steps are not quickly taken" (EEI, 2001b). Although recent industry research has focused on characterizing this decline in transmission construction and on developing investment and policy strategies needed to avert a transmission crisis (Hirst and Kirby, 2002), data and analyses on transmission line siting are limited. Most existing quantitative information is related to specific power technologies, market conditions, system reliability issues, or grid congestion, such as the Transmission Loading Relief Logs from NERC. Similarly, electricity industry articles on siting focus primarily on the individual causes of siting difficulty without any quantifiable estimates for how much each cause contributes to the collective problem (Buell, 2001; Levesque, 2001; Maize and McCaughey, 1992).[1] As a result, data on the causes of siting issues are also difficult to compile and interpret in a broader policy context.

Although many practitioners in the field argue that significant variations among transmission projects even within the same local area make any aggregate analysis of siting practices and problems impractical,[2] the majority of proposed regulations and siting policies focuses on regional or national grid approaches to managing reliability, congestion, and competition (Barton, 2001; Barton, 2003; FERC, 2000). The push toward Regional Transmission Organizations (RTOs) by the FERC exemplifies this trend toward larger units of transmission planning and management, and demonstrates the need for understanding the variability of siting difficulty across states and regions.

Many major energy facilities face serious siting issues and documented public opposition, but siting difficulties associated with transmission lines are especially complex because of the amount of space required and the number of people potentially affected. While generation plants are associated with only a single location, transmission lines, like gas pipelines, can span multiple states and regions. Unlike gas pipelines however, the majority of transmission projects involve highly visible overhead lines that are unregulated by a single federal agency with eminent domain authority (Smead, 2002; Smith Jr., 2002). Although a recent draft of the Electric Reliability Act (2003) proposes to provide the Federal Energy Regulatory Commission (FERC) with back-stop eminent domain authority for major interstate transmission projects, transmission line siting is currently regulated primarily at the state-level (EEI, 2001c). However, the types of agencies that govern siting processes and their respective

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[1] The main causes of transmission line siting difficulty are commonly identified as public opposition; environmental, topographic, and geographic constraints; local, state, and federal regulatory barriers; and interagency coordination. Reasons for public opposition include negative impacts on property values, visual impacts/aesthetics of towers, impacts on view-shed (scenic aesthetics), electromagnetic fields, equity/fairness, compensation for easements/tax implications, and need for the line (Vierima 2001).

[2] Based on personal conversations with siting officials at Allegheny Power (Greensburg, PA), GAI Consultants (Monroeville, PA), and the Tennessee Valley Authority Siting Division.

roles vary significantly by state. For different states, siting oversight is in the hands of the state Public Utilities Commission (PUC), Siting Board, or Department of Natural Resources or management is divided among a variety of related agencies. Similarly, there is no federal standardization in siting permit applications, schedules, and review process requirements (EEI, 2001a; EEI, 2001c). These basic differences between the nature and regulation of transmission infrastructure and other major energy facilities further exacerbate transmission line siting difficulty within and between states.

Overall, the demonstrable need for additional transmission capacity, the awareness of this pressing need, and the continuing inability to serve this need exemplify the problems with building new transmission infrastructure in the U.S. electric industry today. The current attitude toward transmission construction is summarized in a statement by William McCormick, former chairman of CMS Energy Corporation, in criticism of federal regulations that limit the stake investors have in transmission projects- "You can't build it and even if you could, you wouldn't want to invest in it" (McCormick, 1999).

Like McCormick, a number of studies in trade publications and the popular media focus on a financial constraints and siting difficulty as the two main reasons why transmission infrastructure is not being built. First, the market for power that would justify the construction of a new line does not provide adequate investment incentive for prospective investors *even in the absence of siting difficulty* (Collins, 2002; Krapels, 2002). Second, siting is simply so difficult that the additional costs incurred by uncertainty and confounding factors further reduce investment incentive (Bangor Daily News Editorial, 2001; EEI, 2001a; Gale and O'Driscoll, 2001).

Siting difficulty and financial constraints are generally separately blamed for the recent lag in transmission construction, although they are tightly coupled parts of the transmission planning process. To place transmission line siting difficulty in context within the larger problem of transmission underinvestment, and to understand the relative significance of the costs of siting difficulty to overall investment incentive, we performed a basic analysis of potential transmission profits using market data from the Energy Market Reports (EMR) daily price publications (Economic Insight Inc., 2000). This analysis examines 61 hypothetical merchant transmission lines connecting pairs of existing U.S. electricity markets to determine their viability based on forecasted annual revenues and costs.

For the purposes of this analysis, transmission project costs are defined as consisting of two distinct components- engineering costs and siting costs. Engineering costs are the fixed or generally predictable costs associated with line construction such as land acquisition, equipment, materials, and labor. Siting costs, on the other hand, are the variable costs associated with selecting a route, obtaining permits and siting approvals, acquiring rights-of-way, proposing alternatives, conducting public meetings, and especially addressing uncertainty, route changes, or project delays. Siting costs, such as legal fees, could likely increase with siting difficulty, while engineering costs are generally fixed for a given configuration and length of line. Although the costs associated with anticipated siting difficulty must be included in transmission investment benefit-cost analyses, economic justification for a new transmission line based solely on financing for engineering costs is a necessary first check in project viability (Houston, 1995). Therefore, this analysis of transmission investment incentives in the face of siting difficulty addresses the questions, *Which lines are financially viable given engineering costs and forecasted revenues?* and *How do additional siting costs affect this assessment of project viability?*

Each point in Figure 2.2 represents a market pair and illustrates the potential yearly revenues annualized over a 25-year investment period for a transmission owner of a dedicated 230 kv transmission line with an effective capacity of 1,060 MW (EIA, 2001b). The lengths of the proposed lines connecting 55 different pairs of western markets and 6 pairs of eastern markets are estimated as the straight-line distance in miles between market center points (EMR, 2002). This analysis assumes that the owner collects rents for a transmission line between any given market pair equal to the average annual price difference between those markets for the period from January 1, 1999 to December 31, 2000.[3] The total annual price differential is calculated using absolute daily price differences averaged for the selected two-year period at the given prices for 16-hour blocks of on-peak trading and 8-hour blocks of off-peak trading. Transactions between market pairs are assumed to occur for 24 hours a day and 350 days per year at the capacity of the line.

To compare these potential revenues with possible engineering costs, three different cost estimates for AC and DC transmission construction are overlaid on the plot. Transmission costs per circuit-mile are estimated as follows: for AC lines the low cost estimate is \$650,000/ circuit mile, average cost is \$800,000/ circuit mile, and high cost is \$1,000,000/

[3] The authors acknowledge that the period from 1999-2000 reflects unusually high prices because of drought conditions in the Pacific Northwest during the summer of 2000, examples of capacity withholding, and the impacts of deregulation in California. However, a comparison of the calculated averages with EMR data from January 1, 1997-December 31, 1997 for the same western markets yields comparable average annual price differentials for both peak and off-peak periods. Additionally, transactions between market pairs are assumed to be small enough that they do not impact long-term market prices and price differentials.

circuit mile (EIA, 2001b; Hirst, 2002). These cost estimates are then multiplied by the length of each line and an annualized cost estimate is calculated based on a loan payback period of 25 years at a 10% annual discount rate. For lines longer than 400 circuit-miles, DC transmission becomes cheaper than AC transmission; therefore, each of the cost estimate lines includes a break-even pivot point from AC to DC transmission costs at 400 circuit miles on the graph (Lucas, 2001). The DC cost estimate per circuit mile for low-cost lines is $400,000/circ. mile, average cost is $550,000/circ. mile, and high cost is $700,000/ circ. mile (Cassaza, 1993). From the graph, revenues exceed average construction costs for approximately 38% of all possible lines at a minimum 10% return on investment.

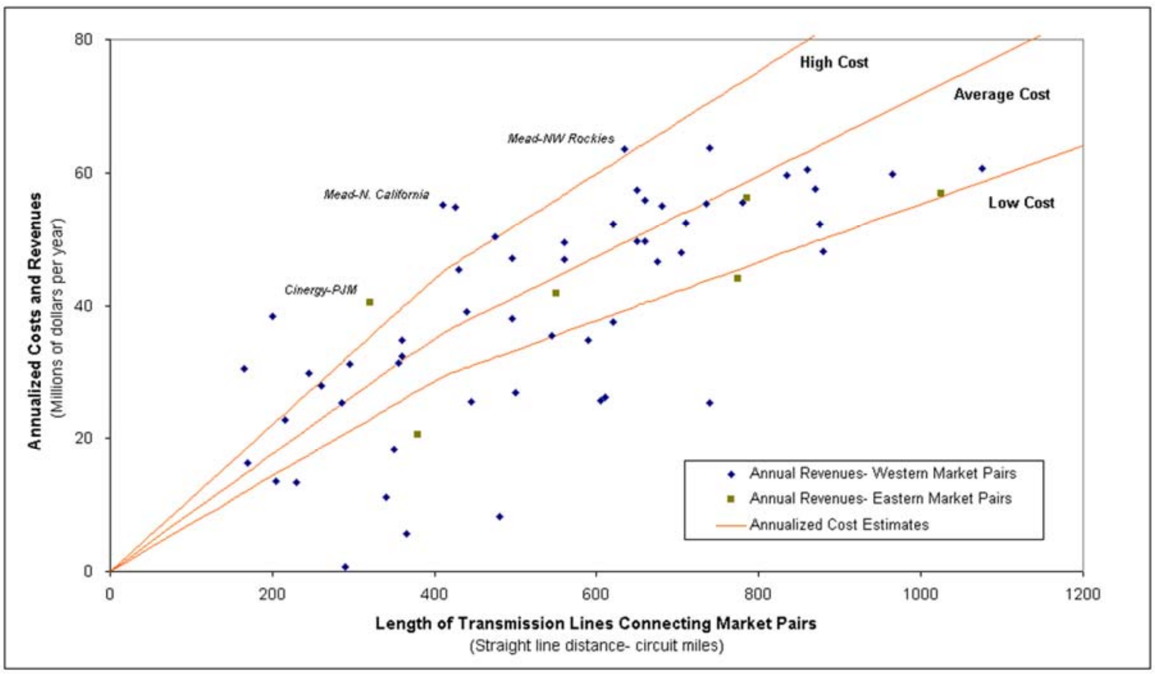

Figure 2.2 Potential revenues and costs for transmission lines connecting market pairs.

Based on this simple "back-of-the-envelope" analysis, if siting costs are not considered, then there appear to be some opportunities for profitable transmission investment. It is very important to note, however, that project viability in this analysis is defined based on the collective private costs and benefits that could accrue to a group of investors. We recognize that transmission ownership is rarely consolidated in the hands of a single owner who sees all the costs and revenues of a project; however, this aggregate characterization of costs and benefits is still particularly relevant within the current market structure, where the "unbundling" of transmission ownership has resulted in shift from traditional methods of system-based transmission financing to toward single-project or merchant financing (Krellenstein, 2004). It is also important to emphasize that although the benefits and costs in this analysis are discussed in aggregate, this is not a social benefit-cost analysis. All of the projected costs and benefits considered here are specific to a private investor or a collection of investors, not society as a whole. At a more detailed level of evaluation, these costs and benefits would be disaggregated among a variety of associated investors and stakeholders, and the viability of any individual project would depend on their allocation and the particular regulatory uncertainties and market characteristics affecting the project financing (Hogan, 2003; Joskow, 2004; Joskow and Tirole, 2004). At this level of aggregation, this analysis simply provides an important estimate or bound of the potential benefits and engineering and siting costs of a set of plausible transmission projects.

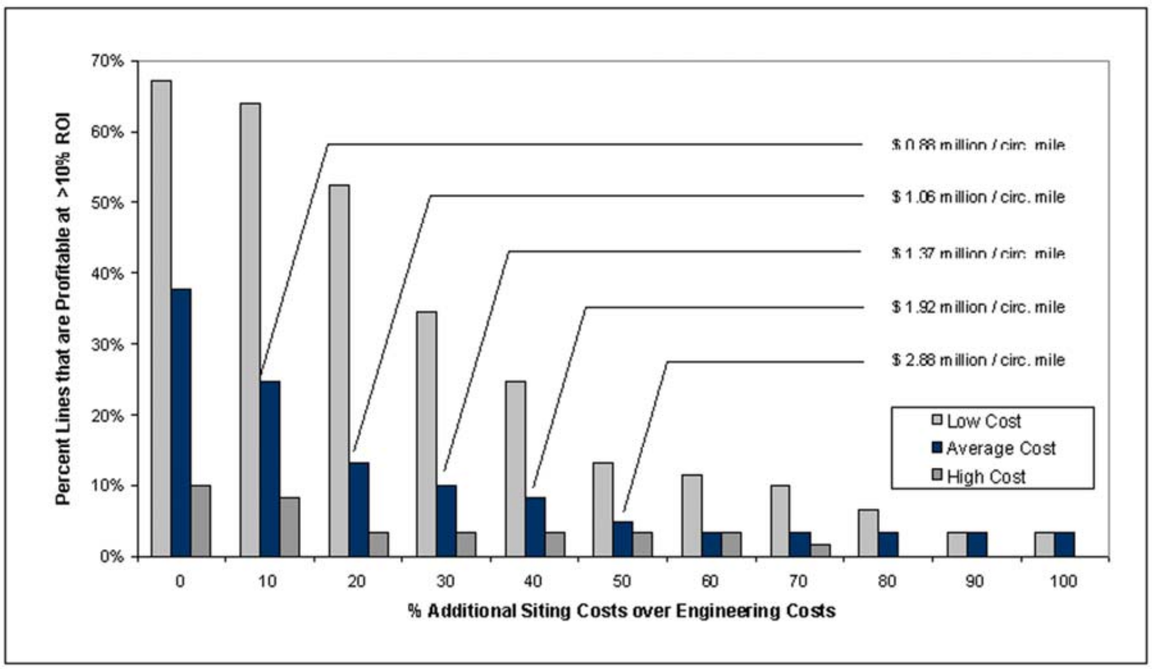

Figure 2.3 Impact of siting costs on total percentage of profitable lines.

Since none of the lines in this analysis is currently under consideration for construction, additional factors, such as siting costs and uncertainty, must be increasing costs and making the lines unprofitable. Figure 2.3 shows the impact of additional siting costs (valued as a percentage of total engineering costs) on the total number of profitable lines. Overall, this analysis does not attempt to suggest that any of these lines would be profitable given a detailed evaluation of land costs, rights-of-way, and market uncertainty; nevertheless, it is simply meant to motivate the remainder of the paper that quantifies siting difficulty.

Developing Indicators of Siting Difficulty and Transmission Demand

Given the intrastate and interstate variations in the factors affecting siting, there are numerous articles in the popular media qualitatively comparing transmission issues and siting problems between states. The most common siting comparisons are between California and Texas, where siting in California is often described as "notoriously difficult," while siting in Texas is "comparatively easy" (McNamara, 2004). These qualitative descriptors, while useful for conveying two extremes of the siting problem to the public, provide little insight into the complex nature of siting practices and issues in either California or Texas. In order to build a series of complementary metrics of siting issues in each state and their implications for national grid planning and policy-making this section presents four state-level quantitative indicators of siting difficulty and the need for additional transmission capacity.

1. An economic indicator based on measures of the variability of the marginal cost of electricity production;
2. A geographic indicator based on the distances separating generation capacity from demand load centers;
3. A construction indicator based on differences in transmission additions relative to generation capacity construction, net generation, and sales;
4. A perception indicator based on a survey of industry experts.

Each of these indicators captures a different aspect of the siting problem and is a summary of a series of metrics derived from available data to provide a "first-pass" analysis of siting issues. Other indicators could be devised to describe the problem; however, we believe that the selected indicators provide a justifiable, quantitative framework that should serve as a starting point for follow-on discussions. It cannot be emphasized enough that transmission line siting is a complex problem, and no single "metric" is perfect. Because each one has its own limitations, we focus on combining the selected metrics using statistical techniques to form a statistically coherent overall indicator. Similarly, none of the selected indicators is intended to be a stand-alone, representative measure of siting difficulty. There are numerous factors influencing each indicator, and that the value of these indicators is collective. All four indicators are used to evaluate and compare demand and difficulty for each state in the continental United States. It is important to note, that transmission demand (the need for additional capacity or lines) and siting difficulty are treated as related problems; states with high need and the economic incentive to build additional transmission capacity are assumed to face a variety of constraints (of which siting difficulty is one) that have prevented them from adding lines. Overall, each indicator and the reasons for its selection, as they relate to the proposed framework, are discussed in detail in the next sections.

Economic Indicator: Variation in the Marginal Cost of Generation

With the recent focus on competition and deregulation, the transmission grid is being reevaluated for its ability to support competitive markets and transactions. Many high-level industry executives and government officials have raised serious concerns about whether the existing transmission infrastructure is inadequate for a deregulated market. In September 2001, Pat Wood, Chairman of the FERC, observed that "The [transmission] grid increasingly is pushed to its operational limit, and transmission constraints frequently prevent the most efficient use of generation facilities" (EEI, 2001b). Similarly David Cook, general counsel of NERC, notes that "The lack of additional transmission capacity means that we will increasingly experience limits on our ability to move power, and that commercial transactions that could displace higher-priced generation with lower-priced generation will not occur" (EEI, 2001b). Both of these observations indirectly address the issues of transmission demand and siting difficulty: states that are currently unable to use their existing generation capacity efficiently have greater economic incentive to build new transmission capacity. The economic indicator proposed here is based on the hypothesis that high variation in generation costs in a state relative to other states is an indication of suboptimal dispatch of generation capacity caused in part by transmission congestion. In order to examine these hypotheses, cost of production data for 1,500 generation plants across the U.S. were evaluated at the state-level (Platts/UDI, 2001a; Platts/UDI, 2001b; RDI, 1999).

The data are divided by size of plant into baseload and peaker categories. The baseload size category includes all hydro plants, all nuclear plants, and all other plants that operated for greater than 7,445 hours load in the year 2000 or 85% of the total possible hours in a year. The peaker category includes all plants that ran fewer than 1,315 hours in the year 2000 (15% of the total possible hours). Table 1 shows the average, inter-quartile range, and standard deviation of the cost of production for each state for both categories.

Also in this table is a measure of the potential savings that could be realized from reallocating the distribution of generator load hours to an optimal dispatch schedule that minimized cost of production as a percentage of total expenditures. This metric is calculated by re-ordering the dispatch of generators and running the cheapest generators for the longest number of hours until all existing demand served by a state is met using online generation capacity.[4] Actual load factors in an integrated power system are dynamically dependent on many assumptions about unit dispatch, plant operating constraints, fuel costs and availability, and the shape of the load duration curve among a host of other variables. While these many factors affect the decision to use different generators, this measure of efficiency is also a basic indicator of the need for transmission. The potential for savings provides a "bound" for efficient dispatch with perfect transmission among all generators and consumers in a state.

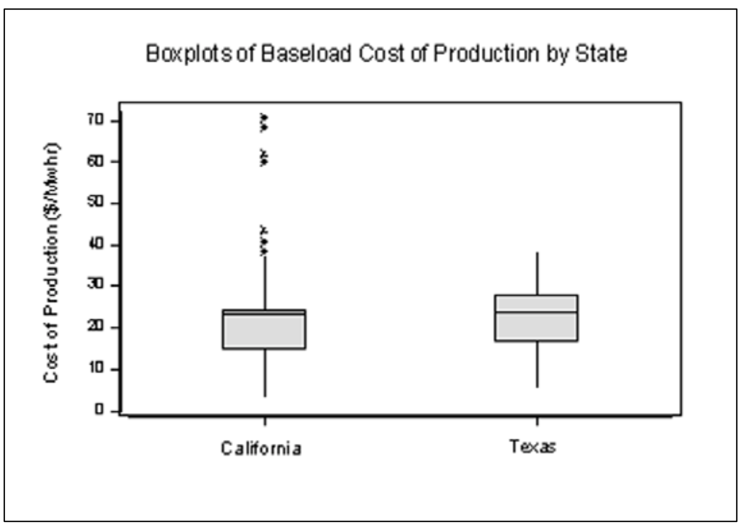

Figure 2.4 Boxplots of baseload plant costs of production in California and Texas

Interestingly, a comparison of California and Texas provides support for the dominant existing qualitative judgments. The mean cost of production at the baseload is similar in both states ($23 $/MWhr), but California has a higher standard deviation and a lower inter-quartile

[4] All hydro plants have been removed from the optimal dispatch calculations in the baseload category because it is assumed that these plants are already run at their maximum capacity.

range than Texas. Because the inter-quartile range is robust to outliers, a lower IQR and higher standard deviation indicate a large number of expensive baseload plants in California (see Figure 2.4). Although the dispatch of different plants is in part dictated by regional fuel availability and environmental regulations, these outliers could serve to reinforce the widely held perceptions of high transmission demand and extreme siting difficulty in California. It should be emphasized that the differences captured by even these two seemingly similar metrics within the economic indicator (standard deviation and IQR) support the need for additional metrics, since any single metric could miss key underlying factors. As expected, states such as Wyoming that export a large percent of their electricity have low costs of production and low potential for savings.

	Baseload Cost of Production ($/Mwhr)				Peaker Cost of Production ($/Mwhr)			
State	**Mean**	**Standard Deviation**	**IQR**	**Opt. Dispatch Savings (%)**	**Mean**	**Standard Deviation**	**IQR**	**Opt. Dispatch Savings (%)**
Alabama	14.74	6.97	9.41	0.0%	40.47	5.85	-	0.0%
Arizona	26.82	16.13	15.28	0.0%	198.18	236.58	260.82	12.8%
Arkansas	21.56	3.07	5.25	0.7%	76.40	50.87	-	3.5%
California	22.97	12.46	9.39	0.8%	165.52	305.64	100.09	33.8%
Colorado	18.50	6.52	9.72	1.6%	219.01	259.93	412.36	42.5%
Connecticut	34.07	12.72	17.35	0.0%	216.75	111.27	162.62	9.8%
Delaware	-	-	-	0.0%	387.51	377.45	582.34	8.6%
Florida	24.68	5.94	8.83	1.0%	276.77	941.38	36.20	10.3%
Georgia	19.41	4.89	6.19	0.0%	61.80	22.63	16.17	3.3%
Idaho	16.06	10.64	16.91	0.0%	-	-	-	0.0%
Illinois	28.42	15.51	15.66	0.3%	117.54	67.26	66.10	30.9%
Indiana	19.51	6.20	6.69	0.1%	80.06	54.81	61.29	3.6%
Iowa	22.29	14.03	12.58	1.5%	77.14	32.24	54.76	4.3%
Kansas	17.17	4.69	9.28	0.5%	75.04	51.13	40.76	14.0%
Kentucky	14.80	3.79	4.49	0.5%	87.82	68.84	37.78	5.6%
Louisiana	25.94	6.05	10.15	1.8%	183.73	25.38	-	0.0%
Maine	17.27	11.20	20.93	0.0%	1125.20	-	-	0.0%
Maryland	19.27	3.45	5.25	0.1%	73.16	25.85	45.63	0.5%
Massachusetts	34.03	18.18	31.56	0.0%	213.92	214.64	252.82	37.7%
Michigan	21.29	5.69	7.96	0.2%	119.99	109.65	51.57	17.6%
Minnesota	26.19	15.16	19.78	0.2%	159.14	168.00	101.83	16.3%
Mississippi	20.25	3.61	6.65	0.9%	152.58	254.73	51.66	3.8%
Missouri	17.67	5.34	10.61	0.5%	89.65	58.08	45.79	22.0%
Montana	12.07	6.16	8.90	0.0%	38.73	4.23	-	0.0%
Nebraska	16.14	9.42	15.54	0.9%	72.64	42.09	32.13	8.2%
Nevada	18.68	3.07	6.12	0.3%	78.80	35.04	67.19	0.0%
New Hampshire	20.01	5.57	9.97	0.5%	332.84	167.09	308.73	6.2%
New Jersey	28.76	8.30	15.33	0.4%	105.42	66.51	82.74	12.3%
New Mexico	27.26	7.23	12.85	0.0%	54.14	-	-	0.0%
New York	27.81	19.68	18.14	2.2%	351.20	801.97	61.14	13.6%
North Carolina	15.42	8.23	10.39	0.4%	103.30	46.84	73.00	2.4%
North Dakota	16.00	5.26	8.34	0.0%	92.46	-	-	0.0%
Ohio	18.94	4.51	5.40	0.7%	175.33	117.41	128.24	5.1%
Oklahoma	20.55	6.75	10.00	0.9%	49.60	7.09	13.68	0.0%
Oregon	18.79	10.20	15.25	0.0%	45.87	-	-	0.0%
Pennsylvania	21.52	7.54	8.20	0.1%	82.27	49.21	39.71	67.5%
Rhode Island	32.26	-	-	0.0%	-	-	-	0.0%
South Carolina	18.91	6.61	9.54	0.2%	96.94	30.73	45.40	6.4%
South Dakota	14.45	8.16	15.66	0.0%	66.21	22.71	32.50	2.1%
Tennessee	13.46	6.48	7.57	0.2%	58.25	18.51	36.34	0.0%
Texas	22.52	7.08	11.23	0.9%	196.95	393.23	73.70	42.4%
Utah	19.47	7.66	12.52	0.1%	-	-	-	0.0%
Vermont	21.65	14.22	28.24	0.0%	119.43	34.73	58.61	0.4%
Virginia	18.37	4.32	7.06	0.1%	82.19	30.25	59.41	0.6%
Washington	14.67	6.29	8.93	2.0%	32.72	7.92	-	0.0%
West Virginia	15.51	1.05	1.71	0.1%	-	-	-	0.0%
Wisconsin	20.59	7.69	15.61	0.4%	90.25	74.04	53.97	8.7%
Wyoming	12.69	2.73	5.25	0.1%	-	-	-	0.0%

Table 1. Economic Indicator: Variations in the Cost of Generation and Production

Geographic Indicator: Distribution of Generation Capacity and Demand

Just as economic variability indirectly indicates the need for transmission lines, a second indicator of siting difficulty and the demand for transmission capacity is the geographic relationship between the locations of existing generation capacity and demand load centers in a state. We hypothesize 1) that states with populations served by proximate generation plants need less transmission than states with dispersed populations and/or generation, and conversely 2) that high population densities concentrated around plants are associated with greater siting difficulty. Although we emphasize throughout this paper that siting difficulty and transmission demand are related problems, it is important to reiterate here that they are not perfectly correlated. As Figure 2.1 illustrates, there are many other dynamics that could contribute to the need for additional capacity. Consequently, both of the above hypotheses are complementary (not contradictory) and together they focus on capturing those states with high transmission demand and low siting difficulty and vice versa.

Using a Geographic Information Systems (GIS) model for all generation plants in the United States, footprints based on 5-mile incremental radii were plotted around each plant as shown in Figure 2.5. Plant latitude-longitude coordinates and generation data are from the EPA e-Grid database (EPA, 2002). These plant data and circular footprints were then overlaid on census zip-code population data and the total population contained within each footprint for all plants was calculated for each state (U.S. Bureau of Census, 2000). Based on the annual power demand for each state (EIA, 2001a), a consumption-per capita was used to approximate the power consumed by the population in each concentric 5-mile radius circle around each plant. The population sufficient to consume a plant's yearly output was then calculated for each footprint.[5] Finally, the population actually served within a given radius of all plants was calculated as a percentage of the state's total population (Table 2).

It is important to note, that although this indicator focuses specifically on population-based estimates of demand, a comparison of U.S. Economic Census data (1997) with census population data (2000) reveals that county populations are highly correlated with measures of local industry, specifically manufacturing, the most electricity-intensive sector.[6] This

[5] If the population within a given footprint was greater than the total population potentially served by the plant's net generation then only the population able to be served based on state average consumption in MWhrs per capita was counted as served.

[6] County population estimates for the continental U.S. are correlated with the number of in-county manufacturing establishments, the number of employees, the annual payroll, the average number of production workers, the

relationship supports the assumption that this indicator properly captures not only the geographic distribution of residential and commercial demand, but also industrial consumption. Furthermore, all of the analyses in this paper focus on total transmission capacity in circuit-miles not MW-miles. This is a crucial distinction since industries make up a large percent of total consumption, but they are often represented by highly concentrated point loads that require fewer total miles of transmission lines at higher effective capacities. We believe that the higher number of dispersed lines required to serve residential and commercial loads are better indicators of siting difficulty (because of the number of people affected) and also the overall need for additional miles of line. As a result, this analysis uses population density and distribution data as a surrogate for all demand.

From the table, a high percentage population served within a small radius indicates a close proximity of generation plants and population loads, and suggests a low demand for transmission, and vice versa. For example, North Dakota with less than 40% of the potential population served within a 25-mile radius of its power plants is hypothesized to have a high demand for transmission lines; while New Hampshire with 100% of the potential population served within a 25-mile radius indicates a low need for lines. For this model, we assume that states that export electricity will first use in-state generation capacity to serve in-state demand, and that states that import electricity can never reach 100% demand served. Since this analysis focuses on the relative need for additional capacity and not the specific amounts of additional capacity, any lack of in-state generation capacity satisfied by imports is also an indicator of a need for transmission capacity.

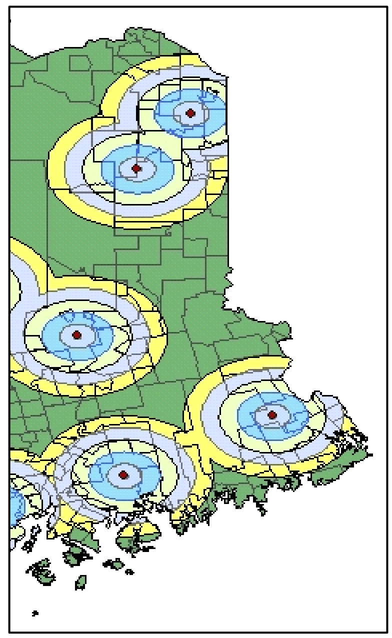

Figure 2.5 Illustration of GIS footprint model for generation plants in Maine.

number of production worker hours, production worker wages, economic value added, and total capital expenditures at an average correlation of 0.9.

	Percent of Total Population Served within Footprint Radius					
State	**1 mile**	**5 mile**	**10 mile**	**15 mile**	**20 mile**	**25 mile**
Alabama	0.4%	7.4%	30.0%	56.6%	74.7%	87.3%
Arizona	0.9%	4.7%	5.9%	59.8%	60.7%	61.7%
Arkansas	0.5%	4.7%	14.9%	37.1%	56.9%	82.6%
California	0.7%	14.2%	23.0%	31.3%	49.1%	55.4%
Colorado	0.8%	10.4%	19.7%	26.6%	51.1%	92.6%
Connecticut	1.9%	32.5%	47.8%	81.9%	98.2%	99.2%
Delaware	1.5%	26.8%	44.6%	83.9%	99.2%	100.0%
Florida	1.2%	17.2%	49.6%	62.9%	87.1%	90.3%
Georgia	0.6%	10.0%	37.5%	57.2%	88.0%	94.3%
Idaho	0.1%	3.9%	13.1%	24.5%	44.6%	85.1%
Illinois	0.9%	11.5%	32.7%	86.0%	95.2%	98.8%
Indiana	0.6%	12.7%	19.4%	68.9%	80.6%	91.4%
Iowa	0.9%	11.8%	26.0%	68.3%	83.0%	89.0%
Kansas	1.0%	17.2%	38.4%	56.9%	89.2%	95.7%
Kentucky	0.7%	15.3%	38.7%	48.4%	55.2%	81.5%
Louisiana	0.9%	19.3%	47.9%	61.9%	80.2%	87.7%
Maine	0.4%	8.4%	30.4%	40.1%	74.4%	82.8%
Maryland	1.7%	22.1%	46.1%	74.2%	95.1%	97.5%
Massachusetts	2.4%	30.9%	50.0%	72.1%	91.5%	95.6%
Michigan	1.1%	13.9%	37.2%	89.3%	96.6%	96.8%
Minnesota	1.4%	13.9%	44.7%	75.5%	87.9%	91.3%
Mississippi	0.3%	6.7%	18.6%	38.9%	51.3%	62.7%
Missouri	0.9%	15.4%	40.7%	73.8%	81.4%	91.5%
Montana	0.1%	5.1%	13.3%	18.0%	30.6%	48.4%
Nebraska	0.9%	5.8%	48.0%	72.4%	83.8%	91.5%
Nevada	1.1%	11.1%	34.3%	39.2%	58.0%	71.5%
New Hampshire	0.6%	11.0%	42.4%	79.7%	99.2%	100.0%
New Jersey	2.2%	19.9%	51.2%	81.0%	98.4%	99.3%
New Mexico	0.3%	2.4%	4.6%	7.3%	12.2%	14.9%
New York	5.7%	24.7%	48.3%	78.7%	94.7%	95.8%
North Carolina	0.7%	11.5%	40.0%	67.4%	86.5%	92.7%
North Dakota	0.1%	1.9%	8.8%	15.5%	19.3%	38.8%
Ohio	0.9%	6.9%	31.2%	56.5%	87.0%	91.2%
Oklahoma	0.7%	12.7%	22.0%	40.9%	52.0%	87.2%
Oregon	0.1%	1.8%	6.4%	14.1%	38.7%	50.6%
Pennsylvania	1.5%	15.8%	58.4%	89.1%	95.5%	98.4%
Rhode Island	2.3%	45.2%	80.0%	84.2%	98.5%	100.0%
South Carolina	0.9%	9.4%	31.2%	78.7%	94.4%	99.9%
South Dakota	0.3%	5.7%	10.5%	15.3%	30.4%	34.5%
Tennessee	0.5%	6.7%	25.9%	47.3%	66.1%	84.0%
Texas	1.1%	14.2%	37.8%	52.6%	80.0%	83.5%
Utah	0.5%	4.0%	6.1%	7.6%	88.2%	92.3%
Vermont	2.2%	13.1%	22.5%	75.9%	98.9%	99.0%
Virginia	1.3%	14.7%	36.3%	75.0%	93.4%	96.5%
Washington	0.4%	2.2%	6.1%	22.9%	38.4%	50.3%
West Virginia	0.6%	12.0%	39.5%	60.1%	72.0%	82.9%
Wisconsin	2.2%	13.7%	39.2%	83.0%	94.4%	94.8%
Wyoming	0.1%	1.4%	4.8%	11.0%	30.6%	41.1%

Table 2. Geographic Indicator: Distribution of Generation Capacity and Demand

Construction Indicator: Differences in Capacity Additions

An intuitive indicator of siting difficulty is the difference in miles between proposed and constructed transmission. Although this indicator is perhaps the most direct measure of siting difficulty, existing data on transmission construction are extremely limited at the state-level and of poor quality because of frequent changes in data collection and reporting protocols. Additionally, such a measure could overestimate siting difficulty because of other factors that lead to canceled projects (such as internal economic considerations), and could underestimate siting difficulty because some projects and lines are never proposed because of anticipated problems.

Given these limitations, this indicator is calculated based on changes in total transmission capacity (circuit miles) relative to the changes in generation capacity (MW), net annual generation (Mwhrs), and electricity sales (Mwhrs). Generation and transmission data for these metrics were compiled for a ten-year period from 1988 to 1998 (EEI, 2001d; EIA, 1999; EIA, 2001a), and normalized to 1 for the first year. The slope of a regression line, or the rate of increase from the baseline, was then calculated for transmission, generation capacity, net generation, and sales in each state. For the entire United States the transmission capacity increased by 1.7% per year from 1988-1998 compared to 0.7%, 2.0%, and 2.5% average increases for generation capacity, net annual generation and sales respectively. Similar data for slopes (rates of change) and the differences between slopes for transmission capacity and generation capacity, net generation, and sales in each state are presented in Table 3. For example, the large positive difference of 9.4% per year of net generation relative transmission capacity in Mississippi indicates a lag in transmission construction associated with the need for additional transmission capacity, while the –16.2% in Delaware indicates greater growth in transmission construction than net generation.

For this indicator, the selection of 1988 as a baseline year is based solely on data availability. The authors recognize that this indicator does not take into account any overbuilding or under building of capacity prior to the baseline year, nor does it capture any of the important differences in line voltages or effective transmission capacity. However, we believe that it does provide a relevant dimension not captured by the other indicators.

	Slope 1988-1998 (Avg. Annual Change)				Difference in Slopes		
State	**Transmission Capacity (Circ. Miles)**	**Net Generation (Mwhrs)**	**Generation Capacity (MW)**	**Sales (Mwhrs)**	**Net Generation- Transmission**	**Generation Capacity - Transmission**	**Sales - Transmission**
Alabama	7.06%	7.01%	1.27%	3.86%	-0.06%	-5.79%	-3.20%
Arizona	1.83%	3.43%	0.47%	4.40%	1.60%	-1.36%	2.57%
Arkansas	1.24%	2.89%	0.02%	5.62%	1.65%	-1.23%	4.38%
California	1.52%	0.36%	-0.24%	1.15%	-1.16%	-1.75%	-0.37%
Colorado	1.48%	1.99%	0.85%	3.48%	0.51%	-0.63%	2.00%
Connecticut	7.43%	-4.90%	-1.39%	0.70%	-12.33%	-8.82%	-6.74%
Delaware	14.76%	-1.48%	2.32%	3.55%	-16.24%	-12.45%	-11.22%
Florida	1.30%	3.93%	2.28%	3.99%	2.64%	0.99%	2.69%
Georgia	4.77%	2.22%	2.13%	4.66%	-2.55%	-2.64%	-0.11%
Idaho	1.54%	7.92%	1.71%	2.52%	6.38%	0.16%	0.98%
Illinois	2.35%	1.32%	0.15%	2.02%	-1.03%	-2.20%	-0.33%
Indiana	0.92%	2.95%	0.35%	3.02%	2.03%	-0.58%	2.10%
Iowa	3.50%	3.06%	0.60%	3.11%	-0.43%	-2.89%	-0.38%
Kansas	0.25%	2.78%	0.33%	3.05%	2.53%	0.08%	2.80%
Kentucky	-2.29%	2.71%	0.54%	4.31%	5.00%	2.83%	6.59%
Louisiana	2.80%	1.19%	0.48%	3.03%	-1.61%	-2.32%	0.23%
Maine	-0.16%	-4.18%	-2.01%	0.39%	-4.01%	-1.85%	0.56%
Maryland	-2.45%	2.99%	1.96%	2.21%	5.45%	4.41%	4.66%
Massachusetts	0.85%	-0.21%	0.00%	0.76%	-1.06%	-0.85%	-0.09%
Michigan	5.72%	0.35%	-0.16%	2.39%	-5.37%	-5.88%	-3.32%
Minnesota	-0.18%	0.88%	0.86%	2.61%	1.06%	1.04%	2.79%
Mississippi	-5.85%	3.62%	0.36%	4.85%	9.46%	6.20%	10.69%
Missouri	-0.70%	2.48%	0.85%	3.23%	3.18%	1.55%	3.93%
Montana	0.03%	0.80%	0.26%	0.13%	0.77%	0.22%	0.09%
Nebraska	1.93%	4.02%	0.72%	3.53%	2.09%	-1.20%	1.61%
Nevada	0.04%	3.13%	2.46%	8.16%	3.09%	2.42%	8.12%
New Hampshire	1.90%	8.60%	5.00%	0.30%	6.69%	3.10%	-1.60%
New Jersey	0.91%	-1.24%	1.03%	0.88%	-2.14%	0.12%	-0.03%
New Mexico	1.00%	1.85%	0.46%	4.27%	0.85%	-0.54%	3.27%
New York	0.84%	0.00%	1.07%	0.39%	-0.84%	0.23%	-0.45%
North Carolina	1.66%	4.24%	0.90%	3.28%	2.57%	-0.77%	1.62%
North Dakota	0.87%	1.54%	0.11%	2.07%	0.67%	-0.76%	1.20%
Ohio	2.84%	1.48%	0.34%	1.89%	-1.36%	-2.51%	-0.96%
Oklahoma	-0.36%	1.62%	0.00%	2.24%	1.98%	0.37%	2.60%
Oregon	0.85%	1.36%	-0.26%	1.66%	0.51%	-1.11%	0.81%
Pennsylvania	4.52%	1.68%	0.49%	1.51%	-2.83%	-4.03%	-3.00%
Rhode Island	-0.78%	6.86%	3.06%	0.84%	7.64%	3.84%	1.63%
South Carolina	1.43%	2.56%	1.90%	3.63%	1.13%	0.47%	2.20%
South Dakota	2.34%	5.19%	1.40%	2.92%	2.85%	-0.95%	0.58%
Tennessee	-2.76%	4.78%	0.41%	2.30%	7.54%	3.16%	5.06%
Texas	4.05%	2.58%	1.17%	3.31%	-1.47%	-2.88%	-0.74%
Utah	2.24%	1.61%	0.75%	4.54%	-0.63%	-1.49%	2.29%
Vermont	2.55%	0.38%	-0.60%	2.10%	-2.17%	-3.15%	-0.45%
Virginia	2.01%	3.84%	1.96%	2.97%	1.83%	-0.05%	0.96%
Washington	1.27%	2.73%	0.70%	0.17%	1.46%	-0.57%	-1.10%
West Virginia	1.48%	1.17%	-0.13%	1.98%	-0.31%	-1.61%	0.51%
Wisconsin	3.17%	1.87%	1.53%	3.13%	-1.29%	-1.64%	-0.04%
Wyoming	3.06%	1.17%	0.59%	0.30%	-1.89%	-2.47%	-2.76%

Table 3. Construction Indicator: Differences in Transmission and Generation Capacity

Perception Indicator: Documentation of Siting Expert Opinions

The final indicator of siting difficulty is based on a survey of siting experts. Transmission planning and site selection are influenced not only by objective factors such as economics and geography, but also by perceptions of siting difficulty. A region known for its siting difficulty is likely to be avoided during the process of site selection (Houston, 2003); therefore, it is equally important to consider indicators that capture both perceived and actual siting difficulty in any quantitative analysis.

In order to create a perception indicator of state siting issues, an internet survey consisting of 154 multiple choice questions was administered to siting experts and professionals across the United States to elicit respondents' opinions about and experience with siting in each of the 48 continental United States.[7] A total of 56 respondents from public electric utilities, regulatory agencies, research institutes, and other transmission companies in 31 different states participated in the survey. All surveys were completed online and a total of ~1,100 state evaluations consisting of ratings for familiarity, siting difficulty, and siting constraints for a given state were collected. Different survey respondents completed evaluations for as few as 1 state to as many as 49 states based on their experiences and opinions of siting in each state. On average each respondent completed evaluations for 20 states. Familiarity with siting was rated on a five-point scale where 1 was associated with the category "No familiarity with siting difficulty," 2 was "Info from media/literature," 3 was "Info from friends/colleagues," 4 was "Worked on 1-3 siting projects," and 5 was associated with the category "Worked on more than 3 siting projects." Siting difficulty was rated on a ten-point integer scale where 1 was easiest and 10 was hardest.

Selected data from the survey are compiled and illustrated in Table 4. Respondents' ratings of siting difficulty in a state are weighted based on their familiarity with siting in that state, where respondents with greater siting experience in a state receive a higher weight, and higher numbers indicate greater siting difficulty in a state. Interestingly, respondents' ratings of average siting difficulty are consistent with each other across all states; however, their

[7] A list of approximately 400 potential survey respondents was compiled from the EEI State-Level Siting Directory (2001c), the Platt's Directory of Electric Power Producers and Distributors (2002), and industry contacts of the Carnegie Mellon University Electricity Center advisory board and members. Respondents were individually contacted by email during a period between November 1, 2002 and January 1, 2003 and were provided a link to the survey website and a password to access the survey. The methods and results of this survey are described in detail in Chapter 2 and Appendix A.

perceptions of the causes of siting difficulty vary dramatically among respondents affiliated with different agencies and stakeholder groups. These differences in the perceived causes of siting difficulty are further motivation for creating an independent quantitative measure of siting difficulty that can later form the basis for analyzing the relative contributions of different causes to siting difficulty as whole (Vajjhala and Fischbeck, 2005). As expected, California is ranked 4th overall for average difficulty by all respondents while Texas is ranked 45th.

Quantifying Siting Difficulty and Transmission Demand

Overall, each of the indicators in this paper provides a different view of transmission demand and siting difficulty, but transmission line siting is simultaneously affected by all of the metrics and the associated indicators described above. As a result, a comprehensive picture of the siting problem requires an aggregation of these metrics. To evaluate collectively the relationships among these metrics and their implications for both transmission demand and siting difficulty, data representing each indicator were used as the input variables in a series of principal component and factor analyses. The results of these analyses and their implications for transmission planning and energy policy making are discussed in detail below.

Aggregating Siting Indicators

Tables 1 to 3 display a collection of economic, geographic, and construction metrics that could support the formation of overall siting difficulty indicators. In order to reduce and summarize this data for input into a common factor analysis, a single principal component was first calculated for each of these three indicators. All data were standardized, and selected metrics from each indicator were input into individual principal component analysis as shown in Table 5.[8] The resulting loadings on the three components are also included in parentheses next to each associated variable in Table 5.

[8] Because many states did not include a sufficient number of peaker plants to calculate variability based on the standard deviation and inter-quartile range, the principal component analysis for this metric uses only the standard deviation and inter-quartile range variables for the baseload level and the percent savings from optimal dispatch at the peak. Based on the available data, both Delaware and Rhode Island do not have a sufficient number of baseload plants to calculate variability using the standard deviation and the inter-quartile range; therefore, these values are defined as zero and the scores for both of these states in the economic principal component analysis are based largely on the peak savings measure.

		Weighted Average Difficulty Ratings by Respondent Groups					
State	**Total state evaluations**	**All Groups**	**Consulting Company**	**Gov't. Regulatory Agency**	**Investor-Owned Utility**	**Public Electric Utility**	**Other**
Alabama	21	5.71	6.81	3.63	7.20	5.64	4.50
Arizona	18	6.21	8.67	8.00	6.00	5.67	3.80
Arkansas	21	5.81	6.64	5.00	6.60	5.20	5.00
California	25	7.73	9.27	8.17	6.00	7.65	5.63
Colorado	20	7.30	8.40	8.00	8.00	5.45	6.80
Connecticut	24	7.66	8.33	8.00	7.60	6.94	8.00
DC	24	7.84	9.06	9.00	8.00	6.95	6.50
Delaware	22	6.57	6.31	8.00	8.00	6.13	5.67
Florida	22	8.08	8.84	8.00	8.50	7.48	7.63
Georgia	22	6.63	7.61	4.00	7.20	6.91	4.56
Idaho	20	6.17	8.00	7.00	6.00	5.25	4.75
Illinois	26	6.38	6.86	5.00	8.00	5.68	5.56
Indiana	20	6.89	7.67	5.00	7.33	7.08	4.67
Iowa	25	6.31	7.23	5.43	7.83	5.71	5.80
Kansas	21	6.21	7.79	5.40	6.60	4.80	5.00
Kentucky	23	6.26	6.63	5.50	7.20	5.93	6.14
Louisiana	21	6.18	8.00	7.00	7.20	4.69	5.83
Maine	25	6.50	7.20	7.00	7.00	6.00	5.67
Maryland	25	7.77	8.13	9.00	8.00	7.63	6.29
Massachusetts	23	7.37	8.88	7.60	8.00	6.39	6.22
Michigan	21	6.46	6.40	4.00	7.67	6.73	6.30
Minnesota	27	7.25	8.29	7.10	7.88	6.70	6.20
Mississippi	21	6.02	8.00	8.00	7.20	4.39	6.00
Missouri	24	6.20	8.08	5.80	7.64	4.73	5.40
Montana	23	6.35	8.00	5.86	7.50	5.38	6.60
Nebraska	19	6.00	7.13	3.00	7.17	4.75	6.20
Nevada	21	5.91	7.91	5.33	6.00	5.27	5.60
New Hampshire	23	7.05	7.50	7.20	7.25	6.94	6.00
New Jersey	26	7.43	7.78	8.75	7.67	6.62	7.30
New Mexico	22	6.82	8.33	7.38	8.00	5.67	6.00
New York	31	7.85	8.53	8.25	8.33	7.30	8.23
North Carolina	22	6.04	6.40	5.00	7.20	5.77	5.11
North Dakota	24	5.04	6.13	2.54	6.88	4.92	5.60
Ohio	24	5.69	6.04	3.00	7.50	5.29	5.17
Oklahoma	19	6.15	8.09	4.00	6.20	4.89	5.40
Oregon	19	6.83	8.00	6.50	6.00	6.80	6.00
Pennsylvania	28	6.61	7.27	8.89	7.17	5.63	6.20
Rhode Island	22	7.17	8.50	8.25	7.75	5.93	7.40
South Carolina	21	6.32	7.63	5.00	7.20	6.36	4.80
South Dakota	23	5.32	6.79	3.69	6.43	4.50	5.20
Tennessee	22	6.31	7.38	3.00	7.20	5.79	5.71
Texas	24	5.70	7.16	2.20	7.00	5.28	4.25
Utah	21	6.82	8.25	8.00	8.00	5.27	6.60
Vermont	21	7.26	7.54	8.75	7.25	6.33	7.00
Virginia	26	7.01	7.65	5.25	8.00	6.76	7.33
Washington	19	7.18	8.57	8.00	6.00	6.75	6.00
West Virginia	21	5.42	5.18	4.00	7.00	4.87	6.50
Wisconsin	29	7.57	8.39	7.44	7.88	7.26	6.11
Wyoming	23	5.84	7.64	5.80	6.67	4.53	6.40

Table 4. Perception Indicator: Weighted Average of Siting Difficulty

Overall, the results of these individual principal component analyses yielded one significant component for each metric based on the mineigen>1 criteria; these components were then used as input variables in a common factor analysis. In addition to the economic, geographic, and construction principal components, the weighted average of perceived siting difficulty by all survey respondents (perception) was used as the final input variable in the factor analysis with one variable representing each original metric. The four chosen input variables (indicators) load on two significant factors that can be characterized as a siting difficulty factor (Factor one) and a transmission demand factor (Factor two).[9] All four variables load on both factors as expected, and together both factors explain approximately 70% of the total variance. Table 6 shows the detailed variable loadings on each factor and the associated variance and communality estimates. Different metrics, input variables, and analytic assumptions could produce slightly different results; however, by combining multiple indicators, we believe that our factors and resulting rankings are robust.

The perception and geographic variables load principally on the siting difficulty factor, and the construction variable loads on the demand factor. Interestingly, the economic variable loads almost equally on both factors. In other words, as the construction indicator increases, the need for transmission lines also increases. Similarly, as either the geographic or perception indicators increase, the siting difficulty factor also increases. In the case of the geographic variable this relationship supports the hypothesis that high population densities near generation plants indicate higher siting difficulty, more than dispersed populations indicate a greater need for total transmission capacity. Finally, the economic variable, which loads positively on both factors, also supports the idea that high variations in the cost of electricity production indicate a greater need for transmission and also higher difficulty associated with building additional capacity. Overall, the relationships between the selected input variables and the resulting factors robustly support the initial hypotheses.

9 Using a principal components method of extraction and a Varimax rotated factor pattern, two significant factors were extracted based on the latent root cutoff value where the eigen values of both significant factors are greater than the average of the input variable communality estimates (mineigen> 0.695).

Factor Analysis Input Variables	PCA Input Variables and Component Loadings
Economic Principal Component (65% variance explained) ←	-Baseload standard deviation (0.68) -Baseload inter-quartile range (0.66) -Peaker optimal dispatch (% savings) (0.33)
Geographic Principal Component (86% variance explained) ←	Population *unserved* within footprints -10 mile radius (-0.47) -15 mile radius (-0.51) -20 mile radius (-0.52) -25 mile radius (-0.50)
Construction Principal Component (91% variance explained) ←	Difference in Slopes -Net generation — transmission (-0.58) -Generation capacity — transmission (-0.59) -Sales — transmission (-0.56)
Perception Indicator- All survey respondents weighted average state difficulty (standardized)	*None*

Table 5. Principal Component Analyses Results and Factor Analysis Input Variables.

Variable	Siting Difficulty (Factor 1)	Transmission Demand (Factor 2)	Communalities
Perception Indicator	0.871	−0.112	0.771
Geographic Component	0.684	0.168	0.495
Economic Component	0.639	0.384	0.556
Construction Component	0.079	0.960	0.929
Total Variance	1.640	1.111	2.751
% Variance Explained	41.0%	27.8%	68.8%

Table 6. Two-Factor Solution with Varimax Rotated Factor Loadings and Communalities.

Factor Analysis Results

In order to illustrate comparatively the results of this demand-difficulty factor analysis for the U.S., the factor scores for each state were calculated and plotted with the demand factor on the x-axis and the difficulty factor on the y-axis. Scores for both factors range from –3 (very low) to +3 (very high) where 0 is the average demand and difficulty for all states. As shown in Figure 2.6, each point on the factor score plot is a state, and states can be grouped into four categories of transmission demand and siting difficulty based on the four quadrants of the graph. Figure 2.7 is a map of this factor score plot that shows the geographic variations in transmission demand and siting difficulty by state. States like Connecticut and California with both above-average transmission demand and siting difficulty appear in the darkest color on the map, while states like Mississippi and Nevada with below-average difficulty and demand appear in the lightest color. Overall, these analyses provide a solid holistic characterization of both transmission demand and siting difficulty across different states and regions, and present an important depiction of the transmission problem as a whole.[10]

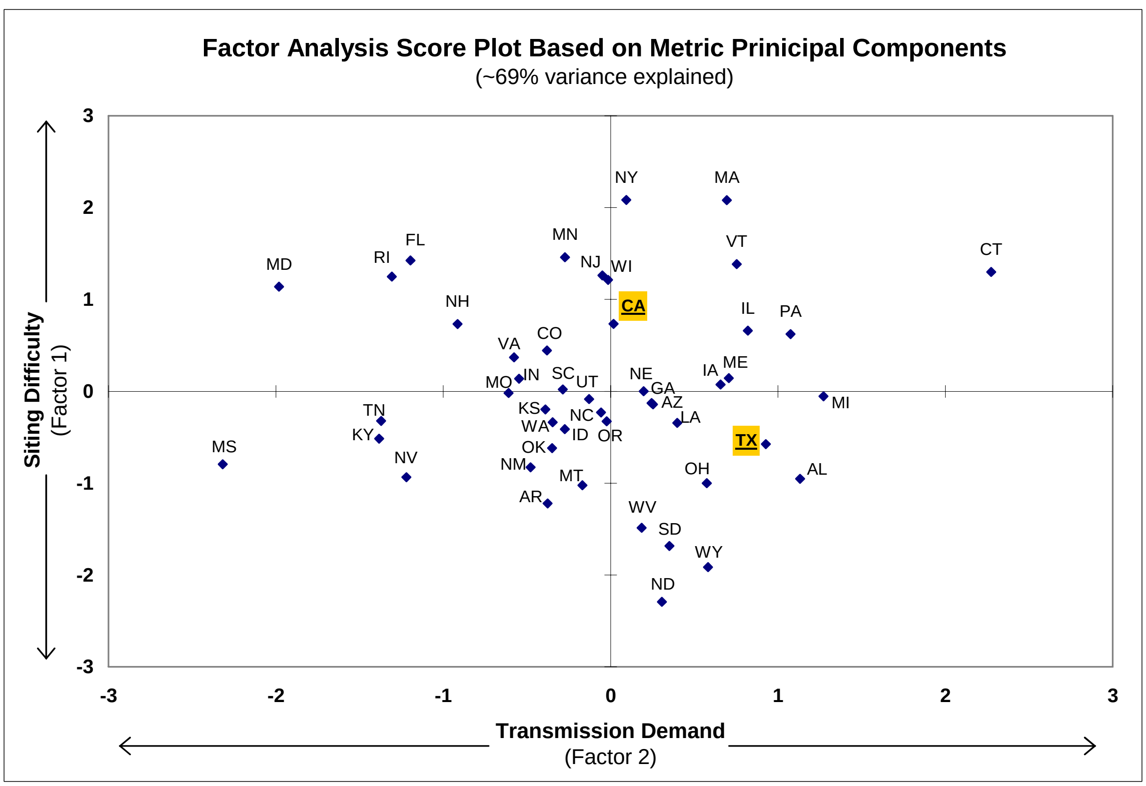

Figure 2.6 Factor plot of state transmission demand and siting difficulty scores.

[10] It is important to note that states with small amounts of transmission capacity, such as Delaware, Rhode Island, and Connecticut have significant influence on the transmission demand factor scores. For example, Delaware with a transmission demand score is outside the scope of Figure 5 above. As a result of these extreme values, the demand factor scores across all states are compressed toward the average and subject to greater uncertainty. The differences between states on this factor are discussed only generally here.

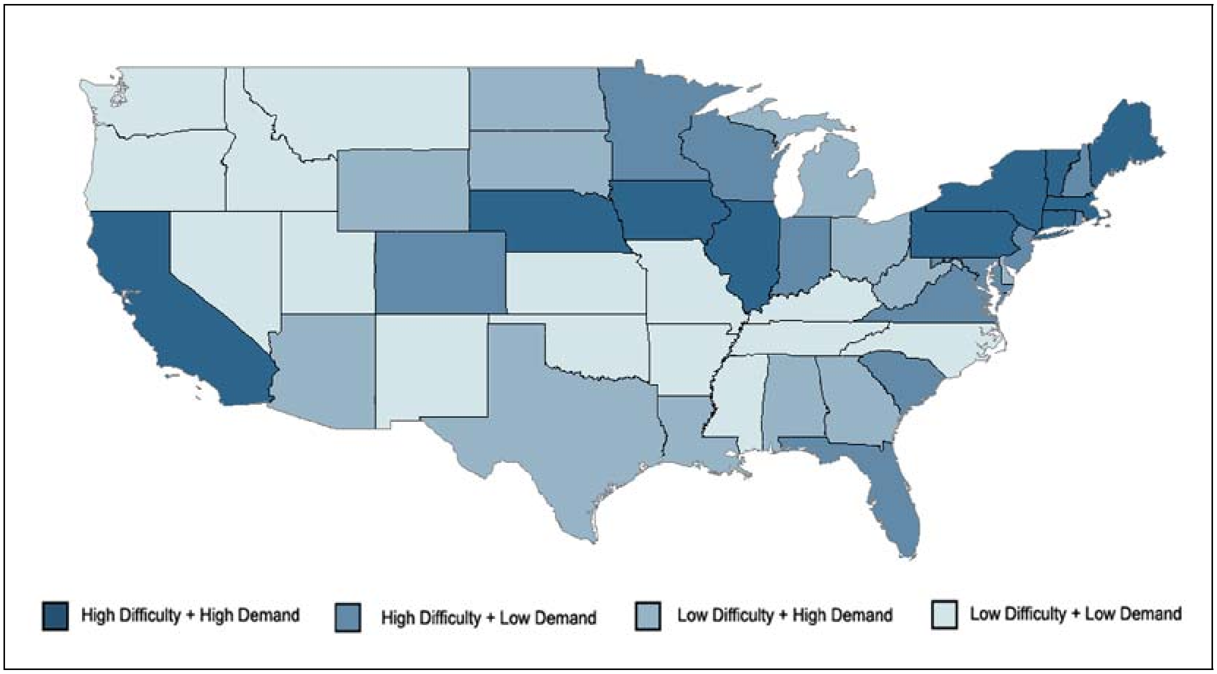

Figure 2.7 National map of state siting difficulty and transmission demand.

A comparison of the results of the demand-difficulty factor analysis with the basic benefit-cost analysis in Section 2 substantiates the positive relationship between potential profitability based only on construction costs and siting difficulty. We hypothesized that none of the lines evaluated in Figure 2.2 was under consideration for construction because siting costs and other factors must be increasing total costs, making these lines unprofitable. Ranking these lines by the potential profits, dividing the data into five equally-sized groups, and comparing the means of these groups with a generic concave siting-difficulty cost measure yields a set of monotonically increasing values.[11] Figure 2.8 shows this relationship; as the potential profits from a line increase, so do the associated siting difficulty costs. This comparative analysis not only validates the results of the siting difficulty measure, it also highlights the relative importance of siting difficulty to the overall problem of transmission investment incentive. The final sections of this paper discuss the implications of this quantitative measure and the particular results above, first, specifically for U.S. transmission

[11] This analysis uses the first 43 most profitable lines from the economic justification analysis based on the average engineering cost ($800,000/circuit mile). The siting difficulty factor score for each state is rescaled from 0-6, and multiplied by a generic concave weighting function in the form $(1-e^{[-x/\alpha]})$ where the results are robust for a range of values of $\alpha > 0$. The average distance-weighted siting difficulty scores are then calculated for each line based on the length of line in each state.

policies, and then, more generally, for related follow-on analyses and application to other energy facilities.

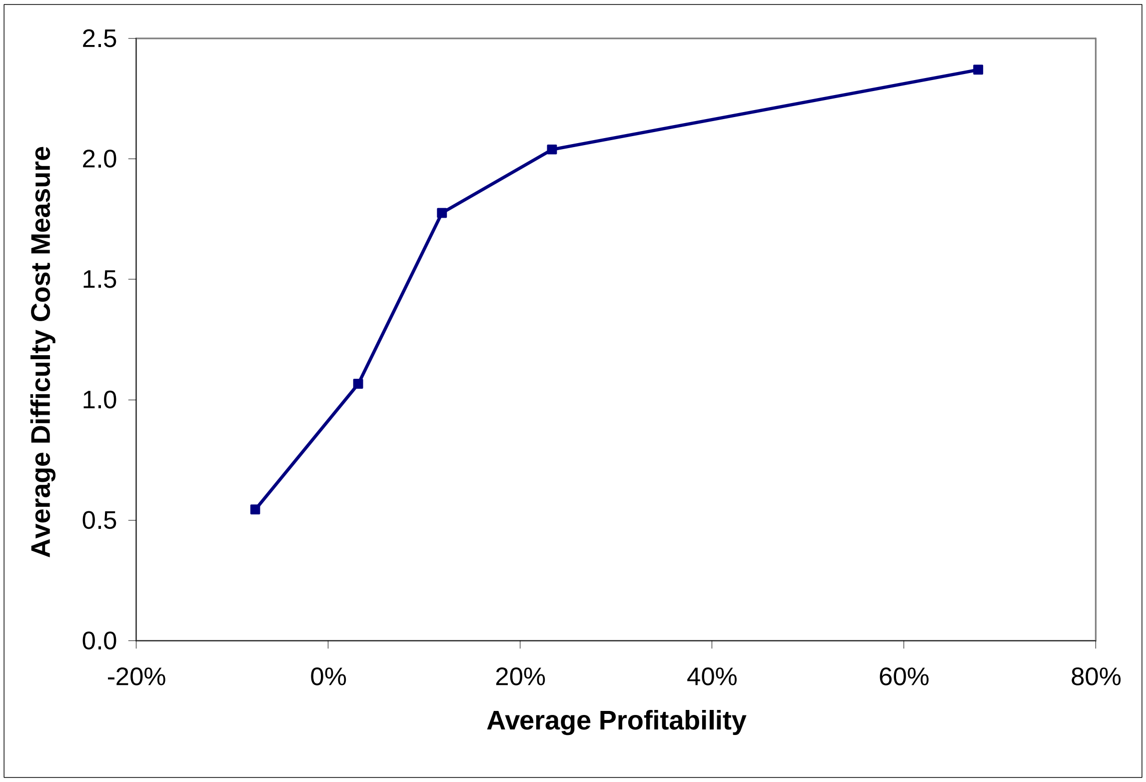

Figure 2.8 Relationship of potential profitability and siting difficulty.

Informing Siting Policies and Practices

Several major policy strategies to improve local, state, regional, and national grid development, management, and reliability are currently being debated in Congress and by the FERC (Barton, 2001; Barton, 2003; FERC, 2000). One major policy solution developed by the FERC is the ongoing implementation of Regional Transmission Organizations (RTOs). RTOs are proposed as a national policy solution to increase transmission construction and overall grid reliability (Hirst, 2002); however, this policy needs to be evaluated in the face of existing transmission demand and siting difficulty. RTO designs have been studied in terms of overall market impacts, economic benefits and costs, and improvements in reliability and congestion (FERC, 2002a; FERC, 2002b), but little attention has been paid to the existing conditions in each state that could drive the success of these organizations. While the goals and intent of this policy as it relates to transmission are appropriate, the current structure of RTOs based on voluntary participation does not guarantee a desirable outcome. Our analyses show that there are large variations in existing transmission demand and levels of siting difficulty across states and regions (Figure 2.7). We believe that these variations will likely affect a state's (or utility's) incentive to join a specific RTO and result in unanticipated patterns of joining behavior and added interstate siting issues.

RTOs have focused on the alleviation of rising transmission demand and siting difficulty as policy goals and outcomes rather than as policy influences and constraints, which we believe they are. Comparing the boundaries of proposed and existing RTOs to Figure 2.7 indicates potential configurations of Southeast and Northwest RTOs that could have no states with both high demand for new transmission lines and high difficulty of siting them, while a possible Northeast RTO could have as many as six such states (FERC Staff, 2000). Depending on the siting difficulty and transmission demand of utilities and states within a given RTO, states will likely have greater or less incentive to join that RTO based on their own needs for power. For example, there is little incentive for a state to enter an RTO when it is located geographically between a high difficulty state that needs power and another state that has excess power to export. A specific example, at the scale of a single transmission line, is the now infamous case of the Cross-Sound Cable connecting Connecticut and New York. This line under Long Island Sound has faced years of extremely high-profile opposition on both environmental and equity grounds that Long Island communities will benefit at the expense of Connecticut consumers (Randell and McDermott 2003; Krellenstein, 2004; Randell and McDermott 2004).

In the same way, at the state-level, states such as Iowa with a high demand for power lines (and/or power) have little incentive to join an RTO with adjacent high demand, high difficulty states, because the lower difficulty in Iowa could likely result in transmission lines across the state to serve the even higher demand and difficulty states in the region. This is supported by Iowa's piece-meal participation in the surrounding MISO RTO during its earliest phases (FERC Staff, 2000). Similarly, the low difficulty states surrounding South Carolina have little incentive to include the high difficulty South Carolina in an RTO. On the other hand, a group of low demand and low difficulty states surrounding a high demand, high difficulty state have a greater incentive to join an RTO that allows them to profit from exporting power to their high demand neighbor. This would be the case with California and RTO West. Finally, two adjacent high difficulty states, have little incentive to join the same RTO; they would instead benefit from joining bordering low difficulty states. Overall, high difficulty areas have the potential to act as barriers both within and between RTOs, and RTOs are only likely to form easily when states with excess power and low siting difficulty are co-located with states with high need. These potential interactions are even more important at smaller scales of evaluation. Depending on a utility's individual incentives to join a specific RTO, the borders or "seams" of new RTOs may simply fall along already defined areas of intrastate and interstate transmission congestion.

Additionally, the consolidation of transmission and siting management into RTOs has the potential to create umbrella organizations that collect and compound existing siting difficulties. For example, even in states such as California where siting authority is consolidated under a single agency, existing siting difficulties remain. Currently, California is among the states with one of the most difficult and prolonged siting processes (California State Auditor, 2001). Overall, if RTOs are unable to characterize the problems associated with individual states within their region and coordinate siting solutions, the binding siting constraint of one state has the potential to become that of the region. These findings have far-reaching implications outside the U.S. as well. The repercussions of high siting variability are relevant for a variety of infrastructures worldwide, where the local incentives to site new infrastructure could come into conflict with the best interests of a larger region, and a clear framework for justifying regional decision-making and developing targeted mitigation strategies is necessary for effective project implementation.

Conclusions and Discussion

Overall, we strongly believe that a quantitative measure of siting difficulty is essential to effectively evaluate a host of related problems, such as infrastructure underinvestment. As the final comparative analysis in Section 4.2 illustrates the quantitative measure developed here highlights the relative importance of siting difficulty within the overall problem of transmission investment incentive. This analysis is also an example of how this measure could be applied more generally to develop targeted policy and investment strategies to addressing siting difficulty and financial constraints. Additionally, this independent measure of siting difficulty here also forms the basis for further analyses in Chapter 3 to understand *What makes siting difficult?* and *How much do various constraints contribute to the problem in different settings?*

To summarize, this framework and approach for quantifying siting difficulty can potentially be applied to siting problems associated with a variety of affected infrastructures and industries. The selection of industry-relevant indicators independent from the common causes and localized effects of siting problems allows for broad-based characterizations of siting difficulty. For example, possible indicators of siting difficulty and infrastructure demand for wind turbines could be developed based on regional renewable portfolio (RPS) standards or measures of back-up power available on the grid. Overall, the emphasis here is on constructing complementary indicators at a relevant scale of analysis that represent a diverse set of impacts across an industry. The final aggregation of these indicators creates a quantitative measure that can then inform a variety of siting analyses, practices, and policies.

Taken as a whole, this research addresses some of the most fundamental questions of the facilities siting problem: *How difficult is siting?* and *What are the implications of variations in difficulty for current siting practices and policies?* All of the analyses presented in this paper are in no way the only appropriate characterizations of an extremely broad and complex problem. Nor are these metrics and models proposed as final solutions, this work is simply intended to give structure to the ever-expanding discussion of energy facilities siting, management, and planning. As more parties have become involved in the debate over siting, technical solutions and policy solutions to infrastructure demand and siting difficulty have increasingly diverged. Successful development of energy infrastructures requires the integration of both technological system-level innovations and large-scale policy changes. This chapter serves as an initial bridge between the quantitative and qualitative issues affecting siting, where a sound strategy for managing siting problems is critical to the success of many industries. Chapter 3 expands on this results of this chapter to explore the causes of siting difficulty and their relationships to the overarching siting difficulty measure developed here.

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Chapter 3

ALIGNING STAKEHOLDER PERCEPTIONS

Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed it is the only thing that ever has. –Margaret Mead

As the previous chapter describes, a wide variety of public utilities and major industries have faced growing problems with siting unwanted facilities. Although the need for new facilities, such as power plants, petroleum refineries, hazardous waste incineration and storage sites, transmission lines, and gas pipelines, is commonly acknowledged, siting these facilities has become increasingly difficult, to the point of being almost impossible. As the results of Chapter 2 illustrate, electric transmission line siting is one of the most extreme examples of this problem (Casper and Wellstone, 1981; Henshaw, 2001; Pierobon, 1995). The call for immediate transmission construction by industry regulators, utilities, and other electricity providers is nearly unanimous (CECA/RF, 1990; DOE, 2002; EEI, 2002), but transmission capacity expansions have not matched growing demand (Hirst and Kirby 2002, EEI 2001a, DOE 2002). In a paper on electricity legislation Senator Bingham of New Mexico emphasizes, "A national transmission grid is a necessity, but cannot occur without a new approach to transmission planning, expansion, and siting" (EEI, 2002). This chapter builds on the results from Chapter 2 to characterize the causes of siting difficulty and assess their relative contributions to the problem as a whole.

Traditionally, siting practitioners relied on a "decide-announce-defend" approach to site selection and construction (Beierle and Cayford, 2002). However, as many facilities have grown in scale and scope, the traditional defenses for siting decisions have often failed. The inequitable distributions of project risks, costs, and benefits have led to widespread public protests, to the extent where conventional approaches have been dubbed "decide-announce-defend-abandon" strategies by many. These failures in implementation have been further compounded in more recent decades by intense, organized local opposition and environmental justice activism (Randell and McDermott, 2003; Randell and McDermott, 2004). Siting as a whole has become almost synonymous with public opposition, and the vocabulary of affected industries has grown to include a broad range of new acronyms, including the most common, NIMBY (not in my backyard), to the most extreme, BANANA (build absolutely nothing anywhere near anything) (Halvorsen, 1999; Inhaber, 1998). [12] Overall, these trends have resulted in a conflict within many utilities between established siting practices and current project demands.

In response to this growing divide, proposed strategies for mitigating siting problems have proliferated. Researchers, planners, regulators, and utility professionals from within the energy, transport, water, and waste management sectors among others have developed a variety of guides and handbooks for overcoming siting difficulty, particularly public opposition, and facilitating public participation in project planning (Keeney 1980; Hester et al. 1990; Kunreuther, Fitzgerald et al. 1993; Kunreuther and Easterling 1996; Inhaber 1998). In contrast, the majority of industry literature focuses on siting difficulty as either an opaque and impenetrable monolith, attributable only to public opposition, or as a market failure to be resolved by compensation programs or tailored regulation (see Ducsik, 1986 for an example). All of these policies and programs have been advanced in the absence of a clear characterization of siting difficulty, and an even more ambiguous understanding of the myriad causes of difficulty and their interactions as described in Chapter 2. As a result, current strategies for mitigating siting problems are often collections of disaggregated solutions designed to alleviate specific constraints, instead of coherent, replicable plans for reducing difficulty as a whole.

This paper focuses on bridging this gap. As the problem of facilities siting has become increasingly widespread, the interactions between and among individual siting constraints have multiplied. As a result, existing patchwork solutions for overcoming siting difficulty have become less tractable, less reliable, and less effective for both local implementation and national policy-making. In order to develop targeted, relevant solutions, siting constraints need to be understood and addressed within the dynamic context of the entire problem of siting difficulty. This paper focuses specifically on a case study of electric transmission line siting. Transmission planning and site selection, like that of many facilities, are influenced not only by objective factors such as economics and topography, but also by perceptions of siting

[12] The term public opposition, as it is used here, is intended encompasses all opposition from non-business or regulatory sources, and also includes politically-motivated opposition, as in the case of the State of Connecticut's opposition to the Cross Sound Cable (Randell and McDermott, 2003)

difficulty. A region known for its difficulty is likely to be avoided during the process of site selection; therefore, it is equally important to understand the subjective and objective causes of siting problems. This paper presents an expert survey and a quantitative model of industry perceptions of siting difficulty to address the questions: *What makes siting difficult? How much does each constraint contribute to the problem?* and finally, *What can be done to ease the siting problem as a whole?* This chapter builds upon the results of the previous chapter which answer the question *How difficult is siting?* and establish a quantified reference level for state-level transmission line siting difficulty. Figure 3.1 below illustrates the relationship between the analyses in this chapter with the indicators of siting difficulty from the previous chapter. The weighted-average difficulty ratings from this survey were described briefly as part of the perception indicator and factor analysis in Chapter 2. This chapter expands on this data summary, presents other major findings from the survey, and uses the siting difficulty factor from the previous chapter as the dependent variable in a final regression model to evaluate independently the causes of siting difficulty.

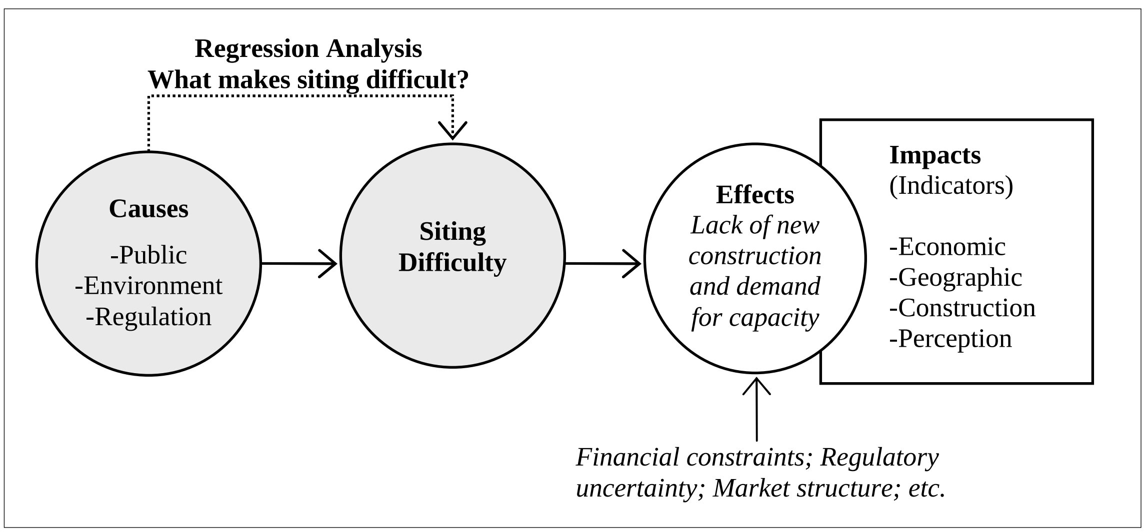

Figure 3.1 Diagram of the causes, effects and impacts of siting difficulty.

Section 2 of this chapter begins with a brief overview of transmission line siting, and highlights the similarities and major differences between transmission infrastructure and other comparable facilities. Section 3 develops a characterization of state-level siting difficulty and its contributing causes, and Section 4 presents our survey design and major findings. All three of these sections expand on aspects of the siting problem and the survey that were introduced generally in Chapter 1. The results from the survey then form the basis for the regression model and analyses in Section 5. Finally, Section 6 concludes with a discussion of the implications of these findings and the resultant model for mitigating difficulty across the host of utilities and industries facing siting problems.

Siting Transmission Lines

Building new transmission lines, like most major infrastructures with siting problems, involves a dynamic series of technical, economic, regulatory, and societal decisions. Until the last decade, this decision making process was largely internal to vertically-integrated utilities. Assessments of the need for a new line, possible alternatives, cost-benefit considerations, technical design options, and finally permitting requirements were made by multi-disciplinary teams in an established sequence, typically unimpeded by external influences (Houston 1990). With electricity deregulation and mounting opposition, the siting process has changed dramatically. Transmission planning now includes substantial numbers of public meetings and even court hearings that make the decision making process more iterative than linear (Houston 2003). In spite of these increasingly uncertain impediments to an already complex process, the emphasis on managing opposition entered the siting process only after it became clear that the public had the potential to indefinitely delay or even terminate critical projects, as the "decide-announce-defend-abandon" formulation suggests.

This trend is visible across many utilities and industries, and transmission infrastructures share several common characteristics with other major facilities. First, because of their typically large-scale and scope of impact, most facilities siting efforts generally encompass a variety of associated stakeholders, including utilities themselves, financing agencies, government and municipal authorities, non-government organizations, and citizens groups. Second, the nature of these projects and the coordination of multiple stakeholders are inherently associated with lengthy project timelines that include many phases from planning to implementation. Third, because of their scale and complexity many infrastructures pose both direct and indirect risks to specific segments of affected populations. For example, power lines, place populations adjacent to the lines at a direct risk of exposure to additional electro-magnetic fields (EMF), and indirect risk of property value losses. Uncertainty surrounding these risks is also related to a widespread loss of public trust in government planners and public officials responsible for highly technical projects (Fischer, 2000). Finally, most facilities are planned to respond to larger societal needs and provide some quantifiable benefit (or public service) to the population at large, but with the inherent risks associated with complex engineered systems, the costs and benefits of projects are often inequitably distributed.

In spite of these similarities, siting difficulties associated with transmission lines are especially complex because of the amount of space required and the number of people potentially affected. While generation plants are associated with only a single location, transmission lines, like gas pipelines, can span multiple states and regions. Unlike gas pipelines however, the majority of transmission projects involve highly visible overhead lines that are unregulated by a single federal agency with eminent domain authority (Smead, 2002; Smith Jr., 2002).[13] Moreover, the recent deregulation of the electric industry and the transition to competitive markets has further complicated the issues of transmission ownership, financing, and management (Krapels, 2002; Joskow and Tirole, 2004; Krellenstein, 2004). Both existing transmission infrastructure and any new construction face significant uncertainty in potential returns on investment.

Although hazardous facilities in general face common causes of siting difficulty, these basic differences between the nature and regulation of transmission lines and other infrastructures further exacerbate transmission line siting difficulty within and between states. Overall, siting transmission lines is a complex and increasingly dynamic process. Siting constraints and resultant difficulty have transformed siting processes on the ground (Houston 2003), but grid planners and policy makers have been slow to respond. As the need for new infrastructure becomes increasingly critical, this widening disconnect has the potential to significantly alter the development of the grid. Consequently, a clear characterization of the causes of siting difficulty is essential for effective transmission expansion and grid management in the electric industry today.

Understanding Siting Difficulty

Given the wide ranging impacts of siting problems, the term siting difficulty, as it is used in this paper, encompasses any combination of obstacles in the transmission planning and siting process, including physical, environmental, topographic, and geographic constraints; public opposition; interagency coordination problems; and local, state, and federal regulatory

[13] Although a recent draft of the Electric Reliability Act (2003) proposes to provide the FERC with federal jurisdiction and back-stop eminent domain authority for major interstate transmission projects, this proposal has been delayed repeatedly in various stages of Congressional review.

barriers to permitting, investment, and/or construction. Houston (2003) defines siting constraints equally broadly as "locations where a transmission line might have a potentially adverse impact on sensitive resources, or locations where conditions might affect reliable and safe operation or economical construction of the line." Based on these definitions and industry literature, the main causes of siting problems can be grouped into three categories: environmental barriers, regulatory roadblocks, and public opposition. Although these constraints are frequently interconnected, each one presents its own unique problems in the process of route selection and transmission construction. Attributes of the natural environment, the characteristics of the local public, and the regulatory standards along prospective routes all have the potential to significantly impact the cost of a project, the timeline of implementation, and perhaps most importantly the certainty of project completion. The underlying factors associated with each constraint are discussed individually below.

Environmental constraints are perhaps the most deep-seated considerations in the routing process. Physical conditions along a route, including variations in topography, terrain, land and forest cover, influence the structural and mechanical limits of tower design, thereby affecting the anticipated cost and viability of a project. Because transmission lines are typically constrained at inflexible endpoints, such as generation plants or substations, avoiding difficult areas completely is rarely an option. Instead, planners are forced to make trade-offs between line attributes and site characteristics in situations where it is rare that one alternative dominates all others (Keeney and Raiffa, 1976; Hester et al. 1990). In conjunction with these environmental constraints, many of the regulations, permits, and approvals required for transmission projects also relate to regional environmental features, such as streams crossings, park lands, or protected species habitats.

Consequently, a second factor affecting siting is regulation. Most transmission line siting is currently regulated at the state-level; however, the agencies that govern siting processes and their respective roles vary significantly by state. Based on data from EEI (2001), 6 states have no state-level oversight of transmission line permitting except with regard to specific geographic attributes such as river crossings, 39 states have a single permitting agency with the overriding authority to approve or deny construction permits, and 6 states have multiple state permitting agencies. For these states, siting oversight is in the hands of the state Public Utilities Commission, Siting Board, or Department of Natural Resources. In necessary cases, federal agency involvement occurs after state and local permitting has already begun.

Overall, the regulatory barriers to siting are compounded by fragmented permitting processes, non-standard project and permit requirements, and inter-agency redundancy.

Last but not least, the third major type of constraint is public opposition. Reasons for public opposition include the negative impacts of transmission lines on property values, the adverse visual/ aesthetic impacts of transmission towers, the negative effects on scenic view-sheds and aesthetics, health and safety concerns related to electromagnetic fields (EMF), equity and fairness issues, insufficient compensation for easements and related tax implications, and inadequate justification of the need for the line (Vierima 2001).[14] Because permitting processes typically require public meetings and reviews, public opposition is heavily intertwined with both local environmental concerns and the associated regulatory standards for public safety and community consensus. Although the blame for additional siting uncertainty and complexity is almost entirely directed toward the public, it cannot be emphasized enough that public opposition is not homogeneous. The umbrella characterization of all opposition as "NIMBY" has obscured the heterogeneity of public and stakeholder opinions (Quah and Tan 1998). We emphasize this diversity here because public concerns related to ecological or equity issues are inextricably linked to the other two categories of siting constraints described above.

In spite of the well-documented need for new infrastructures, the constraints on facilities siting are far less well understood, and examples of siting difficulty are often project-specific and based in industry anecdote. Furthermore, environmental and regulatory constraints are often ignored in discussions of siting difficulty for two reasons. First, they are still typically addressed as part of internal project decision making. Second, siting projects rarely fail because of inadequate technical or environmental considerations (Kuhn and Ballard, 1998). Similarly, regulatory roadblocks may slow a siting process, but rarely are they unanticipated or crippling to a project (California State Auditor 2001). While these are important arguments, they are also limiting. None of the types of constraints described above, such as variations in land cover, are major problems in and of themselves; they are of importance here because they impede necessary projects and siting efforts. Incongruently, proposed solutions to overcoming difficulty focus on individual constraints and perceived causes. This attention to the symptoms of siting difficulty without an eye toward treating the underlying condition has proved to be largely ineffective. As a result, it is essential to consider

[14] The difference between scenic impacts and tower aesthetics is subtle. Different tower sizes or designs could reduce the unpleasant appearance of the towers themselves, but still disrupt a scenic view shed. Similarly, the justification for a line is related to the need for particular route, not the need for a line overall.

the relationships and interactions among constraints to successfully mitigate any single constraint, as well as siting difficulty as a whole.

Eliciting Siting Perceptions

Given the intrastate and interstate variations in the siting constraints described above, there are numerous articles in trade publications and the popular media qualitatively comparing siting problems among states. The most common comparisons are between California and Texas, where siting in California is often described as "notoriously difficult," while siting in Texas is "comparatively easy" (McNamara 2004). These qualitative descriptors, while useful for conveying two extremes of the siting problem to the public, provide little insight into the complex nature of siting practices and issues in either state. Nor do they reveal the underlying causes of siting difficulty in California, or the lack thereof, in Texas.

Overall, this lack of substantial data further supports the need for understanding siting difficulty and its variability across different states and regions. As transmission projects have become increasingly complex and the various constraints more intertwined, the interactions among stakeholders have also become more intricate, to the point where stakeholder perceptions of project constraints play a significant role in the general success of a project. This is particularly relevant in the case of utility and industry professionals, who typically initiate siting programs and often guide project decision making. Because most recent studies on siting center on public opposition and the public viewpoint of siting processes and outcomes, this paper focuses specifically on professional and expert perceptions of siting difficulty. The next sections describe in detail our survey methods and the major results.

Survey Design

In order to develop a baseline assessment of state siting issues, this survey address the questions *How difficult is siting perceived to be?* And *What do siting professionals think makes it difficult?* Using an online multiple-choice format, 154 questions were administered to siting experts and professionals across the United States. The survey was designed to take approximately 15-20 minutes to complete and focused on eliciting experts' perceptions of siting difficulty and its dominant causes based on their own opinions and experiences. Respondents were asked 1) to rate their familiarity with siting in a given state, 2) to rate their perception of the overall siting difficulty within that state, and 3) to select the dominant cause of difficulty for each of the 48 continental United States. Each section of the survey included 5 to 6 states grouped by geographic region. All three questions above were repeated in a matrix format for each region, and participants were asked to answer the survey for as many states as they were familiar with (see Appendix A for survey format and protocols).

Familiarity with siting was defined by five categories "No familiarity with siting difficulty," "Info from media/literature," "Info from friends/colleagues," "Worked on 1-3 siting projects," and "Worked on more than 3 siting projects" respectively. No numbers appeared on the survey scale, but for the purposes of analysis responses associated with each category were assigned values from 1-5 respectively. Siting difficulty was defined as established above, and rated on a ten-point integer scale where 1 = Easiest and 10 = Hardest. The causes of siting difficulty included the following five categories identified in survey pre-tests and interviews with siting professionals: public opposition, state regulation, topography/ environment, inter-agency coordination, and federal regulation. Respondents were asked to select one out of these five causes as the dominant cause of siting difficulty for each state.

Survey subjects from across the country were solicited from an email database of approximately 400 potential respondents, compiled from the EEI State-Level Siting Directory (2001c), the Platt's Directory of Electric Power Producers and Distributors (2002), websites of major utilities, and industry contacts of the Carnegie Mellon University Electricity Center advisory board and members.[15] The sample included engineers, environmental specialists, routing planners, mangers, regulators, and researchers at public and investor-owned utilities, regulatory agencies, research institutes, technology firms, and consulting companies. Subjects were individually contacted by email during a period from November 1, 2002 and January 10, 2003, and were provided a link and a password to access the survey website. All surveys were answered online and approximately 1,100 state evaluations were completed by 56 respondents from 31 states. State evaluations were defined as complete ratings for all three categories of questions (familiarity, difficulty, and cause) for a single state. On average each respondent completed 20 state evaluations and individual responses ranged from as few as 1 state to as many as 49 states. The total number of evaluations for each state varied from a minimum of

[15] With the lack of recent construction, the balkanization of utility transmission divisions under deregulation, and the retirement of large numbers of experienced siting professionals, the numbers of siting professionals in the industry are rapidly dwindling. In compiling this database, every effort was made to contact as many and as diverse a population of respondents as possible. The authors recognize, however, that the results are not that of a random sample, and older more established companies and agencies are more heavily represented than new independent transmission companies.

18 to a maximum of 31, and included an average of 3 evaluations by experienced professionals, who had worked on at least 1 or more siting projects in that state.[16] The data from this survey form the basis for rankings of states based on siting difficulty and a series of comparative analyses outlined below.

Survey Results

Table 7 below illustrates respondents' average ratings of state siting difficulty, their weighted-average difficulty based on their familiarity with siting in a state, and the percent of respondents who selected each of the five types of constraints as the dominant cause of siting difficulty within that state. States are ordered from highest to lowest average siting difficulty, and the averages for the continental U.S. are listed in the last row. Weighted-average difficulty, was calculated using a linear weighting function in the form $y = \Sigma(\beta x)/\Sigma\beta$, where familiarity was rated on a scale of 1(min) − 5 (max).[17] Of the total number of survey participants, approximately 45% came from public electric utilities, 24% from government regulatory agencies, 16% from consulting firms, 7% from investor-owned utilities, and 7% from equipment manufacturing and other siting-related companies. Across all of the agencies above, respondents described their type of work as permitting and regulation (31%), civil, mechanical, or electrical engineering (29%), line routing (22%), management (11%) or research (7%).

Given their different roles in siting projects, survey participants' familiarity and experience with siting in different states varied by their agencies of employment. Respondents from consulting companies had the highest level of familiarity across all groups with work experience on 1 or more projects in an average of 8.7 states, and equipment, manufacturing, and other company respondents were next with an average of 3.5 states, public utility respondents in 2.6 states, investor-owned utility respondents in 1.3 states and government regulatory agency respondents in only 1 state ($F(4) = 5.44$, $p = 0.001$). These significant differences in the self-assessments of familiarity and work experience correspond with the involvement of siting professionals from each agency in different types of transmission projects. State government regulators are typically most familiar with siting in their own states.

[16] Data for Delaware, New Hampshire, and Rhode Island did not include any evaluations from respondents with work experience in those states. This can be attributed to the minimal transmission construction in all three states in the last 35 years (EEI, 2000).

[17] This same weighted average difficulty rating was used as one of the four indicators in the previous chapter, and as expected it loaded primarily on the siting difficulty factor.

On the other hand, large public utilities have service areas that cross adjacent state boundaries, and as a result, employees from these agencies are likely to have experience in all the states in which the utility operates. Finally, consultants offering specialized siting services are the most likely to be involved in a large range of projects across a variety of states. These variations among respondent groups correspond with significant differences in their perceptions of siting difficulty and its dominant causes.

Overall, the average ratings in Table 7 support the prevailing qualitative judgments where California is ranked 1st overall for average difficulty by all respondents while Texas is ranked 46th. Interestingly, as the ratings are weighted by familiarity California drops in the rankings to 4th and Texas rises to 44th, indicating that more familiar professionals do not share the extreme perceptions of siting difficulty in either state to the same degree as unfamiliar respondents. Table 7 also illustrates the diversity in respondents opinions about the dominant causes of siting difficulty. The columns for each of the five major causes evaluated in the survey indicate the percent of respondents who selected a given cause as the dominant cause for each state. The next sections highlight these comparative analyses and major findings by respondents' agencies of employment, their work experience, and their states of employment.

It is important to note, that because participants rated multiple states during the course of the survey, state evaluations by the same respondent are not independent from one another. However, since respondents were not required to respond for all states, the data structure does not allow for a full repeated measures analysis. Instead, most of the following analyses are based on between-subject comparisons of within-subject values that account for variations in familiarity and perceptions of difficulty across all states.

Variations by Agency

As Table 7 shows, public opposition is widely perceived to be the dominant cause of siting difficulty across all states; however, there are significant differences in perceptions between groups of subjects employed at various siting-related agencies. Based on informal conversations with approximately a dozen siting professionals at utilities, consulting firms, and regulatory agencies, individuals articulated specific agency-related concerns about different siting constraints. For example, some regulators felt that environmental issues were of major importance, and many current siting proposals did not give these issues sufficient attention.

	Average Difficulty	Weighted Average Difficulty	Public Opposition	Topography / Environment	State Regulation	Federal Regulation	Inter-Agency Coordination
California	7.72	7.73	56.0%	4.0%	32.0%	8.0%	0.0%
Connecticut	7.63	7.65	80.0%	0.0%	12.0%	4.0%	4.0%
New York	7.61	7.85	59.4%	6.3%	31.3%	3.1%	0.0%
Florida	7.59	8.08	75.0%	12.5%	8.3%	0.0%	4.2%
Maryland	7.40	7.77	69.2%	0.0%	15.4%	7.7%	7.7%
New Jersey	7.19	7.43	59.3%	7.4%	22.2%	3.7%	7.4%
Massachusetts	7.17	7.37	70.8%	4.2%	16.7%	4.2%	4.2%
Vermont	7.05	7.26	78.3%	4.3%	8.7%	0.0%	8.7%
Rhode Island	7.00	7.17	65.2%	8.7%	17.4%	4.3%	4.3%
Washington	7.00	7.18	55.6%	5.6%	22.2%	5.6%	11.1%
Wisconsin	6.97	7.57	69.0%	3.4%	20.7%	3.4%	3.4%
Colorado	6.95	7.30	61.9%	19.0%	9.5%	9.5%	0.0%
Minnesota	6.81	7.25	66.7%	0.0%	29.6%	0.0%	3.7%
New Hampshire	6.78	7.05	64.0%	12.0%	16.0%	0.0%	8.0%
Oregon	6.74	6.83	63.2%	5.3%	15.8%	5.3%	10.5%
Virginia	6.69	6.94	77.8%	0.0%	11.1%	7.4%	3.7%
New Mexico	6.55	6.82	47.6%	19.0%	19.0%	9.5%	4.8%
Pennsylvania	6.50	6.61	75.9%	6.9%	13.8%	3.4%	0.0%
Delaware	6.41	6.57	65.2%	8.7%	13.0%	4.3%	8.7%
Utah	6.33	6.82	40.0%	15.0%	15.0%	20.0%	10.0%
Indiana	6.30	6.89	61.9%	4.8%	23.8%	0.0%	9.5%
Michigan	6.24	6.46	76.2%	4.8%	14.3%	0.0%	4.8%
Arizona	6.22	6.21	44.4%	11.1%	16.7%	22.2%	5.6%
Maine	6.20	6.50	61.5%	11.5%	15.4%	7.7%	3.8%
Louisiana	6.14	6.18	71.4%	4.8%	14.3%	0.0%	9.5%
Georgia	6.14	6.63	72.7%	0.0%	18.2%	0.0%	9.1%
Montana	6.13	6.35	40.9%	18.2%	13.6%	9.1%	18.2%
South Carolina	6.05	6.32	77.3%	4.5%	13.6%	0.0%	4.5%
Kentucky	6.04	6.26	69.6%	8.7%	17.4%	0.0%	4.3%
Illinois	6.04	6.38	66.7%	3.7%	18.5%	3.7%	7.4%
Iowa	6.00	6.31	62.5%	12.5%	20.8%	0.0%	4.2%
Mississippi	5.95	6.02	71.4%	4.8%	19.0%	0.0%	4.8%
Nevada	5.95	5.91	47.4%	5.3%	31.6%	5.3%	10.5%
Tennessee	5.91	6.31	68.2%	4.5%	18.2%	0.0%	9.1%
Idaho	5.90	6.17	36.8%	15.8%	31.6%	5.3%	10.5%
Alabama	5.86	5.71	68.2%	4.5%	18.2%	0.0%	9.1%
North Carolina	5.82	6.04	62.5%	16.7%	16.7%	0.0%	4.2%
Missouri	5.79	6.20	75.0%	4.2%	12.5%	0.0%	8.3%
Nebraska	5.74	6.00	68.4%	5.3%	21.1%	0.0%	5.3%
Kansas	5.71	6.21	75.0%	5.0%	15.0%	0.0%	5.0%
Oklahoma	5.68	6.15	63.2%	5.3%	26.3%	0.0%	5.3%
Ohio	5.67	5.69	75.0%	0.0%	16.7%	0.0%	8.3%
Wyoming	5.61	5.84	50.0%	13.6%	13.6%	13.6%	9.1%
Arkansas	5.52	5.81	66.7%	4.8%	23.8%	0.0%	4.8%
West Virginia	5.52	5.42	60.9%	17.4%	13.0%	4.3%	4.3%
Texas	5.29	5.70	66.7%	4.2%	20.8%	4.2%	4.2%
South Dakota	5.17	5.32	59.1%	13.6%	13.6%	9.1%	4.5%
North Dakota	5.08	5.04	62.5%	12.5%	16.7%	4.2%	4.2%
USA	6.38	6.64	64.7%	7.5%	17.8%	4.0%	6.0%

Table 7. Survey respondents' average ratings of state difficulty and its dominant constraints.

Other regulators expressed concerns about the uncertainty surrounding changes to federal energy policy that could complicate current regulatory requirements. Similarly, several utility engineers and routing specialists said that existing state regulation was already frustratingly complex. This analysis tests selected hypotheses from these early conversations.

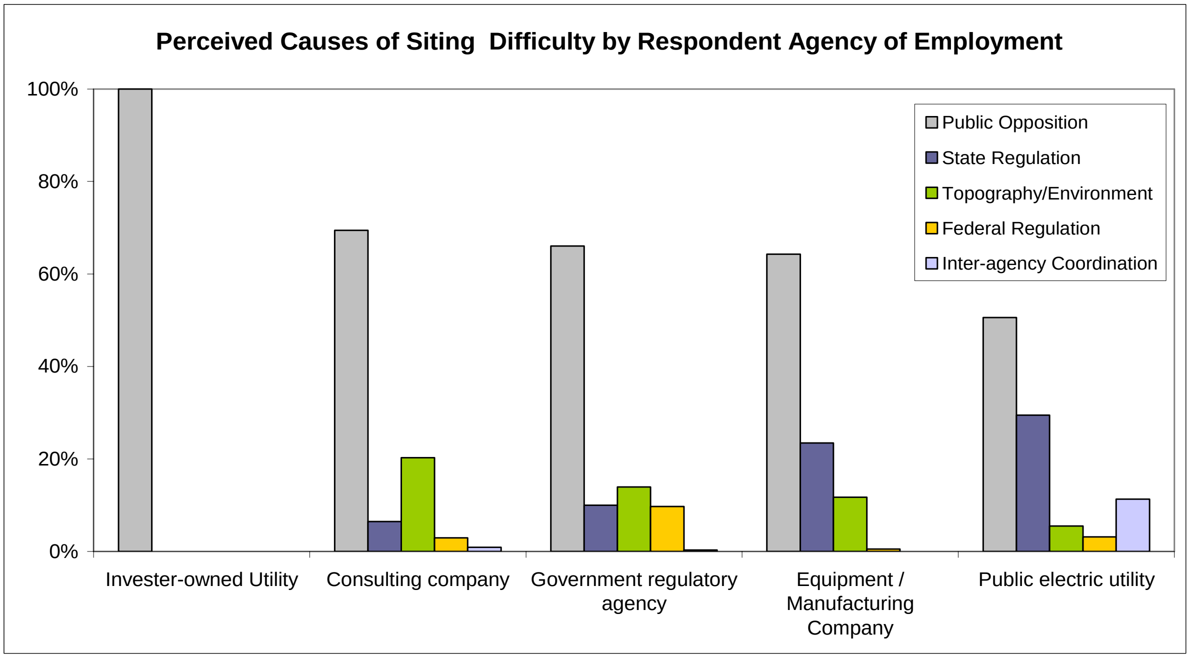

Figure 3.2 Perceptions of Dominant Siting Constraints by Respondents' Agencies of Employment.

Figure 3.2 illustrates the variations in perception for respondents from investor-owned utilities, consulting companies, state government regulatory agencies, equipment and manufacturing firms, and public electric utilities. Each bar on the graph represents the average percent that respondents from a given agency selected a cause of siting difficulty (public opposition, state regulation, topography/ environment, inter-agency coordination, and federal regulation) as the most important constraint on siting difficulty across all states.

As the graph shows, on average respondents from public electric utilities perceive topography and environment to be the primary siting constraint only 5% of the time relative to all other constraints, compared to 14% for respondents from government regulatory agencies ($t(36)= 1.28$, $p=0.104$) and 20% for respondents from consulting companies ($t(32)= 2.01$, $p=0.026$). Similarly, in support of public utility professionals' frustrations about state regulations, regulators (10%) identify state regulation as the dominant siting constraint far less than utility respondents (29%) ($t(36) = -1.92$, $p=0.031$).[18] Finally, testing the hypothesis that state regulators perceive federal regulation to be a greater problem than other siting officials reveals that, although regulators selected it more often as the dominant cause (10%) compared to consultants (3%) and utility employees (3%) these results are not significantly different.

We hypothesize that these variations in the perception of siting constraints among the five groups of respondents can be associated with an agency's control over or involvement with a given constraint. For example, utility siting officials begin a siting project by eliminating economically or physically infeasible locations within the study area, whereas government regulators working with topographical or environmental issues are involved in the siting process only after utilities have already selected preliminary route proposals and narrowed the decision space to include far fewer options. The order in which siting constraints occur and are addressed during the siting process has interesting implications for the perceived importance and difficulty associated with different constraints.

While there is some overlap among constraints, the five constraints from the survey generally affect a siting project as Figure 3.3 illustrates along the course of a standard transmission planning and construction process. A siting project generally begins with preliminary economic feasibility, necessity, and routing analyses internal to the company considering the project, then continues with the submittal of applications for construction permits and approvals to the required state, local, and federal regulatory agencies, and finally concludes with any public hearings and participation efforts prior to the issuance of final permits and construction (Houston 2003; California State Auditor 2001). Regulations governing transmission line siting require that any company interested in building a transmission line indicate a clear need for the line based on changes in existing and projected consumer demand and/or generation capacity by filing a Certificate of Public Convenience and Necessity or an equivalent letter of intent. This initial step is common to all states and is followed by a series of detailed permit applications, reviews and public hearings that are specific to each state and the affected local areas (Houston, 1995). In this process environmental constraints are generally addressed first, then state regulation, federal regulation, interagency coordination, and finally public opposition.

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[18] Because of missing values, this data does not allow for a full ANOVA or Chi-square analysis. As a result, this section only includes results for selected pair-wise comparisons of agencies based on two-sample t-tests assuming equal variances.

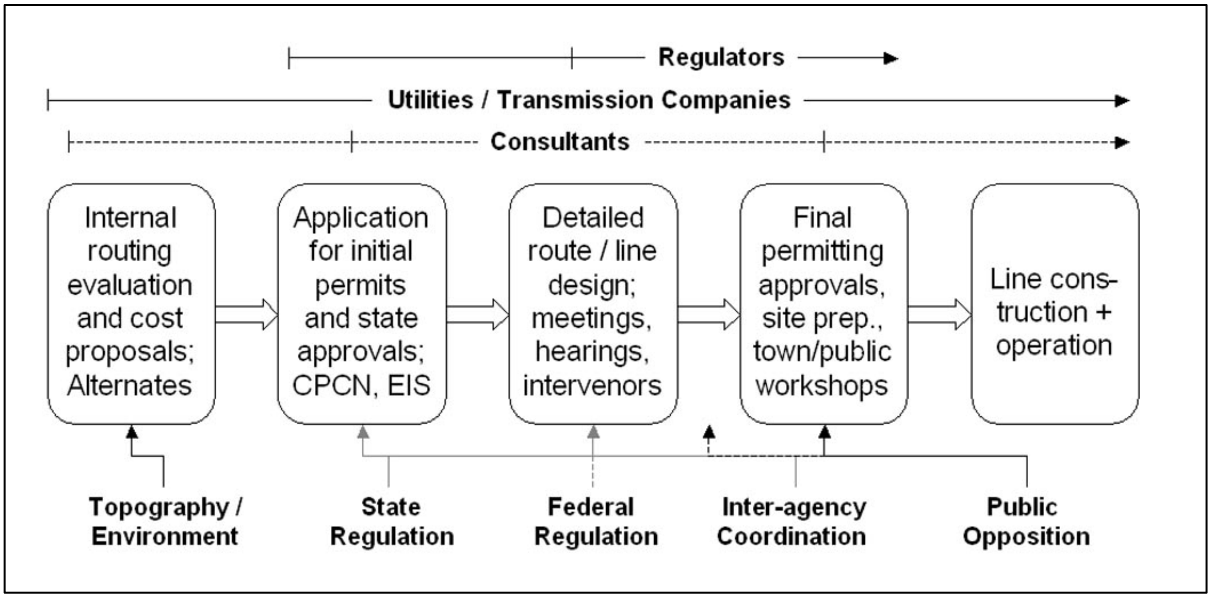

Figure 3.3 Timeline of Transmission Line Siting Process.

Since respondents from different agencies become involved in siting projects at different phases along a project timeline (as shown at the top of Figure 3.3), their perceptions of the contributing factors of siting difficulty vary with their exposure to and control over different siting problems. For example, some local siting regulations allow organized public representatives to participate in the siting process by filing applications of intervention; however, public involvement in siting projects generally occurs after many details of a proposal have already been carefully considered and decided upon in order to file the required permits. Based on this hypothesis, public opposition could be the primary focus of media and research attention to siting constraints because public involvement occurs relatively late in all siting projects, at which point siting agencies have only limited control over the decision-making in a project and citizens could feel as if they are being presented with an inflexible and complete proposal against which there is no alternative but to vigorously oppose. Overall, these significant variations in the perception of siting constraints among respondent groups reveal the importance of timing for effective siting, and the potential impact of delayed stakeholder involvement in a project to project success.

Variations by Experience

Perceptions of siting difficulty are not only affected by individuals' types of employment, but also their level of involvement in siting projects. Two measures of involvement evaluated here are degree of familiarity with siting and total years of work experience with siting projects. We hypothesize that respondents' ratings of difficulty within a state could be influenced by their familiarity with siting in that state. Calculating the correlation of familiarity and difficulty ratings for each state shows that 43 out of 48 states have positive correlations between familiarity and difficulty (see Appendix C for a table of all state correlation coefficients and p-values). This indicates that respondents with higher familiarity think that siting difficulty is higher than less experienced respondents do across all states.

Figure 3.4 illustrates this relationship between familiarity and difficulty for evaluations of California and Texas. The slopes for both states are positive, but the slope of Texas is much steeper than that of California. This indicates that increasing familiarity is associated with a greater increase in perceived difficulty in Texas than in California. Because siting difficulty is perceived to be near the top of the scale for California across all respondents, the ratings are compressed and the higher flatter slope is to be expected. Similarly the lower steeper slope in Texas, supports the prevailing judgments of low siting difficulty, but indicates greater variability in how low difficulty is perceived to be.

There are several possible reasons for this difference. The simplest explanation is that experienced siting professionals are assigned more difficult and unusual projects, and as a result newer siting officials anchor their ratings on their own explanations and underestimate siting difficulty in other projects that they have only heard about from other sources. However, it is also possible that the lack of recent construction has resulted in a trend where only straightforward projects with high certainty of completion and high forecasted rates of return are being proposed and built. This is in contrast to previous decades where long-term planning on a 30-year time horizon was typical, and challenging route proposals could have been actively pursued in an effort to build reserve capacity into the system as a whole.

These results are particularly interesting for their implications in an industry that has undergone dramatic transformations in recent decades. In response to these changes, and with the recent lack of construction and uncertainty surrounding transmission ownership, many utilities and companies have heavily downsized or completely eliminated their siting divisions. Although this trend has been paralleled by the creation and growth of independent transmission companies, a number of experienced siting professionals have retired instead of making the transition to new companies (EEI, 2002). With the critical need for new infrastructure the industry is faced with the task of recruiting, training, and supporting large numbers of newer siting professionals. This shift in the workforce has both potential advantages and disadvantages. The rapid changes in the industry require new strategies for countering significant public opposition, introducing successful participation, and addressing legal challenges. As such, changes in the composition of professionals could foster positive changes to outdated siting processes.

From the survey, respondents also expressed opinions about their perceptions of the current balance between business considerations and environmental concerns, where a score of zero (from -4 to +4) indicated a good balance between business and environment, greater than zero indicated some emphasis on business, and less than zero indicated some emphasis on the environment. On average, respondents felt there was a slight over-emphasis on the environment ($\bar{x}$ = -1.31; $t(55)$= -6.75, p< 0.001). However, based on a median-split of the data, respondents with less than 15 years siting experience said that there was a better balance between business and environment (n= 27, $\bar{x}$ = -0.85) than respondents with 15 or more years of work experience, who felt there was a significant over-emphasis on the environment (n= 28, $\bar{x}$ = -1.75; $t(52)$= 2.42, p= 0.019). These changing views within companies could benefit an industry being pushed to make more environmentally-sensitive siting decisions. On the other hand, it is likely that any new workforce will still face many of the same technical, engineering, and communications challenges encountered over several decades by retiring professionals. As a result, the limited venues for knowledge transfer between these two "generations" could prove to be a major stumbling block in the transition to a truly competitive grid.

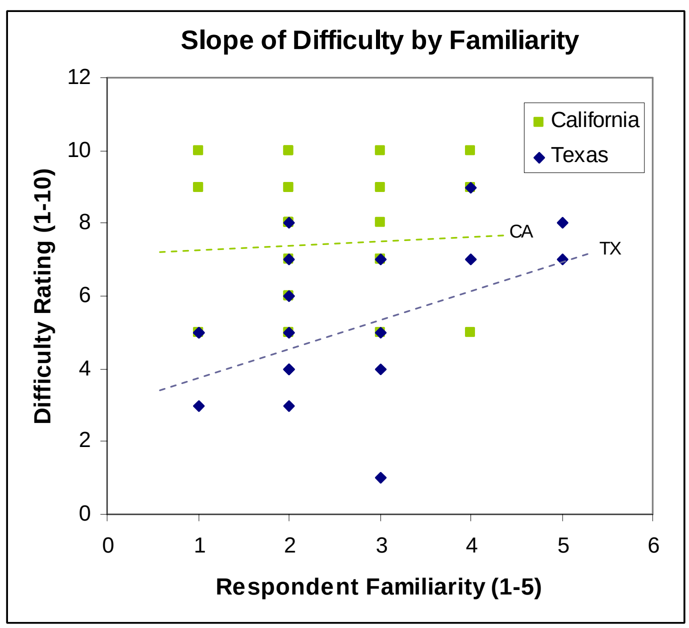

Figure 3.4 Graph of Difficulty by Familiarity by State.

Variations by Geography

The final major results of the survey are based on the relationship between perceptions of siting difficulty and its causes with the difficulty associated with respondents' states of residence and employment. During the course of the survey, respondents were asked to identify their own primary state of residence and employment. Based on the average difficulty ratings from Table 7, the corresponding state difficulty value was assigned to each respondent's own state. Using these values, the correlation of respondent's difficulty ratings for a given state and the average difficulty of their own states was then calculated. As with the comparisons of difficulty by familiarity, all correlations were calculated and evaluated within-state (see Appendix C). In this case, the majority of correlations (36 out of 48 states) is slightly less than zero; however, none of the individual correlations is significant. This result simply suggests that respondents from high-difficulty states perceive difficulty to be slightly lower than respondents from low-difficulty states, but there is no strong evidence any significant anchoring or adjustment effects. Figure 3.5 illustrates this relationship for the case of Texas. Further regression analyses were done for each state to evaluate the impact of both familiarity and geography. The results of these regressions are very similar to the separate correlations (see Table 2 in Appendix C), indicating that respondents' difficulty ratings are robust.

Although respondents' perceptions of difficulty do not vary significantly by the average difficulty in their home states, their perceptions of the dominant causes of difficulty are affected by where they work. Based on a median split of respondents' own state difficulty

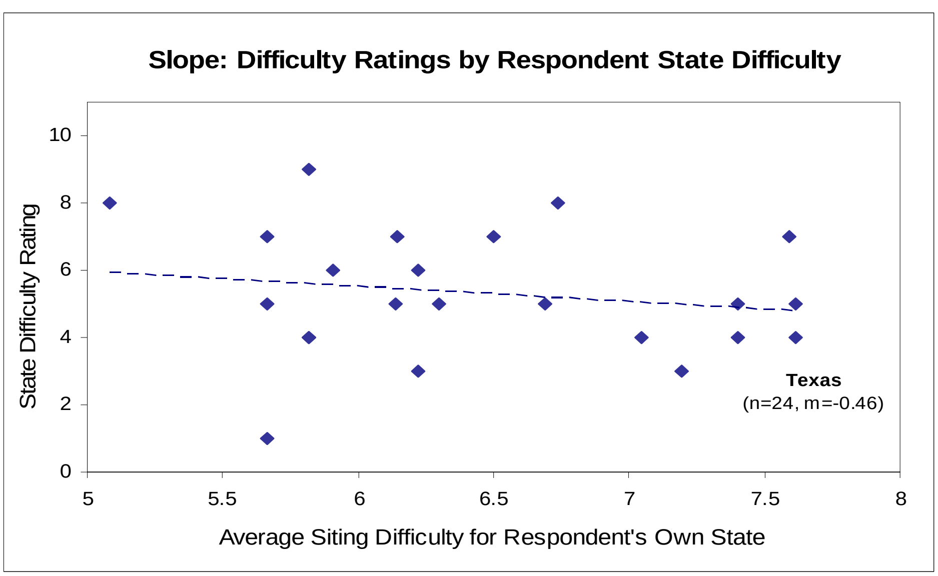

Figure 3.5 Slope of Texas Siting Difficulty Ratings by Respondent State Average Difficulty.

values, respondents from below-average difficulty states (*n*=25) selected public opposition as the dominant cause of siting difficulty 70.4% of the time on average, compared to respondents from above average difficulty states (*n*=29) who selected public opposition only 53.7% overall relative to all other causes ($t(50)= 1.6$, $p=0.116$). Given the low percentages of respondents who identified federal regulation and inter-agency coordination as the dominant causes of siting difficulty across all states, the data for state regulation, federal regulation, and inter-agency coordination were combined into a single regulation category.

Comparing the average percent respondents from low- and high-difficulty states who selected regulation as the dominant cause of siting difficulty, shows that respondents from low-difficulty states felt that regulation was significantly less of a problem ($n= 25$, $\bar{x} = 18.1\%$) than respondents from high-difficulty states ($n= 29$, $\bar{x} = 37.7\%$); $t(50)= -2.10$, $p= 0.041$).[19] This result has implications for the relative magnitude of the perceived difficulty associated with different states. Overall, understanding the prevalence and distribution of different causes of siting difficulty is as relevant to the success of a project as characterizing the magnitude of siting difficulty affecting the project. The final sections of this paper develop a regression model to describe and predict the relative contributions of the three main causes of siting difficulty- the public, regulation, and environment- to state siting difficulty as a whole.

Predicting Siting Difficulty

With the changes to the industry described above, the traditional "decide-announce-defend" siting system has been gradually, though not completely, discarded in favor of a more flexible approach. This new method can be characterized as an "avoid-anticipate-communicate" strategy. If at all possible, planners and stakeholders first seek to avoid problematic areas. After eliminating any unviable alternatives, they then focus on anticipating any potential problems or obstacles that could affect the remaining sites. Inevitably, this involves making trade-offs. In some cases, constraints are both familiar and static, such as unusual stream crossings or soil conditions that alter construction plans, and the trade-offs are more easily quantified and certain; however, this phase is also associated with unfamiliar and dynamic constraints, such as public opposition. As a result, the final step toward overcoming unanticipated problems has been to initiate stakeholder communication, and if at all possible,

[19] The average percent that respondents' selected environment as the dominant cause across all states was not significantly different between groups of respondents from above-average and below-average difficulty states.

to circumvent unpopular decisions that could result in unmitigated opposition. This characterization of current siting strategies is unique in that it requires a dynamic reformulation of traditional practices. Siting decisions cannot be made internally and inflexibly, otherwise, projects risk perpetual delays, uncertain cost overruns, and potential failure.

In order for this approach to be successful in practice, planners and siting professionals need a systematic method for characterizing the relative importance of different constraints. Based on the results from the survey, this next section focuses on predicting regional variations in the magnitude of specific constraints and their interactions using a exploratory factor analysis and regression model. This goal of this model is not only to establish a method for assessing "trouble spots" that can be targeted for early management and mitigation efforts, but also to form a basis for evaluating potential impacts of changes to siting policy or regulation.

Variable Selection

As discussed earlier, both the perceived and actual factors affecting siting can be grouped into three main categories of constraints: public, regulation, and environment. Using these three groups as a framework for the selection of regression predictors, we identified 12 variables that we believe are the most representative and robust indicators of the unique causes of siting difficulty. We hypothesize that each of these predictors is associated with a parallel increase in one or more of the three major categories of siting constraints overall. For example, one of the major reasons for public opposition, identified by Vierima (2001), is loss of property value. As a result, we selected state median housing value as an indicator of potential opposition, where, as housing values increase, the potential for loss and the associated opposition also could increase. Variables are grouped equally into public, regulation, and environment categories based on our hypotheses of their primary relationships with siting difficulty as a whole. It cannot be emphasized enough that these categories are not mutually exclusive, and variables in any one category are related to the other categories to varying degrees. Each selected variable and its underlying hypotheses are described in detail below.

Public

1. *Population Density*- Public opposition is typically associated with the number of people who are affected (or who believe that they are adversely affected) by a specific facility

and as a result protest a siting process, decision, or outcome. We hypothesize that the likelihood of public opposition and siting difficulty as a whole will increase as the number of people potentially affected increases (U.S. Census, 2000).

2. *LCV Score (State Average for House of Representatives 1998-2002)*- Environmental concerns are also frequently identified as reasons for public opposition. We hypothesize that preferences of populations for environmentally sensitive decision making or their support for environmental activism could also indicate a greater likelihood of opposition. This predictor variable is derived from the League of Conservation Voters State Environmental Scorecard, which assigns state Senators and Representatives a score based on their votes (for or against) selected environmental bills and legislation. Score for each congressman range from 0 (least environmental) to 100 (most environmental). As a proxy for public environmental activism and preferences, this variable is the average of all the scores from the House of Representatives for each state from 1998-2002. (League of Conservation Voters, 1998-2002).

3. *Median Housing Value*- Another major reason for public opposition as discussed above, is the potential loss of value of property adjacent to unwanted facilities. We hypothesize that the higher the median value of owner-occupied homes, the more probable it is that affected residents will oppose a project (U.S. Census, 2000).

4. *Education*- A final important basis for public protest are concerns about risks to health and safety from exposure to EMF and risks of ecological destruction (Vierima, 2001). We hypothesize that that severity and complexity of protests related to these concerns are positively correlated with the education level of the affected population. This variable is based on Census data for the percent of a state's population over the age of 25 that has completed a Bachelor's degree (U.S. Census, 2000).

Regulation

5. *Permitting by kv*- With the extensive permitting and review process for current siting projects, we hypothesize that any increase in the amount of regulation is an indicator of longer siting processes with greater uncertainty, and as a result higher siting difficulty. This variable is constructed from the Edison Electric Institute State Level Siting Directory (2001) map of state requirements for permitting of new lines based on

their voltages. Some states require no oversight, some require permits only for lines larger than 200kv, other states require permits for lines larger than 100kv, and still other states require permits for all lines, even those less than 100kv. These four levels of regulation are assigned scores from 0-3 respectively, where 0 is associated with the least regulation and lowest difficulty, and 3 is associated with the highest. (EEI, 2001)

6. *State Natural Resources Employment (full-time equivalent employment as a % of total state full-time equivalent employment)*- Because many siting regulations are based on environmental protection considerations, we hypothesize that the greater the percent of state officials working on natural resources issues in a state the more likely it is that environmental issues are a priority, relative to other sectors. As a result, we hypothesize that siting regulations could be more stringent and lead to increased siting difficulty. This input variable is calculated from government census data (U.S. Bureau of Census, 2004).

7. *Siting Authority*- Regulatory difficulties are not only associated with the types of required permits, but also the numbers and types of agencies involved in granting approvals. This variable is also based on the EEI State-Level Siting Directory (2001), where each of the four major types of agencies that are the primary siting authorities in a given state are assigned a score from 0-3 based on the hypothesis that difficulty increases with each associated agency. A state with no primary siting authority is defined as 0 (easiest), a state regulated by a PUC is defined as 1, a state with a consolidated Siting Board is equal to 2, and finally a state with a non-siting agency as the primary authority is equal to 3, and hypothesized to be the most difficult. These hypotheses are based on the fact that PUCs are the most experienced and commonly affiliated with siting permits, while Siting Boards are typically created to counter existing regulatory redundancy and difficulty, and as a result these boards are newer to the process with less established standards and procedures. Finally, a non-dedicated siting authority, such as a state Department of Natural Resources, is assumed to be associated with the highest difficulty because of its other priorities and responsibilities (EEI, 2001).

8. *Number of Siting Agencies*- The final regulatory variable is the total number of state agencies involved in siting and permitting processes. The EEI State-Level Siting Directory (2001) includes a map that places all states into one of three categories: no

state siting authority, a single siting agency, or multiple associated state-level agencies. This variable is based on these three categories, where states with no siting authority are assigned a 0, states with a single siting agency are assigned a 1, and states with multiple agencies are assigned a score of 2.

Environment

9. *Land Cover Score (Roughness Length)*- The type of land cover along a route significantly influences siting decisions and route selection. This variable is developed based on data from the global wind models that characterize surface roughness for grid regions based on the type of land cover as a measure of wind turbulence. We hypothesize that the higher the roughness length, the more difficult the physical environment is for construction. Water bodies have the lowest roughness length, followed by pastures, and fields, while dense shrubbery, hills, urban construction, and unevenly forested regions make up the roughest land covers (Collins et al., 2003)

10. *State Forest Acres (% of total land area)*- Just as the type of land cover influences the feasibility of different line alternatives, we hypothesize that the amount of state forest land limits the total available area for siting, and also affects the ease of access to potential sites, the cost of construction, and overall physical difficulty (National Association of State Foresters, 2003).

11. *Standard Deviation of Elevation*- Other areas that constrain physical site selection and project construction are very steep, rocky, or mountainous areas. Given the limited amount of existing infrastructure in regions such as the Rockies and Appalachians, we hypothesize that extreme changes in terrain are associated with higher environmental siting difficulty. This variable was calculated based on the standard deviation of the average elevations of all zip codes in each state (Zip-codes, 2005).

12. *Percent Farm Lands (Inverse)*- As a counterpart to the 'bumpiness' variable defined by variations in the elevation, we hypothesize that more flat and relatively easy to access farm lands (as a percent of total land area) are associated with lower physical and environmental siting difficulty. This variable is adapted from the USDA Census of Agriculture and State Fact Sheets (2002) and multiplied by −1 to maintain a positive relationship with increasing siting difficulty.

Overall, all twelve variables above were normalized and input into a factor analysis. The resulting three-factor solution explains ~65% of the total variance, and the loadings support the original categorization of variables. Table 8 shows the Varimax rotated factor loadings for all three factors, which are defined as public, environment, and regulation respectively.

	Public Factor 1	**Environment** Factor 2	**Regulation** Factor 3	Communalities
Population Density	0.56	0.56	0.20	0.67
LCV Environmentalism Score	0.48	0.61	0.27	0.68
Median Housing Value	0.87	0.07	0.26	0.83
Education (% of population)	0.82	0.05	0.30	0.76
Permitting by Voltage (kV)	0.02	0.11	0.78	0.62
Natural Resources Employment	-0.75	-0.26	0.35	0.75
Type of Siting Authority	0.16	-0.03	0.72	0.55
Number of Siting Agencies	0.14	0.02	0.66	0.46
Land Cover Score	0.03	0.84	-0.04	0.70
% State Forest Land	0.42	0.57	0.25	0.57
Elevation Standard Deviation	0.10	-0.78	0.25	0.68
% Farm Lands	0.31	0.59	0.15	0.46
Variance Explained	24%	23%	18%	65%

Table 8. Regression Predictors: Varimax Rotated Factor Loadings and Communalities

As hypothesized the selected variables load primarily on the three categories of constraints as grouped above.[20] The next section builds on this analysis, using the state factor scores as input variables in a series of regression analyses.

Regression Results

In order to understand the relative contributions of individual siting constraints to overall siting difficulty, the three factor scores above were regressed on the siting difficulty factor score from Chapter 1. The regression equation below shows that the coefficients of all three factors are significant at $p<0.05$, and together they account for approximately 64.4% of

[20] Although the Natural Resources Employment variable loads positively on the regulation factor as hypothesized, it also loads negatively on both the public and environment factors. These negative relationships could be caused in part by interactions among public and regulatory concerns surrounding the environment. As the number of state officials working on natural resources increases, it is possible that public confidence in state environmental priorities could limit public opposition to major facilities on environmental grounds, under the assumption that strict regulation avoids the need for parallel public opposition. A second slightly unusual loading is the negative loading of the Elevation variable on the environment factor. This relationship can be explained by the interactions among variables loading on the environment factor, where land cover, state forest acreage, and farmlands all have slightly negative correlations with variability in elevation.

the total variance in the dependent measure, state siting difficulty. Taken as a whole, the results of this analysis strongly support current qualitative judgments about the relative importance of different siting constraints to siting difficulty, where the coefficient for the public factor is significantly higher than either the environment or regulation factors.

Siting Difficulty Factor = 0.62 Public + 0.47 Environment + 0.18 Regulation

Predictor	Coefficient	SE Coef.	T	P
Constant	0.00000	0.08899	0.00	1.000
Public	0.62255	0.08994	6.92	0.000
Enviro	0.47264	0.08994	5.26	0.000
Regulation	0.18211	0.08994	2.02	0.049

N= 48 S= 0.617 R^2 = 64.4% R^2 (adj)= 62.0%

At the state level, this model is a valuable tool for understanding the relative importance of different siting constraints. Comparing the coefficients above with the perceptions of the causes of siting difficulty in Table 7 and Figure 3.2, validates the model and shows that public opposition is the most important factor across all states in both cases. These results make a first step toward breaking down the siting problem, and establishing a structure for prioritizing siting difficulty mitigation efforts, including federal policies, state regulations, and local practices.

Because the factor analysis in this section combines all types of regulatory difficulty into a single factor, we summed the ratings from the original survey for state regulation, federal regulation, and inter-agency coordination into a single regulation percentage across all states for comparison. When aggregated, the average regulation ratings are below public opposition and above the percent of respondents who selected environment as the dominant cause. This relationship is reversed in the regression equation where the environment coefficient is over twice that of the regulation coefficient. However, it is important to note that the survey results reflect the dominant cause of siting difficulty across all states not the relative importance of each cause. As a result the order of importance of the environment and regulatory factors is difficult to compare. At a more detailed level of disaggregation, the order of importance of the regression predictors (public, environment, then regulation) most closely aligns with the consultants' perceptions of the overall causes of siting problems in Figure 3.2. Given that consultants have the greatest degree of familiarity and work experience in the most states compared with all other agency groups, this evaluation provides important independent support for the regression model and the major findings.[21]

Not only does this model make an important step toward understanding and characterizing the causes of siting difficulty at the state level, but it also provides a basis for extrapolating the approach to evaluate siting problems at the regional and local levels. For example, at a regional scale, it is important to understand how causes of siting drive (or limit) grid expansion within and between Regional Transmission Organizations (RTOs). As an example of this level of evaluation, we performed a second regression analysis to include multiplicative interactions terms for each factor with the PJM RTO.[22] PJM is specifically selected for analysis, because it is widely-viewed by federal agencies as a model for other regions. This analysis assesses if there is lower siting difficulty within PJM than in the rest of the country that has potentially aided the success of PJM as an RTO.

The equation below shows that all three original predictors remain significant, and the environment coefficient increases from 0.47 to 0.55 to indicate that environment-related difficulty is slightly higher in non-PJM states than within PJM. Although this change is small in magnitude, this result is particularly interesting because the environment constraint is the most static of the three predictors. In other words, environmental factors, such as state forest acreage and elevation, are the least likely (or able) to change to reduce siting difficulty in a region. The only variable within this factor that could potentially be adjusted to reduce environment-driven siting difficulty is the percent of a state's budget allocated to natural resource employment. Based on the factor loadings in Table 8, increasing the number of state officials working on natural resource issues could lower siting difficulty related to the environment; however, this solution is only relevant for states without high regulation-related difficulty, since the addition of resource employees is also associated with an increase in regulatory difficulty. In spite of the slight variation in the environment coefficient, neither the PJM dummy variable nor the related interaction terms are significant. This indicates that PJM is not dramatically different from other regions, and the model and original predictor variables

21 Respondents' evaluations of the dominant causes of siting difficulty within each state were never used as input variables into any of the factor or regression analyses in Chapters 2 and 3. Therefore, they provide independent points of comparison.

22 The PJM RTO is defined here as including the following states, where the majority of the state participates in the RTO: Delaware, Maryland, New Jersey, Pennsylvania, Ohio, Virginia, and West Virginia. The PJM service area also includes parts of Indiana, Illinois, Kentucky, Michigan, North Carolina, and Tennessee; however, only small portions of these states participate in the RTO, and as a result these states are not included in the analysis (PJM, 2005).

are largely robust to changes in organization.[23] Taken as a whole, these results illustrate the value of this approach for evaluating state, regional and national siting issues.

Difficulty = 0.09 + 0.62 Public + 0.55 Environment + 0.19 Regulation - 0.49 PJM + 0.08 Public*PJM - 0.16 Environment*PJM + 0.18 Regulation*PJM

Predictor	Coef	SE Coef	T	P
Constant	0.08701	0.09650	0.90	0.373
Public	0.62384	0.09801	6.37	0.000
Environment	0.54889	0.09870	5.56	0.000
Regulation	0.18754	0.09181	2.04	0.048
PJM	-0.4922	0.4723	-1.04	0.304
Public*PJM	0.0825	0.2459	0.34	0.739
Enviro*PJM	-0.1644	0.4977	-0.33	0.743
Reg*PJM	0.1750	0.4947	0.35	0.725

N=48 S = 0.610 R-Sq = 68.3% R-Sq(adj) = 62.8%

Not only is this model relevant for large-scale assessments of siting policies and practices, but it also provides the basis for characterizing siting difficulty at the local level. All of the input variables into the factor analysis in this chapter were specifically selected for their relevance at multiple scales, and data for the majority of the variables summarized in Table 8 are available (or could be developed) at a county-level. Calculating public, environment and regulation factor scores at this scale allows for a finer-grained evaluation of siting difficulty within each state to first, identify high-difficulty problem areas and their dominant constraints , and then to develop targeted solutions. Finally, the extrapolation of this model to a local-scale provides the structure for predicting siting difficulty along potential routes and comparing site alternatives for lines that cross multiple counties or states.

Conclusions and Discussion

Taken as a whole, this chapter provides a fundamental framework for characterizing, evaluating, and predicting the causes of transmission line siting difficulty. The specific results from the survey give important insights into how the views and characteristics of siting

[23] To test further the robustness of the model for other interactions, an analysis of coastal v. interior states was performed. Like the results of the PJM analysis, the original predictors remain significant, but in this case the interaction of the public factor and the coastal dummy variable is also significant. The specific results and a brief discussion are included in Appendix C.

professionals at different agencies could potentially affect siting policies and practices, and validate the prevailing view of public opposition as a dominant constraint. Overall, the two-step approach developed in this dissertation to quantitatively characterize siting difficulty (Chapter 2) and then assess its contributing causes (Chapter 3) is relevant for a wide-variety of industries facing growing siting difficulty and planning constraints on critical infrastructures.

It cannot be emphasized enough that siting difficulty and its associated constraints are not monolithic. This paper makes a first step toward breaking down causes of siting problems into manageable pieces for evaluation and planning, while simultaneously maintaining a holistic overview of the problem to recognize that siting difficulty as a whole is more than the sum of its causes. In no way is the predictive model intended to characterize and blacklist certain areas of high siting difficulty. Nor do we suggest that all siting difficulty can be predicted and addressed in advance of a planning process. There are cases of both poor siting decisions, and insurmountable obstacles to specific route proposals; however, in those cases where siting practitioners have made a concerted effort to involve all affected parties and overcome associated obstacles, this model can serve as a tool for addressing the problem as a whole. This work is intended to serve as a guide for developing targeted, locally relevant, sustainable solutions, as an alternative to sweeping legislations such as federal backstop eminent domain authority by the FERC or limited local outreach programs.

Because public participation is increasingly viewed as the only lasting solution to public opposition, this chapter provides baseline for understanding the components of public opposition in the context of other siting constraints. The "avoid-anticipate-communicate" siting strategy formulated here requires a dynamic characterization of siting difficulty, provided by the final regression model, to inform and structure early and effective public participation programs. Together, Chapters 2 and 3 illustrate the escalating impact of public opposition on transmission planning and policy and highlight the growing focus on participation as an answer to public opposition. Chapter 4 builds on this chapter and shifts the focus to 1) unpacking participation and 2) developing a strategy to facilitate stakeholder participation that is relevant to a wide-variety of development programs, including facilities siting.

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Chapter 4

UNPACKING PARTICIPATION

The rung of a ladder was never meant to rest upon, but only to hold a man's foot long enough to enable him to put the other somewhat higher. –Thomas Huxley

The failure of traditional decide-announce-defend approaches to development projects, most prominently in transmission line siting efforts as described in Chapters 2 and 3, has led to a wide-spread call for more inclusive and effective public participation. Recent work has focused on NIMBY-style public opposition, and promoted participation as a strategy to counter this type of stakeholder conflict. In spite of this growing trend, most participatory research remains highly context specific, and as a result, the vast literature on participation is difficult to assess and aggregate. Although increasing efforts are being made toward meta-analytic evaluations and comparative studies, current work on participation remains scattered.

This section provides a brief review of participation literature. Because there are many comprehensive overviews and annotated bibliographies of theoretical and applied papers on participation, this chapter avoids replicating these studies. Instead, this review is unique in its organization of participation work into five major categories: 1) characterizations of the different types and levels of participation, 2) theoretical assessments of the general goals and objectives of participation, 3) development of specialized participatory methods or tools, 4) applications of participation within specific research domains or projects, 5) and evaluations of the processes and/or outcomes of participatory programs. Very few reviews pull together the various project-, domain-, and method-specific studies on participation encompassed by these categories, and even fewer provide a clear picture of participation as whole. As a result, this chapter first focuses on "unpacking" participation based on the research areas outlined above. Given the depth and breadth of participatory work, this overview only identifies some of the most important and unique contributions to the field as a whole, recognizing that there are hundreds of papers associated with each area that are outside the scope of this chapter.[24]

[24] There are several online sources for more extensive bibliographies of citizen and public participation and related literatures, such as the following: http://www.indiana.edu/~workshop/wsl/citizenbib.html;

Based on this review, Section 2 of this chapter develops a framework for characterizing participation as a whole. This section identifies three fundamental 'building blocks' that are shared by a large majority of participatory processes. This framework then serves as a basis for evaluating a proposed tool for improving participatory planning and decision making- *digital participatory mapping*. The second half of this chapter focuses on this new mapping strategy. Section 3 outlines the motivations for using mapping in general, and describes why current mapping tools and methods fall short of the demands of many participation projects. Section 4 then develops the theoretical basis for digital participatory mapping based on the common dimensions shared by conventional GIS and traditional participatory mapping. Finally, Section 5 places the proposed tool in the context of the three building blocks from Section 2. Overall, the framework in this chapter also provides the structure for the remaining chapters in the dissertation.

Participation Literature Review

Participation, as we know it today, is a relatively recent phenomenon. The first area of research on participation categorized here is also the most general, with its basis largely in planning literature. Studies in this area focus primarily on the question *What is participation?* The shared objectives of the many papers under this heading are to define participation, to characterize degrees of public inclusion and engagement, and to evaluate different levels of stakeholder involvement. The initial critical evaluations of citizen and public participation in the U.S. emerged in the wake of urban renewal programs, public health and welfare projects, and public administration efforts in the late 1950's and 1960's. These papers focused on bringing structure to the vague, top-down notions of participation of the time.

Two of the earliest and most influential evaluations in this area are Edmund Burke's "Citizen Participation Strategies" (1968) and Sherry Arnstein's "A Ladder of Citizen Participation" (1969). Traditionally, all participation (in both theory and practice) was viewed positively as a general effort to engage citizens and public stakeholders. Arnstein's ladder dispels this notion and establishes eight 'rungs' of public involvement that range from levels of non-participation, such as manipulation and persuasion, to levels of citizen power, such as partnership and civic control. These original value-judgment based characterizations of

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http://www.uc.edu/cecs/PPB.html; http://www.dietzkalof.org/publicparticbiblio/publicparticbiblio.htm. (Accessed online: 15 June 2005).

participation have since been widely adapted to changing attitudes about and approaches to participation (see Pretty, 1995 (adapted from Adnan et. al., 1992) for examples).

Participation today is rarely described in as general terms as it once was, and participatory studies now differentiate among public, citizen, and stakeholder involvement, and various forms of voluntary, solicited, and strategic participation, among others. Since the early evaluations by Arnstein and Burke, it has also become commonplace for agencies and organizations promoting participatory strategies to internalize their own relevant definitions and characterizations of participation. For example, the Environmental Protection Agency (EPA) has over the years supported various working groups on stakeholder involvement in environmental decision making and published numerous reports defining and describing different types of participation (see online source EPA, 2005). With the increasing specificity of participatory projects, even general works on participation have gained a degree of domain-specificity. As a result, broad studies on participation have grown fewer and farther between.

Contrary to this trend of specialization, the recent books *Fairness and Competence in Citizen Participation* by Renn, Webler, and Wiedemann (1995) and *Democracy in Practice: Public Participation in Environmental Decisions* by Beierle and Cayford (2002) both include more modern overviews of the history and philosophy of participation that highlight the changing dynamics of contemporary participatory processes. These transformations have extended current participation-related work to the fields of democracy, civil rights, consensus building, social movements, risk communication, public policy, and environmental justice, among others.

Like the efforts on defining participation, the second major category of participatory research is equally broad. This set of studies generally seeks to describe the goals and objectives of participation, and answer the question *Why is participation important?* Although these issues are directly related to the different types and levels of stakeholder involvement discussed above, there are also fundamentally independent underlying motivations for choosing to engage in participation at all, either as an organizer or as a contributor. Depending on their priorities, facilitators and participants focus on short-term or long-term, individual or societal, and process- or outcome- oriented agendas, among others. Renn, Webler, and Wiedemann (1995) describe these differences as stemming from either an ethical-normative basis or functional-analytic basis for participation. Similarly, Rowe and Frewer (2000) distinguish between participation based in knowledge-based decisions and value-based decisions, which require differential levels of involvement.

In addition to these general classifications of different types of motivations for participation, there is also substantial research characterizing more specific objectives. For example, Beierle and Cayford (2002) define five social goals of participatory processes:

- Incorporating public values into decisions
- Improving the substantive quality of decisions
- Resolving conflict among competing interests
- Building trust in institutions
- Educating and informing the public

Fischer (2000) emphasizes the importance of local knowledge and adds educating experts and filling in gaps between local and expert knowledge to this list of social objectives.

In contrast, to these general long-term, societal, process-oriented objectives, there are also a host of related short-term, project-specific, and outcome-based objectives. These could include siting a hazardous facility, managing community opposition to a proposal, or eliciting required local information. In this vein, the National Research Council (NRC, 1996) defines one of the primary goals of participation as improving the acceptability of risk and policy decisions. Arvai (2003) presents evidence, on the other hand, that engaging in participatory processes does not necessarily improve outcome-satisfaction among indirect or non-participants. On the whole, just as characterizations of participation have grown increasingly context-specific, the aims and intentions of participation have also become equally specialized.

Given the complexities and uncertainties surrounding the most basic goals and objective of participation, even the most well-intentioned and organized of participatory processes could fail. As a result, the particular tools and methods for facilitating participation have drawn greater attention in an effort to reduce uncertainty and improve both participation projects and outcomes. This brings us to the third category of participatory research outlined here, which focuses on how participation is implemented and facilitated. Research in this area ranges from normative analyses (how participation ideally could be done), descriptive studies (how participation is currently engaged on the ground), and prescriptive approaches (how current participatory strategies could be improved) (see Sexton et. al., 1999 for examples of all three in government, business, and community environmental decision making).

This area encompasses a variety of participation-based methods, such as public forums, participatory resource mapping, citizen advisory panels, consensus conferences, town meetings, household surveys, citizens' juries, etc., and larger strategies, such as Participatory

Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) which include collections of related methods (Chambers, 1994). These are only a few examples of the ever-growing numbers of participatory methodologies. These numbers increase further when considering domain specific strategies for stakeholder involvement. For example, Kasperson (1986), Fiorino (1990), and Brody et. al. (2003) develop and assess methods for facilitating participatory risk communication, evaluating institutional mechanisms for participatory management of environmental risk, and implementing state mandates for participatory planning, respectively. Additionally, agencies such as the World Bank have developed manuals and toolkits for participation, including the World Bank Participation Source Book (1996).

Overall, methods and strategies for citizen participation abound, and tools for participation have developed in equal measure. Participatory tools are fundamentally different from the mechanisms of participation described above. Participatory methods are designed for the sole purpose of supporting specific types of engagement or inclusion, while participatory tools are often general instruments that have been adapted to participation-related work. For example, in recent years, the most widespread tools for supporting stakeholder involvement have come from the information and communications technology (ICT) sector. Internet-based dialogues have transformed both solicited and voluntary participation efforts. Furthermore, global initiatives, such as the UN Millennium Development Goals (UN, 2000) and the World Summit on the Information Society (WSIS, 2003), have made ICTs a cornerstone of participatory development planning and environmental decision making. With the rapid spread of ICTs, opportunities for engaging stakeholders and the general public have entered a variety of previously top-down projects and fields. As a result of this diffusion of participation, critical evaluations of participatory methodologies have also become a major part of this literature. Aspects of current research on both "appropriate technology" and "the digital divide" focus directly on the implications of using tools for facilitating participation in settings where a technology could drive a social process (Abbot et. al., 1998; Dunn et. al., 1997; Yapa, 1991). In response to these criticisms, various tools and methods of participation have become progressively more sophisticated and even more widely-used.

The fourth category of participation research outlined above is also directly related to the extension of various participatory tools and methods to increasingly diverse projects. This area is associated with where and how participatory processes and techniques are applied, and covers the most specialized, yet extensive work on participatory applications. Conventionally, participation was in the hands of social scientists, anthropologists, and other field-work based researchers. However, as described above, the dynamics of participation have changed dramatically to encompass a wide range of disciplines, fields, and domains, including architecture, design, planning, engineering, and public health, among a host of others.

The literature in this category is largely a collection of individual field projects and specific efforts to incorporate and test participatory tools and methods in innovative ways for unique applications. Examples include participatory forest management in Cameroon (Mbile et. al. 2003), land cover evaluations in Zimbabwe (Mapedza et. al., 2003), community natural resource planning in Kerala (Fischer, 2000), community-based facilities siting programs across the U.S. (Kunreuther et. al., 1998; Inhaber, 1998), large-scale displacement and resettlement projects worldwide (Cernea and McDowell, 2000), and developing world rural poverty mitigation (Chambers, 1983). Overall, participation is increasingly a global priority for countless types of public projects, and as a result, both the academic and applied literature in this area is already vast and ever-expanding.

The final category of participatory work and research defined above brings together the work in the four previous categories to address the question- *What are the results of participatory efforts?* This area includes meta-analytic evaluations and critical analyses of the largely qualitative, highly project-specific studies described above. Work in this category assesses participation projects based on both their processes and outcomes. Several studies compare the relative effectiveness of different techniques and methods for specific applications, such as community meetings versus household surveys (Davis and Whittington, 1998). Others evaluate the differences between process and outcome satisfaction with participatory efforts among direct participants and non-participants (Arvai, 2003). Beierle and Cayford (2002) find that "the process of participation, rather than its context, is largely responsible for the success or failure of public participation." (p. 7); however, they also emphasize that successful project implementation depends on a variety of additional factors. Taken as a whole, all of these critiques are based largely on empirical evidence, critical theory, and multi-criteria evaluations of specific types of projects (see Fiorino, 1990; Renn, Webler, et. al., 1995; and McDaniels, Gregory, et. al, 1999; Webler, 1999 for additional examples).

This category also includes more general and larger-scale evaluations of the effectiveness of participation. Although the need for evaluation criteria and measures of success of both formal and informal participatory programs is widely acknowledged within the field, coherent standards have yet to be widely implemented in practice. As Chess and Purcell (1998) describe, the specificity of both participatory research and embedded practice make it difficult to evaluate the relative effectiveness of different participatory tools and methods across a variety of contexts and applications. Similarly, Webler (1999) underscores the increasing divergence of participation theory and craft. As a result participation in practice currently suffers from the problem that "when you have a hammer, all the world looks like a nail." Because the call for participation is so overwhelming, participatory methods, such as town meetings and resource mapping, are often applied without clear theoretical underpinnings, goals, or even context within a larger project. Similarly, there are few standards for integrating participatory information into decision making, evaluating different levels of involvement, or defining success.

Awareness of this growing gap has drawn attention to the importance of setting coherent standards for participatory methods, tools, and their applications. Toward this end, Rowe and Frewer (2000) define several process and acceptance criteria for formal participation processes, and Chess and Purcell (1999) establish related rules of thumb for implementing participation. Finally, Irvin and Stansbury (2004) argue that participation is not always necessary or appropriate in all cases, and discuss "conditions under which community participation may be costly and ineffective and when it can thrive and produce the greatest gains in effective citizen governance."

Overall, as Fischer (2000) notes, "Citizen participation, in short, is a complicated and uncertain business that needs to be carefully thought out in advance." (p. 144). The five main questions defining participation can be summarized as follows:

1. *What is participation?* (Definitions and Characterizations)
2. *What makes participation important?* (Goals and Objectives)
3. *How is participation implemented and facilitated?* (Methods and Tools)
4. *Where and how is participation applied?* (Domains and Projects)
5. *What are the results of participatory efforts?* (Process and Outcome)

This literature review draws attention to the diversity of participatory research and practice, where understanding participation as a whole requires a clear, simple, and general framework for organizing participation efforts and evaluating both participatory methods and processes. The next section makes an important step toward developing this framework, and places this new template in the context of the literature review above.

The Building Blocks of Participation

Based on the body of participation literature and applications outlined above, there is a growing need for better models to organize participatory projects at large and define at least general areas for evaluation in advance of implementation. Toward this end, this section proposes a guide based on three fundamental 'building blocks' of participation: 1) information exchange, including data gathering and dissemination, 2) dialogue and stakeholder communication, and 3) decision-making and assessment. These elements describe the basic levels of stakeholder interaction that form a large majority of participatory efforts. As Figure 4.1 illustrates, participation is a complex process consisting of a series of feedback loops among these three basic components. These building blocks do not individually or sequentially complete any participatory process; instead, effective participation requires an appropriate assembly of these fundamentals to address specific project goals and stakeholder needs.

In order to place this framing in the context of existing literature and practice, the proposed framework is compared to Arnstein's Ladder (1969). A comparison of Figures 4.1 and 4.2 clearly illustrates that, as participatory processes move up the levels of involvement on the ladder, combinations of building blocks are added to the process. Projects that are focused on persuasion and manipulation require only the most basic information dissemination, while even the lowest forms of consultation require some information gathering and feedback. As discussed above, Rowe and Frewer (2000) make a similar distinction between one-way communication, typically associated with knowledge-based decisions, and the higher levels of input and feedback or participation, generally required for value-based decision-making. The upper rungs of the ladder involve cyclic and iterative progressions of various combinations of all three participatory building blocks. Although different levels of participation are associated with unique combinations of various building blocks, many participatory tools and methods focus solely on one of the three individual stages of participatory processes.

For example, household surveys and resource mapping serve primarily as information gathering tools. Technical risk assessments are often based on simple one-way communication (Rowe and Frewer, 2000). Similarly, town meetings are methods for fostering dialogue among specific stakeholders. Very few participatory tools focus on the dynamic decision making aspect of participation, and even fewer tools are designed to carry stakeholders through all the phases of participation and the resulting feedback loops. The specialization of participatory tools and methods has exacerbated the need for a simple, general structure to plan and evaluate participatory processes. The next sections of this chapter focus on this gap and present a proposal for a new approach to facilitating participation: *digital participatory mapping*.

Because a large majority of development planning and environmental decision making projects are inherently linked to spatial information, we propose to use mapping as a tool that supports all three major building blocks across a variety of levels of participation. The next section outlines the characteristics of mapping, in general, and discusses the strengths and weaknesses of both participatory mapping and GIS technology as they are current used within participatory processes. Section 4 then develops a strategy for combining both GIS and participatory mapping to maximize their respective strengths and counterbalance their individual weaknesses. This new combined method, digital participatory mapping, is finally evaluated across the remaining three chapters of the dissertation for the three building blocks, information exchange, stakeholder communication, and participatory decision making respectively. Overall, to avoid the scattered implementation of the other participatory tools and methods, as described above, the remainder of this dissertation builds on the framework in Figure 4.1 to organize critical analyses and test the effectiveness of the proposed tool for participation as a whole.

Building Blocks of Participation

Three components of stakeholder interaction

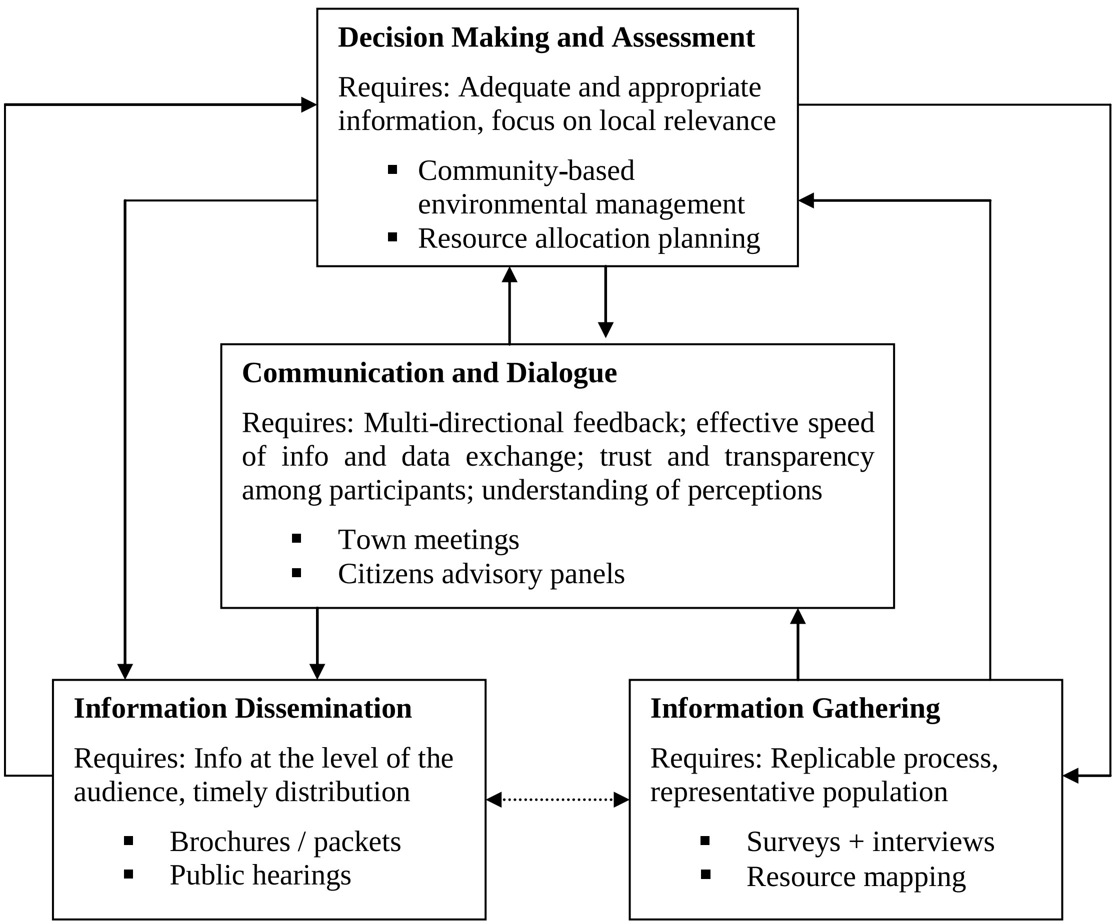

Figure 4.1 Building Blocks of Stakeholder Participation

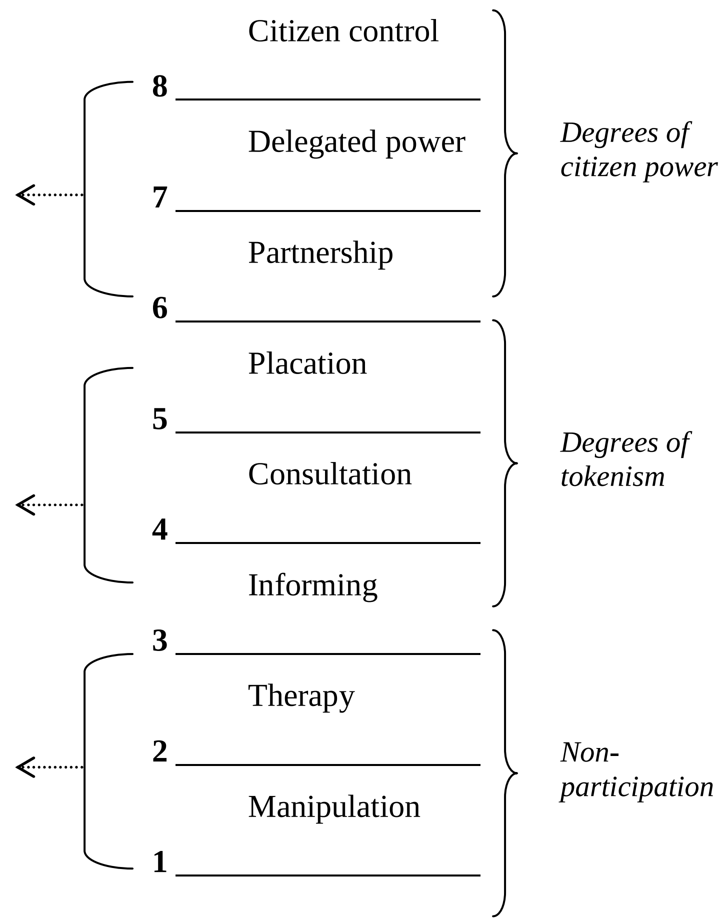

Figure 4.2 Arnstein's Ladder of Citizen Participation

Arnstein, S. R. (1969). "A Ladder of Citizen Participation." Journal of the American Planning Association **35**(4): 216-224.

The Case for Mapping

Participation related to both development and environmental issues inherently has its basis in spatial information, where the locations of key resources, people, and issues dominate participatory processes (Brodnig and Mayer-Schönberger 2000). As a result, various mapping methodologies have become increasingly important for characterizing, understanding and improving development planning and environmental decision making projects. Currently, two of the most widely used mapping tools for these purposes are Geographic Information Systems (GIS) technology and participatory mapping; however, both have become increasingly limited in their abilities to address the dynamic needs of the growing numbers of diverse participation-based projects. This section briefly describes the basic characteristics of both GIS and participatory mapping, and highlights their respective strengths and weaknesses for facilitating participatory planning and decision making.

A GIS is a computer system and software capable of assembling, storing, manipulating, displaying, and analyzing geographically referenced data. GIS software and related-technologies can be used to gather and record spatial data, and also perform complex analyses of the spatial relationships among objects and areas being mapped. While other maps represent a road simply as a line, a GIS has the potential to attach other information to the line and identify a significant cultural boundary or socio-economic division between adjacent communities. In contrast, participatory mapping is traditional method for collecting spatial information from community residents about their perceptions and relationships with local resources, places, or issues (McCall, 2003). The term participatory mapping, as it is used here, is defined very broadly as any combination of participation-based methods for eliciting and recording spatial data. Specific examples of these methods include sketch mapping, scale mapping, and transect walking, among others (Chambers 1994; World Bank 1996). Resulting maps are particular to the participants' cultures, languages and education levels and can vary from maps drawn in the dirt with sticks to paper sketches to three-dimensional physical site models. On the whole, both GIS and participatory mapping have important strengths for enabling participatory planning and decision making. However, the changing dynamics of participation coupled with some of the inherent limitations of these tools, has led to the need for a new approach to mapping to support effective participation.

As described above, the transformation of participation has drawn widespread attention to a variety of information and communication technologies (ICTs) as potential tools to facilitate participatory development that is both inclusive and environmentally-sensitive. However, the massive quantities and highly sophisticated presentations of data associated with many development and environmental projects have resulted in a divide beyond a lack of access to technology and even a lack of access to information. This new divide − between information and communication − is evident in a variety of global programs, where various stakeholders and diverse groups require common information about a project, but understand and use this information very differently from one another. In some cases, information is both available and relevant, but it is represented in a form that is too general or too specific to be useful for the intended audience.

GIS technologies provide one of the most striking examples of this paradox. The abilities of GIS to synthesize a wide variety of data and analyze complex spatial relationships has made it an essential planning tool for projects ranging from transport planning to forest conservation to infrastructure siting. As GIS have been extended to more complex and diverse applications, the resulting maps and output from the system have also become increasingly intricate, and arguably, divergent from the users and communities the technology was originally intended to serve (Dunn, Atkins et al. 1997; Abbot, Chambers et al. 1998). This divergence has led to critical assessments of the social implications and applications of GIS and its outputs through forums such as the Varenius Initiatives (Goodchild, Mark et al. 1997). In spite of these efforts and the rapid growth of new Participatory GIS (PGIS) and Public Participation GIS (PPGIS) research areas, GIS technology and its maps remain largely focused on characterizing and analyzing attributes of locations, instead of populations and livelihoods.[25] This chapter argues that with the changing nature of development, the increasing emphasis on social and environmental sustainability, and the global attention to community-level planning, GIS need to move beyond conventional representations of *where* people live to describe more effectively the dynamics of *how* people live. This subtle distinction is central to this chapter.

Since its inception, the potential of a GIS to illustrate collectively numerous aspects of a location has been its primary strength; however, with the emphasis on participatory information, this strength of the technology has also become a fundamental weakness of its output. GIS maps with multiple layers of information that include *all of the features* of a selected

[25] For more information about PGIS and PPGIS (and the distinction between the two), the IAPAD website (http://www.iapad.org/) is an excellent source of examples and references. (Accessed: 20 May 2005)

area, such as schools or green spaces, are now widely recognized as representing only one possible reality, and a collective reality at that (Chambers 1997). Rarely do all residents of a community interact with every school or park in their region, let alone in similar ways or for the same reasons. Individuals' connections with their physical surroundings are based on their unique priorities, perceptions, preferences, and potentials. In other words, populations are not homogenous, and *where* people live only forms a starting point for *how and why* they live there.

Although the overarching picture offered by GIS maps is important, this view is no longer enough. Effective development requires the disaggregation of both actual and perceived spatial relationships by gender, age, and income, among other characteristics, to understand and address the differential impacts of development among diverse populations. These impacts are widely acknowledged and studied, but neither conventional nor participatory GIS currently serve the related information needs effectively. The processes of data collection, integration, and map creation using GIS, have only recently begun to change in response to these distinctive dynamics of community development (Weiner, Harris et al. 2002).

In contrast a variety of the existing methodologies for facilitating participation, such as participatory mapping, have emerged from different disciplines and been adapted to fill these gaps and promote equitable development (Chambers 1994; Cornwall and Jewkes 1995). These methods are referred to within PGIS and PPGIS literature as counterparts to GIS for their ability to capture individuals' or groups' perceptions of local issues and development efforts (see (McCall 2003) for examples). Although participatory maps, in contrast to GIS, describe *how* people live, many of these methods are limited in their usefulness. Often the process of data collection is extremely time-consuming, and the resulting information is difficult to compile and unwieldy for effective use by decision makers (Tripathi and Bhattarya 2004).

On the whole, the individual strengths and weaknesses of both participatory mapping and GIS outlined here are largely complementary. The next section describes the shared characteristics of these tools along three dimensions. These dimensions then form a theoretical basis for integrating these methods to maximize their respective strengths and balance their weaknesses for facilitating participation.

The Dimensions of Mapping

Traditionally, there has been little overlap between the users, audiences, and objectives of GIS and participatory mapping; however, with the recent changes in development practices, mapping professionals and projects in these domains have gradually come together (Brodnig and Mayer-Schönberger 2000; Weiner, Harris et al. 2002). Specialists in participatory methods or in GIS have each extended their respective research areas to include aspects of the other; but many of these efforts remain grounded in the strengths and weaknesses of their points of departure. For example, PGIS and PPGIS efforts typically retain the complexity and precision of a GIS, while participatory maps input into GIS often remain largely informal, socially focused, and locally relevant.

The growing movement toward integrating participatory methods and GIS highlights that fact that neither approach alone currently meets society's changing information needs (Weiner, Harris et al. 2002; Mapedza, Wright et al. 2003; Mbile, DeGrande et al. 2003; Robiglio, Mala et al. 2003; Kienberger, Steinbruch et al. 2005). Combining participatory mapping methods and GIS and finding and appropriate balance between the two requires a clear assessment of their relative value for different applications. This assessment is essential for mapping professionals, development planners, and community stakeholders alike. In spite of this awareness, there has been little critical analysis evaluating the effectiveness of current methods. This problem is not unique to mapping. As highlighted above, with the diversity of participation projects, their contexts, and their objectives, many participatory strategies have been applied in the absence of standard definitions and measures of success (Chess and Purcell 1999). Avoiding these indiscriminate applications of participatory tools, such as mapping, requires a clear framework for planning and evaluation.

This section seeks to overcome this problem by defining a theoretical framework based on three key "dimensions" shared by both participatory mapping and GIS. Figure 4.3 illustrates how the balance between 1) spatial and social objectives, 2) accuracy and precision in map displays, and 3) representativeness and comprehensiveness of spatial information collectively define the fundamental attributes of the two different mapping methods and their resulting maps. Each of the attributes on the left side of the three dimensions focus primarily on the issues surrounding *how* people live and are connected more strongly to participatory mapping, and those on the right side characterize *where* people live and are more strongly associated with GIS. The combination of GIS and participatory maps into participatory digital mapping at the center of the figure seeks balances these complementary attributes and create a dynamic equilibrium across all three dimensions.

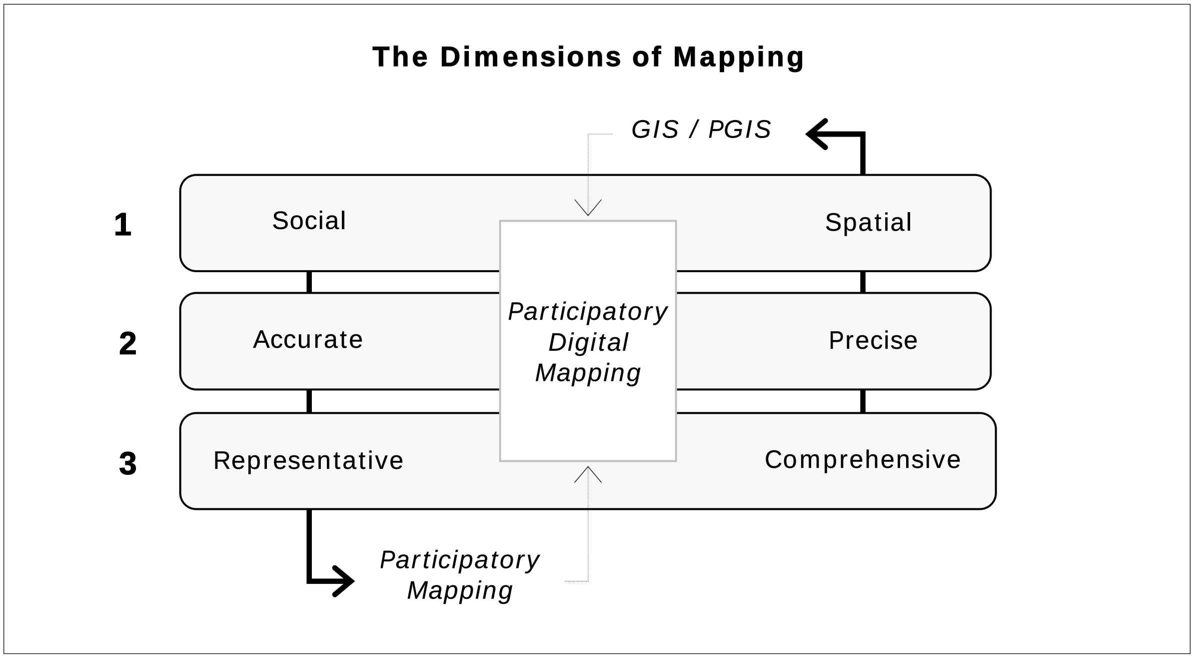

Figure 4.3 Diagram of three dimensions of paired attributes shared by GIS and participatory maps.

It is important to note here that the attributes along each dimension are not opposites nor are they exclusively associated with either GIS or participatory mapping. Instead these attributes illustrate the dominant values and objectives most commonly associated with each method. The interactions among them make up the unique characteristics of different maps and applications. Even within the domains of participatory mapping and GIS, there are varying emphases on these different characteristics. For example, certain types of participatory maps, based on transect walks or scale mapping, demand far more spatial precision than others, such as sketch maps. Similarly, some GIS maps focus more strongly on social accuracy than others. For example, a map could represent a village as a single abstract point on a GIS layer or as a collection of polygons showing the dynamic changes in village boundaries, depending on the availability of relevant social data. Taken as a whole, the characteristics of maps along all three dimensions are dynamically driven by their underlying mapping methods and how the selected data is elicited, integrated, and displayed.

In the case of the first dimension, the primary purpose of participatory maps is to elicit social information and organize it spatially; while GIS does the reverse, and arranges spatial information to shed light on social phenomena. As a result, social issues appear on the left side of the figure with a dark arrow toward participatory maps, while spatial issues appear on the right connected more strongly to GIS maps. This is not to say that GIS maps are not associated with social issues or vice versa, only that both GIS and participatory maps have different dominant characteristics and influences. The central position of digital participatory mapping in the figure illustrates the flexibility of this method in balancing multiple attributes and making project-relevant (instead of technology-driven) trade-offs. Collecting participatory information using traditional methods allows the focus of the dialogue to remain on social not spatial issues, while integrating the data into the GIS formalizes the spatial characteristics and maximizes the relevance and potential for integration with other related data. Striking this balance goes back to the differences between *how* and *where* people live and brings both types of information together.

The second dimension in Figure 4.3 is formed by the relationship between accuracy and precision. These attributes are central to traditional cartography, and as a result, the terms have almost become interchangeable; however, the differences between the two are important, if subtle. The term accuracy, as it is used here, is intended to describe the 'correctness' of information, while precision is a description of the 'resolution' of the representation. In all cases it is important for maps to be both accurate and precise (to their respective scales and resolutions). Placing GIS maps on the right-hand side of the figure connected more strongly to precision does not imply that these maps are inaccurate. In this case, most participatory mapping efforts focus on eliciting and recording accurate social information with varying degrees of spatial precision, while GIS maps demand a specific degree of spatial precision to illustrate social phenomena. Ideally, all maps would be both socially and spatially accurate and socially and spatially precise; however, this dimension is particularly important because decisions about the required levels of precision or accuracy often drive how spatial data is dealt with at the earliest phases of a project.

Figures 4.4 and 4.5 provide examples of these dimensions in practice. Figure 4.4 is a photo from a World Bank watershed project in Karnataka, India (2003) and Figure 4.5 is a graphic from a Map India conference presentation on urban sprawl, also in Karnataka (Sudhira et al. 2003). This pair of maps is simply included here to illustrate the basic attributes of participatory mapping and GIS along all three dimensions. The participatory map to the left captures the social features of watershed use and management within a village in Karnataka, while the map on the right describes the spatial distribution of all water bodies in the state.

Similarly, the map on the left accurately depicts local social interactions with water resources (based on village consensus); however, this map does not appear to be either socially precise or spatially accurate or precise (nor is this type of mapping typically intended to be). On the other hand, the GIS map to the right is developed to be both spatially precise and accurate to the selected scale, but the related social information is not readily available or interpretable in this representation.[26]

Figure 4.4 Participatory micro-watershed mapping in Karnataka, India. Map made by villagers using colored chalk on the ground (World Bank 2003).

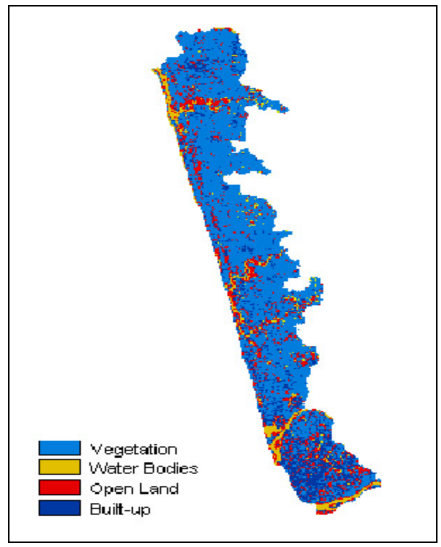

Figure 4.5 GIS map showing land covers and watersheds in Karnataka state (adapted from (Sudhira, Ramachandra et al. 2003).

This example brings us to the third and final dimension in Figure 4.3, which is based on the equilibrium between representativeness and comprehensiveness. As the maps above show, the variation along this dimension best captures the main visual differences between participatory maps and GIS maps. Participatory maps are largely subjective and focused on representing local perceptions and descriptive information. As a result, these maps are often small-scale and widely understood, like a sketch map one would use to give directions based on familiar routes and landmarks. On the other hand, GIS maps are designed to be objective depictions of reality and comprehensive sources of data, hence their visual complexity. The

[26] It is very important to note that the examples here are included solely for illustrative purposes. These maps were made by different groups for different applications, and the side-by-side placement of the two is not intended to suggest that they are in any way related or comparable to one another at a detailed level of evaluation.

fundamentally different aims and applications of participatory mapping and GIS have shaped their dominant attributes. In theory, however, a collection of all possible locally representative views of a place could be assembled into a single comprehensive map, and participatory digital maps could both maintain the representative 'frames' or views provided by participatory maps while taking advantage of the comprehensiveness provided by collective integration in GIS.

Overall, weighing the different attributes (deciding where a map should fall along each of these three dimensions) is akin to selecting the most appropriate projection for a cartographic map. The attributes of a map that best describe a location to fit the needs of both the map-maker(s) and the map-reader(s) should drive the methods and objectives used to create the map. Stated otherwise, the trade-offs between attributes should not be driven by the limitations of the individual mapping methods, but by the needs of the project to which they are being applied. For example, mapping is currently widely used for projects including border dispute resolution, resettlement planning, and community based natural resource management. Each of these applications requires different levels of social and spatial information, accuracy and precision, and representative and comprehensive data. Defining the balance of attributes in advance of a project's implementation requires careful evaluation of the primary project and stakeholder needs. This framework is a critical tool for understanding how different mapping methods and their combinations of methods could be both best applied and best evaluated within different scenarios along each dimension.

Participatory Digital Mapping

Given the complementary characteristics of participatory mapping and GIS described above, this chapter proposes to bridge the growing gap between spatial information and stakeholder communication in community development planning by uniting these two methodologies. The integration of the two into participatory digital mapping as illustrated in Figure 4.3 makes an important step toward developing a tool that addresses all three building blocks of participation across a variety of development and environment related projects. The combination of participatory methods and GIS is not new, but this research is unique in its collective focus on 1) the participatory inputs into GIS, 2) the direct users of GIS software, and 3) the indirect users of GIS output. The goal of this work is to develop a medium for participation that retains the elaborate information storage and consolidation capacities of GIS while simplifying and tailoring the graphic display to different audiences using elements and attributes of traditional mapping.

Because several different variations of the methods for 1) collecting data using adapted participatory mapping methods, 2) inputting the information into GIS, and 3) generating participatory maps from GIS are tested in the chapters to follow, the specific integration processes are each illustrated in detail in Chapters 5 and 6. However, it is important to emphasize here, that this research is fundamentally different from the other recent studies combining participatory mapping and GIS (Mapedza, Wright et al. 2003; Mbile, DeGrande et al. 2003; Robiglio, Mala et al. 2003; Kienberger, Steinbruch et al. 2005). In all of the recent cases where these two tools have been used jointly, the methods and results are very project-specific, and the process is primarily one-directional, focused on the large-scale input of participatory information into GIS. As a result there is considerable attention to cartographic details (e.g. scale, resolution, etc.), but there is little focus on making the approach widely applicable. Taken as a whole, all of these studies provide important and detailed applied examples, but they do not, individually or collectively, establish any holistic strategy for adapting the methods to projects with different needs and objectives.

The work here, in direct contrast to these projects, focuses primarily on testing the proposed combination of GIS and participatory mapping to generalize and implement the proposed approach across all three building blocks of participation and their linkages. The final chapters of this dissertation respectively address each of the three individual building blocks. Chapter 5 examines the strengths and weaknesses of the tool for improving information collection, dissemination, and integration. Chapter 6 expands on this work to evaluate the role of the new digital participatory maps in broader communication and information exchange. Finally Chapter 7 highlights opportunities for a variety of real-world applications of this tool for participatory decision making. Each of these three chapters ties directly into the diagrams of participation and the dimensions of mapping above, and presents a unique evaluation of the proposed digital mapping tool for facilitating participatory planning and decision making as a general practice.

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Chapter 5

UNDERSTANDING THE 'BACKYARD'

When one is to succeed in leading a person to a certain place, one must above all take care to find out where he is and start there. –Søren Kierkegaard

Throughout the last four chapters of this dissertation, the emphasis has been on the growing importance of participation in development planning and environmental decision making efforts worldwide. The first half of this work illustrates this movement for the specific case of transmission line siting, where public opposition to major infrastructures and the varied stakeholder perceptions of siting have become fundamental components of traditional engineering projects. As a result, the demand for participation to counter these negative impacts has also risen. This trend is not unique to siting projects alone. Chapter 4 highlights the diversity of participatory research and applications, and shifts the focus to mapping as a potential tool for facilitating effective participation. This chapter applies this new mapping approach to bring the discussion full-circle to the problem of not-in-my-backyard (NIMBY) based opposition that currently plagues a host of facilities siting projects.

Although NIMBY and an alphabet soup of related acronyms have become highly successful rallying cries for individuals and communities in recent years, strategies to overcome public opposition and related protests have been far less effective. These programs have focused primarily on developing new communication and compensation programs (Kunreuther and Easterling, 1996; Inhaber, 1998). Other efforts include improved information dissemination about project risks and benefits, attempts at engaging the public earlier in planning processes, and scheduling more relevant and frequent public meetings (TVA 2000). These approaches have shown some success, and begun to transform the conventional "decide-announce-defend" strategies into the "avoid-anticipate-communicate" approach described in Chapter 3; however, many efforts continue to focus on overcoming opposition instead of facilitating participation. From this perspective, participation is still a vehicle for project implementation rather than a means of addressing local concerns and building public consensus. As a result of these primarily short-term goals and project-specific objectives of most citizen participation processes in siting projects, NIMBY remains a widespread problem.

This work takes a different approach to the problem, and centers on facilitating participation instead of managing opposition. As a result, the study here looks indirectly at the issues of NIMBY and public opposition, by focusing primarily on what is important to individuals about their communities. We argue that effectively addressing the problem of NIMBY and accounting for significant heterogeneity of public opinion requires, first and foremost, a clear definition of the 'backyard.' As a result, this chapter presents a unique study using digital participatory mapping techniques to capture the dynamics of individuals' relationships with their surroundings that are central to the concept of the backyard.

Using a combination of surveys and interviews, this study elicits Pittsburgh community residents' priorities, perceptions, and preferences for different neighborhood attributes. The next section provides a brief discussion of NIMBY and public opposition to place this work in context. Section 3 then describes the details of the study design as a whole, and outlines the overarching objectives, methods, participants, and procedures. Sections 4, 5, and 6 respectively present the specific methods and results associated with the three major parts of the study, a written survey, mapping interview, and evaluation interview respectively. Finally, Section 7 concludes with a discussion of the implications of the major results and findings for informing the NIMBY problem from the perspective of both planners and the public. This section also more generally evaluates the process of digital participatory mapping, tested across the two interview components of the study, for its relationship to the dimensions of mapping outlined in Chapter 4 and it effectiveness for facilitating the different building blocks of participation. Overall, the local perspectives presented here balance the high-level characterization of public opposition developed in Chapters 2 and 3.

Confronting NIMBY

Both top-down and bottom-up development planning projects have increasingly revolved around communities and neighborhoods. In the face of NIMBY-style opposition to a variety of development efforts, planners and stakeholders alike now require extensive information about both the objective and subjective characteristics of potential project-affected areas and their residents. Spatial information is essential to understanding these local priorities, perceptions, and preferences and to making socially-acceptable decisions; however, as stated above, most strategies to addressing NIMBY problems have been advanced in the absence of a clear geographic characterization of the 'backyard.' Additionally, almost all recent strategies proposed to confront and mitigate public opposition fall relatively low on Arnstein's ladder (1969), where in most cases, these efforts are still focused on persuasion and placation. More advanced strategies and compensation programs, such as Dutch auctions, that give communities some basic decision-making power to bid on, accept, or veto a proposed facility, have been tested in recent years, but it is rare that communities are deeply involved in planning and decision making (Inhaber, 1998).

Kunreuther's and Fitzgerald's test of the"The Facility Siting Credo" (1993) moves a step beyond these efforts, and promotes partnership with communities based on the premise that the status-quo is unacceptable, and voluntary siting is an option. This credo advances the idea that, "representatives of all affected groups should be invited to participate in and be assisted at each stage of the siting process." This is a high ideal for siting processes, and one which is becoming increasingly necessary to implement many projects facing NIMBY protests; however, even well-intentioned participatory processes could fail if a potential site and its surrounding neighborhoods are poorly characterized in advance of a participatory process. For example, planners' definitions of project-affected individuals and areas could vary significantly from the perceptions of local residents. Typically, only the individual properties directly adjacent to a transmission line right-of-way are defined as affected areas and targeted for direct communication and compensation. On the other hand, all individuals within sight of the proposed power lines could consider themselves 'affected' by the proposal to an extent that would justify their involvement and/or opposition.

As discussed in Chapter 3, there are multiple related reasons for public opposition (Vierima, 2001), and a large part of NIMBY-based opposition is based on arguments about project equity. Individuals who feel that they are being forced to bear a disproportionate distribution of costs of a project for the larger benefit of society have used these concerns as a basis for largely successful protests (Vierima 2001). This attitude has even crept in to undermine generally positively perceived facilities, such as wind turbines and wind farms (Strachan, 2004). Furthermore, equity issues have become strongly coupled with environmental justice issues, where facilities sited based on competitive or voluntary siting processes are more likely to be located in low-income or minority communities, who are more likely and willing to submit low-bids or accept lower compensation packages (Fischer 2000).

As a result, implementation of The Facility Siting Credo requires a complementary strategy for developing a baseline assessment of local issues, *prior* to engaging participation around specific project issues. Early and voluntary participation efforts are typically avoided by project planners and decision makers because many details of the project have yet to be resolved and any major uncertainties could fuel opposition. The process proposed and tested in this chapter focuses on eliciting information about backyards, independent from specific development plans and projects. This approach provides an early opportunity along a project timeline to involve citizens and work with residents to elicit important site information, without making the focus of participation entirely about a project, but instead about identifying and meeting the needs of the affected community and its residents.

Overall, current efforts to better involve the public and address local concerns have done little in the way of addressing local priorities and development agendas. The rising incidence of opposition, in spite of the increased attention to participation, highlights this gap and the parallel need for clearly characterizing what is important to local stakeholders. This work focuses on the following questions: *What attributes are important to individuals about their own neighborhoods and communities? How does this vary among residents of the same communities? What are the perceived boundaries of 'community'? Is mapping an effective media for information exchange about neighborhood issues? and Finally, what are the implications of these results for facilities siting specifically and local development planning in general?* In order to answer these questions, these studies use the proposed digital participatory mapping process to elicit information about individuals' neighborhoods and generate information about their own and other communities. The specific methods and results associated with each part of the study are described individually below.

Study Design

As stated above, this study is divided into three parts: a written survey, an individual participatory mapping interview, and a follow-on evaluation interview. The specific protocols for the three parts of the study are included in Appendices D, E, and F respectively, and the next sections individually describe the methods and findings associated with each part. This section provides a brief overview of the participants and procedures associated with the study.

Participants for this study were recruited from three Pittsburgh area community organizations representing a diverse set of neighborhoods. Respondents came from three major communities, The Hill District, a low-income primarily African-American neighborhood, Squirrel Hill, an adjacent mid- to high-income urban community with an ethnically diverse distribution of residents, and the Fox Chapel area, a high-income, predominantly white, suburban area across a river from Squirrel Hill and the Hill District at the north of the Pittsburgh region. Equal numbers of respondents were recruited from all three communities and donations were made to their respective organizations for their participation in the study. In addition to these participants, a random sample of participants from the Pittsburgh region was selected to complete only the written survey as part of several larger group survey sessions. All three parts of the study were completed during the period from June to August 2001, and all participants were compensated for their time.[27]

A total of 69 participants completed the 15-minute written survey, 32 participants from the subset of selected community groups then completed individual 1 ½- to 2-hour mapping interviews, and finally 25 of those map-makers participated in a final 1-hour individual follow-up interview. Across all survey participants, most participants were between 40 and 60 years old, with an average age of 47 years, and about 60% of all respondents were female. Subjects' educations ranged from high school degrees to graduate degrees. Approximately 57% came from zip-codes with median incomes below $30,000/year, but on average respondents' incomes were between $50,000 and $100,000/year. The majority of respondents owned their own homes, and had lived in Pittsburgh for an average of 18.3 years. Overall, the sub-set of participants from the survey sample who also completed interviews had similar demographic characteristics, and included almost equal numbers of men and women

Participants in all three parts of the study were surveyed and interviewed on a one-on-one basis, and provided with all materials required to complete the study. Interview subjects each were asked to fill out the survey at the beginning of their first interview, and follow-on interviews were scheduled a minimum of two to three weeks after the initial interview at the convenience of the participants. The time between the interviews was used to develop variations and versions of each respondent's elicited participatory map from the first interviews for use in the second evaluation interview.

Overall, the objectives of the study as a whole were 1) to elicit individuals' priorities for their communities, 2) to gather their perceptions of their own and other adjacent communities,

[27] Because all data recording, interview transcription, general documentation, and integration of the participatory maps into GIS, was done by Vajjhala as the sole interviewer, this work does not include any discussion of issues related to inter-code reliability and standards for transcription that would be necessary for any larger implementation of these methods.

3) to assess their ability to create and interpret different types of maps, and 4) to evaluate their preferences for different maps and neighborhoods. As part of this study this chapter also presents the detailed participatory digital mapping methods for collecting local definitions and representations of 'community', integrating this data into GIS, and then generating participatory information from the GIS to evaluate the potential for communication and decision making about a variety of community-level projects.

Neighborhood Survey

As described above, the first component of this study was a brief written survey consisting of three primary tasks (see Appendix D for full survey protocol). The first section of the survey included demographic and general questions about individuals' mobility patterns, habits, and preferences as they relate to common neighborhood destinations, including places of employment, stores and restaurants, and public resources. The next section of the survey included a series of ranking and rating questions about individuals own communities. Based on a review of neighborhood and community planning literature and a series of survey pre-tests, these sections were structured around the following 11 neighborhood characteristics:

1. Access to amenities (parks, playgrounds, entertainment, etc.)
2. Community organizations (church, YMCA, daycare, e
3. Community stability (long-term residence)
4. Convenience of shopping (grocery, drugstore, general retail, etc,)
5. Living close to work (local job opportunities)
6. Neighborhood appearance (maintenance of properties)
7. Neighborhood interaction/ sense of "community"
8. Neighborhood safety
9. Quality of local schools
10. Quality of public services (mail, utilities, sanitation, etc.)
11. Ties to surrounding neighborhoods and the region

Participants were asked to rank order the neighborhood attributes above from most important (1) to least important (11) based on their own priorities, and then subjects were asked to rate (on a five-point scale) the quality of each attribute within their own neighborhoods. The final section used these same attributes to elicit respondents' perception of four other widely-recognized Pittsburgh neighborhoods. As with their own communities, participants rated their perceptions and opinions of these neighborhoods along the same 11-attributes scale from

1(poor) to 5 (excellent). Results from this survey provide a baseline assessment of individuals' priorities, preferences, and their perceptions of their own and other neighborhoods.

Taken as a whole, the results of the survey support common beliefs about what people value in their neighborhoods. The top three attributes across all respondents based on individuals' ranking are 1) neighborhood safety, 2) quality of local schools, and 3) convenience of shopping. These attributes were consistently most important across all respondent groups, and variations in priorities across different groups were primarily reflected in the attributes ranked in the middle of the rankings. For example, living close to work was ranked slightly higher by respondents from urban zip-codes than suburban zip-codes, but none of the comparisons of ranking across respondent groups revealed significant differences. This result supports the current understanding of NIMBY concerns, where one of the primary reasons for public opposition to transmission lines is based on health and safety fears related to electro-magnetic fields. Eliciting local priorities provides a basis for anticipating specific concerns related to a facility that could differ from typical concerns, like health and safety and those described in detail in Chapter 3. Other results from the survey show specific variations in community residents' perceptions that also support the need for clearly capturing the heterogeneity within communities and shared backyards.

Respondents average ratings of their own neighborhoods ranged from 1.7 to 5.0 with an average rating of 3.49 across all respondents. Each respondent's ranking was also used as the basis for a linear weighting function to create a satisfaction score from each individual's priorities (ranks) and perceptions (ratings). On the whole, respondents' satisfaction scores were highly correlated with their average ratings, indicating that the most important attributes (highest rankings) were not associated with extremely high or low ratings. Both the average and weighted-average ratings were used to test for variations based on respondents demographics. Like the regression analysis in Chapter 3, which used respondents' education and housing values to predict a general likelihood of opposition, we hypothesize similarly that respondents' ratings of their own communities could be significantly affected by their incomes, educations, and how long they have lived in a community.

Based on the differences between *where* people live and *how* people live discussed in Chapter 4, individuals with higher-incomes living in low-income areas could have access to a variety of amenities and services that are unavailable to lower-income people within the same area. For example, owning a car could change the availability and accessibility of a variety of neighborhood amenities. In contrast, lower-income individuals living in higher-income areas could be limited in their access to the relative advantages of the neighborhood, and could be disproportionately exposed to the negative aspects of the community. Similarly, individuals who have lived in a community longer could have higher neighborhood ratings and satisfaction associated with greater familiarity and attachment. To test these hypothesis and other post-hoc comparisons, we evaluated respondents' average and weighted-average ratings by various demographic variables using a series of ANOVA and step-wise regression analyses.

Overall, respondents' average ratings and satisfaction scores were not significantly influenced by any demographic characteristic except income, where respondents with higher incomes had significantly higher average ratings than those with lower incomes. Given the relationship between respondents' own incomes and their ratings of the own communities, we hypothesize that respondent's incomes could also impact their perceptions of other communities. Interestingly, the ratings of the other selected communities in the final section of the survey were not significantly influenced by respondents' own incomes; however, there were significant differences based on the median income of respondents own zip-code of residence. Figure 5.1 illustrates these results, and includes the results of two-sample t-tests comparing the ratings of each neighborhood, as shown on figure. The graph shows that individuals from higher-income zip-codes think that lower income neighborhoods are worse than the residents of those zip-codes, and conversely that the residents of lower-income zip-code think that higher-income zip-codes are better than they actually are.

This result reveals a general anchoring and adjustment effect where individuals inflate or deflate their ratings of other neighborhoods depending on their own neighborhoods (Kahnemann, Slovic, et. al., 1982), and supports the idea that where people live significantly influences their perceptions of their surroundings. Overall, the results of this survey provide an important baseline assessment of individuals' priorities, preferences and perceptions for their communities, and highlight key variations that could 1) influence their perceptions of major facilities 2) drive their priorities in a participation process, and 3) form the specific basis for any opposition. The next section of this chapter moves from this survey to the mapping interview, and presents an alternative graphic method of capturing residents' relationships with their communities and neighborhoods.

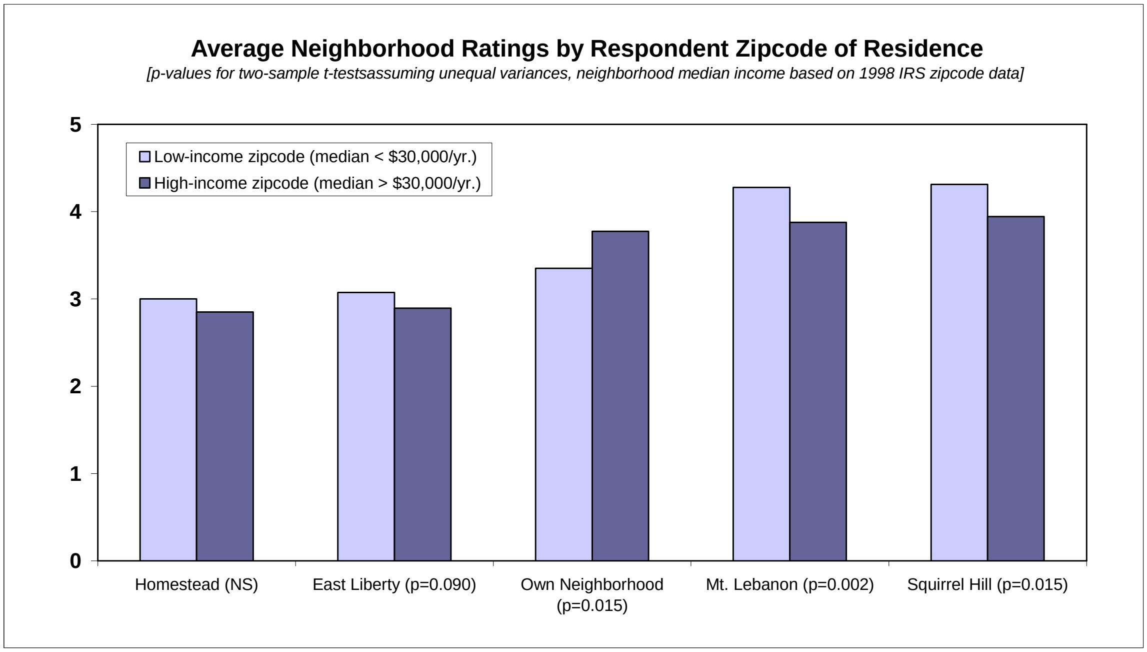


Figure 5.1 Respondent Ratings of Neighborhoods based on Median Income of Own Zip Code.

Mapping Interview

As a follow-up to the survey, mapping interviews were conducted with 32 individuals from the Hill District, Squirrel Hill, and Fox Chapel. All mapping interviews in this study were done on a one-on-one basis, and consisted of a semi-structured questionnaire designed to elicit a participatory map (see Appendix E for complete interview protocol). A total of 32 maps were collected across the course of the interviews, and each map was hand-drawn using *only symbols and no text* in response to the sequence of interview questions. Respondents were first provided with an 18" x 24" piece of paper (to which they could attach additional sheets as needed) and colored markers, and asked to think about their range of travel in a regular week to scale their maps. They then began by drawing a symbol for their home at the center of the page, and continued by adding other frequent routes and destinations.

All symbols were uniquely selected by each map-maker to best represent and communicate their personal associations with specific community attributes. Once respondents selected symbols, they were asked to use that symbol consistently for similar types of places. For example, many map-makers used a shopping cart to represent all grocery stores. Additionally, symbols were not limited to physical places, but also included issues, concerns, and benefits of different neighborhoods. For example, various participants' maps included symbols for attributes, such as diversity and ethnic sub-communities, crime, rising prices of public transportation, abandoned housing, accessibility and 'walkability.' Participants also included landmarks, places of special significance, and positive and negative spaces on their maps. Using this format, individuals added information to their maps to describe their activities, their interests, and their mobility.

Figure 5.2 is an example of the type of participatory sketch map generated using this process. The colors on the maps are associated with different categories of questions, where blue indicates places of special significance, orange indicates descriptive landmarks or locally important markers, red defines any negative places or areas, and green marks positive spaces.

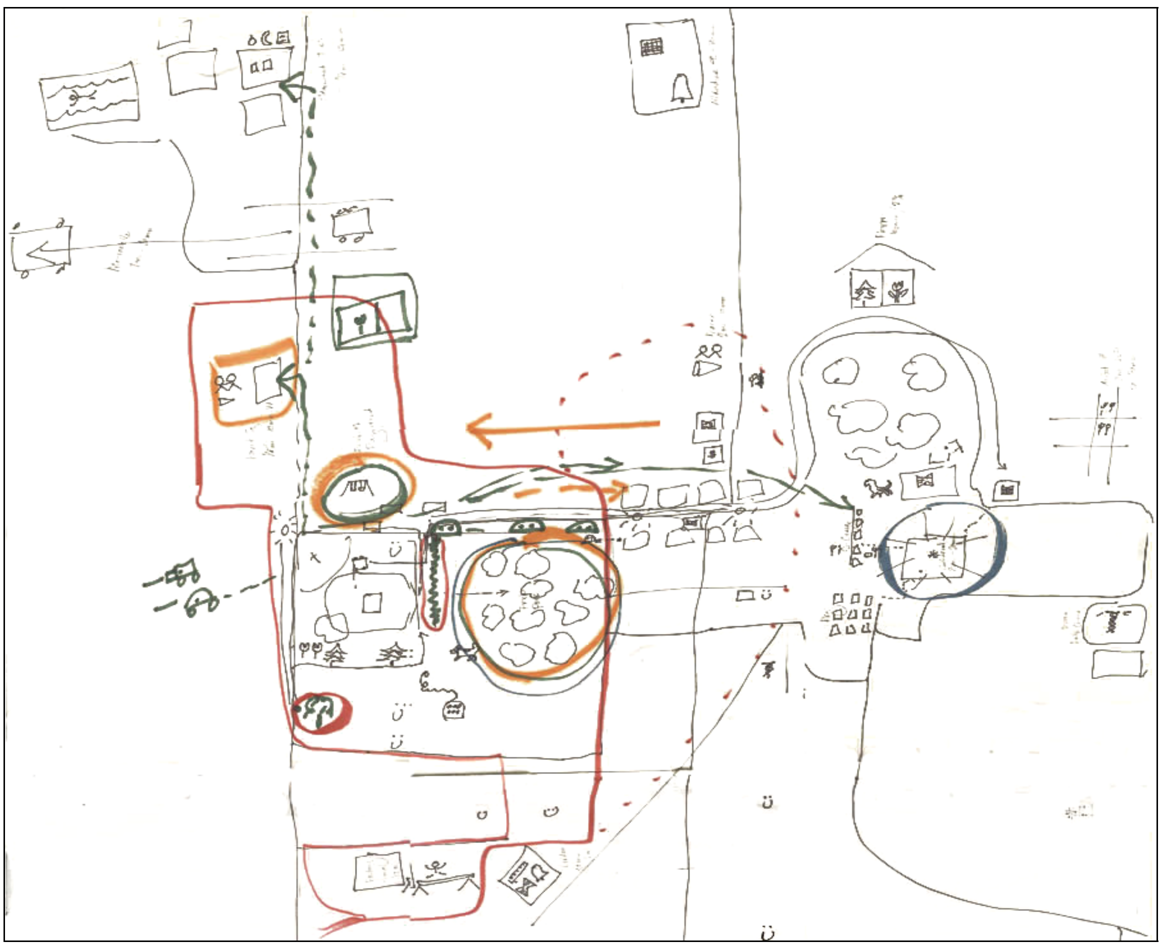
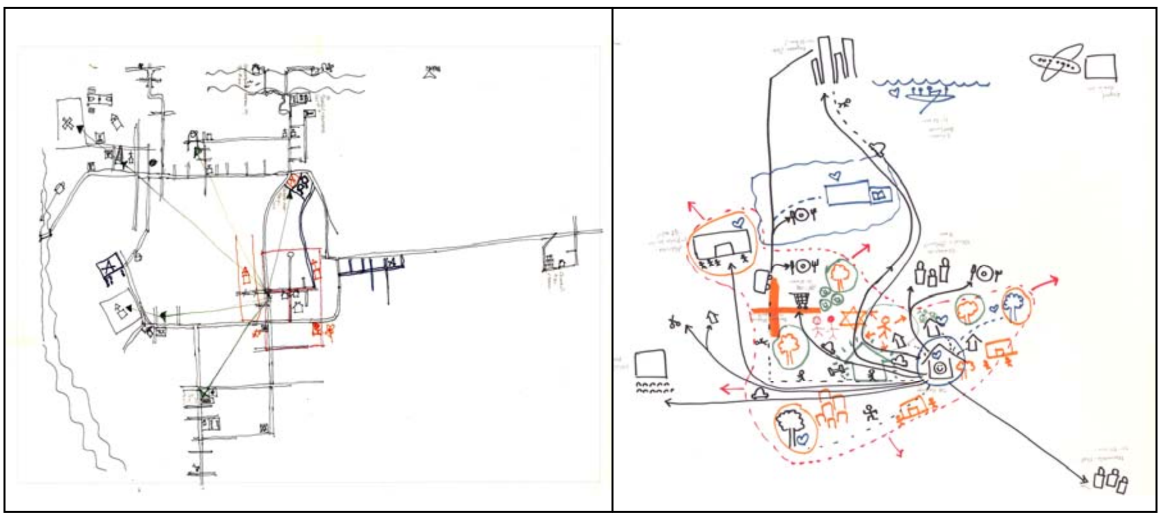


Figure 5.2 Part of a 48" x 60" map drawn by a female resident of a mid- to high-income urban area.

As a final step in the mapping interview, participants were asked very generally to draw a red line around all of the places that they felt were part of their community. Figures 5.3 and

5.4 below, illustrate how even neighbors can have entirely different perceptions of and priorities for their shared community. The extent of the map-maker's community in Figure 5.3 includes only the 2-blocks in all directions around his home. On the other hand, his neighbor's community in Figure 5.4 includes most of the places on her map. This is a central result that speaks directly to the concept of 'backyard'. Not only does the geographic definition of community vary among community members, these perceived boundaries do not correspond with typical, artificial boundaries such as zip codes, census tracts, or other superimposed divisions. Given that individuals' definitions of community and stakeholders' needs for information vary so drastically, communicating with a broad audience requires an acknowledgement of their diverse frames of reference (or backyards) within any dialogue in order to make new development decisions locally-relevant, understood, and accepted.



Figures 5.3 and 5.4 Sketch maps drawn by a 74-year old man (left) and his 19-year old female neighbor.

On the whole, all 32 participants who completed the interview were able to develop highly detailed, descriptive maps of their communities based on their own unique symbols and scales. Each map is a socially accurate and representative picture of each map-maker's neighborhood, but in all cases, the maps were spatially-distorted, imprecise to varying degrees, and of limited comprehensiveness along the dimensions of mapping outlined in Chapter 4. Also just as respondents' definitions and boundaries for their communities varied significantly, their approaches to map-making and way-finding were also significantly different from one another. For example, women relied on personal landmarks for orientation than men, who referenced major physical landmarks (rivers, valleys, hills, etc.).[28] These variations correspond with the typical distortions and biases associated with cognitive maps (see Tolman, 1913; Trowbridge, 1945; Tversky, 1992; and Golldege, 1999 for examples of common biases and heuristics). Respondents specific map-making techniques and preferences are discussed further in the next section in the context of their responses to the evaluation interview.

Although many participants initially expressed reservations about their drawing skills and way-finding abilities, after completing the interview all subjects expressed high levels of satisfaction with both the process and their final maps. The maps from this interview support both the process of participatory map elicitation, and the relevance of the method for developing dynamic definitions of local backyards. As stated above, this approach could also serve as a tool for characterizing the extent of 'affected' populations related to siting projects. This approach allows for evaluations based on concrete local perceptions instead of arbitrary definitions, such as radii around selected site or adjacencies to rights-of-way. Understanding which residents and groups believe they are affected by a project and the boundaries of their respective backyards forms the basis for structuring locally-tailored communication, compensation, and voluntary siting processes. The final component of this study describes several types of participatory digital maps developed from each respondent's participatory map to evaluate the effectiveness of this approach for communication and decision making related to respondents own neighborhoods and other unfamiliar communities.

Evaluation Interview

Of the 32 subjects that drew maps, 25 completed a second interview to evaluate their comprehension of different symbols and maps and their preferences for two different hypothetical neighborhoods, Neighborhood A, a version of a Pittsburgh suburban neighborhood, and Neighborhood B, an adaptation of a Pittsburgh urban neighborhood. This interview was structured in three major sub-sections (see Appendix F for full interview protocol). The first section included a symbol-comprehension test, the next section evaluated of subjects understanding of and preferences for different versions of their own maps, and the final section elicited participants comprehension and preferences for Neighborhoods A and B

[28] Because respondents used multiple way-finding and orientation techniques and the sample size is very small when divided into sub-groups by gender or education, two-sample t-tests of the different approaches do not yield any significant differences; however, the general differences are similar to those biases in literature and experiments in cognitive mapping

relative to their own neighborhoods. The results of these evaluations are described below, and discussed relative to the map-making methods used in the first interview.

Symbol Comprehension Test

The results of the symbol test in the first part of the interview overwhelmingly support individuals' understandings of both their own and other map-makers' symbols. Respondents were given a sheet with approximately 30 randomly selected symbols, including combinations of their own unique symbols and other respondents' symbols, and asked to fill in the blanks and identify the type of place represented by each symbol (see Appendix F for a completed symbol sheet). On average, respondents correctly identified the types of places each symbol was intended to represent approximately 87% of the time. Participants' responses also revealed interesting differences in the types of places they associated with different symbols. For example, several map-makers from low-income urban areas used a gun and needle symbols to represent crime and drugs, respectively. In a few cases where these symbols were evaluated by high-income neighborhood residents, they most frequently identified the gun as representing a shooting range or hunting area and the needle as a symbol for a clinic or hospital. Similarly, symbols for tennis courts and golf courses were often left unidentified by low-income neighborhood participants. These differences are important in that they reveal local specificity in the interpretation of different symbols.[29] This result has interesting implications for how maps are understood and interpreted by different map-readers in general. The final mapping study in Chapter 6 also confirms and builds on this result.

Participatory Digital Map Evaluations

This second section of the evaluation interview was based on several versions of participants own maps from their first interviews. These map-versions were created using a combination of GIS software and other graphics applications to test several different input methods and evaluate various examples of the types of participatory digital maps that could be generated using participatory mapping and GIS integration. Overall, participants' original maps were used to create several different types of maps, a personal graphic map, two distance-scale

[29] Because there were several hundred symbols generated in the course of all mapping interviews, there were not sufficient evaluations of each symbol by different respondents to determine if these errors represented a widespread and systematic bias, where respondents from the same communities have common associations with different symbols than certain others.

maps, and up to four time-scaled maps. Each of these types of maps is described in detail and illustrated below for selected map-makers representing different neighborhoods.

This first map developed for evaluation was a graphic personal map. This version was the most similar to individuals' original participatory maps, and is simply a graphic re-creation of the original maps with standardized symbols at a proportionate scale. The goal of this map was simply to standardize each original map, and reduce any artistic or graphic concerns of the map-maker. As the figures in Section 4 above illustrate, respondents' maps were often clear, but rough; therefore, all symbols developed by each map-maker were re-drawn, collected in a new symbol library, and loaded into GIS. Next an 8.5" x 11" graphic version of the original map with all of the original destinations and routes was created using the new standardized symbols (see Figures 5.6 and 5.8 for examples of two map-makers' personal graphic maps).

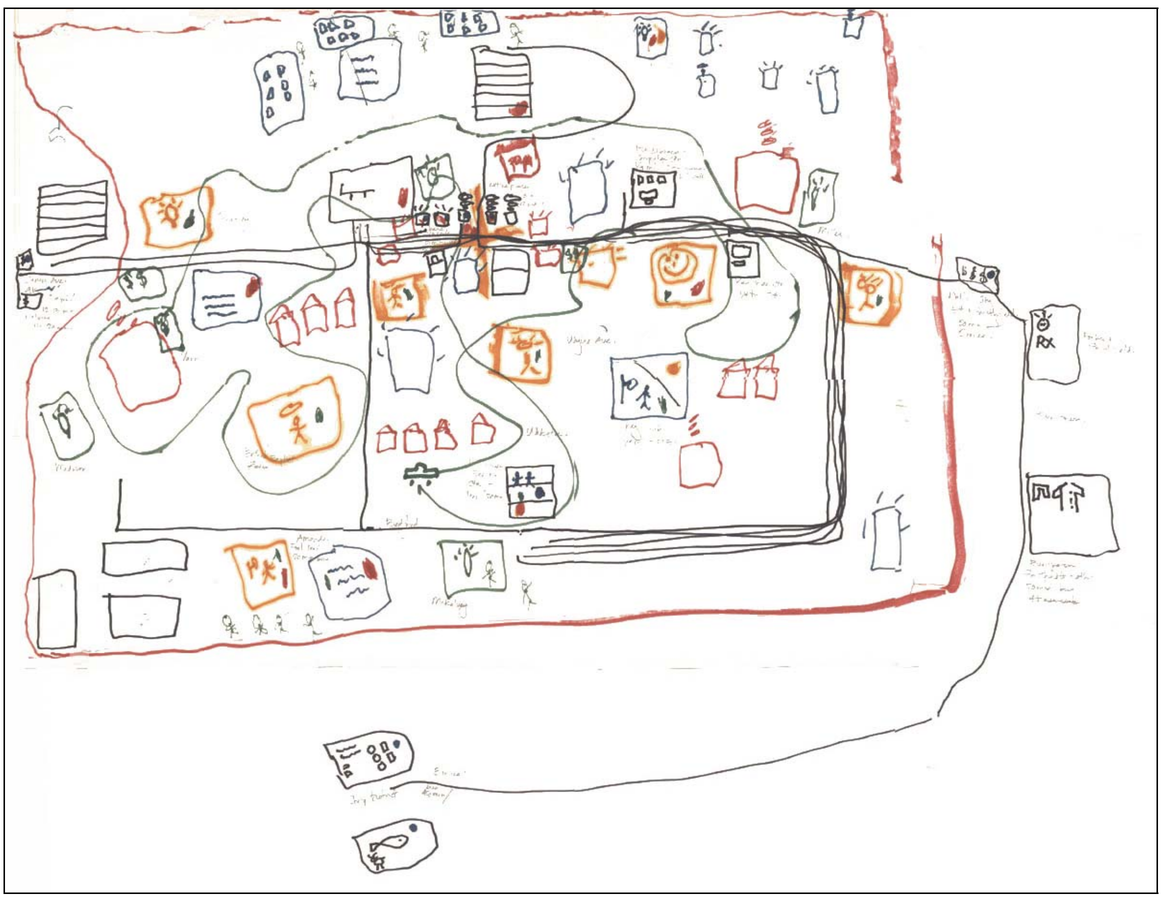


Figure 5.5 Sketch map by a 68-year old male resident of a low-income urban neighborhood.

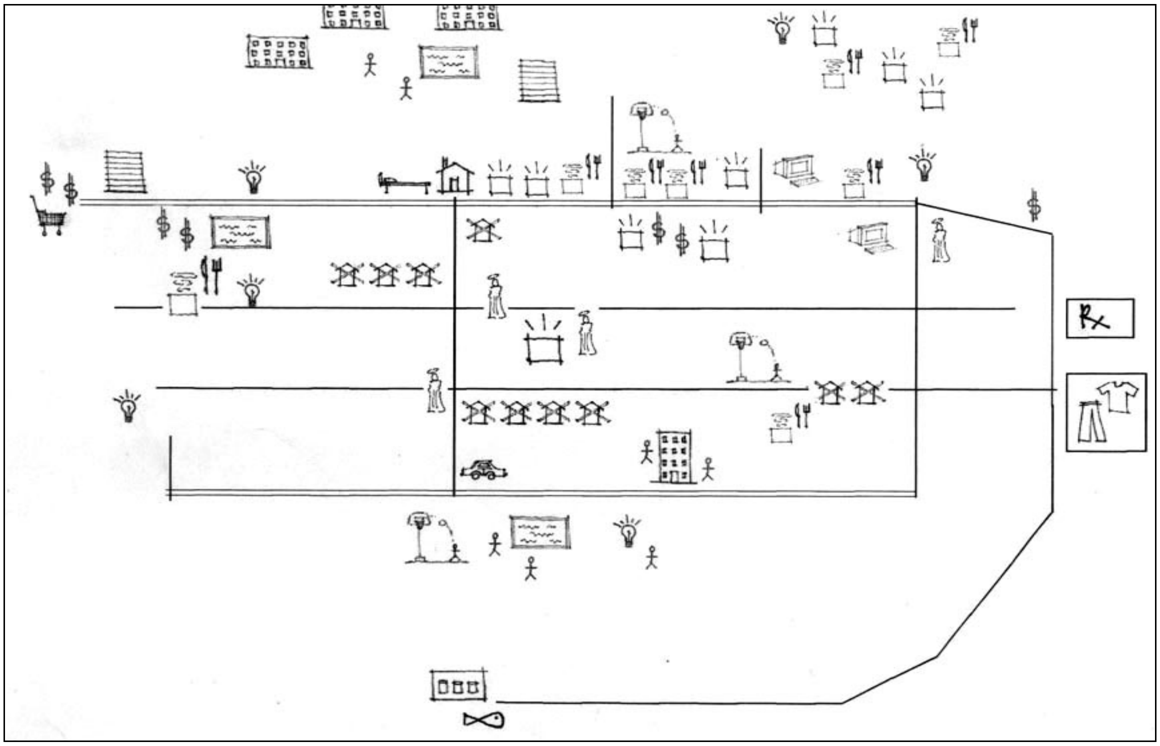


Figure 5.6 A graphic of the sketch map in Figure 5.5 with standardized symbols at their original 'scale.'

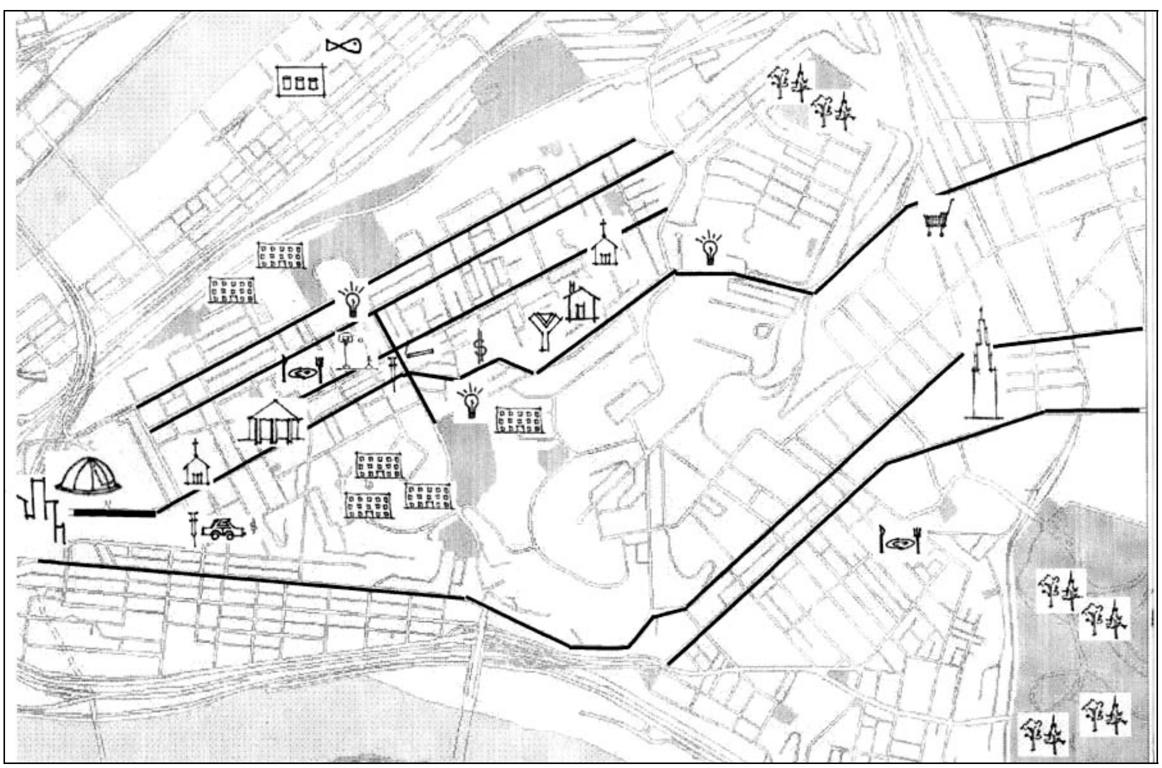


Figure 5.7 A scaled GIS map version of Figure 5.5 with standardized symbols at their actual locations.

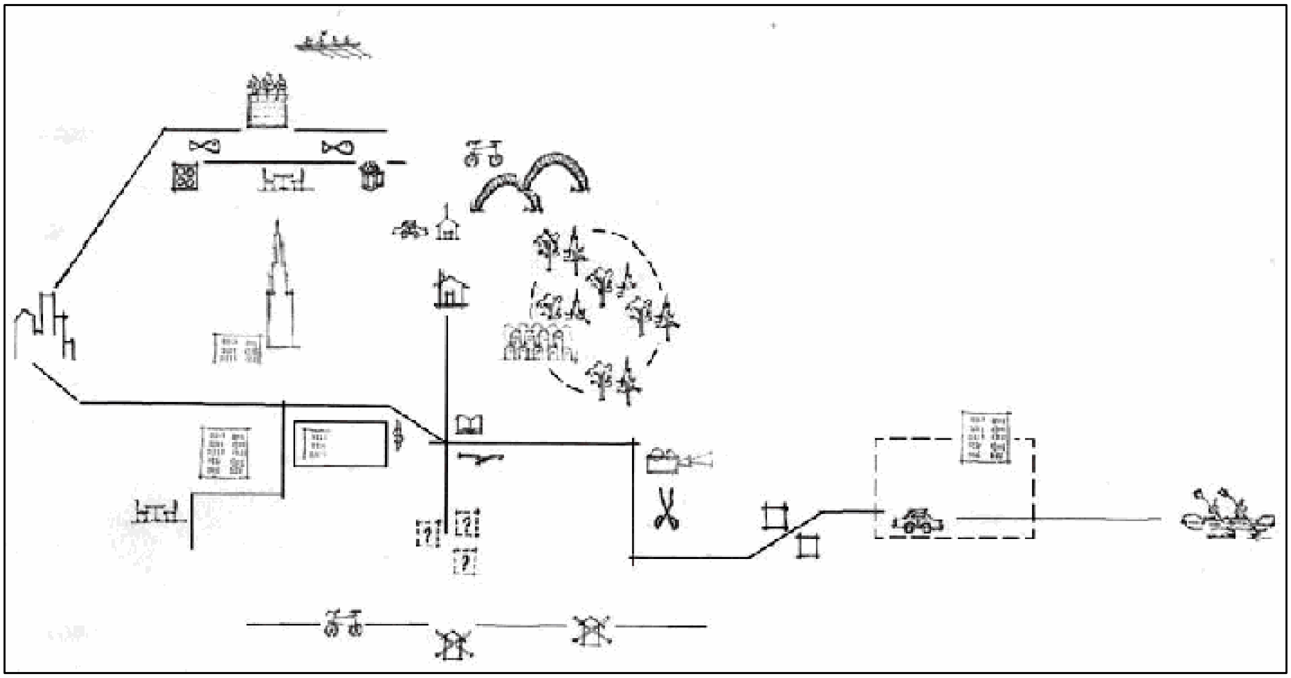


Figure 5.8 A graphic standardized version of a 58 year-old woman's personal scale map.

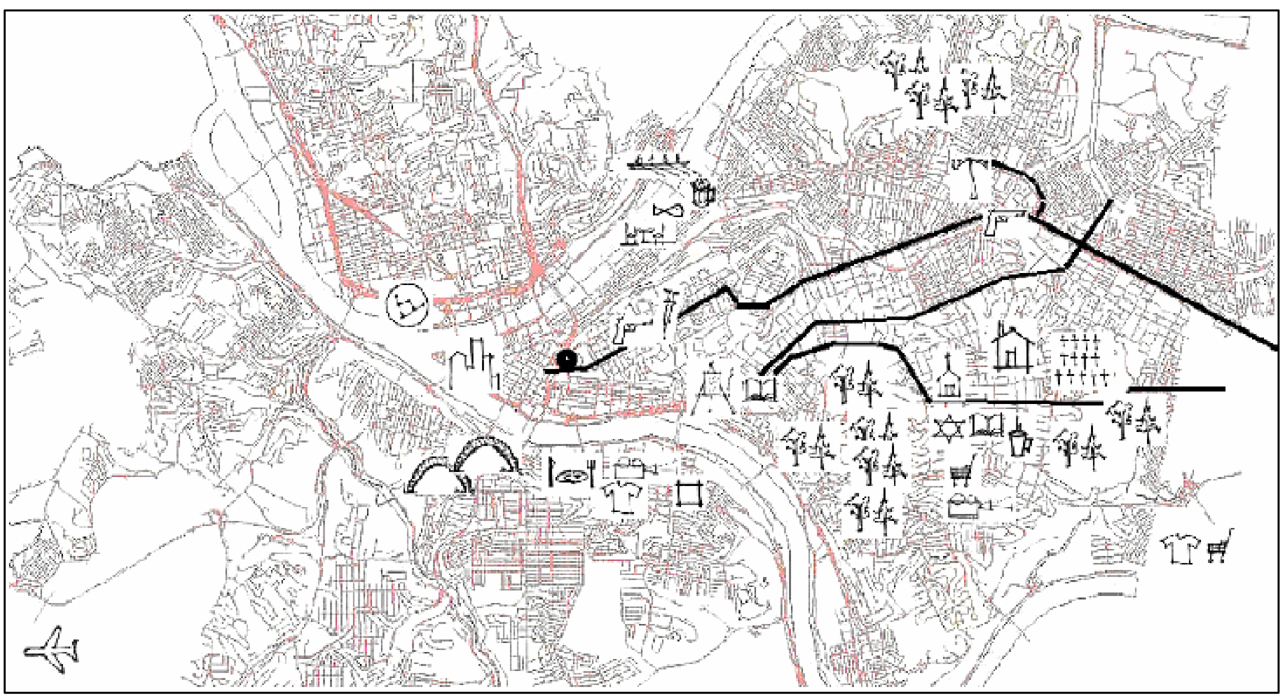


Figure 5.9 A GIS version of the personal participatory map in Figure 5.8 at 1"= 2 miles (not to scale)

The next set of maps was formed based on both the original participatory map and the standardized graphic map. These maps were developed by geo-referencing points on the original cognitive maps to correspond with the actual locations of the real place. Participatory maps were input into GIS using a process of direct address-matching and extrapolation to create as spatially accurate a representation of the participant's map as possible (see Figures 5.7 and 5.9). Point markers were added on new layers for each subject at the locations defined on the original maps. Picture icons from the symbol library were then individually selected to replace the default markers on each layer. Based on this process of graphic data entry, GIS versions of the original participatory maps were generated at two different scales, local (1"= ½ mile) and regional (1"= 2 mile). The figures below illustrate this transformation from one participant's elicited participatory map (Fig. 5.5) to his standardized graphic map (Fig. 5.6) to a local scale GIS map (Fig. 5.7). Figures 5.8 and 5.9 show another participant's graphic map and converted regional scale representation.

The final type of participatory digital map that was developed as part of this study were a series of time-maps. The process of creating the distance maps described above transforms a conventional GIS to generate maps based on a variety of user-defined symbols. However, the comprehensibility of participatory maps comes not only from locally-relevant symbols, but also the cognitive simplification of map scales (Tversky 1981). Throughout the process of creating their maps, participants relied on both time and distance to orient themselves, scale their maps, and locate important places relative to one another. These multi-dimensional relationships between places provide a fundamental "sense of place" and allow individuals to make inferences about the "livability" of a community. For example, a place that is only be one mile away could take 25 minutes to reach by car if it is across a major river; therefore, it is important for any combination of participatory mapping and GIS to capture this aspect of scale and represent both distance and accessibility.

In order to also address the issue of scale in this study, all participants were asked during the first interview to describe the travel times and distances to several places on their maps by different modes of transportation. Then time-maps were developed based on these elicited travel times for up to four modes of transportation (car, bicycle, public bus, and walking) as were relevant to individual participants. Each time-map (see Figure 5.10) is organized with the map-maker's home at the center and all other map symbols positioned along concentric rings of increasing numbers of minutes. All map symbols are located in the same cardinal-direction from the map-maker's home as on the standard distance maps. In conjunction with the typical distance scale maps, these maps illustrate both proximity and accessibility of different locations. All of these personal, distance, and time-scale maps and were evaluated by respondents in during this evaluation interview.

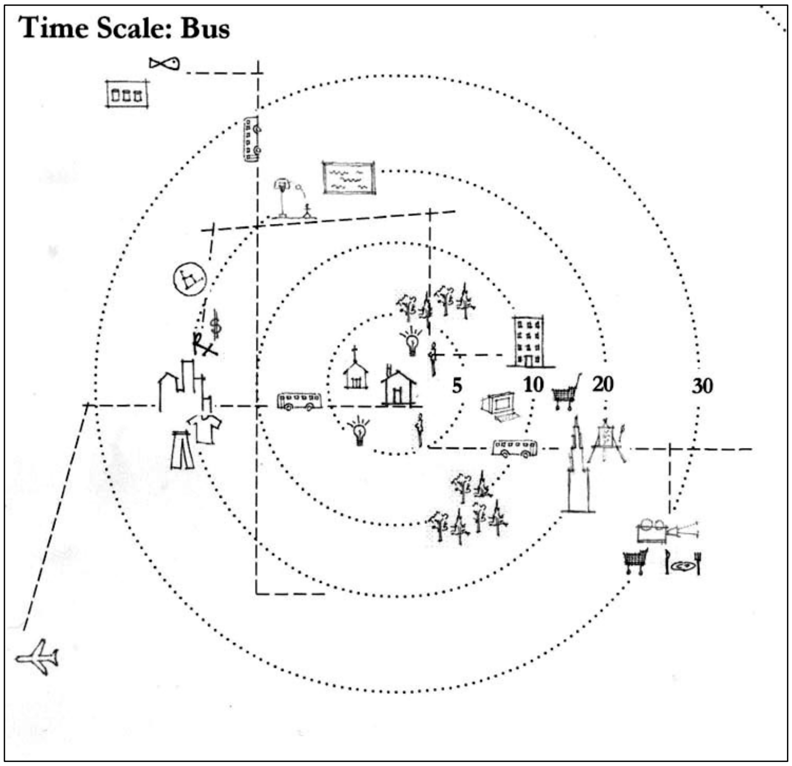


Figure 5.10 An illustration of a time-map developed from elicited information about travel times from home. Versions of these maps could potentially be created in GIS using path and network analysis data.

Respondents were asked a series of comprehension questions about each type of map, and asked to find various locations and estimate their relative distances and times from other selected location. On the whole, all respondents were highly proficient at using all types of maps, without any significant differences by specific demographic groups. Surprisingly, even those participants with limited high school education and trade school graduates had few problems with the comprehension evaluations. As part of this section respondents were also asked to select the type of map(s) that they would use to help describe Pittsburgh to a stranger, to help someone moving into the city, to talk over with another Pittsburgher, or to give directions in general.

The majority of respondents expressed preferences for either or both of the distance maps in all four cases, but over 1/3 of all respondents also said they would most prefer the time-maps to describe the region and convey a sense of place to someone moving into the area. During the first interview, participants were asked upon completing their maps and identifying the relative distances and times of several places on their maps, if they preferred thinking about scalar information in miles or in minutes. Overall, 35% of respondents said that they preferred distances in miles, 52% preferred minutes, and 13% said that both were equal as measures of scale. Several respondents also said that the time maps were only useful for talking with people who were very familiar with the area, because of the variability in travel times at different times of day. As one respondent put it, these maps did not provide a "reliable metronome" to understand a place.

Hypothetical Neighborhood Preferences

To conclude this final interview, respondents were asked to view two distance-scale maps and four time-maps for each of two hypothetical neighborhoods, Neighborhoods A and B, described briefly above. The order in which respondents viewed the neighborhoods was randomized, and respondents were asked a few brief comprehension questions about each neighborhood to allow them to familiarize themselves with the area. Not only were subjects highly proficient at understanding and describing each hypothetical neighborhood, but all 25 individuals were capable of forming strong opinions about places that they had never seen before (represented by Neighborhoods A and B). Respondents were asked if they preferred Neighborhoods A or B or their own neighborhood. Only 10% of all respondents said they preferred A to their own, 14% said they preferred B to their own, and 71% of respondents preferred Neighborhood B over A. After reviewing both distance and time maps for both neighborhoods, subjects gave some of the following reasons for their preferences:

> "Neighborhood B is too noisy, I wouldn't want to live there." - Subject 120
> "I like the 'walkability' of my neighborhood; A is too suburban."-Subject 107
> "I love Neighborhood A! It's perfect, it is just so peaceful!" - Subject 109

While traditional GIS maps convey information about a place, they do not provide a "sense of place." This fundamental "feeling" about a place usually comes from visiting that place, seeing photographs, or hearing stories, and is essential to being able to make decisions or form opinions about a place. These responses support participatory digital maps as media that connect the "sense of place" captured by participatory maps with the precision of GIS.

Conclusions and Discussion

As the figures above illustrate, the simple addition of familiar symbols to a GIS map, dramatically transforms the map display and brings social elements into a typically spatial format to combine these two complementary dimensions of mapping as discussed in Chapter 4. Entering related social data in the attribute tables of each layer also sets up the potential for organizing new queries and developing comparative maps. These combined maps integrate the social accuracy of the original participatory maps with the spatial precision of the underlying GIS layers. Also the new participatory digital maps maintain both the representativeness of the participatory data and the comprehensiveness of the GIS maps by organizing participatory information on individual layers. Unlike typical layers grouping similar features, such as schools, these new layers represent individuals or groups that describe specific sub-populations, such as women, minorities, or the elderly. These new layers act as a series of perceptual 'lenses' through which to disaggregate data, view, and describe a region as a whole.[30]

The artificial boundaries imposed by politicians and planners rarely acknowledge, let alone capture actual community dynamics, and technical plans do not provide the reference point and "sense of place" that is essential for local participation in decision-making (Fischer 1980). Overall this evaluation interview provides strong support for the following findings:

- Communities are not heterogeneous, individuals from the same neighborhoods have varied priorities, perceptions, and preferences for their 'backyards'
- Individuals are able to effectively articulate their values and their personal definitions of their 'backyards' through both surveys and participatory maps
- The backyard is a dynamic space with its own particular sense of place

The general implications of this study for participatory planning and addressing NIMBY-based public opposition are discussed below.

Confronting the problem of NIMBY requires the recognition that nearly every place is part of someone's backyard to some degree. In general, the abstractness of NIMBY-based opposition has hindered planners' and siting professionals efforts to make effective counter-

[30] This interview was designed specifically for one-on-one interviews with individuals and tailored to the target population in the Pittsburgh area; however, the same method could be adapted and applied in a variety of other contexts, including rural or developing world communities, or specific projects, such as facilities siting efforts. The interview format here focuses generally on mapping livelihoods and could be modified to elicit data for a wide range of places, projects, and populations.

arguments and propose targeted solutions. This chapter provides a medium for concretizing the NIMBY problem in the context of local priorities, perceptions and preferences. The challenge, from this point forward, lies in streamlining the method of eliciting definitions of community 'backyards' for different types of projects and decisions, and then making both acceptable and optimal decisions as they relate to these overlapping backyards.

The process of participatory digital mapping as it is used here is both a flexible and replicable for use with groups in diverse planning and decision making contexts. The value of this approach is two-fold. First, the focus on community issues and the resulting separation of siting concerns from project details, allows for early implementation of participation processes, even as project decisions are being made and refined. Second, the concrete definition of local priorities for the 'backyard' allows planners avoid abstract arguments and directly elicit and address reasons for opposition and propose compromises and alternative solutions. Because the process evaluated here was simultaneously designed to evaluate the proposed mapping approach and inform the NIMBY debate, the approach is particularly detailed and time-consuming. As a result, the interview process used here is not appropriate in its current form for complex projects such as transmission line siting. The number of stakeholders affected by transmission projects requires that any siting related participatory process to be timely and effective in its implementation. In the case of these projects, this tool could be used to structure dialogue at town-meetings or focus groups rather than develop individual definitions of backyards (see Hester et al., 1990 for an example of a structured participatory decision-making process). These methods could be significantly condensed and streamlined for efficient use with community focus groups and town-meetings. Similarly, other options for rapid data entry into GIS also exist (see Vajjhala, 2005 for various examples).

Although, different projects require tailored and tested participatory approaches, this study provides strong support for participatory digital mapping as a general tool for local data gathering and dissemination related to neighborhoods, communities, and backyards. This combination brings the major strengths of both sketch mapping and GIS together to create a flexible medium for participatory planning. In spite of the effectiveness of the final digital maps for information exchange and communication with the various map-makers, the value of this process for use with wider audiences still needs to be tested. The next chapter of this dissertation builds on the methods and results used here to evaluate the maps from this study as media for communicating the results of participatory processes to unfamiliar audiences.

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Chapter 6

FACILITATING PUBLIC PARTICIPATION

The biggest problem with communication is the illusion that it has been accomplished.
–George Bernard Shaw

In spite of the of the growing demand for participation and its widely-recognized benefits, discussed in Chapters 4 and 5, participatory tools and methods often have only limited value for outreach. Although, one of the primary benefits of participation is perceived to be the improved general acceptability of project decisions (NRC, 1996; Beierle and Cayford, 2002; Fischer, 2000), there is little evidence to support this extension of participatory benefits to broader audiences. In an experiment to evaluate individuals' satisfaction with participation-based risk decisions versus non-participatory decision-making processes, Arvai (2003) finds that individuals comparatively express higher satisfaction with the participatory process; however, he notes that this satisfaction does not automatically indicate significantly higher satisfaction with related project outcomes. As a result, it is conceivable that even highly representative participation efforts at the top-rungs of Arnstein's Ladder (1969) are insufficient to address general project objectives, such as mitigating opposition, if the process and outcomes are not readily and effectively communicated to wider audiences.

Given the limits on resources (time and money) for facilitating and supporting broad and sustained participation in most development and environmental projects, typically groups of direct participants make up only a small sample relative to the population of all possible stakeholders (see Kunreuther and Fitzgerald (1993) for a brief discussion of the importance of broad-based stakeholder inclusion). As a result, it is extremely important that the substance and outputs of participation efforts communicate effectively to larger groups of project-affected people. Efforts to mitigate widespread opposition cannot be countered by localized participation, when the benefits are difficult to extrapolate. To address this problem in the context of the process of digital participatory mapping, this chapter evaluates the effectiveness of the maps from the study in Chapter 5 for communication with unfamiliar audiences as part of a final written survey. The goal of this survey is two-fold. First, this study focuses specifically on the second building blocks of participation, stakeholder communication, to test if participatory digital maps are effectively understood and accurately interpreted by non-map-makers and non-community residents. Second, the results of this survey provide a critical analysis of the potential for this tool as a medium for outreach in the context of participatory digital mapping processes more generally.

Because much of the literature review and introductory text associated with this paper has been covered in Chapters 4 and 5, this chapter moves directly into the discussion of the final study in the dissertation. The next section describes the major research goals and objectives of this work. Section 3 then presents the details of the survey design, including the methods, participants, and procedures. Section 4 outlines all of the major findings and results. Results are grouped in five major categories as follows: 1) evaluations of subjects' map, neighborhood, and map-makers comprehension 2) comparisons between GIS maps and the participatory digital maps representing each neighborhood, 3) correlations between and among the original map-makers' and map-observers' ratings for each map, 4) test of agreement among map-observers, and lastly, 5) characterizations of survey participants preferences for different map-makers and map for different applications. Finally, Section 5 concludes with a discussion of the implications of these results both specifically for mapping as a communication tool and generally for facilitating participatory planning and decision making.

Research Objectives

To evaluate the potential of participatory digital mapping for outreach and stakeholder communication, the survey presented here was designed based on the results from Chapter 5 to allow for comparisons across the two studies and groups of participants. This survey is structured around 1) the attributes from the written survey in the first part of the previous study and 2) distance-scaled digital versions of the participatory maps of selected respondents.[31] The pairing of survey ratings with the original maps allows for direct comparisons between the original neighborhood map-makers' and new map-readers' ratings. Using a set of eight selected participatory digital maps and general GIS maps of each neighborhood, this study evaluates individuals' comprehension of and preferences for participatory information as part of unfamiliar audiences. Stated otherwise, *how well are*

[31] Only ten of the eleven original neighborhood attributes were included in this survey. Quality of public services was dropped from the set because this attributes is not associated with any of the original map-makers' maps.

participatory digital maps understood by viewers who are unfamiliar with both the areas being mapped and the processes of mapping?

This question is crucial to implementing successful participation using this process, and the work here also contributes to the general discourse on the benefits of participation and its associated potential for communication with a wider public. On the whole, the goal of this survey was to answer the following major research questions:

- How well do GIS maps communicate the basic attributes of a community?
- How well do the selected participatory digital maps communicate:
    - The basic attributes of the community?
    - The original map-makers' perceptions about their neighborhoods?
    - The original map-makers' priorities for their neighborhoods?
- Do subjects understand a neighborhood differently based on the information on GIS maps compared to participatory maps?
- How do their impressions of the neighborhood as a whole change after viewing only the GIS map to viewing all participatory maps?
- Are the participatory digital maps more or less effective for communication compared to conventional or standard GIS maps?

In addition to all of the comparative questions above and their associated analyses, this survey also includes basic tests of participants map comprehension and information preferences evaluated by demographic. Results associated with each of these specific objectives are presented in detail in Section 4. The next section describes the specifics of the survey design and implementation with groups of volunteers from the Monongahela (Mon) Valley region of the greater Pittsburgh area.

Survey Design

As outlined above, the survey design in this chapter is based on a pair of written-questionnaires (booklets) for two contrasting Pittsburgh neighborhoods, The Hill District and Squirrel Hill. The Hill District is a low-income urban African-American neighborhood centrally located in the Pittsburgh region, and Squirrel Hill is an adjacent high-income urban neighborhood with a variety of resident ethnic groups. These two neighborhoods were selected for evaluation in this survey because of their comparable densities, and the availability of complete maps and survey ratings representing each community from the original mapping study in Chapter 5. Four hand-drawn maps collected from neighborhood residents and a single GIS map of the same area form the basis for each survey booklet (see Appendix G for complete booklets). All five maps in each booklet describe a common 2-mile by 2-mile square area. The first map in each booklet is a GIS map developed with standard city of Pittsburgh data. The remaining four maps representing each neighborhood were made by resident map-makers from the previous study. Symbols keys for all maps were also included with each booklet (see Appendix G). These maps were selected based on the completeness of their associated neighborhood ratings and the inclusion of the map-makers' homes and a major community intersection within the selected area. From this subset of possible maps and map-makers, four map-makers were specifically chosen to represent different demographic groups within each neighborhood.

Because both neighborhoods in the study are dense urban communities, the cropped 4-square mile area superimposed on all maps included the majority of all locations on the selected map-makers' complete original maps; however, in all cases, some information from the original map was outside of this area. Only the portions of the original maps within the selected area were included in the survey. Additionally, because of its symmetry, the defined square does not correspond with any official neighborhood and district boundaries. Instead this area was circumscribed to capture as much of all resident map-makers' definitions of community as possible, and robustly describe each neighborhood. Overall, the collection of maps in each booklet included some common information, but each map also contained symbols and places unique to the activities and interests of each resident map-maker. All maps were paired with a series of repeated questions to test comprehension, elicit perceptions of map-makers ratings and priorities, and evaluate respondents own preferences for the area.

Participants

Participants for the survey were recruited from community organizations in the Mon Valley region of Pittsburgh and compensated with donations to the sponsoring organization for their participation in the study. This region was specifically selected for its relative geographic isolation, in order to work with a survey population that was largely unfamiliar with the two neighborhoods mapped in the survey. Surveys were administered to groups of 15 to 50 volunteers in three moderated survey sessions in a two-week period during October 2004. Study participants were randomly assigned to receive a written survey booklet with maps of either of two neighborhoods, the Hill District or Squirrel Hill. Surveys took approximately 1 to 1-½ hours to complete, and a total of 91 completed responses were collected from all participants across all sessions.

In addition to the responses from Mon Valley participants, 20 completed surveys from early pre-test sessions were also added to the dataset. Surveys were pre-tested with university staff volunteers to test for any ordering or recency effects on respondent ratings (Kahnemann, Slovic, et. al., 1982). Pair-wise correlations of each map rating and the original map-makers' ratings and the correlation between each map ratings and respondents' final neighborhood assessments based on all pre-test responses, revealed neither effect. As a result the survey was not significantly modified between the pre-test and final survey sessions, and the responses from the pre-tests were combined with all others to yield a total of 111 completed surveys.

Procedures

All surveys were completed individually largely within moderated sessions. It is important to note, that only comparisons of participatory digital maps with GIS maps are considered in this study. Although participatory digital mapping is proposed as an improvement over both traditional participatory mapping and conventional GIS as described in the dimensions of mapping in Chapter 4, analyses comparing participatory maps with the new digital versions are of little value. Participatory mapping is typically focused on information elicitation, not information display (Chambers, 1994), in contrast to GIS maps which are frequently used for information dissemination and as the basis for dialogue. Because these maps have inherent specificities and distortions, they convey little direct information to viewers without extended explanations or supporting material, as a result, it is rare the participatory maps are used for communication. Both GIS maps and participatory digital maps could conceivably stand-alone as media for very basic information exchange and communication; therefore, only these types of maps are compared quantitatively here.

Other sections of the survey focus on supporting information to assess observers own preferences for different types of information, maps, and map-makers. Extensive demographic information, including respondents' use of maps, their experiences with participation and opposition, and their preferences for environmental decisions were also elicited. Based on the results of the study in Chapter 5, we hypothesize that differences in neighborhood and map perceptions could be associated with respondents' income. Because almost all respondents in this survey are from the same zip-code, the potential for additional comparisons based on median income as before is limited; however, in this study we expect education and map-use to more strongly influence individuals comprehension and perceptions of different maps. The next section presents the results of these comparisons and analyses.

Survey Results

On average the demographic characteristics and distributions of participants in this survey were very similar to the characteristics of participants in the original study, described in Chapter 5. Across all survey participants, most participants were between 32 and 77 years old, with an average age of 55 years, and a majority (73%) of all respondents were female. Subjects' educations ranged from less than high school degrees to graduate degrees with most subjects having completed trade school or more. Most respondents' incomes were between $10,000 and $25,000/year, the majority (68%) of respondents owned their own homes, and all had lived in Pittsburgh for an average of 26 years. For comparison, Table 9 (below) outlines the basic demographic characteristics of the map-makers whose maps are used in the survey. All of the analyses in the following sections are evaluated for significant variations and interactions among respondent sub-groups. As stated above, we expect subjects' education and self-assessments of map-use to most significantly influence their comprehension and perceptions.

		Age	Gender	Household Income *(see survey)*	Education	Years of Residence	Own Average Ratings	Own Weighted Avg. Rating
Squirrel Hill	Map-maker A	19	Female	4	College Student	19	4.1	4.0
	Map-maker B	61	Female	5	Graduate Degree	2.5	3.9	3.8
	Map-maker C	68	Male	4	Bachelors Degree	55	3.9	3.7
	Map-maker D	50	Male	5	Graduate Degree	22	4.6	4.4
Hill District	Map-maker A	56	Male	1	Some college	7	2.6	2.9
	Map-maker B	56	Female	3	Bachelor's Degree	20	2.8	3.1
	Map-maker C	57	Male	3	Graduate Degree	17	3.4	3.2
	Map-maker D	48	Male	4	Graduate Degree	17	3.5	3.5

Table 9. Table of original map-makers' demographic characteristics for all survey booklet maps.

Comprehension and Accuracy Tests

The first and most basic results, outlined in the research questions above, were the general comprehension tests of map-reading. A multiple-choice symbol and scale comprehension question was included within the sets of repeated questions associated with each map. On average across all five questions (GIS and four participatory maps) respondents answered an average of 68% of the comprehension questions correctly for the Hill District booklets and 64% of the Squirrel Hill booklet. Interestingly, respondents' accuracy was not significantly correlated with their average self-assessments of map use. As expected, however, respondents' correctness was significantly correlated with their levels of education at 0.46 for the Hill District ($p<0.001$) and at 0.36 for Squirrel Hill ($p=0.012$).

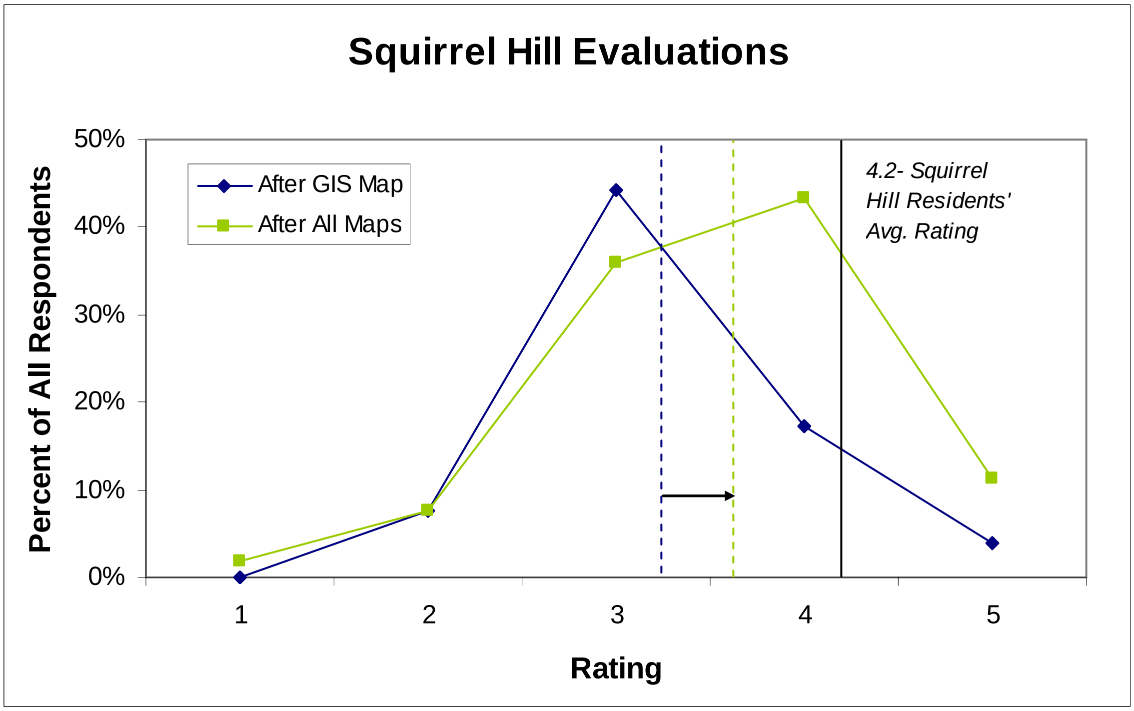
A second comprehension question was also included with only the GIS map rating and the final neighborhood ratings after all maps. Respondents were asked to select from multiple short descriptions the one that best depicted the neighborhood being mapped. After viewing the GIS map an average of 17% of respondents selected the correct description, and after all maps still less than 30% of respondents selected the correct one. A paired t-test between the two assessments revealed no significant differences. Overall, a large majority of respondents correctly interpreted and answered the basic symbol and scale comprehension questions for both the GIS and the participatory digital maps, and individuals' ability to interpret symbols and scales was not significantly different for GIS maps than any of the participatory maps. Surprisingly, those subjects who answered incorrectly were still able to provide reasonable assessments of the participatory maps and their ratings as discussed below.

Before and After Ratings

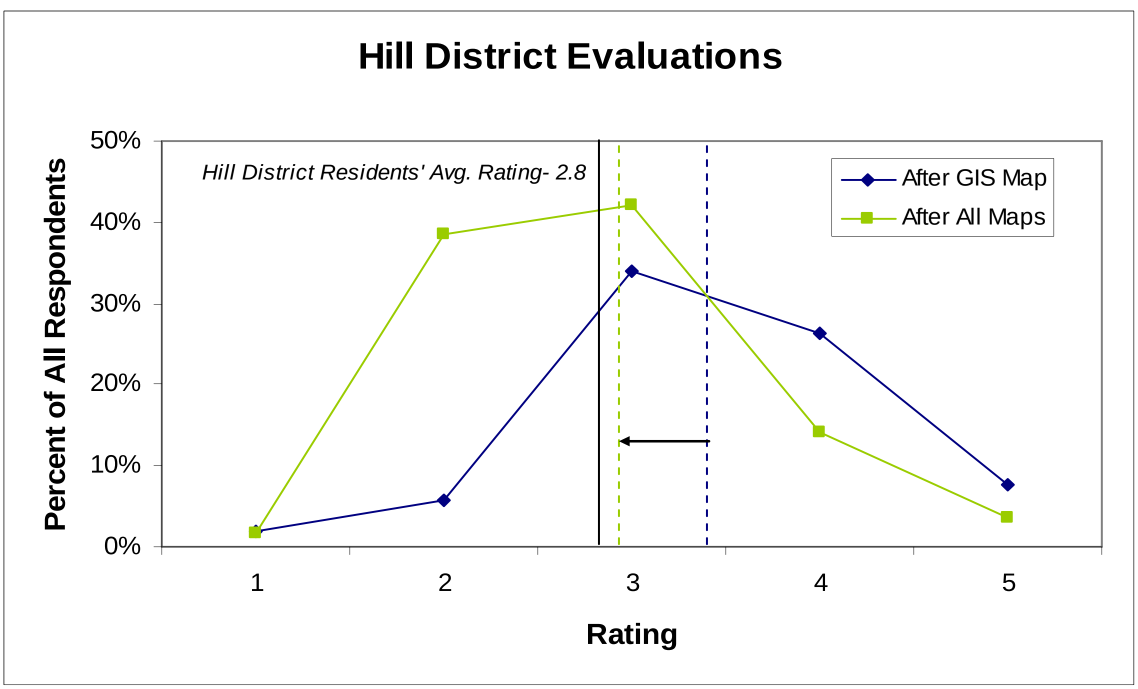
The most significant findings from this survey, are the result of relative comparisons of the different maps, the two neighborhoods, and the original map-makers' and respondents' ratings. First, respondents were asked to give their own ratings for the survey community after viewing only the GIS map and then after viewing all five maps. The average percent of times each respondent selected NA (Don't know / Not applicable) across all neighborhood attributes dropped significantly, from approximately 40.0% after only the GIS map to only 9.6% after all five maps for both neighborhoods ($t(111)= 8.56, p<0.001$). A check of attributes that received the highest percentages of NA ratings revealed that community interaction, local schools, and local employment remained the most difficult to assess even after evaluating all maps. These results above reveal that participatory maps provide respondents with a greater quantity of information than GIS maps for assessing a neighborhood overall based on the selected attributes. The next analysis checks to see if these maps also provide accurate information. Similar to the paired t-test above, respondents' before-and-after average and overall neighborhood ratings were compared after only the GIS map with respondents' final assessments after all five maps.

The results of these comparisons provide strong support for the accuracy of participatory digital maps over and above the GIS maps as well. Figures 6.1 and 6.2 clearly show that after viewing GIS maps individuals gave overall ratings on the scale of 1-5 that were not significantly different for two very different communities (~3.4 for the Hill District and ~3.2 for Squirrel Hill on a 5-point scale). After viewing the four respective digital participatory maps, however, respondents' overall neighborhood ratings shifted considerably. Paired t-tests of the before-and-after means for each neighborhood show these differences to be significant. Participants who evaluated the Hill District on average adjusted their ratings downward (~2.95) and moved toward the actual ratings of the initially surveyed Hill District residents and the original mapmakers ($t(40)= 2.97$, $p=0.005$). Similarly, Squirrel Hill respondents shifted their ratings upward (~3.6) to reflect a more positive impression of the community that also aligned with the ratings of community residents ($t(38)= -2.25$, $p=0.031$). This change in perceptions and neighborhood evaluations clearly illustrates that the digital participatory maps not only communicate additional information over the standard GIS maps, but that they also convey accurate information about the original map-makers' perceptions of their neighborhoods.

The graphs below illustrate these differences and the relative shifts of the means for both neighborhoods. On the y-axis is the percent of all respondents who selected each rating score from 1 to 5 as the overall rating for the neighborhood. The vertical dashed lines on both graphs mark the average ratings across all respondents after the GIS and then after all maps. The solid line indicates the average rating of actual neighborhood residents from the survey in Chapter 5. Paired t-tests of ratings based on an average of all 10 attributes, instead of overall ratings in the figures below, also reveal similar significant shifts in respondents' ratings; however, the number of NA ratings associated with the GIS makes this comparison less robust. The next set of analyses takes these assessments of respondents' perceptions one step further to compare their ratings with those of the original map-makers to determine if, and to what extent, the different maps conveyed map-makers own perceptions to different observers.



Figures 6.1 Respondents' Initial and Final Squirrel Hill Overall Neighborhood Evaluations.



Figures 6.2 Respondents' Initial and Final Hill District Overall Neighborhood Evaluations.

Agreement with Map-Makers

At the outset of this study, we hypothesized that the new maps in this project could potentially convey the original map-maker's perceptions of his or her neighborhood and also allow map-viewers to develop a "sense of place" that is currently missing from traditional GIS maps. To test this hypothesis, respondent and map-maker ratings for each map were normalized to the mean, and then the correlations between these 10-attribute ratings were calculated for each neighborhood and map. Seven of the eight resulting correlations (four maps for each of two neighborhoods) were found to be significantly different from zero at the $p<0.05$ level; however, only four of these correlations were positive, indicating agreement between the map readers and map makers. The highest average correlation of 0.28 is associated with the Hill District's Map-Maker B, followed closely by Map-maker A from the Hill District, and map-makers A and D from Squirrel Hill. The detailed results of these individual 1-sample t-tests are listed below, and Table 10 illustrates the range of all correlations between respondents and map-makers for each map and neighborhood.

One-Sample t-tests: All Squirrel Hill (SQ) Maps and All Hill District (HD) Maps
Test of mu = 0 vs. not = 0

Variable	N	Mean	St. Dev.	SE Mean	T	P
SQ- Map A	50	0.18	0.31	0.04	4.14	0.000
SQ- Map B	46	-0.07	0.25	0.04	-2.04	0.047
SQ- Map C	43	-0.12	0.30	0.05	-2.57	0.014
SQ- Map D	45	0.10	0.26	0.04	2.50	0.016
HD- Map A	57	0.25	0.34	0.04	5.50	0.000
HD- Map B	53	0.28	0.32	0.04	6.37	0.000
HD- Map C	54	-0.03	0.34	0.05	-0.55	0.584
HD- Map D	55	-0.13	0.31	0.04	-2.98	0.004

An examination of Table 10 reveals that correlations between individual respondents' and map-makers' ratings vary from as high as 0.90 to as low as -0.78. We hypothesize that these variations in respondents' levels of agreement (or disagreement) could be a product of the map-observers, the map-makers, or the maps. In the case of the map-observers, these variations could be associated with observers' levels of education or preferences for maps, or it is possible that individuals who are more similar to a map-maker along certain demographic characteristics could better understand the map-makers and thus have higher correlations.

Hill District					Squirrel Hill				
Obs.	*Map A*	*Map B*	*Map C*	*Map D*	*Obs.*	*Map A*	*Map B*	*Map C*	*Map D*
1	0.78	0.40	0.00	0.04	*3*	0.52	-0.32	-0.27	0.45
2	0.56	0.18	0.54	0.07	*4*	0.43	-0.02	-0.60	0.07
9	0.39	0.58	0.12	-0.14	*5*	0.12	0.04	0.00	0.22
11	0.72	0.10	0.00	-0.57	*6*	0.53	-0.08	-	0.03
12	-0.48	0.18	0.22	-0.20	*7*	0.53	-0.04	-0.18	0.25
13	0.02	0.18	-0.69	0.19	*8*	0.16	-0.17	-0.63	0.25
15	0.51	0.56	0.14	0.04	*10*	0.24	-0.15	-0.58	0.22
16	0.40	0.51	0.00	0.50	*14*	0.41	-0.02	-0.43	0.20
17	0.07	0.12	0.59	-0.31	*18*	0.29	-0.12	0.00	0.35
19	0.84	0.90	0.56	-0.52	*24*	0.27	-0.38	-0.37	0.13
20	0.69	-0.06	0.41	-0.25	*25*	0.62	0.24	0.00	0.25
23	0.71	0.16	-0.32	-0.16	*26*	0.05	-0.29	0.00	0.34
28	0.12	-0.41	0.46	0.29	*27*	0.86	0.02	0.00	0.31
29	0.43	0.57	0.00	-0.43	*30*	-0.22	0.13	0.44	0.38
32	0.64	-0.12	0.10	0.09	*31*	0.01	0.39	-0.23	-0.34
33	0.22	0.68	-0.11	0.02	*35*	0.12	0.17	-	-0.28
34	-0.15	0.56	0.78	-0.38	*36*	0.72	-0.55	-0.61	0.68
37	0.07	0.63	-0.30	-0.26	*38*	-0.53	0.17	-0.14	-0.16
39	0.40	-0.08	0.00	-0.43	*45*	-0.24	-0.43	0.00	-0.37
40	0.62	-	-0.30	-0.39	*47*	-0.05	-0.19	0.00	0.36
42	-0.08	0.32	0.00	-0.23	*48*	0.18	-0.14	0.14	0.16
43	0.52	0.62	-0.25	0.19	*51*	0.07	-0.19	0.11	0.12
44	-0.06	-0.22	-0.53	-0.41	*52*	0.32	0.00	0.00	0.22
46	0.69	-0.45	-0.60	-0.48	*53*	0.23	-	0.28	0.25
49	0.62	0.15	0.00	-0.29	*54*	0.19	-0.29	0.16	-0.26
50	0.31	-0.03	0.17	-0.09	*57*	-0.53	-0.23	0.22	-0.60
55	0.37	0.73	0.17	-0.13	*61*	0.09	0.18	-0.43	0.35
56	-0.11	0.40	-0.33	-0.35	*64*	0.56	-0.19	-0.55	-0.04
58	-0.31	-0.22	-0.20	0.63	*65*	0.07	-0.02	0.00	-0.16
59	0.33	0.49	-0.23	-0.25	*67*	0.10	0.37	-	0.06
60	0.22	0.24	-0.36	-0.22	*68*	0.42	0.40	-0.66	0.20
62	0.29	-0.10	-	-0.40	*71*	-0.23	-0.09	-0.58	-0.23
63	-0.35	0.24	-0.47	-0.36	*72*	0.07	-0.32	0.07	-
66	-0.24	0.38	0.16	-0.72	*73*	0.37	0.09	0.17	-
69	0.47	0.41	-0.41	0.34	*74*	-0.24	-	-	0.28
70	0.19	0.27	-0.19	-0.09	*76*	0.09	-0.52	-0.12	0.27
75	0.29	-0.16	-0.15	-0.78	*77*	0.74	0.13	0.35	-0.35
78	0.08	0.76	-0.38	0.19	*85*	-0.13	0.16	0.00	0.16
79	-0.06	0.41	-0.36	0.39	*88*	-0.48	0.39	0.00	-0.13
80	0.60	0.57	-0.53	-0.18	*89*	-0.17	-0.41	0.00	0.16
81	-0.39	-0.24	0.00	0.07	*91*	0.39	-	-	-
82	-0.17	0.76	-0.16	-0.42	*92*	0.09	-0.38	-0.38	0.10
83	-0.31	-	0.41	-0.25	*93*	0.00	-0.26	-0.40	0.10
84	0.49	0.09	-0.39	0.31	*97*	0.39	-0.07	-	-
86	0.60	0.47	0.56	-0.07	*101*	0.50	-0.20	-0.28	-0.07
87	0.52	-	-0.09	-0.58	*104*	0.37	0.29	0.00	0.03
90	-0.17	0.10	-	-	*106*	0.15	-	-	-
96	0.45	0.29	-0.33	0.04	*107*	0.17	-0.22	0.00	0.23
98	0.24	0.32	0.20	-0.21	*112*	0.18	-0.19	0.55	0.21
100	0.06	-	-	-	*113*	0.39	-0.09	-0.17	-0.13
102	0.73	0.33	-0.12	-0.45					
103	0.26	0.42	0.50	0.03					
105	0.22	0.11	0.33	0.25					
108	0.15	0.40	0.00	0.33					
109	0.06	0.02	0.00	-0.03					
110	-0.03	0.57	0.32	0.17					
111	0.00	0.63	-0.33	-0.04					

Table 10. Correlations between normalized ratings of each original map-maker with all map-observers.

For example, based on the observed qualitative differences in different individuals' map-making processes, respondents of the same gender or education-level as the original map-maker could have a more similar view of the neighborhood. To test these hypotheses and compare respondents based on their degree of similarity to each map-maker, absolute difference scores were calculated between each respondent and map-maker along several dimensions. These difference scores were then tested against the correlations for each map using a series of regression analyses and one-way ANOVAs. Surprisingly none of the selected demographic variables or difference scores was a significant influence on respondents' correlations with the original map-makers. Future work will include more detailed evaluations of this data using repeated measures or balanced ANOVA analyses to characterize possible interactions among demographic variables and alternative approaches. Taken as a whole, however, the results from these comparative analyses indicate the selected maps communicate effectively residents' perceptions about their neighborhoods to unfamiliar audiences.

As a second-level of evaluation, survey respondents were also asked to rank-order the top three priorities of all survey respondents from Chapter 5, in the order that they thought was most important to the original map-maker. Results of these questions for all maps show that map-makers' priorities were not effectively conveyed or understood by map-readers. Fewer than 20% of all respondents correctly ranked all three attributes for each map. From the data it is clear that these questions were difficult for nearly all respondents, and the information necessary to answer this type of question is not readily available or accurately inferred from the participatory maps. This result indicates that, while the selected maps are effective for providing both actual information comparable to a GIS map and conveying map-makers perceptions, they do not provide an accurate picture of respondents' priorities. The next section expands further on respondents' interpretations of different maps to evaluate the level of agreement among respondents for selected evaluations.

Agreement among Map-Observers

Another look at the correlations between map-observers and map-makers described above reveals that among the seven significant correlations, three are negative. This relationship indicates that for these maps, respondents in general interpreted the maps and rated different attributes opposite to how the original map-maker rated the same attributes.

There are several possible reasons for this disagreement that could be a product of any combination of the characteristics of the map-maker, the map, and the map-observers.[32]

To investigate these results further, this section evaluates the agreement among map-observers for the different neighborhood maps using attribute agreement analyses for each map. Selected results are summarized in Table 11 below. The Kendall's correlation coefficients (comparing map-observers to the original map-makers) are very similar to the correlations in the previous section, and as above, 7 of the 8 coefficients are significant and 3 are negative. In contrast, the Kendall's W results (comparing between observers) indicate significant agreement among observers, even where there is disagreement with the original map-maker as with Map D in both the Hill District and Squirrel Hill. Interestingly, the highest correlations with the original map-makers, such as Hill District Map A, are not associated with the greatest agreement among observers.

	Hill District				**Squirrel Hill**			
	Map A	Map B	Map C	Map D	Map A	Map B	Map C	Map D
Between Observers: Kendall's Coefficient of Concordance (W)	0.1041 (0.0000)	0.1831 (0.0000)	0.0750 (0.0001)	0.2163 (0.0000)	0.1186 (0.0000)	0.1711 (0.0000)	0.1390 (0.0000)	0.2274 (0.0000)
All Observers v. Standard (Original Map-Makers' Ratings): Kendall's Correlation Coefficient	0.2374 (0.0000)	0.2269 (0.0000)	-0.0301 (0.3993)	-0.1039 (0.0032)	0.2106 (0.0000)	-0.1557 (0.0000)	-0.1003 (0.0147)	-0.1753 (0.0000)

Table 11. Kendall's correlations and p-values for individual map attribute agreement analyses.

Just as we hypothesized that map-observers rating of map-makers perceptions could be a product of their similarity with the original map-maker, it is also possible that map-observers who are more similar to one another are more likely to perceive a community in similar ways. To check for this relationship, we also did cluster analyses of observations and means to evaluate significant clusters, the results of these analyses were difficult to interpret, and require further analysis. Overall, the significant agreement among observers for all maps provides support for the robustness of the correlations between observers and map-makers.

32 It is interesting to note, however, that the standard deviations of these three negative correlations are not very different from all other maps, indicating that there is not much greater variability in respondents' ratings that is the basis for overall disagreement with the original map-maker.

Preferences for Information

The final analyses in this chapter evaluate respondents' preferences for different types of maps and information. At the end of the survey, respondents were asked to match actual descriptions of the four map-makers with their respective maps. Although less than 15% of respondents matched more than one map with the correct map-maker, respondents were also asked at the end of the survey to select the map-maker (based on the descriptions) they would most prefer to have as a representative of their community. Interestingly, a comparison of respondents' correlations with each original map-makers reveals that approximately 40% of all respondents had the highest correlation with the map made by their preferred map maker. Similarly, respondents were asked to choose the map they thought best described the neighborhood overall. Calculating the correlation of the ratings associated with each of the five maps to respondents' final overall neighborhood ratings shows that 30% of respondents chose the map that had the highest correlation with their own final assessment as the map that best describes the neighborhood. On the whole, these comparisons validate respondents' ratings across all maps, and indicate that a significant percent of respondents demonstrate consistent preferences for the maps and map-makers that they themselves best understood.

Finally, from the last section of the survey, the majority of respondents selected maps or geographic information as the preferred form of information for making decisions related to community environmental planning (33%), rezoning the local school district (42%), locating a community waste facility (55%), and participating in a public hearing for siting an electric power line (44%). Booklets or written descriptions were the least popular media across all the surveyed scenarios. These variations in individuals' preferences for different types of information are interesting given the current focus of many participatory programs on improved information dissemination and communication. Although, the dominance of maps as a preferred media could be confounded with the focus of the survey on mapping, in the context of strategies for improving participatory information, this result indicates that heavily text-based information packets and brochures could be less effective than combinations of other media. Overall, all of the major results from this survey highlighted in this chapter support the value of participatory digital maps for both direct participation and outreach.

Conclusions and Discussion

In summary, this study provides a unique evaluation of the role and effectiveness of both GIS and participatory maps for facilitating information exchange and communication. The results of this survey show that the added value of participatory digital maps over conventional GIS maps is two-fold. First, these maps convey a "sense of place" not typically captured in a GIS. Second, these digital participatory maps communicate different types of information than comparable GIS maps. In each case, this study provides strong support for these new maps as tools to facilitate stakeholder communication, and the results of this study strongly support individuals' abilities to correctly interpret and evaluate the participatory digital maps of other map-makers from unfamiliar communities. Not only do these maps provide additional information over and above conventional GIS maps, but they also convey accurate information about individuals' perceptions about their own communities. Coupled with other approaches for communication and participation, these maps have the potential to serve as an important medium for communication and outreach.

It cannot be emphasized enough that this is a preliminary study. As discussed in Chapters 4 and 5 there are inherent strengths and weaknesses of different methods and participatory processes for diverse applications, and the results of both Chapter 5 and this chapter provide general support for the proposed mapping tool as an effective medium for the first two building blocks of participation. However, any detailed application of this approach and the resulting maps to any specific participatory process requires more extensive evaluations of the strengths and weaknesses of the method for the particular audience and project. This chapter highlights some of the possible idiosyncrasies of both map-makers and map-viewers that could drive specific communication efforts, in spite of the significance and robustness of the general results presented here.

Overall, this work is still in its early phases, and more detailed analyses of the data from this survey and their implications for different applications make up the bulk of the future work from this dissertation. The final chapter of this dissertation concludes with a description of a real-world application of the participatory digital mapping methods, findings, and strategies developed here in a World Bank infrastructure development project in Lesotho, Southern Africa. This chapter also discusses this potential for extending the major findings and methods from the dissertation as a whole to other types of development planning and environmental decision making projects and areas for further research.

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Chapter 7

CONCLUSIONS AND DISCUSSION

Unless we change our direction, we are likely to end up where we are headed.

–Chinese Proverb

Overall, this dissertation examines a sequence of important interconnected issues: the need for new infrastructure, the causes of siting difficulty, the demand for participation in siting projects, and strategies for improving participatory planning. Much of the research in this dissertation is original work addressing major interdisciplinary gaps in existing literature and industry practice. Each of the chapters is a stand-alone paper that provides a unique contribution to a series of different industries and academic disciplines. They are assembled in this dissertation to provide a unique integrated evaluation of these related problems.

Collectively these chapters capture the major problems associated with development planning from characterizing and mitigating siting difficulty to providing insight into new opportunities for facilitating participation and mitigating public opposition. This final chapter presents a brief description of a real-world application of the digital mapping method to participatory transportation decision-making in Lesotho, Southern Africa, and discusses the implications of using the proposed process in the field. Finally, the dissertation concludes with a brief discussion of three other potential development planning and environmental decision making applications, including resettlement planning, health service delivery and trans-boundary natural resource management, and general areas for further research.

Mobility and Transport Mapping in Lesotho

As a real-world application of aspects of this research and as a test of the proposed mapping methods for the final building block of participation (see Chapter 4), some of the mapping strategies from the second half of this dissertation were applied within a ongoing World Bank development program in Lesotho, Southern Africa during a three-week pilot study in March-April 2005. The goal of this study was to develop and refine a community-based participatory methodology to link local level information on mobility and impact indicators for roads works to the enhanced Lesotho national GIS in the transport sector. This process was designed to help communicate communities' needs and their perceptions of the impacts of transport projects to decision makers in local government and in the Ministry of Public Works and Transport (MoPWT). Only the aspects of this work that relate to both the siting and mapping aspects of the preceding chapters are very briefly outlined here (for a full description of this project see the report Walker, W.M., S.P. Vajjhala, et al. 2005.)

In Lesotho, the constraints imposed by both topography and poverty combine to pose serious challenges for the transport sector in achieving its objectives of providing affordable and available access to basic services and opportunities to rural populations. Spatial exclusion is an important and poorly characterized component of social exclusion and vulnerability. While it is widely acknowledged in the sector that decisions regarding transportation planning and infrastructure siting cannot rest solely on economic justifications, systematically accounting for other factors, such as geography, has proven very difficult. To date no method has been rigorously applied and decision makers have had to rely only on partial knowledge, thereby limiting the effectiveness of monitoring and evaluation of the impacts of investments. In an effort to move toward integrated development planning, the Ministry of Public Works and Transport (MoPWT) has begun to examine how it can enhance its existing GIS by including social and poverty information at the national and local levels to assist in the planning, design, monitoring and evaluation of investments. Building on the national GIS, this work applied participatory digital mappings methods for improving communication with rural communities.

In collaboration with a team from the MoPWT, participatory mapping interviews were conducted with groups in seven villages and associated service provider centers along a currently isolated valley targeted for new road and bridge construction. Village mobility and access maps were developed by participating villagers to illustrate their typical patterns of movement, major services, destinations, and barriers to access. In some cases, groups chose to draw their own maps, and in other cases, team members acted as scribes. The resulting participatory maps were richly detailed depictions of village-specific mobility and access patterns. These maps were then input into GIS as described in Chapter 4. In areas where only limited local GIS data was available, GPS points were used to mark key locations and place roads, tracks, footpaths, and routes in the field.

The final participatory digital maps connected the MoPWT GIS with these local mobility patterns, and revealed important interactions between individuals, road infrastructure, and transport services. For example, gender and age differences in mobility revealed significantly different ranges of movement and also variations in the use of main roads (mostly by men) and primarily footpaths (by women) in day to day activities from certain villages. These findings are important underlying elements in understanding the differential impacts on livelihoods of new infrastructure improvement and transport service development. Similarly, villagers' participatory maps also highlighted the prohibitive costs of emergency transport, the barriers to seasonal mobility, and the implications for health service delivery, particularly relevant given the high AIDS rates (~31%) in Lesotho.

Taken as a whole, the applied methods were successful in eliciting and documenting local information that is critical for effective national level roads planning and management. The process of mapping was explored as an important tool for information collection, communication, and decision making in transport planning and service delivery at both the local and national levels. The full report on this pilot project includes the collected maps, documentation of the interview process and the integration into GIS, and a field guide for collecting local information using participatory mapping and GPS. On the whole, this project provides strong support for the applied value of digital participatory mapping, and establishes a basis for understanding its strengths and weaknesses in a real-world context. The next sections briefly describe further extensions of this work to other potential areas of application.

Potential Applications

The transport project in Lesotho, described above, is only one of many possible areas of application for participatory digital mapping. Because this dissertation as a whole focuses on spatially-based development planning and environmental decision-making projects, the potential extensions of this work are very broad. This section very briefly discusses three specific types of projects and policy domains, separate from facilities siting and transport planning, for which the results of this dissertation could be most relevant. These other applications include development-induced displacement and resettlement planning, health service planning and delivery, and finally community-based natural resource management. Each of these applications and their policy implications are discussed briefly below.

Resettlement Planning

During the decade between 1990 and 2000, infrastructural development programs such as dam construction, urban development, highways, and roads displaced approximately 10 million people each year worldwide (Cernea and McDowell, 2000). A growing body of resettlement research has shown a direct relationship between displacement of populations and their resulting impoverishment. With the rising demand for major infrastructure projects, described in the first half of this dissertation, resettlement programs have drawn increasing attention. Research on a variety of displacement and resettlement efforts has concentrated on characterizing and managing the risks of impoverishment associated with relocation.

Cernea and McDowell (2000) define eight major risks, including loss of land, increased morbidity and mortality, and social marginalization, and propose a process for reconstruction of local livelihoods. However, both social research on these risks and practical application of proposed mitigation strategies have focused on a variety of top-down approaches to managing risks and reconstructing resettlers' lives and livelihoods. Although citizen participation has been incorporated into a variety of resettlement projects, a comprehensive strategy for risk awareness and communication has yet to be developed and tested.

The participatory digital mapping process developed here has the potential to serve as a tool for risk communication and local risk mitigation. This process provides a basis for implementing reconstruction strategies using participatory digital mapping as a means of creating a spatial "mental model" to develop place-based risk communication and mitigation strategies (Morgan, M.G., B. Fischhoff, et. al., 2001). Understanding what is important to individuals and groups about their current communities establishes a basis for communicating any relevant and anticipated project impacts, such as the disruption of a local market. This approach, in contrast to conventional risk mitigation strategies, could allow populations to make trade-offs in attributes of their own communities and host communities, and sets up a basis for participatory negotiation and spatially-based compensation planning.

In this way, GIS has the potential to serve as a comprehensive tool for risk-communication and rapid information exchange and participatory decision making. The approach focuses on communicating the factors associated with the major risks of resettlement to the resettlers themselves. Since resettlement is an inherently place-oriented phenomenon, the risks of impoverishment due to displacement are readily connected to characteristics of a physical location. Moreover, because of this connection between risk and geography, resettlement planning and risk communication lend themselves to a graphic form of data representation and mapping. Creating any communication link between planners and resettlers requires establishing a medium for disseminating a vast quantity of information to a large and diverse population in short periods of time, and simultaneously receiving feedback from this population in an equally short time. The ability of participatory digital mapping to consolidate and graphically represent information has the potential to address all of these established requirements for communication and information dissemination.

Many local NGOs and community organizations currently use participatory mapping exercises and have individuals identify key features of their communities. Combining these two levels of information, local participatory maps and planning GIS data, allows planners to overlay resettlers' values and perceptions of "place" onto their own database of information on an existing site. This process can then be extended to potential sites for resettlement, and the risks and opportunities of each potential relocation site can be conveyed back to resettlers using their own symbols to address the priorities, perceptions, and preferences articulate through participatory mapping. Thus the GIS databases of resettlement planning agencies can be effectively combined with existing NGO and citizen participation methodologies to introduce an active medium for communication into the fundamental stages of resettlement projects (Chambers, 1994; World Bank, 1996).

Health Service Delivery

A second potential area of application is the use of participatory digital mapping as a tool to characterize health-related decision making from both the provider and patient perspectives. One area in which this approach could be particularly relevant is for communication with large and socially isolated immigrant communities in the U.S. For example, recent studies of Somali immigrant women's groups reveal significantly different attitudes toward and expectations of pregnancy and pre-natal health care (Almquist and Flynn, 2005). Given the rate of high-risk pregnancies within this population, health professionals and Somali women have increasingly come into conflict over delivery decisions. In some cases, this conflict has extended to the point where court-orders have been sought to administer Caesarean-sections. Because of cultural, religious, and even linguistic issues (Somali is primarily an oral language), avenues for communication with this largely closed community have been limited, and recent studies by Almquist and Flynn have sought to educate both patients and providers, in order to tailor more culturally appropriate and effective care.

In cases such as this, participatory mapping has the potential to serve as a tool for both conflict resolution and risk communication. Using mapping interviews to elicit women's mental models about pregnancy and their specific health behaviors, especially in a community where written surveys are impractical, allows for an understanding of the physical and traditional social networks that Somali women use during pregnancy. This information can then be established as a basis for identifying key areas for communication and points for service delivery that are more accepted by the community as a whole.

This approach also has the potential to be more widely applicable to other health planning and communication efforts in a variety of developed and developing world contexts to map local patterns (and perceptions) of illness, infection, treatment, and so on that are affected by factors outside the scope of many health care systems. As with the case of characterizing emergency transport access in Lesotho, mapping has the potential to more clearly identify problems that reach across many sectors, such as health care and transport, and define a basis for interdisciplinary communication and decision making.

Community-Based Natural Resource Management

One final area where the methods and findings of this dissertation could be applied is in community-based natural resource management for both local implementation and large-scale policy-making. Given the growing attention to local environmental behaviors and decision making and their global impacts, there is a worldwide demand for designing and documenting environmental best-practices. The process of mapping can in part meet this demand by integrating environmental information across scales to connect local behaviors with regional impacts.[33] Because this domain is so vast, this section only lists some of the general areas in which these methods could be applied, including the following:

- Understanding the local impacts of climate change on vulnerable populations and resources, mapping resulting changes in land and resource use (and quality), and developing strategies for local mitigation and adaptation.

[33] Ongoing research by the Trans-boundary Protected Areas Research Initiative (TBPARI) (see http://hdgc.epp.cmu.edu/misc/TBPA.htm) provide several examples of types of work into which the proposed mapping methods could be integrated.

- Implementing effective community-based and trans-boundary natural resource management to manage responsibility and communicate among multiple stakeholders and actors about shared resources.
- Working with indigenous populations in protected areas and reserves to identify and document threatened species and resources.

Overall, the projects and potential areas of application described above are very generally only a few of the possible areas to which this research could extend.

Further Research

Taken as a whole, this work provides a basis for enabling substantive and productive dialogues among stakeholders in a wide variety of participatory development planning and environmental management projects. The applications of the methods and findings presented in all five main chapters of this dissertation have broad relevance in both the developed and the developing world for a wide-variety of applications including: community based design and planning, trans-boundary natural resource management, development-induced displacement and resettlement projects, environmental justice programs, border and resource conflict resolution, health policy and service delivery analysis, and many other participatory processes. All of these fields of research share the common associations with spatial planning, the potential for public opposition and stakeholder conflict, and the need for effective stakeholder participation that tie together the studies in this dissertation.

It can not be emphasized enough that the work in this dissertation is not intended to resolve all stakeholder conflict nor is it a replacement for existing methods or types of information. The models, methods, and tools developed in this work are a supplement and complement to established techniques. Taken as a whole, this research addresses some of the most fundamental questions and issues of participatory development planning and environmental decision making. The papers in this dissertation provide a quantitative basis for understanding development project issues, evaluating policy solutions, and improving citizen participation in planning processes. In conclusion, the combination of the top-down and bottom-up evaluations within this research provides a vital transition from designing and informing effective policies to coordinating and implementing locally relevant solutions in a variety of development projects around the world.

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APPENDICES

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APPENDIX A

Transmission Line Siting Survey: Introductory Email (Sample)

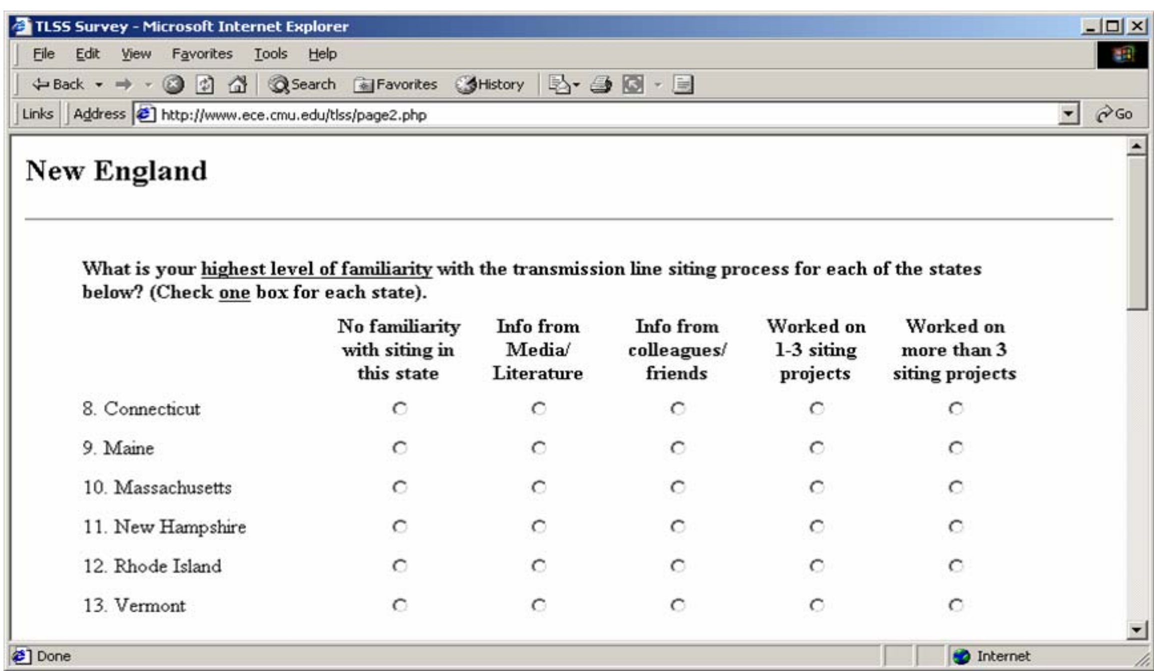
Dear Siting Expert,

I am contacting you regarding your experience with transmission infrastructure in the U.S. electric industry. Over the past year, I have been working as part of the Carnegie Mellon University Electricity Industry Center on research pertaining to transmission line siting, and I would appreciate your participation in a research survey on siting issues. This is a strictly confidential Internet survey that takes approximately 15 minutes to complete. The survey focuses on your familiarity with transmission line siting in different states, your perceptions about transmission line siting difficulty, and your opinions about causes of siting problems. To complete this survey, please click on the link below or paste the address below into your Internet browser, and enter the password provided below to access the survey.

Survey: http://www.ece.cmu.edu/tlss
Password: 908605

Since transmission line siting is a highly specialized process and the number of individuals working on siting in the electric industry is limited, your response to this survey is especially important. If by some chance I have made a mistake and your work does not pertain to transmission line siting, I apologize for any inconvenience and I would appreciate if you could forward this email to any of your colleagues across the U.S. who are associated with the siting process. If you have any questions feel free to contact me, Shalini Vajjhala, by phone at 412-268-5607 or by email at vajjhala@andrew.cmu.edu. Thank you in advance for your participation.

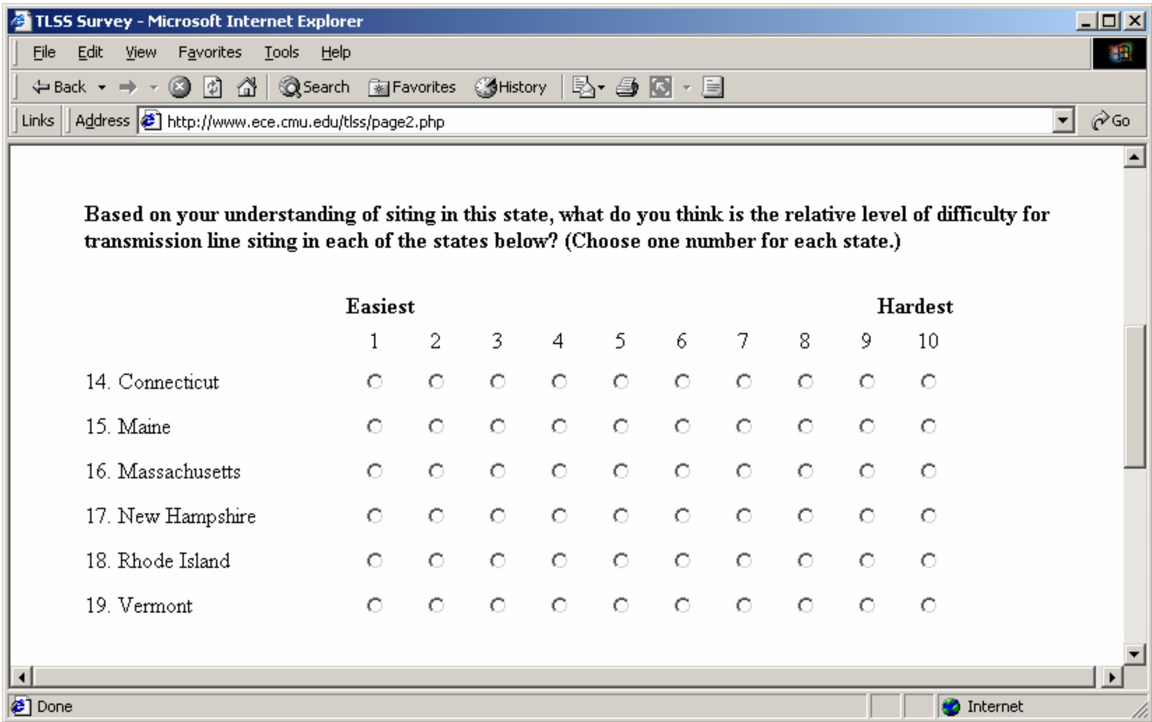
Transmission Line Siting Survey: Online Survey Screen Shots



New England

What is your highest level of familiarity with the transmission line siting process for each of the states below? (Check one box for each state).

	No familiarity with siting in this state	Info from Media/ Literature	Info from colleagues/ friends	Worked on 1-3 siting projects	Worked on more than 3 siting projects
8. Connecticut	○	○	○	○	○
9. Maine	○	○	○	○	○
10. Massachusetts	○	○	○	○	○
11. New Hampshire	○	○	○	○	○
12. Rhode Island	○	○	○	○	○
13. Vermont	○	○	○	○	○

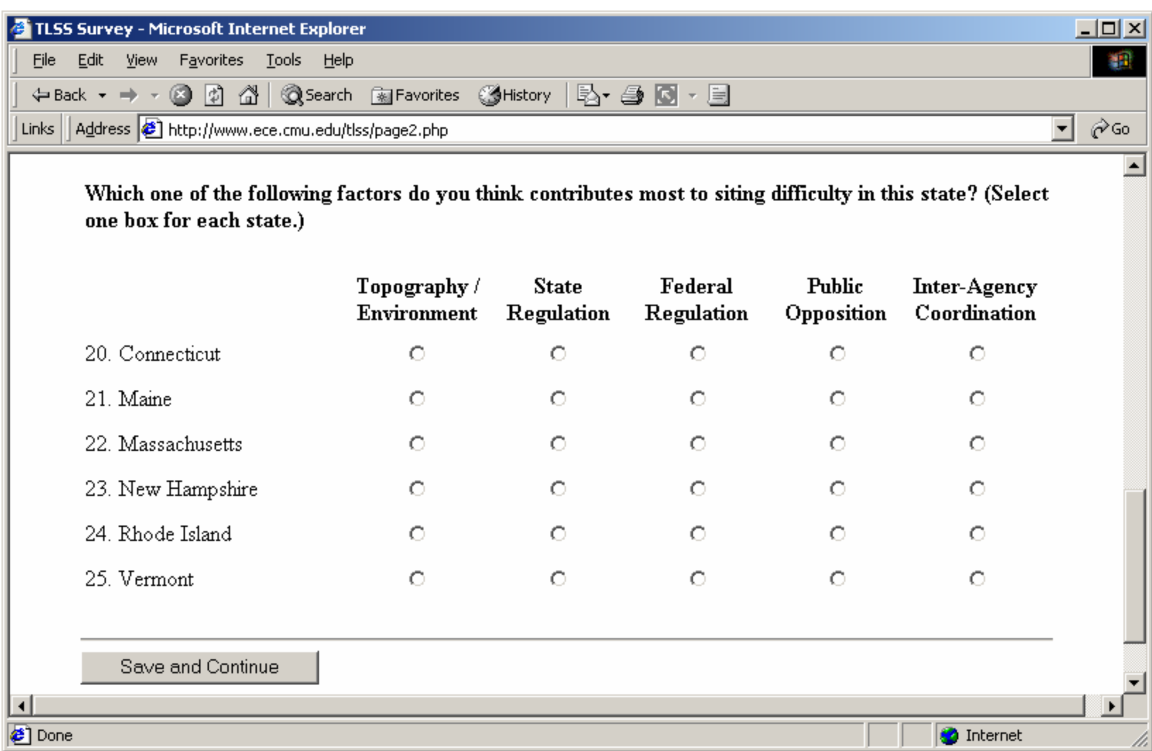


TLSS Survey - Microsoft Internet Explorer

http://www.ece.cmu.edu/tlss/page2.php

Based on your understanding of siting in this state, what do you think is the relative level of difficulty for transmission line siting in each of the states below? (Choose one number for each state.)

	Easiest 1	2	3	4	5	6	7	8	9	Hardest 10
14. Connecticut	○	○	○	○	○	○	○	○	○	○
15. Maine	○	○	○	○	○	○	○	○	○	○
16. Massachusetts	○	○	○	○	○	○	○	○	○	○
17. New Hampshire	○	○	○	○	○	○	○	○	○	○
18. Rhode Island	○	○	○	○	○	○	○	○	○	○
19. Vermont	○	○	○	○	○	○	○	○	○	○



TLSS Survey - Microsoft Internet Explorer

http://www.ece.cmu.edu/tlss/page2.php

Which one of the following factors do you think contributes most to siting difficulty in this state? (Select one box for each state.)

	Topography / Environment	State Regulation	Federal Regulation	Public Opposition	Inter-Agency Coordination
20. Connecticut	○	○	○	○	○
21. Maine	○	○	○	○	○
22. Massachusetts	○	○	○	○	○
23. New Hampshire	○	○	○	○	○
24. Rhode Island	○	○	○	○	○
25. Vermont	○	○	○	○	○

Save and Continue

Transmission Line Siting Survey: Protocol

The online version of the protocol below was prefaced by an introductory screen with a description of the survey design and objectives and a password protected login. After participants completed the survey they were directed to a final screen thanking them for their participation in the survey, and providing them with contact information to address any questions or IRB-related concerns.

Transmission Line Siting Survey

Carnegie Mellon Electricity Industry Center

The following questions address your familiarity with transmission line siting in different states, your perceptions about transmission line siting difficulty, and your opinions about causes of siting problems. Please answer the questions below based on both your opinions and your expertise. We are interested in learning about both your perceptions of siting difficulty and also your personal experience with siting projects.

1. Which of the categories below best describes the agency where you currently work?
    - ❑ Public electric utility
    - ❑ Independent electricity service provider
    - ❑ Consulting company
    - ❑ Government regulatory agency
    - ❑ Non-government organization
    - ❑ Other (please specify) ________________________________

2. What kind of work do you do most often?
    - ❑ Civil Engineering
    - ❑ Electrical Engineering
    - ❑ Routing Design
    - ❑ Environmental Assessment
    - ❑ Administration / Managing
    - ❑ Permitting / Regulation
    - ❑ Other (please specify) ________________________________

3. In total how many years have you been working with transmission line siting projects?

    _________________ years

4. In which state is the agency where you are currently employed?

    ____

5. Is there a correct balance between business/industrial development and concern for the environment?
    - ❑ Too much emphasis on business
    - ❑ Some emphasis on business
    - ❑ Correct balance between business and the environment
    - ❑ Some emphasis on the environment
    - ❑ Too much emphasis on the environment

6. Do environmental policies and regulation impact economic development?
    - ❑ Significantly help economic development
    - ❑ Somewhat help economic development
    - ❑ No impact
    - ❑ Somewhat hurt economic development
    - ❑ Significantly hurt economic development

7. Are long-term consequences adequately considered by today's policy makers?
    - ❑ Too little long-term emphasis
    - ❑ Adequate consideration of the long-term
    - ❑ Too much long-term emphasis

New England

What is your highest level of familiarity with the transmission line siting process for each of the states below? (Check one box for each state).

		No familiarity with siting in this state ▼	Info from media/ literature ▼	Info from colleagues/ friends ▼	Worked on 1-3 siting projects ▼	Worked on more than 3 siting projects ▼
8.	Connecticut	□	□	□	□	□
9.	Maine	□	□	□	□	□
10.	Massachusetts	□	□	□	□	□
11.	New Hampshire	□	□	□	□	□
12.	Rhode Island	□	□	□	□	□
13.	Vermont	□	□	□	□	□

Based on your understanding of siting in this state, what do you think is the relative level of difficulty for transmission line siting in each of the states below? (Select one number below for each state.)

		Easiest									Hardest
14.	Connecticut	1	2	3	4	5	6	7	8	9	10
15.	Maine	1	2	3	4	5	6	7	8	9	10
16.	Massachusetts	1	2	3	4	5	6	7	8	9	10
17.	New Hampshire	1	2	3	4	5	6	7	8	9	10
18.	Rhode Island	1	2	3	4	5	6	7	8	9	10
19.	Vermont	1	2	3	4	5	6	7	8	9	10

Which one of the following factors do you think contributes most to siting difficulty in this state? (Check one box for each state.)

		Topography / Environment ▼	State Regulation ▼	Federal Regulation ▼	Public Opposition ▼	Inter-Agency Coordination ▼
20.	Connecticut	□	□	□	□	□
21.	Maine	□	□	□	□	□
22.	Massachusetts	□	□	□	□	□
23.	New Hampshire	□	□	□	□	□
24.	Rhode Island	□	□	□	□	□
25.	Vermont	□	□	□	□	□

Middle Atlantic

What is your highest level of familiarity with the transmission line siting process for each of the states below? (Check one box for each state).

		No familiarity with siting in this state ▼	Info from media/ literature ▼	Info from colleagues/ friends ▼	Worked on 1-3 siting projects ▼	Worked on more than 3 siting projects ▼
		▼	▼	▼	▼	▼
26.	Delaware	☐	☐	☐	☐	☐
27.	District of Columbia	☐	☐	☐	☐	☐
28.	Maryland	☐	☐	☐	☐	☐
29.	New Jersey	☐	☐	☐	☐	☐
30.	New York	☐	☐	☐	☐	☐
31.	Pennsylvania	☐	☐	☐	☐	☐

Based on your understanding of siting in this state, what do you think is the relative level of difficulty for transmission line siting in each of the states below? (Select one number below for each state.)

		Easiest									Hardest
32.	Delaware	1	2	3	4	5	6	7	8	9	10
33.	District of Columbia	1	2	3	4	5	6	7	8	9	10
34.	Maryland	1	2	3	4	5	6	7	8	9	10
35.	New Jersey	1	2	3	4	5	6	7	8	9	10
36.	New York	1	2	3	4	5	6	7	8	9	10
37.	Pennsylvania	1	2	3	4	5	6	7	8	9	10

Which one of the following factors do you think contributes most to siting difficulty in this state? (Check one box for each state.)

		Topography / Environment ▼	State Regulation ▼	Federal Regulation ▼	Public Opposition ▼	Inter-Agency Coordination ▼
38.	Delaware	☐	☐	☐	☐	☐
39.	District of Columbia	☐	☐	☐	☐	☐
40.	Maryland	☐	☐	☐	☐	☐
41.	New Jersey	☐	☐	☐	☐	☐
42.	New York	☐	☐	☐	☐	☐
43.	Pennsylvania	☐	☐	☐	☐	☐

East North Central

What is your highest level of familiarity with the transmission line siting process for each of the states below? (Check one box for each state).

		No familiarity with siting in this state ▼	Info from media/ literature ▼	Info from colleagues/ friends ▼	Worked on 1-3 siting projects ▼	Worked on more than 3 siting projects ▼
44.	Illinois	☐	☐	☐	☐	☐
45.	Indiana	☐	☐	☐	☐	☐
46.	Michigan	☐	☐	☐	☐	☐
47.	Ohio	☐	☐	☐	☐	☐
48.	Wisconsin	☐	☐	☐	☐	☐

Based on your understanding of siting in this state, what do you think is the relative level of difficulty for transmission line siting in each of the states below? (Select one number below for each state.)

		Easiest									Hardest
49.	Illinois	1	2	3	4	5	6	7	8	9	10
50.	Indiana	1	2	3	4	5	6	7	8	9	10
51.	Michigan	1	2	3	4	5	6	7	8	9	10
52.	Ohio	1	2	3	4	5	6	7	8	9	10
53.	Wisconsin	1	2	3	4	5	6	7	8	9	10

Which one of the following factors do you think contributes most to siting difficulty in this state? (Check one box for each state.)

		Topography / Environment ▼	State Regulation ▼	Federal Regulation ▼	Public Opposition ▼	Inter-Agency Coordination ▼
54.	Illinois	☐	☐	☐	☐	☐
55.	Indiana	☐	☐	☐	☐	☐
56.	Michigan	☐	☐	☐	☐	☐
57.	Ohio	☐	☐	☐	☐	☐
58.	Wisconsin	☐	☐	☐	☐	☐

West North Central

What is your highest level of familiarity with the transmission line siting process for each of the states below? (Check one box for each state).

		No familiarity with siting in this state ▼	Info from media/ literature ▼	Info from colleagues/ friends ▼	Worked on 1-3 siting projects ▼	Worked on more than 3 siting projects ▼
59.	Iowa	□	□	□	□	□
60.	Minnesota	□	□	□	□	□
61.	Nebraska	□	□	□	□	□
62.	North Dakota	□	□	□	□	□
63.	South Dakota	□	□	□	□	□

Based on your understanding of siting in this state, what do you think is the relative level of difficulty for transmission line siting in each of the states below? (Select one number below for each state.)

		Easiest									Hardest
64.	Iowa	1	2	3	4	5	6	7	8	9	10
65.	Minnesota	1	2	3	4	5	6	7	8	9	10
66.	Nebraska	1	2	3	4	5	6	7	8	9	10
67.	North Dakota	1	2	3	4	5	6	7	8	9	10
68.	South Dakota	1	2	3	4	5	6	7	8	9	10

Which one of the following factors do you think contributes most to siting difficulty in this state? (Check one box for each state.)

		Topography / Environment ▼	State Regulation ▼	Federal Regulation ▼	Public Opposition ▼	Inter-Agency Coordination ▼
69.	Iowa	□	□	□	□	□
70.	Minnesota	□	□	□	□	□
71.	Nebraska	□	□	□	□	□
72.	North Dakota	□	□	□	□	□
73.	South Dakota	□	□	□	□	□

South Atlantic

What is your highest level of familiarity with the transmission line siting process for each of the states below? (Check one box for each state).

		No familiarity with siting in this state ▼	Info from media/ literature ▼	Info from colleagues/ friends ▼	Worked on 1-3 siting projects ▼	Worked on more than 3 siting projects ▼
74.	Florida	◻	◻	◻	◻	◻
75.	Georgia	◻	◻	◻	◻	◻
76.	North Carolina	◻	◻	◻	◻	◻
77.	South Carolina	◻	◻	◻	◻	◻
78.	Virginia	◻	◻	◻	◻	◻
79.	West Virginia	◻	◻	◻	◻	◻

Based on your understanding of siting in this state, what do you think is the relative level of difficulty for transmission line siting in each of the states below? (Select one number below for each state.)

		Easiest									Hardest
80.	Florida	1	2	3	4	5	6	7	8	9	10
81.	Georgia	1	2	3	4	5	6	7	8	9	10
82.	North Carolina	1	2	3	4	5	6	7	8	9	10
83.	South Carolina	1	2	3	4	5	6	7	8	9	10
84.	Virginia	1	2	3	4	5	6	7	8	9	10
85.	West Virginia	1	2	3	4	5	6	7	8	9	10

Which one of the following factors do you think contributes most to siting difficulty in this state? (Check one box for each state.)

		Topography / Environment ▼	State Regulation ▼	Federal Regulation ▼	Public Opposition ▼	Inter-Agency Coordination ▼
86.	Florida	◻	◻	◻	◻	◻
87.	Georgia	◻	◻	◻	◻	◻
88.	North Carolina	◻	◻	◻	◻	◻
89.	South Carolina	◻	◻	◻	◻	◻
90.	Virginia	◻	◻	◻	◻	◻
91.	West Virginia	◻	◻	◻	◻	◻

East South Central

What is your highest level of familiarity with the transmission line siting process for each of the states below? (Check one box for each state).

		No familiarity with siting in this state ▼	Info from media/ literature ▼	Info from colleagues/ friends ▼	Worked on 1-3 siting projects ▼	Worked on more than 3 siting projects ▼
92.	Alabama	☐	☐	☐	☐	☐
93.	Kentucky	☐	☐	☐	☐	☐
94.	Louisiana	☐	☐	☐	☐	☐
95.	Mississippi	☐	☐	☐	☐	☐
96.	Tennessee	☐	☐	☐	☐	☐

Based on your understanding of siting in this state, what do you think is the relative level of difficulty for transmission line siting in each of the states below? (Select one number below for each state.)

		Easiest									Hardest
97.	Alabama	1	2	3	4	5	6	7	8	9	10
98.	Kentucky	1	2	3	4	5	6	7	8	9	10
99.	Louisiana	1	2	3	4	5	6	7	8	9	10
100.	Mississippi	1	2	3	4	5	6	7	8	9	10
101.	Tennessee	1	2	3	4	5	6	7	8	9	10

Which one of the following factors do you think contributes most to siting difficulty in this state? (Check one box for each state.)

		Topography / Environment ▼	State Regulation ▼	Federal Regulation ▼	Public Opposition ▼	Inter-Agency Coordination ▼
102.	Alabama	☐	☐	☐	☐	☐
103.	Kentucky	☐	☐	☐	☐	☐
104.	Louisiana	☐	☐	☐	☐	☐
105.	Mississippi	☐	☐	☐	☐	☐
106.	Tennessee	☐	☐	☐	☐	☐

West South Central

What is your highest level of familiarity with the transmission line siting process for each of the states below? (Check one box for each state).

	No familiarity with siting in this state ▼	Info from media/ literature ▼	Info from colleagues/ friends ▼	Worked on 1-3 siting projects ▼	Worked on more than 3 siting projects ▼
107. Arkansas	☐	☐	☐	☐	☐
108. Kansas	☐	☐	☐	☐	☐
109. Missouri	☐	☐	☐	☐	☐
110. Oklahoma	☐	☐	☐	☐	☐
111. Texas	☐	☐	☐	☐	☐

Based on your understanding of siting in this state, what do you think is the relative level of difficulty for transmission line siting in each of the states below? (Select one number below for each state.)

	Easiest									Hardest
112. Arkansas	1	2	3	4	5	6	7	8	9	10
113. Kansas	1	2	3	4	5	6	7	8	9	10
114. Missouri	1	2	3	4	5	6	7	8	9	10
115. Oklahoma	1	2	3	4	5	6	7	8	9	10
116. Texas	1	2	3	4	5	6	7	8	9	10

Which one of the following factors do you think contributes most to siting difficulty in this state? (Check one box for each state.)

	Topography / Environment ▼	State Regulation ▼	Federal Regulation ▼	Public Opposition ▼	Inter-Agency Coordination ▼
117. Arkansas	☐	☐	☐	☐	☐
118. Kansas	☐	☐	☐	☐	☐
119. Missouri	☐	☐	☐	☐	☐
120. Oklahoma	☐	☐	☐	☐	☐
121. Texas	☐	☐	☐	☐	☐

Mountain

What is your highest level of familiarity with the transmission line siting process for each of the states below? (Check one box for each state).

		No familiarity with siting in this state ▼	Info from media/ literature ▼	Info from colleagues/ friends ▼	Worked on 1-3 siting projects ▼	Worked on more than 3 siting projects ▼
122.	Colorado	☐	☐	☐	☐	☐
123.	Montana	☐	☐	☐	☐	☐
124.	New Mexico	☐	☐	☐	☐	☐
125.	Utah	☐	☐	☐	☐	☐
126.	Wyoming	☐	☐	☐	☐	☐

Based on your understanding of siting in this state, what do you think is the relative level of difficulty for transmission line siting in each of the states below? (Select one number below for each state.)

		Easiest									Hardest
127.	Colorado	1	2	3	4	5	6	7	8	9	10
128.	Montana	1	2	3	4	5	6	7	8	9	10
129.	New Mexico	1	2	3	4	5	6	7	8	9	10
130.	Utah	1	2	3	4	5	6	7	8	9	10
131.	Wyoming	1	2	3	4	5	6	7	8	9	10

Which one of the following factors do you think contributes most to siting difficulty in this state? (Check one box for each state.)

		Topography / Environment ▼	State Regulation ▼	Federal Regulation ▼	Public Opposition ▼	Inter-Agency Coordination ▼
132.	Colorado	☐	☐	☐	☐	☐
133.	Montana	☐	☐	☐	☐	☐
134.	New Mexico	☐	☐	☐	☐	☐
135.	Utah	☐	☐	☐	☐	☐
136.	Wyoming	☐	☐	☐	☐	☐

West Pacific

What is your highest level of familiarity with the transmission line siting process for each of the states below? (Check one box for each state).

		No familiarity with siting in this state ▼	Info from media/ literature ▼	Info from colleagues/ friends ▼	Worked on 1-3 siting projects ▼	Worked on more than 3 siting projects ▼
137.	Arizona	□	□	□	□	□
138.	California	□	□	□	□	□
139.	Idaho	□	□	□	□	□
140.	Nevada	□	□	□	□	□
141.	Oregon	□	□	□	□	□
142.	Washington	□	□	□	□	□

Based on your understanding of siting in this state, what do you think is the relative level of difficulty for transmission line siting in each of the states below? (Select one number below for each state.)

		Easiest									Hardest
143.	Arizona	1	2	3	4	5	6	7	8	9	10
144.	California	1	2	3	4	5	6	7	8	9	10
145.	Idaho	1	2	3	4	5	6	7	8	9	10
146.	Nevada	1	2	3	4	5	6	7	8	9	10
147.	Oregon	1	2	3	4	5	6	7	8	9	10
148.	Washington	1	2	3	4	5	6	7	8	9	10

Which one of the following factors do you think contributes most to siting difficulty in this state? (Check one box for each state.)

		Topography / Environment ▼	State Regulation ▼	Federal Regulation ▼	Public Opposition ▼	Inter-Agency Coordination ▼
149.	Arizona	□	□	□	□	□
150.	California	□	□	□	□	□
151.	Idaho	□	□	□	□	□
152.	Nevada	□	□	□	□	□
153.	Oregon	□	□	□	□	□
154.	Washington	□	□	□	□	□

THANK YOU

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APPENDIX B

Principal Component and Factor Analyses: Alternative Approaches

The organization of the analyses in Chapter 2 into a series of principal component analyses (PCA) before the overall factor analysis (FA) was intended to capture the shared variance among metrics within the same indicator. Although the sequential use of PCA and FA is atypical, we believe it is the most appropriate and sophisticated approach given the structure of the data. An alternative approach to this analysis is to simply input the original metrics from all four indicators directly into the factor analysis. This method yields final factor scores that are highly correlated with the results of the combined principal component and factor analyses. However, we would suggest that this solution is inappropriate for use here for two reasons. First, there is only one metric for the siting survey, and with all other indicators being represented by multiple, collinear metrics, the siting difficulty indicator is underrepresented. Second, this approach does not adequately take into account the common hypotheses connecting metrics under the same indicator and it over-emphasizes any other correlations among metrics between indicators. For example, the percent peak savings from optimal dispatch metric is significantly correlated with the populations unserved in all footprint radii; however, we are uninterested in an analysis that captures these correlations. Instead each indicator is hypothesized to be largely uncorrelated with the remaining indicators, and these correlations between metrics are extraneous to the analysis.

A check of the results of this approach, reveals that the resulting siting difficulty scores are correlated at 0.8 ($p < 0.001$) and the transmission demand scores are correlated at 0.96 ($p < 0.001$). Other possible approaches that avoid the problem of having unequal numbers of metrics representing each indicator, could include calculating a single score for each indicator based on a normalized sum or average of all selected metrics. Several such variations were also tested and the resulting factor scores are similarly highly correlated (> 0.7) with the final results in the chapter. Overall, these results validate the robustness of the selected approach.

Factor Analysis: Economic-3, Geographic-4, Construction-3, and Survey-1 Metrics
Principal Component Factor Analysis of the Correlation Matrix

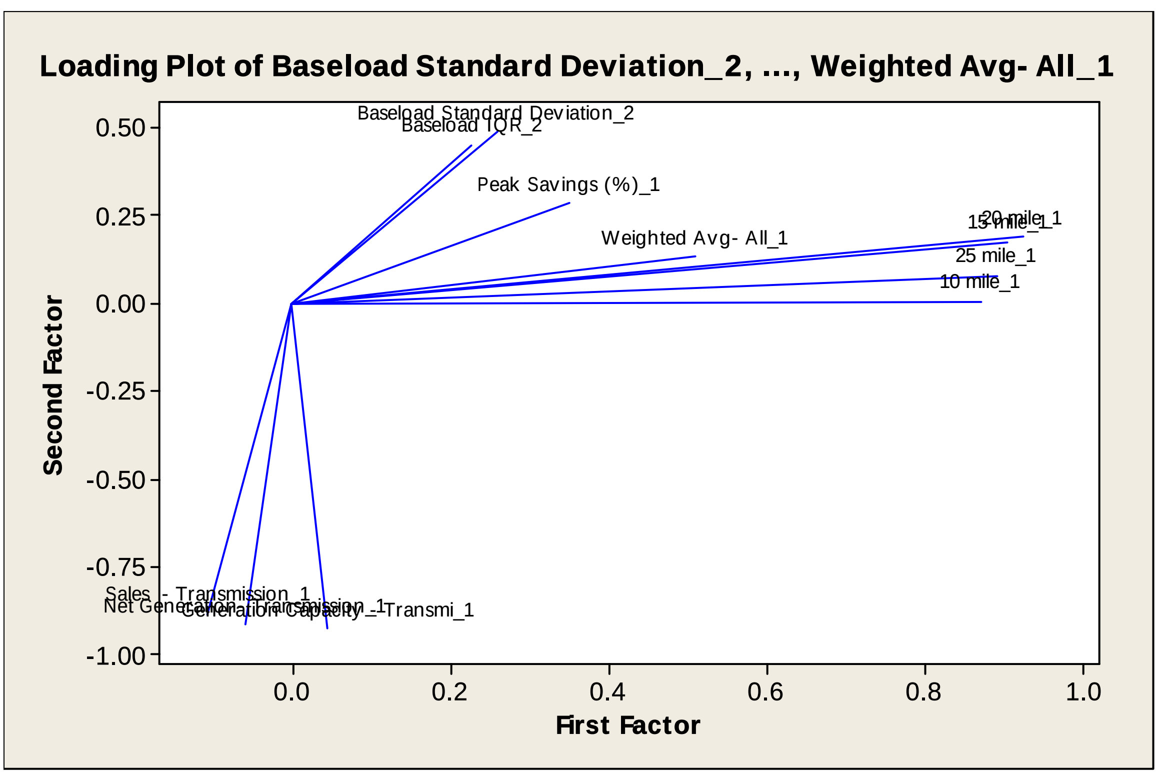
Rotated Factor Loadings and Communalities: Varimax Rotation

Variable	**Factor1**	**Factor2**	**Communality**
Baseload Standard Deviation	0.259	0.488	0.305
Baseload IQR	0.227	0.450	0.254
Peak Savings (%)	0.350	0.282	0.202
10 mile	0.870	0.005	0.757
15 mile	0.904	0.174	0.848
20 mile	0.924	0.190	0.889
25 mile	0.891	0.079	0.800
Net Generation- Transmission	-0.059	-0.916	0.842
Generation Cap. - Transmission	0.044	-0.928	0.863
Sales - Transmission	-0.106	-0.885	0.794

Survey Weighted Avg. Difficulty	0.510	0.132	0.277
Variance	3.7405	3.0930	6.8335
% Var	0.340	0.281	0.621

Factor Score Coefficients

Variable	Factor1	Factor2
Baseload Standard Deviation	0.033	0.148
Baseload IQR	0.027	0.138
Peak Savings (%)	0.077	0.069
10 mile	0.250	-0.072
15 mile	0.246	-0.016
20 mile	0.250	-0.012
25 mile	0.250	-0.048
Net Generation- Transmission	0.060	-0.314
Generation Cap. - Transmission	0.091	-0.327
Sales - Transmission	0.044	-0.299
Survey Weighted Avg. Difficulty	0.136	0.003



APPENDIX C

Chapter 3: Analyses of Siting Difficulty by Respondent Familiarity and Home State

The analyses in Section 4 of Chapter 3 are based on within-state correlation calculations of 1) respondents' familiarity and difficulty ratings and 2) respondents' ratings of state difficulty the average difficulty within their own home states. Table 1 (below) shows each of the 48 state-level correlations and their respective p-values for these two analyses. For the comparisons of familiarity and difficulty, 43 of the 48 correlations are greater than zero, and 19 of these correlations are significant at the $p<0.1$ level. As stated in the text, this slightly positive relationship between familiarity and difficulty indicates that subjects who are more familiar with siting in a state also perceive higher siting difficulty. For the second analysis, 36 of the 48 correlations are less than zero, indicating that respondents from higher-difficulty states perceive siting difficulty to be lower than those from low-difficulty states; however, none of these correlations are significant.

Table 2 presents the results of a combined state-level regression analyses with both familiarity and own state difficulty as predictors. The results of this analysis are very similar to those in Table 1, where the familiarity coefficient is positive and significant for 16 out of 48 states (Maine, Missouri, and New Hampshire are no longer significant), and the own state difficulty coefficient is negative and non-significant for 36 out of 48 states. In this analysis, only the coefficient of own state difficulty for New Jersey is both significant (and negative.)

Because subjects' responses for multiple states are not independent, it is not possible to compare correlations across states to test for significance. Also, a within-subject analysis of the slope of difficulty by familiarity shows that the average slope across all respondents is not significantly different than zero; however, we would argue that this is because familiarity is confounded with proximity. For example, subjects from the Midwest are likely to have high familiarity with siting in their own and other surrounding lower-difficulty states, and low familiarity with a perceived high-difficulty state, such as California. This resulting slope, where difficulty drops as familiarity increases, does not reflect the influence of familiarity on difficulty. Instead, it simply shows that subjects are more familiar with proximate states. Given the limited number of respondents with high siting experience in multiple states, it is not possible to test this within-subject or interaction without additional data.

		Within-State Correlation of Familiarity and Difficulty Ratings		Correlation of State Difficulty Ratings and Average Difficulty of Respondents' Own States of Employment	
State	*State ID*	*Correlation*	*P-value*	*Correlation*	*P-Value*
Alabama	AL	-0.101	0.66	-0.205	0.39
Arkansas	AR	0.280	0.22	-0.184	0.44
Arizona	AZ	-0.010	0.97	-0.090	0.73
California	CA	0.014	0.95	0.094	0.66
Colorado	CO	0.448	0.05	0.112	0.65
Connecticut	CT	0.030	0.89	0.031	0.89
Delaware	DE	0.235	0.29	-0.132	0.57
Florida	FL	0.596	0.00	-0.113	0.63
Georgia	GA	0.477	0.03	-0.173	0.45
Iowa	IA	0.361	0.08	-0.213	0.32
Idaho	ID	0.310	0.18	-0.357	0.13
Illinois	IL	0.377	0.06	-0.108	0.61
Indiana	IN	0.572	0.01	-0.107	0.66
Kansas	KS	0.524	0.02	-0.197	0.41
Kentucky	KY	0.198	0.37	-0.195	0.40
Louisiana	LA	0.029	0.90	-0.209	0.39
Massachusetts	MA	0.254	0.24	-0.204	0.36
Maryland	MD	0.564	0.00	0.024	0.91
Maine	ME	0.342	0.09	-0.089	0.68
Michigan	MI	0.283	0.22	0.180	0.45
Minnesota	MN	0.521	0.01	-0.240	0.24
Missouri	MO	0.359	0.09	-0.248	0.25
Mississippi	MS	0.068	0.77	-0.286	0.24
Montana	MT	0.259	0.23	-0.090	0.69
North Carolina	NC	0.223	0.32	-0.170	0.46
North Dakota	ND	-0.044	0.84	0.114	0.60
Nebraska	NE	0.252	0.30	0.056	0.83
New Hampshire	NH	0.384	0.07	-0.127	0.57
New Jersey	NJ	0.330	0.10	-0.281	0.17
New Mexico	NM	0.340	0.12	-0.076	0.75
Nevada	NV	-0.053	0.82	-0.295	0.21
New York	NY	0.336	0.06	0.077	0.68
Ohio	OH	0.017	0.94	0.158	0.47
Oklahoma	OK	0.491	0.03	-0.118	0.64
Oregon	OR	0.097	0.69	-0.230	0.36
Pennsylvania	PA	0.160	0.42	-0.135	0.50
Rhode Island	RI	0.241	0.28	-0.014	0.95
South Carolina	SC	0.274	0.23	-0.230	0.33
South Dakota	SD	0.174	0.43	0.150	0.51
Tennessee	TN	0.421	0.05	-0.068	0.78
Texas	TX	0.468	0.02	-0.181	0.41
Utah	UT	0.577	0.01	-0.163	0.49
Virginia	VA	0.269	0.18	0.051	0.81
Vermont	VT	0.200	0.39	0.001	1.00
Washington	WA	0.206	0.40	-0.099	0.70
Wisconsin	WI	0.670	0.00	-0.156	0.43
West Virginia	WV	-0.122	0.60	-0.030	0.90
Wyoming	WY	0.262	0.23	-0.050	0.83

Table 1. Correlation of Familiarity and Own State Difficulty with State Difficulty Ratings.

		Constant		Familiarity		Own State Difficulty		
State	*State ID*	*Coefficient*	*P-value*	*Coefficient*	*P-value*	*Coefficient*	*P-Value*	*R-square*
Alabama	AL	10.181	0.05	-0.120	0.75	-0.655	0.39	0.048
Arkansas	AR	7.143	0.07	0.376	0.27	-0.377	0.51	0.103
Arizona	AZ	8.496	0.18	-0.069	0.88	-0.319	0.73	0.01
California	CA	5.462	0.23	0.165	0.71	0.310	0.63	0.015
Colorado	CO	3.097	0.42	0.882	0.06	0.323	0.58	0.221
Connecticut	CT	7.051	0.06	0.043	0.93	0.073	0.89	0.001
Delaware	DE	8.163	0.05	0.715	0.25	-0.502	0.41	0.09
Florida	FL	7.063	0.03	1.007	0.00	-0.368	0.43	0.422
Georgia	GA	6.639	0.09	0.670	0.04	-0.345	0.54	0.247
Iowa	IA	7.353	0.02	0.510	0.10	-0.390	0.40	0.163
Idaho	ID	10.941	0.02	0.411	0.26	-0.923	0.18	0.196
Illinois	IL	6.026	0.12	0.621	0.08	-0.259	0.65	0.145
Indiana	IN	4.525	0.23	0.879	0.01	-0.023	0.97	0.327
Kansas	KS	7.463	0.02	0.795	0.02	-0.508	0.28	0.324
Kentucky	KY	7.682	0.08	0.233	0.45	-0.370	0.55	0.07
Louisiana	LA	9.381	0.06	0.162	0.74	-0.580	0.42	0.051
Massachusetts	MA	9.721	0.01	0.605	0.16	-0.590	0.27	0.139
Maryland	MD	6.693	0.02	0.830	0.01	-0.203	0.62	0.32
Maine	ME	6.405	0.10	0.753	0.10	-0.256	0.65	0.128
Michigan	MI	1.625	0.66	0.467	0.21	0.540	0.33	0.121
Minnesota	MN	8.404	0.01	0.980	0.01	-0.602	0.20	0.333
Missouri	MO	7.737	0.05	0.420	0.13	-0.474	0.40	0.167
Mississippi	MS	9.888	0.03	0.131	0.73	-0.684	0.27	0.089
Montana	MT	6.163	0.12	0.412	0.25	-0.154	0.79	0.077
North Carolina	NC	7.620	0.06	0.276	0.38	-0.400	0.50	0.07
North Dakota	ND	3.231	0.43	-0.026	0.94	0.288	0.63	0.013
Nebraska	NE	3.426	0.37	0.358	0.27	0.228	0.68	0.083
New Hampshire	NH	7.516	0.03	0.863	0.11	-0.342	0.49	0.146
New Jersey	NJ	12.120	0.00	1.032	0.02	-1.161	0.03	0.272
New Mexico	NM	5.693	0.15	0.495	0.13	-0.055	0.92	0.128
Nevada	NV	12.851	0.02	-0.160	0.66	-1.015	0.20	0.098
New York	NY	8.291	0.01	0.594	0.06	-0.375	0.46	0.132
Ohio	OH	2.084	0.67	0.072	0.83	0.537	0.46	0.027
Oklahoma	OK	6.295	0.07	0.780	0.04	-0.318	0.53	0.26
Oregon	OR	10.776	0.04	0.168	0.63	-0.678	0.37	0.068
Pennsylvania	PA	8.380	0.01	0.243	0.40	-0.396	0.41	0.047
Rhode Island	RI	6.225	0.07	0.478	0.35	-0.014	0.98	0.048
South Carolina	SC	8.810	0.04	0.353	0.26	-0.582	0.34	0.122
South Dakota	SD	1.326	0.71	0.357	0.30	0.487	0.34	0.077
Tennessee	TN	4.423	0.22	0.630	0.06	0.013	0.98	0.193
Texas	TX	5.738	0.10	0.733	0.03	-0.334	0.51	0.243
Utah	UT	5.353	0.13	1.027	0.01	-0.150	0.77	0.341
Virginia	VA	5.316	0.14	0.369	0.22	0.057	0.92	0.07
Vermont	VT	6.308	0.13	0.302	0.42	0.028	0.96	0.039
Washington	WA	8.161	0.12	0.345	0.43	-0.280	0.72	0.052
Wisconsin	WI	6.487	0.02	1.183	0.00	-0.396	0.34	0.487
West Virginia	WV	6.225	0.10	-0.251	0.47	-0.041	0.94	0.031
Wyoming	WY	5.042	0.22	0.507	0.25	-0.076	0.90	0.071

Table 2. Regression of Familiarity and Own State Difficulty on State Siting Difficulty Ratings

Regression Analysis with Interaction Terms by Geography
An Evaluation of Differences between Coastal and Interior States

This analysis was conducted to test the robustness of the regression model and original predictors to changes in geography. All states with significant coastlines along the Atlantic Ocean, Gulf of Mexico and Pacific Ocean were coded as coastal states (n=17), and all others were coded as zeros. The multiplicative interaction terms with all three initial factor scores were also included in the analysis. Results show that all original predictors remain significant at the $p<0.1$ level, and the slightly higher coefficients for all three factors indicate that interior states have higher difficulty associated with all factors. Additionally, the coast*public interaction variable is negative and significant, which indicates far lower public-related difficulty in coastal states than interior states.

Difficulty = 0.132 + 0.875 Public + 0.570 Enviroment + 0.202 Regulation - 0.069 Coast - 0.542 Coast*Public - 0.048 Coast*Enviro + 0.151 Coast*Reg

Predictor	Coef	SE Coef	T	P
Constant	0.1323	0.1309	1.01	0.318
Public	0.8751	0.1451	6.03	0.000
Enviro	0.5695	0.1207	4.72	0.000
Regulation	0.2016	0.1165	1.73	0.091
Coast	-0.0692	0.2295	-0.30	0.765
Coast*Public	-0.5420	0.2137	-2.54	0.015
Coast*Enviro	-0.0478	0.2294	-0.21	0.836
Coast*Reg	0.1512	0.1950	0.78	0.443

N= 48 S = 0.596 R-Sq = 69.7% R-Sq(adj) = 64.4%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	7	32.7678	4.6811	13.16	0.000
Residual Error	40	14.2322	0.3558		
Total	47	47.0000			

Source	DF	Seq SS
Public	1	18.2903
Enviro	1	10.2955
Regulation	1	1.5605
Coast	1	0.0607
Coast*Public	1	2.3242
Coast*Enviro	1	0.0228
Coast*Reg	1	0.2138

Unusual Observations

Obs.	Public	Difficulty	Fit SE	Fit	Residual	St Resid
8 (FL)	-0.94	1.4243	0.6875	0.4605	0.7368	1.94 X *(large influence)*
25 (NE)	-0.82	0.0016	-1.1975	0.1972	1.1991	2.13R *(large standardized residual)*

APPENDIX D

Mapping Survey Protocol

General Information:

Age: _______

Sex: M F

Zip code where you live: ____

How long have you lived in this zip code? __________________

Do you own or rent your home? __________________________

Zip code where you work: _______________________________________

Household Income:

- ❑ less than $10,000
- ❑ between $15,000 and $25,000
- ❑ between $25,000 and $50,000
- ❑ between $50,000 and $100,000
- ❑ more than $100,000

Education:

- ❑ Some high school but no degree
- ❑ High school degree
- ❑ Some college but no degree
- ❑ Trade school
- ❑ College degree
- ❑ Graduate or Professional degree

Please answer the following questions.

Do you have access to public transportation?... □ Yes □ No

How many minutes away is the nearest bus stop? .... ______________

How long does it usually take you to get to work? .... ______________

How do you get to work (bus, car, walking)?.. ______________

If it were possible, would you want your work closer to home?........................... □ Yes □ No

Where do you usually buy groceries? (example: Giant Eagle on Centre) .... ____________

How do you get to the grocery store (bus, car, walking)? .... ______________

If it were possible, would you want your grocery store closer to home?.............. □ Yes □ No

How many times per week do you eat dinner out? .... ______________

List several of places you usually go to when you go out: ____________________________

____

How do you usually get there (bus, car, walking)? .... ______________

If it were possible, would you want these places closer to home?......................... □ Yes □ No

How many times per week do you use public resources (parks, libraries, etc.)? ________

Where is the public resource (park, library, etc.) that you use most often? ______________

How do you usually get there (bus, car, walking)? .... ______________

If it were possible, would you want these places closer to home?......................... □ Yes □ No

Your Neighborhood

Please list the three best and three worst things about your neighborhood

Best: *1.* ______________________________

2. ______________________________

3. ______________________________

Worst: *1.* ______________________________

2. ______________________________

3. ______________________________

What You Value in a Neighborhood or Community:

Listed below are 11 features that people may consider when evaluating a neighborhood. Think about what is important to you and rank these features in order of importance from 1 (most important) to 11 (least important).

Access to amenities (parks, playgrounds, entertainment, etc.) ________

Community organizations (church, YMCA, daycare, etc.) ________

Community stability (long-term residence) ________

Convenient shopping (grocery, drugstore, general retail, etc,) ________

Living close to work (local job opportunities) ________

Neighborhood appearance (maintenance of properties) ________

Neighborhood interaction/ sense of "community" ________

Neighborhood safety ________

Quality of local schools ________

Quality of public services (mail, utilities, sanitation, etc.) ________

Ties to surrounding neighborhoods and the region ________

Evaluating Your Neighborhood or Community:

Listed below are the same 11 features from the previous section. Now think about your own neighborhood and assess how well it does for each of these features. Rate each feature on the scale to the right from 1(poor) to 5 (excellent).

	Poor		OK		Excellent
Access to amenities (parks, playgrounds, entertainment, etc.)_____	1	2	3	4	5
Community organizations (church, YMCA, daycare, etc.)________	1	2	3	4	5
Community stability (long-term residents)____________________	1	2	3	4	5
Convenient shopping (grocery, drugstore, general retail, etc.)_____	1	2	3	4	5
Living close to work (local job opportunities)_________________	1	2	3	4	5
Neighborhood appearance (maintenance of properties)_________	1	2	3	4	5
Neighborhood interactions/ sense of "community"____________	1	2	3	4	5
Neighborhood safety_____________________________________	1	2	3	4	5
Quality of local schools___________________________________	1	2	3	4	5
Quality of public services (mail, utilities, sanitation, etc.)_________	1	2	3	4	5
Ties to surrounding neighborhoods and the region_____________	1	2	3	4	5

Evaluating Other Communities:

Think about each of the neighborhoods listed below and assess how well you think each of these features is provided for in that neighborhood. Rate each feature from 1(poor) to 5 (excellent).

Squirrel Hill

	Poor		OK		Excellent
Access to amenities (parks, playgrounds, entertainment, etc.)_____	1	2	3	4	5
Community organizations (church, YMCA, daycare, etc.)________	1	2	3	4	5
Community stability (long-term residents)____________________	1	2	3	4	5
Convenient shopping (grocery, drugstore, general retail, etc.)_____	1	2	3	4	5
Living close to work (local job opportunities)_________________	1	2	3	4	5
Neighborhood appearance (maintenance of properties)_________	1	2	3	4	5
Neighborhood interactions/ sense of "community"____________	1	2	3	4	5
Neighborhood safety______________________________________	1	2	3	4	5
Quality of local schools____________________________________	1	2	3	4	5
Quality of public services (mail, utilities, sanitation, etc.)_________	1	2	3	4	5
Ties to surrounding neighborhoods and the region_____________	1	2	3	4	5

East Liberty

	Poor		**OK**		**Excellent**
Access to amenities (parks, playgrounds, entertainment, etc.)_____	1	2	3	4	5
Community organizations (church, YMCA, daycare, etc.)________	1	2	3	4	5
Community stability (long-term residents)____________________	1	2	3	4	5
Convenient shopping (grocery, drugstore, general retail, etc.)_____	1	2	3	4	5
Living close to work (local job opportunities)_________________	1	2	3	4	5
Neighborhood appearance (maintenance of properties)_________	1	2	3	4	5
Neighborhood interactions/ sense of "community"____________	1	2	3	4	5
Neighborhood safety______________________________________	1	2	3	4	5

Quality of local schools	1	2	3	4	5
Quality of public services (mail, utilities, sanitation, etc.)	1	2	3	4	5
Ties to surrounding neighborhoods and the region	1	2	3	4	5

Homestead

	Poor		OK		Excellent
Access to amenities (parks, playgrounds, entertainment, etc.)	1	2	3	4	5
Community organizations (church, YMCA, daycare, etc.)	1	2	3	4	5
Community stability (long-term residents)	1	2	3	4	5
Convenient shopping (grocery, drugstore, general retail, etc.)	1	2	3	4	5
Living close to work (local job opportunities)	1	2	3	4	5
Neighborhood appearance (maintenance of properties)	1	2	3	4	5
Neighborhood interactions/ sense of "community"	1	2	3	4	5
Neighborhood safety	1	2	3	4	5
Quality of local schools	1	2	3	4	5
Quality of public services (mail, utilities, sanitation, etc.)	1	2	3	4	5
Ties to surrounding neighborhoods and the region	1	2	3	4	5

Mount Lebanon

	Poor		OK		Excellent
Access to amenities (parks, playgrounds, entertainment, etc.)	1	2	3	4	5
Community organizations (church, YMCA, daycare, etc.)	1	2	3	4	5
Community stability (long-term residents)	1	2	3	4	5
Convenient shopping (grocery, drugstore, general retail, etc.)	1	2	3	4	5
Living close to work (local job opportunities)	1	2	3	4	5
Neighborhood appearance (maintenance of properties)	1	2	3	4	5
Neighborhood interactions/ sense of "community"	1	2	3	4	5
Neighborhood safety	1	2	3	4	5
Quality of local schools	1	2	3	4	5
Quality of public services (mail, utilities, sanitation, etc.)	1	2	3	4	5
Ties to surrounding neighborhoods and the region	1	2	3	4	5

APPENDIX E

Chapter 5: Mapping Interview Protocols

CMU Neighborhood Study: Interview Protocols (Part 1)

Briefly introduce the project to the subject. Begin with a description of what types of maps the project is trying to collect and how the subjects' participation is important. Emphasize that drawing skills or map-making skills are not required; however, the subject should carefully consider size, shape, icons, and how objects on the map relate to one another.

The goal of this session is for you to draw a map. There are sheets of paper, pens and pencils here for you. I will ask you specific questions about places in your community, and you should answer the questions by adding locations that you identify from the question on to your map. NO TEXT! *Think carefully about the sizes, shapes, and symbols that you use. If you run out of room on your paper, don't worry- you can add other sheets of paper to your map. Try to define the neighborhood in a way that someone new to the area would be able to recognize the symbols without any labels or text. Do you have any questions about the project?*

Okay, let's begin.

1. I'd like you to start by thinking about all of the places in the region that you go regularly. Think about how big your range of travel is, and now please begin by locating and drawing your home on the sheet of paper in front of you. Think carefully about how your home and the area immediately surrounding it look.

2. *How many people live in your household?*

3. Now I am going to ask you about your daily activities. Are you employed? Full-time or part-time?
   a. Yes, full-time. Go to question 4.
   b. Yes, part-time. Go to question 4.
   c. No (school, retired, other, etc.) Go to question 7.

4. Do you work outside of your home or do you work at home?
   a. Outside of home.
   b. At home. Go to question 6.

5. Where do you work? Now I want you to think carefully about how you get to work and where your workplace is in relation to your home.
   Do you stop anywhere along the way regularly? If so, where?

   Do you make any trips regularly from work? If so, where?

If subject answers "No" for trips made from work add additional "What about…" prompts. Such as "What about lunch? Do you leave the office regularly for lunch or do you pack a lunch from home?"

6. Do you make any work related rips from home?
   a. Yes. If so, where, how often, and how do you get there?
   b. No. Go to question 7.

If subject spends substantial amounts of time traveling to various client offices. Ask the subject to simply define a "range of work" boundary containing the majority of his regular or frequent trips.

7. Where do you spend the most time outside of your home/work? Locate and draw this space on the map. Again think carefully about where you usually come from to get there and how it relates to the other places on the map.
   a. School
   b. Public space (library, park, etc.)
   c. Community center
   d. Other- Where?

8. Okay, now I'd like you to think carefully about other regular activities and trips that you make. What are they?

As the subject begins to list, identify, and locate these places, continue to prompt her about the symbols used and the relationship of places to one another. These trips may include the following, but if not, prompt the subject "What about …?"

- Groceries- Do you buy all of your groceries in one place? Separate trips for ethnic foods, fruits, vegetables, etc?
- Other shopping- furniture, clothing, etc.
- Entertainment- Movies, restaurants, clubs, concerts, etc.
- Religious or community activities

- Medical- Doctor, dentist, clinic, psychiatric treatment, etc.
- Exercise- Park, gym, health club, etc.
- Dropping someone off/ Picking someone up- Do you regularly take or accompany a child, neighbor, friend anywhere? If so, where?
- Trips to visit family/friends- Where? How often?
- Other services- car repair, haircut, bank, etc.

9. Look back on the places that you already have on the map. Now think about any places of special significance to you that are not included on the map. Draw any of these favorite or important places on the map. These can be places that you don't go to regularly or even at all, but that you appreciate and have significance to you personally.
    - Park
    - Monument/ Sculpture
    - Religious Institution or site
    - Other
    - Occasional trips to visit family or friends

10. Okay, I'd like you to look at your map again and now draw a line around everything on the map that is in your neighborhood or community. From now on all of the questions that I will ask you focus specifically on your neighborhood.

11. Now I'd like you to think about any landmarks or significant places for the community. For example, if you were giving someone directions through your neighborhood what features might you use to describe the place? Think about places that may define your community even though you may not use them or go there.

    - Physical / Descriptive features- Hill, Lake, River, Cemetery
    - Landmarks/ monuments
    - Other

12. Look again at the area defining your neighborhood, and think about the three best and worst things that you identified earlier about your neighborhood. What are the areas of concern or spaces that need improvement in your neighborhood? Is there anything that you would like to see taken away form the community?

Prompts may include the following: What are the negative aspects of your community that you would like to see improved? Are there any high crime areas? Are there any rundown spaces in the community? Any spaces that you would warn a newcomer to the area to stay away from?

13. What are some of the positive aspects or benefits of your community? Is there anything more that you would like to see added to your neighborhood?

14. Now I want you to take one final look at your map and see if there is anything missing that is important to you. Do you feel that this map accurately and adequately describes your activities and community? Is there anything that you would like to add to the map or take away from it?

15. Do you feel like the places that you've identified have an appropriate relationship to one another on the map? Are they far enough? Close enough?

16. What is the thing that you would miss most if it disappeared from your map?

This may include a place, person, thing, etc.

17. Now I'm going to ask you to quickly identify how far some of the key places on your map are from each other.

Start with the distance between home and work. Also ask for the street address and zipcode of the home. Pick two to three other major locations to get an idea of where things are actually located. Ask for distance in both miles and minutes.

18. Would you rather have these distances that I've asked you about presented in miles or minutes?

Congratulations- you're finished! Do you have any questions about this exercise?

Please feel free to take the next few minutes to make any changes that you would like to the map. I will be contacting you in one week to arrange another brief meeting to discuss the map you just created and other related maps. Thank you for your time …

Remind subject again to remember their participant number from the survey and the map for the next session.

APPENDIX F

Chapter 5: Evaluation Interview Protocols

CMU Neighborhood Study: Interview Protocols (Part 2)

Briefly remind the subject that this session is a continuation of the mapping project they started before. Explain to the subject that this session will take between 30-45 minutes and the subject is NOT required to do any drawing.

The goal of this session is for you to answer some questions about the map you drew the last time we met, and also some new maps. Do you have any questions about the project?

Okay, let's begin.

1. The first map I'm going to show you today is your original map from a couple of weeks ago. Does this look familiar?

(In general, subjects will recognize their maps, although they map express some surprise or confusion about details, symbols, or specific locations on their maps. If the subject asks specific questions about what certain symbols represent, etc. move immediately to the computer version of their map without answering the question. Do not give the subject any information about their own map prior to filling out the symbol identification sheet.)

2. Now I have another version of your own map for you. This map is just a cleaned-up version of your own map at your personal scale. It should be almost exactly the same, although some of the symbols may be a combination of both your own and symbols used by other individuals in the study. I would like you to take a moment and compare the two maps and see if there is anything that looks unfamiliar. Please feel free to add or change anything on this version of your map. Are you comfortable with this new version of your map?

3. Okay, you won't need your original map any longer so I'm going to put that aside, and I'd also like you to flip over your personal scale map so that you can no longer see it. Now I'd like you to fill out this symbol sheet. On the sheet are both some of your own symbols and also some that other individuals have drawn, and I would like you to

identify as best as you can the **type of place** that you think each symbol represents. (Strongly emphasize that the subject should not just identify what the symbol it is but what kind of space or place it represents.) Please go through the entire sheet and identify as many of these places as possible, and then place a star by any remaining symbols that you cannot identify. (See p.178 for a sample symbol sheet)

If there are any remaining symbols that the subject was unable to identify, ask the subject to flip over their personal scale map and use this to help them identify any remaining symbols.

4. Take a minute to go over the symbol sheet with the subject, explaining any symbols they missed or were unclear about. Also clarify any alternate meanings of symbols they did identify. (For example, the gun symbol has been identified by other subjects as crime, a police station, or a shooting range; however in all of the following maps it is intended to represent ...)

5. Okay, now I have several different versions of your own map for you to look at. (Emphasize that these are based on the subjects own map and are intended to represent the subject's own neighborhood and range of activities.) The first two maps I have for you are Distance scale maps. These maps are scaled in miles and represent the actual locations of the places you indicated on your own map relative to the city. (Take a moment to point out the rivers and other identifying landmarks if the subject does not understand.) Now these next few maps are also transformations of your own map- these maps are based on a time scale. Each of the rings on the time scale map represents a certain number of minutes away from your home. When you were drawing your own map during the last session, you were asked to identify what modes of transportation you used and how long it took you to get to the locations on your map. These time scale maps are based on that information. Do you have any questions?

6. Now ask a series of comprehension questions to familiarize the subject with the maps and the different displays. Remind the subject to use the maps! The subject should not simply give you the answer based on what they already know.

    a. Locate and point to your home on all of the maps.
    b. Locate and point to your work on all of the maps.
    c. Using the map- please tell me how far it is from your home to your work in miles and how long in minutes it would take you to get there by all of the modes of transportation indicated here?
    d. How far is the closest grocery store in miles and how long does it take to get there in minutes by car and by walking?

Continue with this type of questioning using other locations such as the park, movie theater, mall, etc. until the subject is fairly proficient with using the maps.

7. Now I am going to ask you a couple of questions just about the types of maps in front of you, and I would like you to tell me which map you prefer to use.
    a. Which map would you use if you were describing your neighborhood to someone from out-of-state?
    b. Which map would you use if you were describing your neighborhood to someone who was considering moving in to the area?
    c. Which map would you use if you were describing your neighborhood to another Pittsburgher who is from the region but now necessarily form your community?
    d. Which map would you use to give directions?

If the subject has used only the distance or only the time displays for the previous questions then ask: Can you think of any reason where you would use these other maps?

8. Ask the subject to place the maps of their own neighborhood off to the side- and give the subject the maps for Neighborhood A. Explain that Neighborhood A does not exist. This is a fictional neighborhood completely different from the subject's own.

9. Conduct the same comprehension exercise from the subject's own neighborhood: Remind the subject to use the maps! The subject should not give you the answer based on their own neighborhood- continue to remind them to answer based on the information for Neighborhood A.

    a. Locate and point to your home on all of the maps.
    b. Locate and point to your work on all of the maps.
    c. Using the map- please tell me how far it is from your home to your work in miles and how long in minutes it would take you to get there by all of the modes of transportation indicated here?
    d. How far is the closest grocery store in miles and how long does it take to get there in minutes by car and by walking?

Continue with this type of questioning using other locations such as the park, movie theater, mall, etc. until the subject demonstrates an understanding of the characteristics of Neighborhood A.

10. Now I'd like you to tell me about this neighborhood- describe the neighborhood and the region. Tell me what you like about the neighborhood and what you dislike.

Prompts may include: Imagine that you are living in this neighborhood… Do you like where you live? Do you like where you work?

11. Which neighborhood do you prefer, your own neighborhood or Neighborhood A? Why?

12. Now remove Neighborhood A from the table and repeat the same process with Neighborhood B including the comprehension and preference questions. Which neighborhood do you prefer, your own neighborhood or Neighborhood B? Why?

13. Now I have one last question for you – Between Neighborhoods A and B, do you prefer Neighborhood A or Neighborhood B? Why?

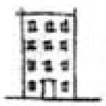
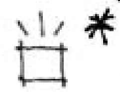
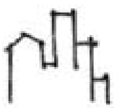
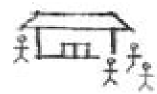
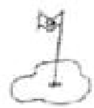
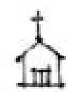
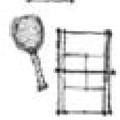
Congratulations- you're finished! Do you have any questions about this exercise?

Take a moment to explain the purpose of the exercise to the subject, and the overall goal of the project. Thank the subject for his time.

Participant # 10

Symbols and Icons

Look at each of the symbols and icons below and without looking at any maps fill in the blanks with the *type of place* each symbol represents or describes.

	House		Barber Shop		Travel
	Pool - Swimming		Coffee Shop		Library
	Hirise		Art		Food place
	Row House		Bank		Home
	Restaurant				Basket Ball Court
			River		church
	Trees		Fish Store		clothing store
	School		Dope		Gun
	Bar		Restaurant		Hospital
	Cleaners		Recreation		Supermarket

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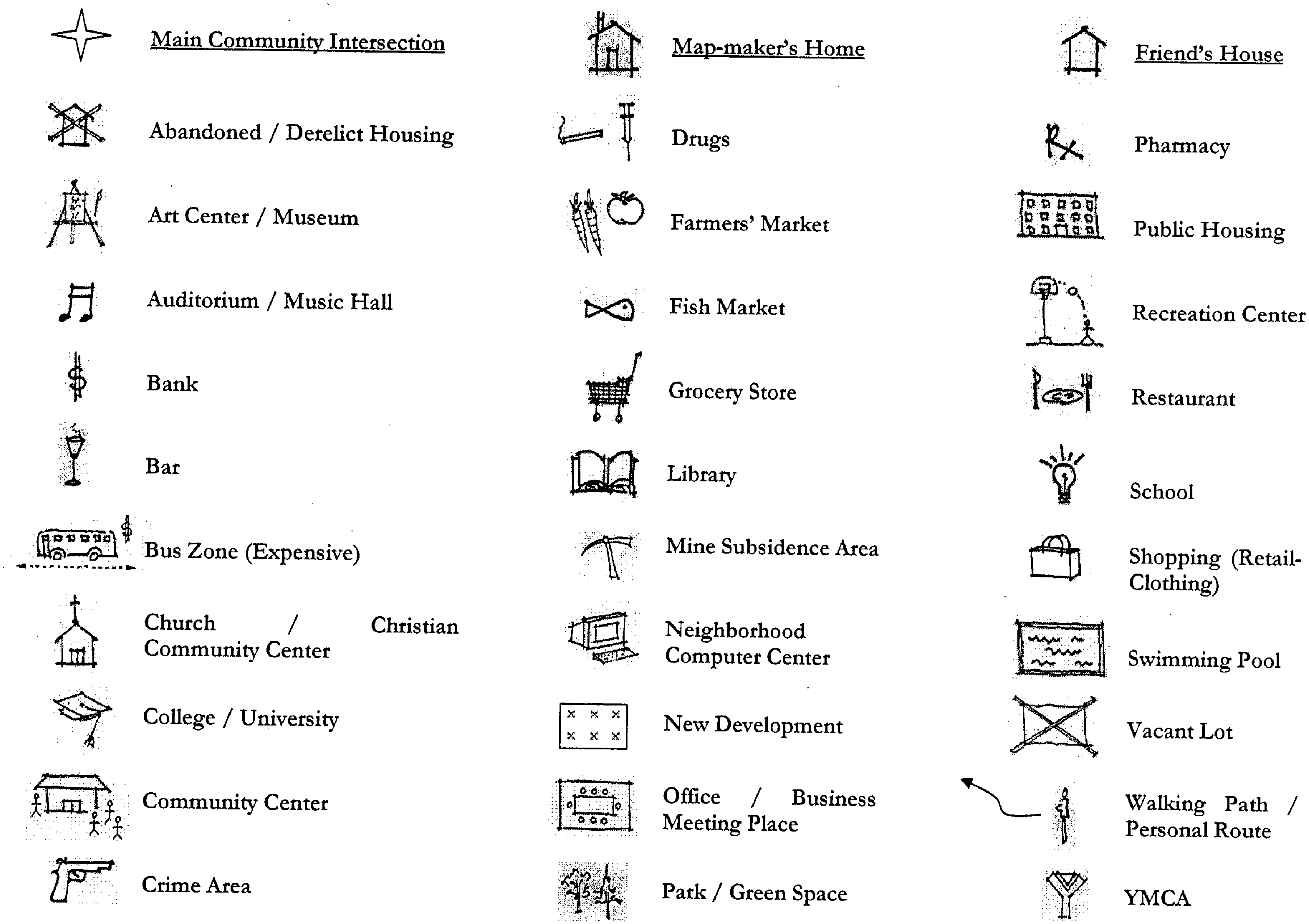
APPENDIX G

Chapter 6: Survey Booklets

This appendix includes the two survey booklets used in Chapter 6 and their respective map legends and symbol keys. Booklets were printed double-sided on 11" x 17" paper, folded in half, and stapled up the middle. Because of the type of binding used here, both booklets were reprinted as 8 ½" by 11" sheets, and the maps in the booklets as they are shown here, could be missing some information at the inside margin.

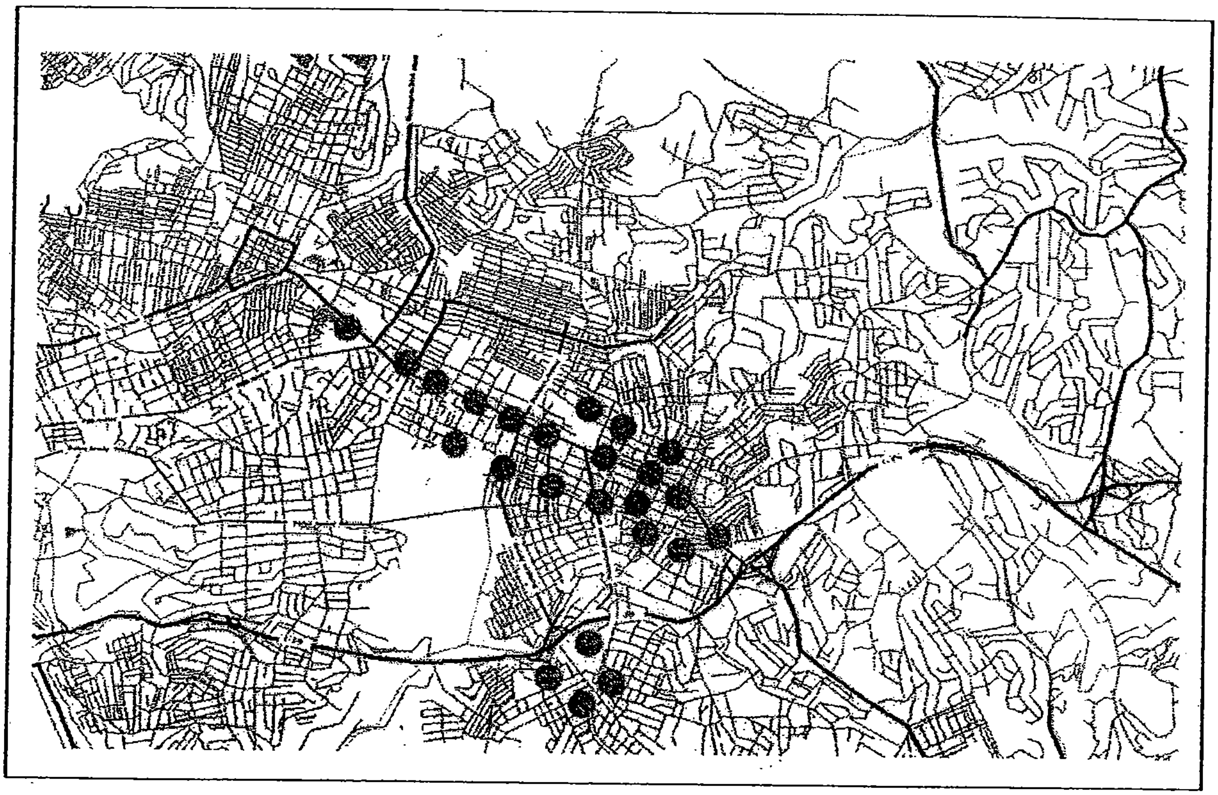
The first booklet includes maps from the Hill District and the second represents Squirrel Hill.

Symbol Key (Hill District)



Carnegie Mellon University

Neighborhood Survey



2004 Mon Valley Providers Council

Dave Coplan
Executive Director
519 Penn Avenue
Turtle Creek, PA 15145

Survey Number _____

Part 1

This survey is part of an effort to learn what is important to people about their neighborhoods, and to improve local participation in development planning and decision making. We have been using a process called "community mapping" to gather neighborhood information and understand different residents' priorities, preferences, and perceptions of their own and other communities.

The first section of this survey includes some simple questions about different neighborhoods. First we would like you to think about what is important to you about a neighborhood in general. Then we would like you to evaluate your own neighborhood. Finally, you will review a computer-generated map of an urban neighborhood in the eastern United States, and answer a series of questions about this neighborhood.

[CONTINUE]

Listed below are 10 characteristics that residents may feel are important about their communities. Think about what is important to you and rank the features below in order of importance from 1 (most important), 2 (next most important, etc.) to 10 (least important).

1. **What is most important to you about a neighborhood?** (Rank all 10 features. Write 1 in the space beside the feature you think is most important and 10 beside the least important.)

Access to amenities *(parks, entertainment, etc.)*	______
Community organizations *(YMCA, religious ctr., etc.)*	______
Community stability *(long-term residency)*	______
Convenience of shopping *(grocery, retail, etc.)*	______
Living close to work *(local job opportunities)*	______
Neighborhood appearance	______
Neighborhood interaction / sense of "community"	______
Neighborhood safety	______
Quality of local schools	______
Ties to surrounding neighborhoods and region	______

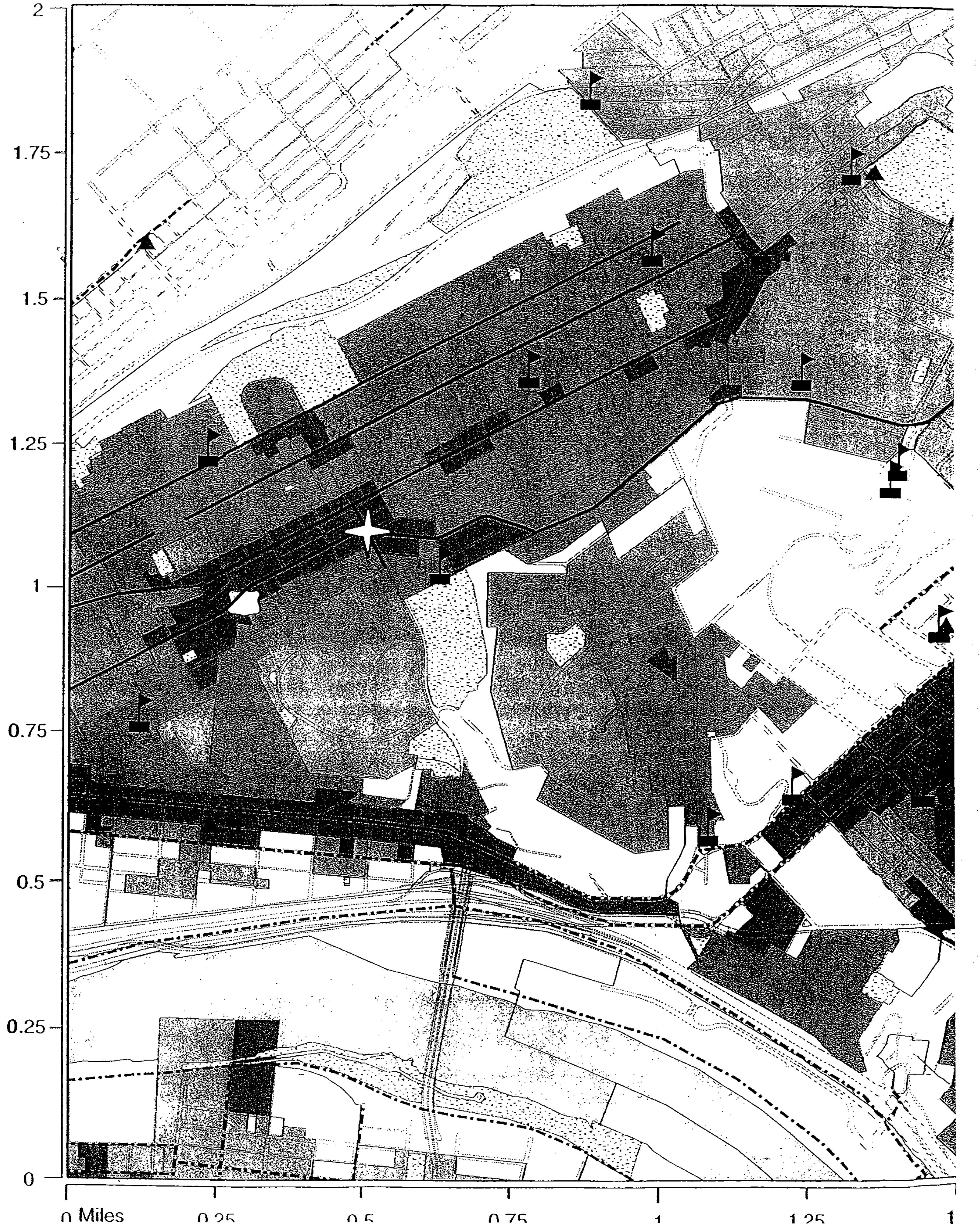
Listed below are the same ten characteristics. Now think about your own neighborhood and rate each attribute on the scale to the right by circling the number that you think best represents your neighborhood. Circle one number from 1(poor) to 5 (excellent).

2. **How would you rate your neighborhood for each of the ten features below?** (Circle one number for each question.)

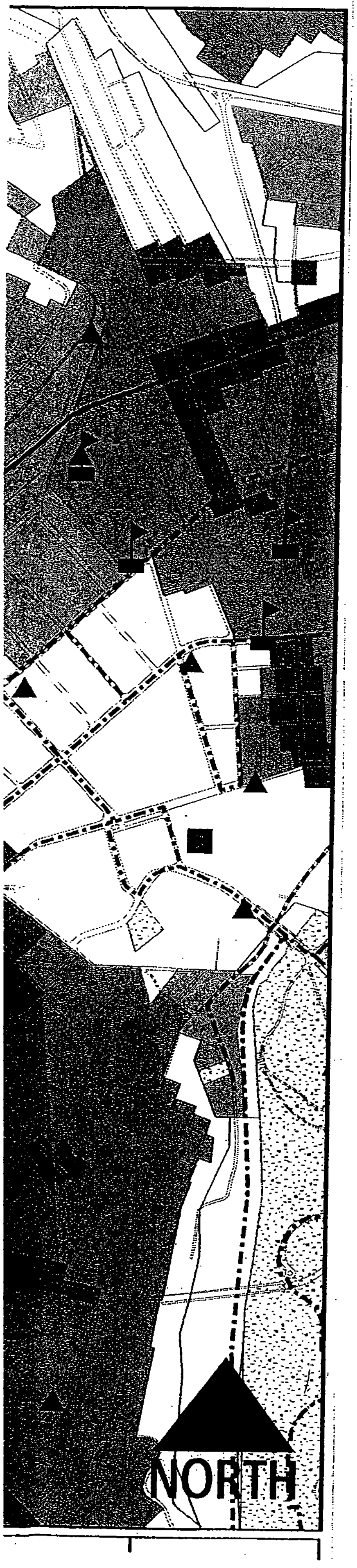
		Poor		Average		Excellent
a.	**Access to amenities** *(parks, entertainment, etc.)*	1	2	3	4	5
b.	**Community organizations** *(YMCA, religious ctr., etc.)*	1	2	3	4	5
c.	**Community stability** *(long-term residency)*	1	2	3	4	5
d.	**Convenience of shopping** *(grocery, retail, etc.)*	1	2	3	4	5
e.	**Living close to work** *(local job opportunities)*	1	2	3	4	5
f.	**Neighborhood appearance**	1	2	3	4	5
g.	**Neighborhood interaction / sense of "community"**	1	2	3	4	5
h.	**Neighborhood safety**	1	2	3	4	5
i.	**Quality of local schools**	1	2	3	4	5
j.	**Ties to surrounding neighborhoods and region**	1	2	3	4	5

3. **How would you rate your neighborhood overall?** (Check one box.)

- ☐ Excellent
- ☐ Good
- ☐ Average
- ☐ Below Average
- ☐ Poor



2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
0 Miles
0.25
0.5
0.75
1
1.25



Carefully review the map and legend on this page and answer the questions below.

1. **Find the symbol for the main intersection on the map. Draw a circle around it**

2. **Using the map scale, how many schools are there on the map <u>within 0.5 mile</u> in a straight-line (as the crow flies) from the main intersection?** (Check one box.)

   - ❑ 0
   - ❑ 1-2
   - ❑ 3 or more

3. **Which of the following statements best describes the neighborhood on this map?** (Check one box.)

   - ❑ A mid to high-income, culturally diverse, urban neighborhood
   - ❑ A low-income, culturally diverse, urban neighborhood
   - ❑ A mid to high-income, non-diverse, urban neighborhood
   - ❑ A low-income, non-diverse, urban neighborhood
   - ❑ Not enough information on this map

Using the map, rate each neighborhood attribute on the scale to the right by circling the number that best represents this neighborhood from 1 (poor) to 5 (excellent). If you don't know or think that there is not enough information to rate an attribute, circle NA.

4. **How would you rate <u>the neighborhood on this map</u> for each of the 10 features below?** (Circle one number for each question.)

	Poor		Average		Excellent	
a. **Access to amenities** *(parks, entertainment, etc.)*___	1	2	3	4	5	NA
b. **Community orgs.** *(YMCA, religious ctr., etc.)*____	1	2	3	4	5	NA
c. **Community stability** *(long-term residency)*______	1	2	3	4	5	NA
d. **Convenience of shopping** *(grocery, retail, etc.)*___	1	2	3	4	5	NA
e. **Living close to work** *(local job opportunities)*____	1	2	3	4	5	NA
f. **Neighborhood appearance** ________________	1	2	3	4	5	NA
g. **Neighborhood interaction / sense of community**_	1	2	3	4	5	NA
h. **Neighborhood safety**___________________	1	2	3	4	5	NA
i. **Quality of local schools**_________________	1	2	3	4	5	NA
j. **Ties to surrounding neighborhoods / region**____	1	2	3	4	5	NA

5. **Based on the map, how would you rate this neighborhood overall?** (Check one box.

   - ❑ Excellent
   - ❑ Good
   - ❑ Average
   - ❑ Below Average
   - ❑ Poor
   - ❑ Don't know / Not enough information

Legend

- Low to Mid-Density Residential
- High-Density Residential
- Commercial Zone
- Park / Green Space
- Main Community Intersection
- Street
- Bike Path
- Historical Site
- Library
- Police Station
- School

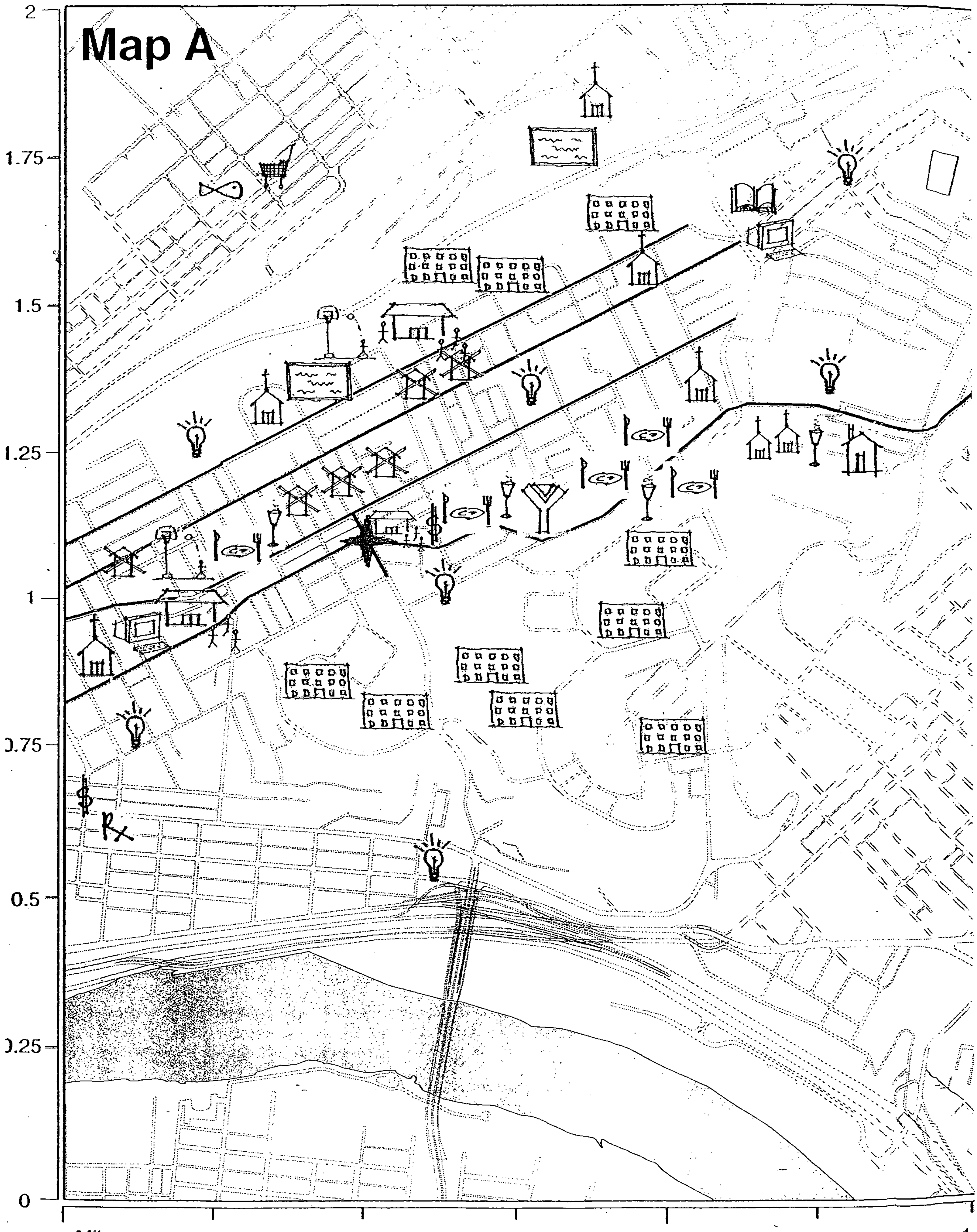
Part 2

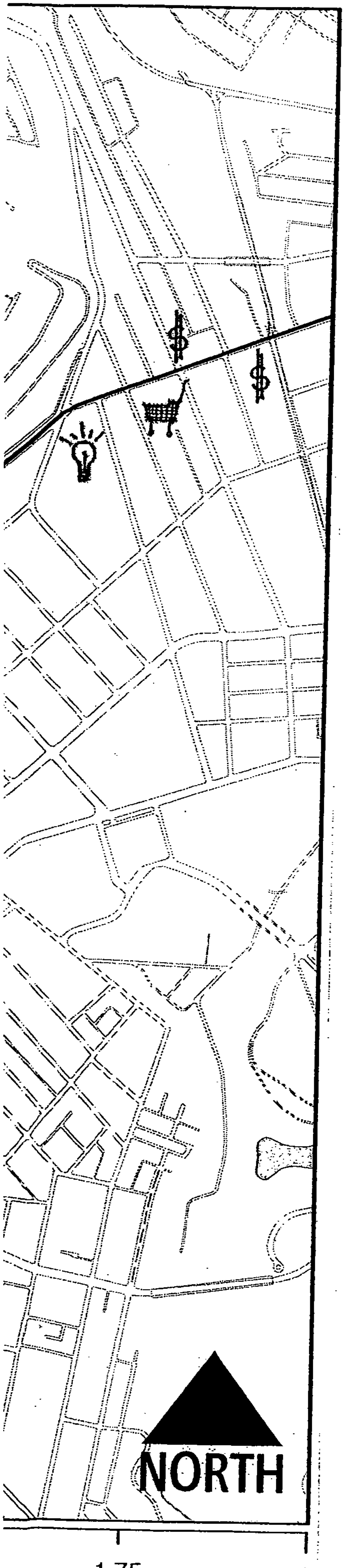
This section of the survey includes a set of four maps of an urban neighborhood in the eastern U.S. created by four different individuals. Each map includes unique symbols created by the resident map-makers, and all of the symbols represent the same type of place on each map. For example, a book symbol represents a library on all four maps. The places that these map-makers identify on their maps include their homes, friends' and family members' homes, places that they visit often, landmarks, and spaces of special significance in the community. They also include some of the positive and negative attributes of the community. All of the symbols on each map represent places that each resident personally thought was important in the neighborhood, but not all of the symbols represent places that they visit often.

On a separate page is a symbol key that identifies each symbol on all the maps in this section. Keep this symbol sheet handy to refer to as you review each map and answer the questions associated with each map. Not all the symbols appear on all four maps, only the symbols that represent places that are important to each map-maker show up on their maps.

Carefully review the symbol sheet and each map. Some of the questions in this section are similar to those in the previous section, but now we would like you answer each page of questions based on the information from the map on the same page. Some of the questions may be difficult to answer based only on the information on the maps, but <u>take your best guess</u>.

[CONTINUE]


Map A
2
1.75
1.5
1.25
1
0.5
0



Carefully review the neighborhood map on the left and the symbol key (separate sheet) The symbols on the map are places that are important to <u>this specific map-maker</u>. This map is based on one individual's perception of his or her neighborhood. Answer the questions below based on the information on the map to the left.

1. **Find the symbol for this map-maker's home on the map. Draw a circle around it.**

2. **Using the map scale, approximately how far is it in a straight line (as the crow flies) from this map-maker's home to the main intersection?** (Check one box.)

   - ☐ Less than 0.5 mile
   - ☐ Between 0.5 mile and 1 mile
   - ☐ Between 1 mile and 1.5 miles
   - ☐ Greater than 1.5 miles

Listed below are the same 10 characteristics from the previous section. Based on the types of features on this map and their locations, rate each attribute on the scale to the right by circling the number that you think best represents this map-maker's perception of his or her neighborhood. <u>Take your best guess.</u>

3. **How do you think the <u>ORIGINAL MAP-MAKER</u> rated his neighborhood for each of the 10 features below?** (Circle one number for each question.)

	Poor		Average		Excellent
a. **Access to amenities** *(parks, entertainment, etc.)*________	1	2	3	4	5
b. **Community orgs.** *(YMCA, religious ctr., etc.)*_________	1	2	3	4	5
c. **Community stability** *(long-term residency)*__________	1	2	3	4	5
d. **Convenience of shopping** *(grocery, retail, etc.)*________	1	2	3	4	5
e. **Living close to work** *(local job opportunities)*________	1	2	3	4	5
f. **Neighborhood appearance** _____________________	1	2	3	4	5
g. **Neighborhood interaction/ sense of "community"**____	1	2	3	4	5
h. **Neighborhood safety**___________________________	1	2	3	4	5
i. **Quality of local schools**_______________________	1	2	3	4	5
j. **Ties to surrounding neighborhoods and region**______	1	2	3	4	5

On average, community map-makers ranked convenience, local employment, and safety as the most important attributes of a neighborhood.

4. **Of these three attributes below, how important do you think each one is to <u>this map-maker</u>?** (Rank the three attributes from 1= most important to 3= least important.)

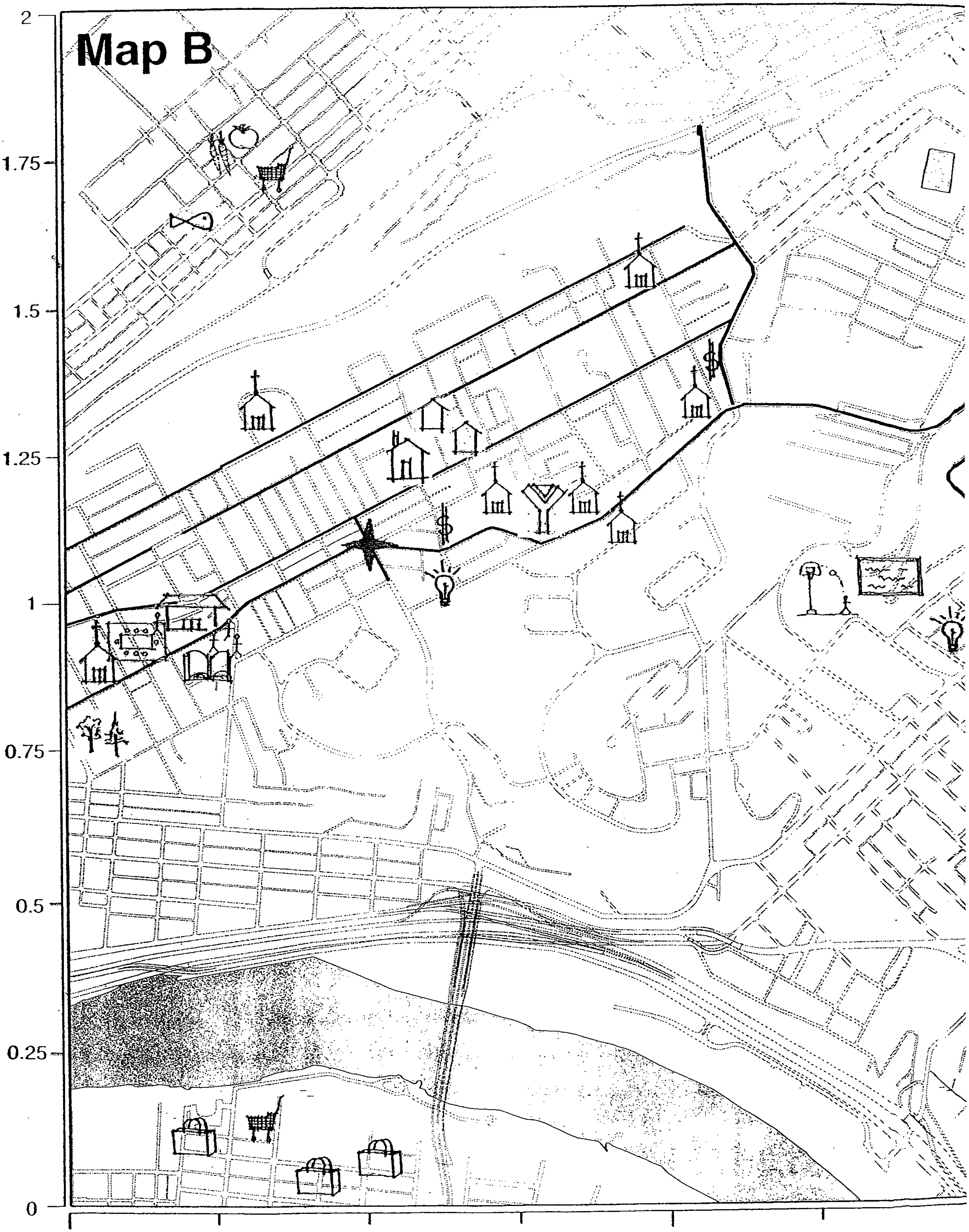
   __________ Convenience of shopping

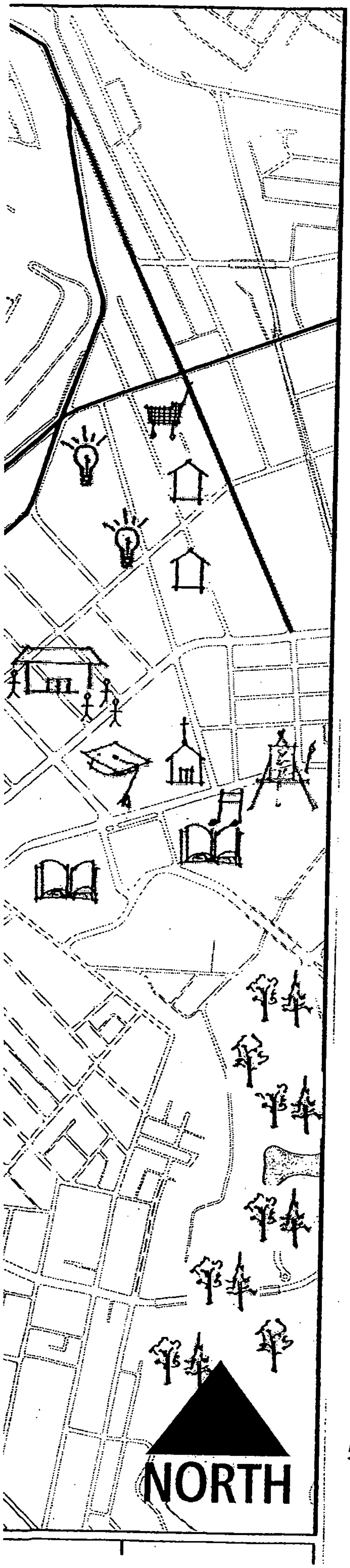
   __________ Living close to work / Neighborhood employment

   __________ Neighborhood safety

5. **Based on this map, would you want to live in this neighborhood?** (Check one box.)

   - ☐ Yes
   - ☐ No


Map B
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0



Carefully review the neighborhood map on the left and the symbol key (separate sheet). The symbols on the map are places that are important to this specific map-maker. This map is based on one individual's perception of his or her neighborhood. Answer the questions below based on the information on the map to the left.

1. **Find the symbol for this map-maker's home on the map. Draw a circle around it.**

2. **Using the map scale, approximately how far is it in a straight line (as the crow flies) from this map-maker's home to the main intersection?** (Check one box.)

   - ☐ Less than 0.5 mile
   - ☐ Between 0.5 mile and 1 mile
   - ☐ Between 1 mile and 1.5 miles
   - ☐ Greater than 1.5 miles

Listed below are the same 10 characteristics from the previous section. Based on the types of features on this map and their locations, rate each attribute on the scale to the right by circling the number that you think best represents this map-maker's perception of his or her neighborhood. Take your best guess.

3. **How do you think the ORIGINAL MAP-MAKER rated his neighborhood for each of the 10 features below?** (Circle one number for each question.)

	Poor		Average		Excellent
a. **Access to amenities** *(parks, entertainment, etc.)*________	1	2	3	4	5
b. **Community orgs.** *(YMCA, religious ctr., etc.)*_________	1	2	3	4	5
c. **Community stability** *(long-term residency)*___________	1	2	3	4	5
d. **Convenience of shopping** *(grocery, retail, etc.)*________	1	2	3	4	5
e. **Living close to work** *(local job opportunities)*__________	1	2	3	4	5
f. **Neighborhood appearance** _______________________	1	2	3	4	5
g. **Neighborhood interaction/ sense of "community"**____	1	2	3	4	5
h. **Neighborhood safety**_____________________________	1	2	3	4	5
i. **Quality of local schools**_________________________	1	2	3	4	5
j. **Ties to surrounding neighborhoods and region**_______	1	2	3	4	5

On average, community map-makers ranked convenience, local employment, and safety as the most important attributes of a neighborhood.

4. **Of the these three attributes below, how important do you think each one is to th map-maker?** (Rank the features from 1= most important to 3= least important.)

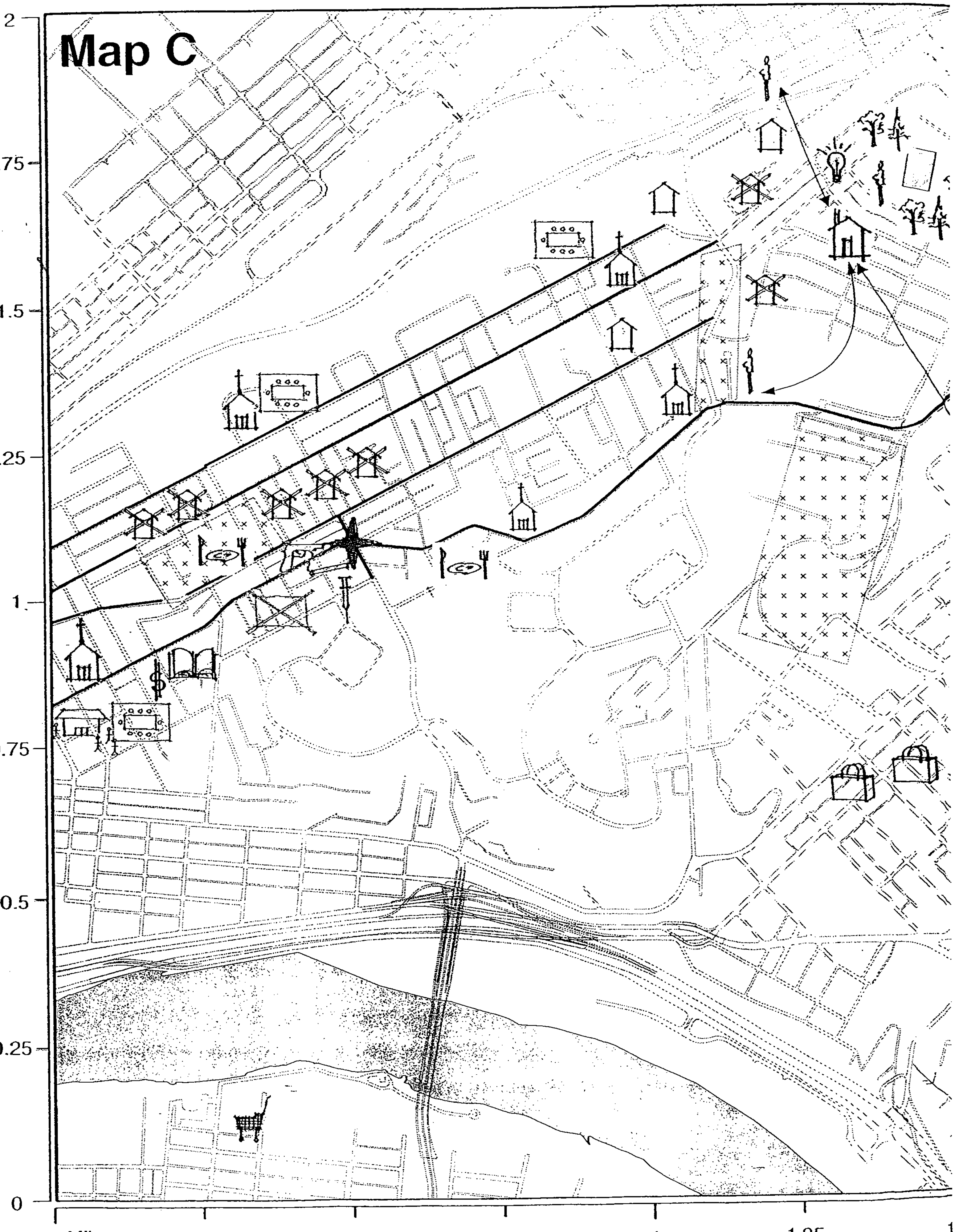
   __________ Convenience of shopping

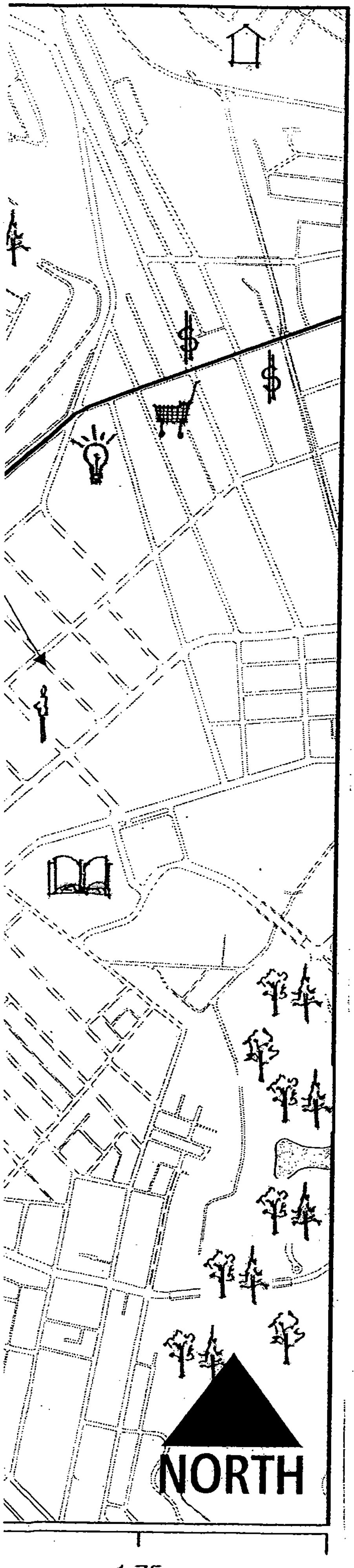
   __________ Living close to work / Neighborhood employment

   __________ Neighborhood safety

5. **Based on this map, would you want to live in this neighborhood?** (Check one box.)

   - ☐ Yes
   - ☐ No


Map C
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0



Carefully review the neighborhood map on the left and the symbol key (separate sheet) The symbols on the map are places that are important to <u>this specific map-maker</u>. This map is based on one individual's perception of his or her neighborhood. Answer the questions below based on the information on the map to the left.

1. **Find the symbol for this map-maker's home on the map. Draw a circle around it.**

2. **Using the map scale, approximately how far is it in a straight line (as the crow flies) from the map-maker's home to the main intersection?** (Check one box.)

   - ☐ Less than 0.5 mile
   - ☐ Between 0.5 mile and 1 mile
   - ☐ Between 1 mile and 1.5 miles
   - ☐ Greater than 1.5 miles

Listed below are the same 10 characteristics from the previous section. Based on the types of features on this map and their locations, rate each attribute on the scale to the right by circling the number that you think best represents this map-maker's perception of his or her neighborhood. <u>Take your best guess.</u>

3. **How do you think the <u>ORIGINAL MAP-MAKER</u> rated his neighborhood for each of the 10 features below?** (Circle one number for each question.)

	Poor		Average		Excellen
a. **Access to amenities** *(parks, entertainment, etc.)*________	1	2	3	4	5
b. **Community orgs.** *(YMCA, religious ctr., etc.)*__________	1	2	3	4	5
c. **Community stability** *(long-term residency)*____________	1	2	3	4	5
d. **Convenience of shopping** *(grocery, retail, etc.)*________	1	2	3	4	5
e. **Living close to work** *(local job opportunities)*_________	1	2	3	4	5
f. **Neighborhood appearance** ______________________	1	2	3	4	5
g. **Neighborhood interaction/ sense of "community"**____	1	2	3	4	5
h. **Neighborhood safety**__________________________	1	2	3	4	5
i. **Quality of local schools**______________________	1	2	3	4	5
j. **Ties to surrounding neighborhoods and region**______	1	2	3	4	5

On average, community map-makers ranked convenience, local employment, and safety as the most important attributes of a neighborhood.

4. **Of these three attributes below, how important do you think each one is to <u>this map-maker</u>?** (Rank the features from 1= most important to 3= least important.)

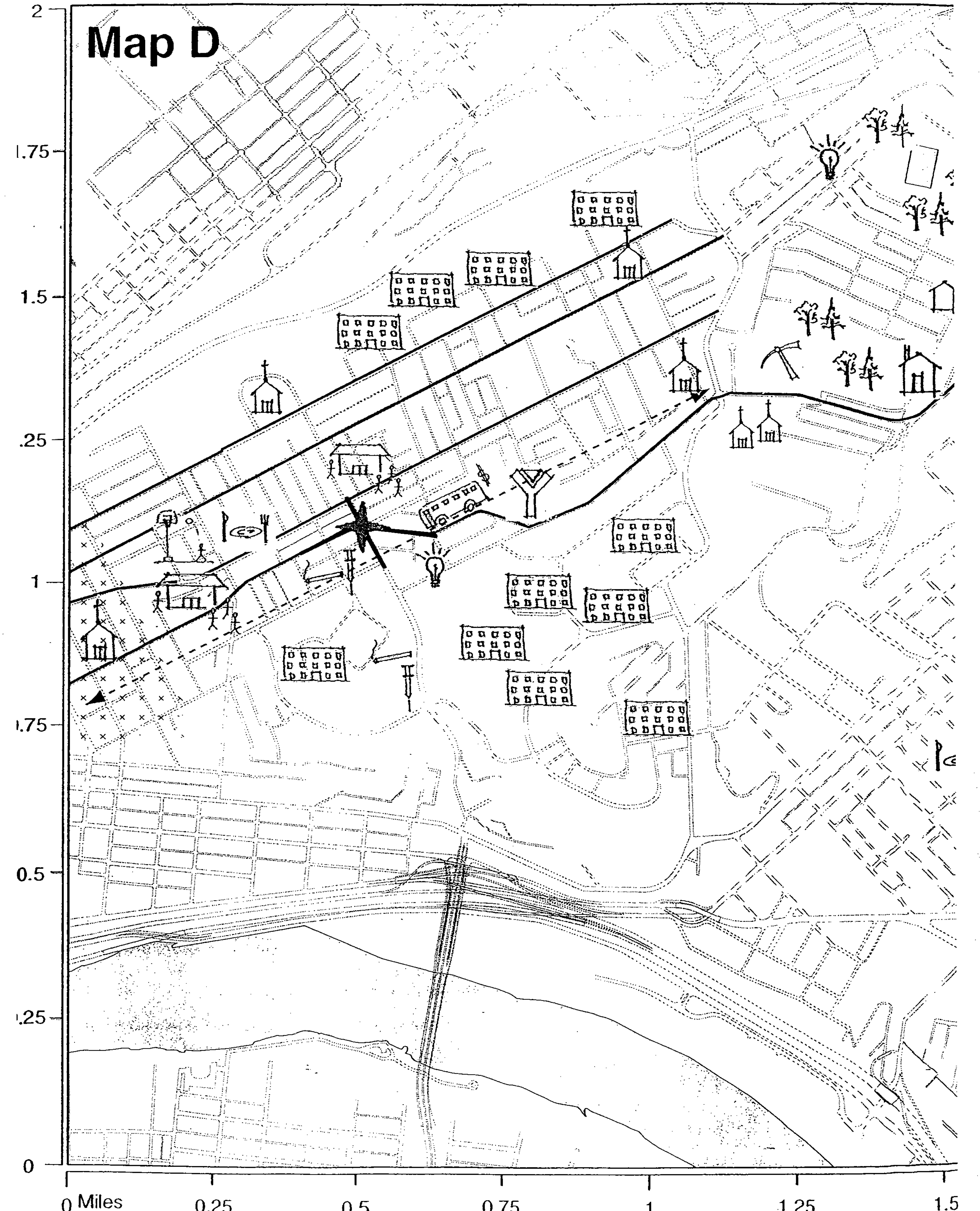
   __________ Convenience of shopping

   __________ Living close to work / Neighborhood employment

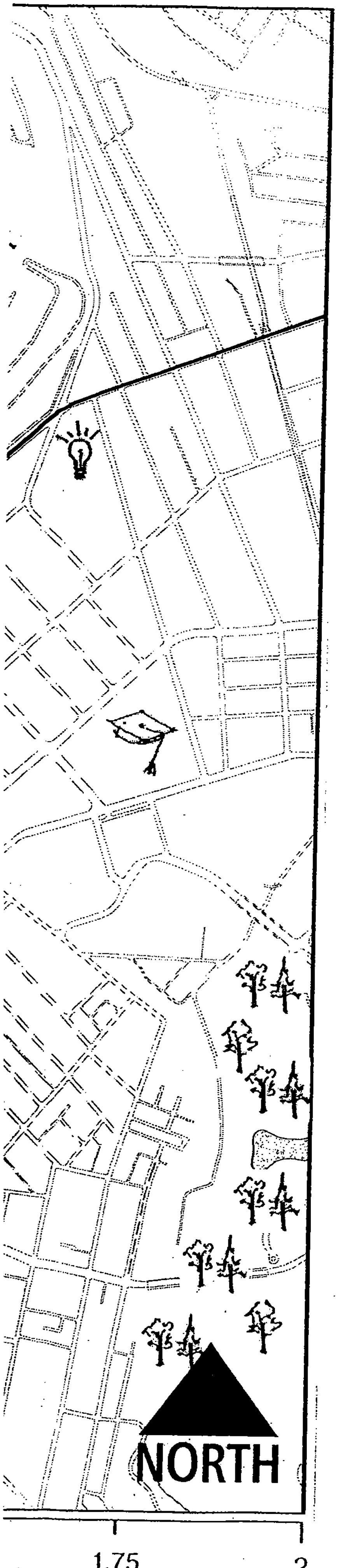
   __________ Neighborhood safety

5. **Based on this map, would you want to live in this neighborhood?** (Check one box.)

   - ☐ Yes
   - ☐ No



Map D
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
0 Miles
0.25
0.5
0.75
1
1.25
1.5



Carefully review the neighborhood map on the left and the symbol key (separate sheet). The symbols on the map are places that are important to <u>this specific map-maker</u>. This map is based on one individual's perception of his or her neighborhood. Answer the questions below based on the information on the map to the left.

1. **Find the symbol for this map-maker's home on the map. Draw a circle around it.**

2. **Using the map scale, approximately how far is it in a straight line (as the crow flies) from the map-maker's home to the main intersection?** (Check one box.)

   - ☐ Less than 0.5 mile
   - ☐ Between 0.5 mile and 1 mile
   - ☐ Between 1 mile and 1.5 miles
   - ☐ Greater than 1.5 miles

Listed below are the same 10 characteristics from the previous section. Based on the types of features on this map and their locations, rate each attribute on the scale to the right by circling the number that you think best represents this map-maker's perception of his or her neighborhood. <u>Take your best guess.</u>

3. **How do you think the <u>ORIGINAL MAP-MAKER</u> rated his neighborhood for each of the 10 features below?** (Circle one number for each question.)

	Poor		Average		Excellent
a. **Access to amenities** *(parks, entertainment, etc.)*________	1	2	3	4	5
b. **Community orgs.** *(YMCA, religious ctr., etc.)*_________	1	2	3	4	5
c. **Community stability** *(long-term residency)*__________	1	2	3	4	5
d. **Convenience of shopping** *(grocery, retail, etc.)*________	1	2	3	4	5
e. **Living close to work** *(local job opportunities)*_________	1	2	3	4	5
f. **Neighborhood appearance** ______________________	1	2	3	4	5
g. **Neighborhood interaction/ sense of "community"**____	1	2	3	4	5
h. **Neighborhood safety**___________________________	1	2	3	4	5
i. **Quality of local schools**________________________	1	2	3	4	5
j. **Ties to surrounding neighborhoods and region**______	1	2	3	4	5

On average, community map-makers ranked convenience, local employment, and safety as the most important attributes of a neighborhood.

4. **Of the these three attributes below, how important do you think each one is to <u>th</u> <u>map-maker</u>?** (Rank the features from 1= most important to 3= least important.)

   __________ Convenience of shopping

   __________ Living close to work / Neighborhood employment

   __________ Neighborhood safety

5. **Based on this map, would you want to live in this neighborhood?** (Check one box.)

   - ☐ Yes
   - ☐ No

Part 3

This is the final section of the survey. Think about all the maps you have seen until now, and where it is indicated, answer the questions in this section based on the information on all five maps. You may refer back to each map as many times as necessary.

[CONTINUE]

All of the maps that you have seen so far in this survey describe the same neighborhood. Carefully re-examine all five maps together, and answer the questions below based on the information on all of the maps.

1. **Based on the information on all of the maps, which of the following statements best describes this neighborhood?** (Check one box.)

   - ☐ A mid to high-income, culturally diverse, urban neighborhood
   - ☐ A low-income, culturally diverse, urban neighborhood
   - ☐ A mid to high-income, non-diverse, urban neighborhood
   - ☐ A low-income, non-diverse, urban neighborhood
   - ☐ Not enough information on all of the maps

Listed below are the same neighborhood characteristics from the previous sections. Using all of the maps, rate each attribute on the scale to the right by circling the number that best represents the feature in this neighborhood from 1 (poor) to 5 (excellent). If you don't know or think that there is not enough information available on the maps to rate an attribute, circle NA.

2. **Using all five maps, how would you rate this neighborhood for each of the 10 features below?** (Circle one response for each question.)

	Poor		Average		Excellent	
a. **Access to amenities** *(parks, entertainment, etc.)*	1	2	3	4	5	NA
b. **Community organizations** *(YMCA, religious ctr., etc.)*	1	2	3	4	5	NA
c. **Community stability** *(long-term residency)*	1	2	3	4	5	NA
d. **Convenience of shopping** *(grocery, retail, etc.)*	1	2	3	4	5	NA
e. **Living close to work** *(local job opportunities)*	1	2	3	4	5	NA
f. **Neighborhood appearance**	1	2	3	4	5	NA
g. **Neighborhood interaction/sense of community**	1	2	3	4	5	NA
h. **Neighborhood safety**	1	2	3	4	5	NA
i. **Quality of local schools**	1	2	3	4	5	NA
j. **Ties to surrounding neighborhoods / region**	1	2	3	4	5	NA

3. **Based on the information on all five maps, how would you rate this neighborhood overall?** (Check one box.)

   - ☐ Excellent
   - ☐ Good
   - ☐ Average
   - ☐ Below Average
   - ☐ Poor

4. **All of the maps in this survey describe a real neighborhood in the eastern U.S. Which Pittsburgh neighborhood do you think this neighborhood most closely resembles?** (Write the name of the neighborhood in the space below. If you do not know, leave the space blank.)

____

5. **Think about the different types of maps you have seen so far. Which map do you think best describes the neighborhood overall?** (Check one box.)

   - ☐ The computer-generated map in Part 1
   - ☐ Map A
   - ☐ Map B
   - ☐ Map C
   - ☐ Map D

Think about all four maps from Part 2. Each of these maps was developed by an individual resident of the same neighborhood. Look carefully at the descriptions of the map-makers below and match the description on the right with the maps from the previous section.

6. **Which map-maker do you think made each map?** (Match the items below. Draw a line to connect each pair. Each map corresponds with only one map-maker.) Take your best guess.

Map A	**Map-Maker 1:** 56-year old female with a college degree, lived in the neighborhood for 20 years, household income between $25,000 and $50,000/year.
Map B	**Map-Maker 2:** 57-year old male with a graduate / professional degree, lived in the neighborhood for 17 years, household income between $25,000 and $50,000/year.
Map C	**Map-Maker 3:** 48-year old male with a graduate / professional degree, lived in the neighborhood for 17 years, household income between $50,000 and $100,000/year.
Map D	**Map-Maker 4:** 56-year old male with some college but no degree, lived in the neighborhood for 7 years, household income less than $10,000/year.

Think about some of the local planning decisions that are made in your own neighborhood and community. Now think about the type of person from your own community that you would most prefer to have represent you and your neighborhood in local planning and decision making.

7. **Based on the description of each map-maker in question 6 above, which of these map-makers would you most prefer to have as a community representative?** (Check one box.)

   - ☐ Map- maker 1
   - ☐ Map- maker 2
   - ☐ Map- maker 3
   - ☐ Map- maker 4
   - ☐ None of the above

8. **Why would you prefer the map-maker you selected in question 7 above as a community representative?** (Write your answer in the space below.)

____

____

____

9. **About how often do you use the following types of maps or geographic information?** (Check one box for each type of map.)

	Never ▼	Daily ▼	Weekly ▼	Monthly ▼	Yearly ▼
a. Local or regional street maps	☐	☐	☐	☐	☐
b. A national or world atlas	☐	☐	☐	☐	☐
c. Travel guides and maps	☐	☐	☐	☐	☐
d. Real estate information	☐	☐	☐	☐	☐
e. Educational maps (Books, TV, etc.)	☐	☐	☐	☐	☐
f. News or current affairs maps	☐	☐	☐	☐	☐
g. National Geographic maps	☐	☐	☐	☐	☐

10. **What type of information would you most prefer to have to participate in the following planning projects or make the types of decisions described below?** (Check one box for each type of decision.)

	Booklet / written description ▼	Pamphlet of pictures or photos ▼	Map / geographic information ▼	Data table / statistical information ▼
a. Siting a new recreation center	☐	☐	☐	☐
b. Community environmental planning	☐	☐	☐	☐
c. Township budget-making	☐	☐	☐	☐
d. Moving to a new neighborhood	☐	☐	☐	☐
e. Rezoning the school district	☐	☐	☐	☐
f. Locating a community waste facility	☐	☐	☐	☐
g. Public hearing for siting a power line	☐	☐	☐	☐

11. Is there a correct balance between business/industrial development and concern for the environment? (Check one box.)

- ☐ Too much emphasis on business
- ☐ Some emphasis on business
- ☐ Correct balance between business and the environment
- ☐ Some emphasis on the environment
- ☐ Too much emphasis on the environment

12. Do environmental policies and regulation impact economic development? (Check one box.)

- ☐ Significantly help economic development
- ☐ Somewhat help economic development
- ☐ No impact
- ☐ Somewhat hurt economic development
- ☐ Significantly hurt economic development

13. Are long-term consequences adequately considered by today's policy makers? (Check one box.)

- ☐ Too little long-term emphasis
- ☐ Adequate consideration of the long-term
- ☐ Too much long-term emphasis

14. How often do you participate in the following types of community or neighborhood activities, meetings, or events? (Check one box for each question.)

	Never ▼	Rarely ▼	Occasionally ▼	Often ▼
a. Public environmental hearings	☐	☐	☐	☐
b. City / town planning meetings	☐	☐	☐	☐
c. Community organization meetings	☐	☐	☐	☐
d. Public awareness campaigns	☐	☐	☐	☐
e. Local school-related events	☐	☐	☐	☐

15. To what degree do you consider yourself to be active or involved in your neighborhood or community? (Check one box.)

- ☐ Not at all involved
- ☐ Somewhat involved
- ☐ Very involved

16. Have you ever participated in a public or civic protest of a political, social, or economic issue? (Check one box.)

- ❑ Yes
- ❑ No

17. Do you vote in elections for your local officials? (Check one box.)

- ❑ Yes
- ❑ No

Demographic Questions

Now we would like you to answer some questions about yourself and your neighborhood.

1. What is the zip code where you currently live? (Write your answer in the space below.)

_ _ _ _ _ Zip code

2. How many years in total have you lived in this zip code? (Does not need to be consecutive. Write your answer in the space below.)

____________ Years

3. Do you own or rent your home? (Check one box.)

- ❑ Own
- ❑ Rent
- ❑ Other (please explain) ________________________

4. What is your age? (Write your answer in the space below.)

____________ Years

5. What is your gender? (Check one box.)

- ❑ Male
- ❑ Female

6. **Approximately what is your total annual household income?** (Check one box.)

- ❑ less than $10,000
- ❑ between $10,000 and $25,000
- ❑ between $25,000 and $50,000
- ❑ between $50,000 and $100,000
- ❑ more than $100,000

7. **What is your highest level of education?** (Check one box.)

- ❑ Some high school but no degree
- ❑ High school degree
- ❑ Some college but no degree
- ❑ Trade school
- ❑ College degree
- ❑ Graduate or Professional degree

8. **What do you consider to be your ethnic background?** (Check one box.)

- ❑ White or Caucasian
- ❑ Hispanic or Latino
- ❑ Black or African-American
- ❑ Asian or Asian American
- ❑ Other (please specify) ____________________

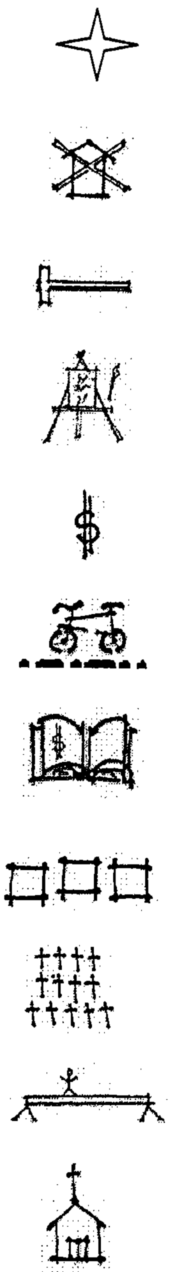
Please return your completed survey to the survey moderator and sign-out.

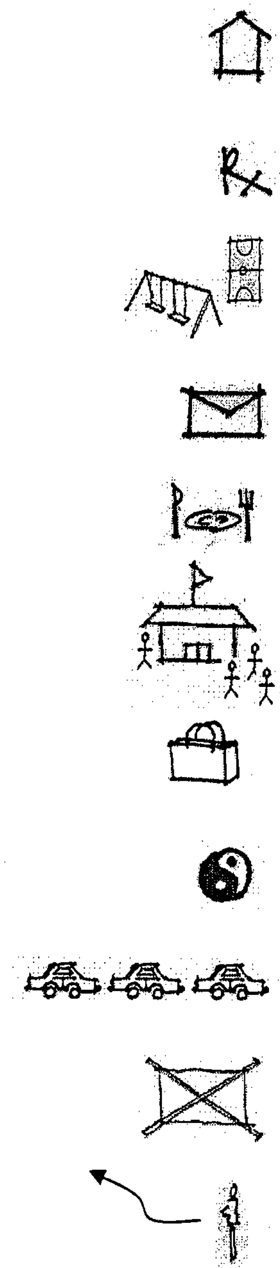
If you have any questions about this study, please feel free to ask them now or anytime throughout the study by contacting:

Shalini Vajjhala
Engineering and Public Policy
Carnegie Mellon University
Baker Hall 129
5000 Forbes Avenue
Pittsburgh, PA 15213
412.860.5708

Thank you very much for participating in this survey!

Symbol Key (Squirrel Hill)

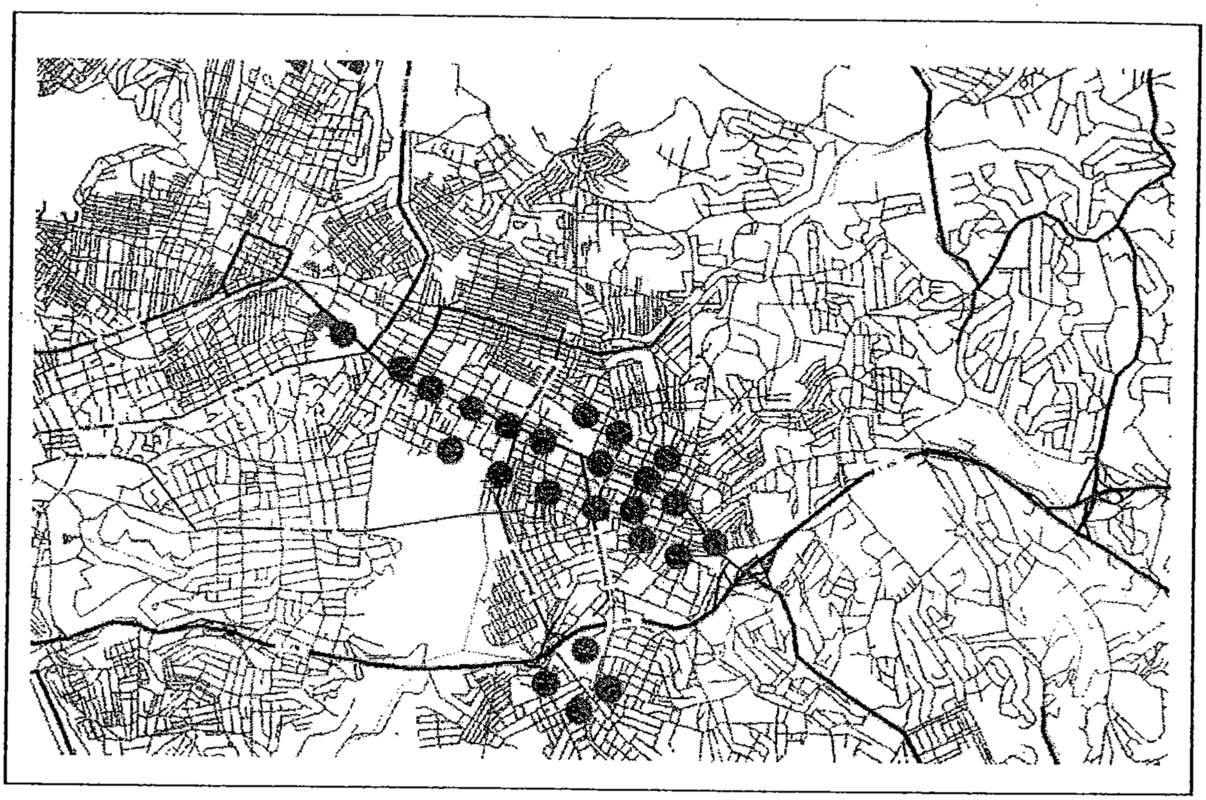




Main Community Intersection	Map-maker's Home	Friend's House
Abandoned / Derelict Housing	Coffee Shop	Pharmacy
Architect's Office	College / University	Playground
Art Center / Museum	Farmers' Market	Post Office
Bank	Garden Center	Restaurant
Bike Path / Personal Route	Grocery Store	School
Bookstore	Hair Dresser / Barber Shop	Shopping (Retail-Clothing)
Business District - Shops	Synagogue / Jewish Community Center	Tai Chi Center
Cemetery	Library	Traffic
Gymnastics Center	Movie Theater	Vacant Lot
Church / Christian Community Center	Park / Green Space	Walking Path / Personal Route

Carnegie Mellon University

Neighborhood Survey



2004 Mon Valley Providers Council

Dave Coplan
Executive Director
519 Penn Avenue
Turtle Creek, PA 15145

Survey Number _____

Part 1

This survey is part of an effort to learn what is important to people about their neighborhoods, and to improve local participation in development planning and decision making. We have been using a process called "community mapping" to gather neighborhood information and understand different residents' priorities, preferences, and perceptions of their own and other communities.

The first section of this survey includes some simple questions about different neighborhoods. First we would like you to think about what is important to you about a neighborhood in general. Then we would like you to evaluate your own neighborhood. Finally, you will review a computer-generated map of an urban neighborhood in the eastern United States, and answer a series of questions about this neighborhood.

[CONTINUE]

Listed below are 10 characteristics that residents may feel are important about their communities. Think about what is important to you and rank the features below in order of importance from 1 (most important), 2 (next most important, etc.) to 10 (least important).

1. **What is most important to you about a neighborhood?** (Rank all 10 features. Write 1 in the space beside the feature you think is most important and 10 beside the least important.)

Access to amenities *(parks, entertainment, etc.)*	______
Community organizations *(YMCA, religious ctr., etc.)*	______
Community stability *(long-term residency)*	______
Convenience of shopping *(grocery, retail, etc.)*	______
Living close to work *(local job opportunities)*	______
Neighborhood appearance	______
Neighborhood interaction / sense of "community"	______
Neighborhood safety	______
Quality of local schools	______
Ties to surrounding neighborhoods and region	______

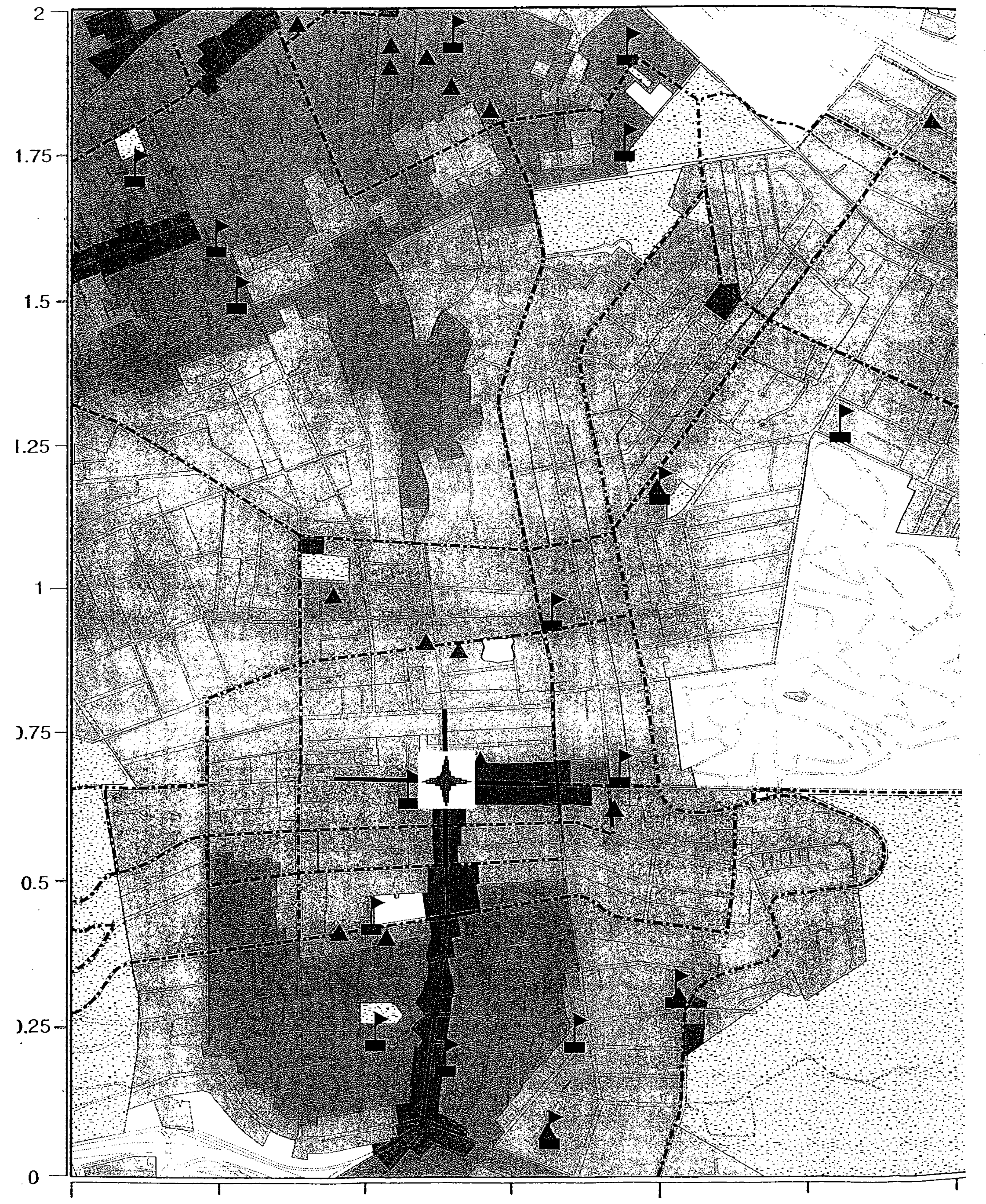
Listed below are the same ten characteristics. Now think about your own neighborhood and rate each attribute on the scale to the right by circling the number that you think best represents your neighborhood. Circle one number from 1(poor) to 5 (excellent).

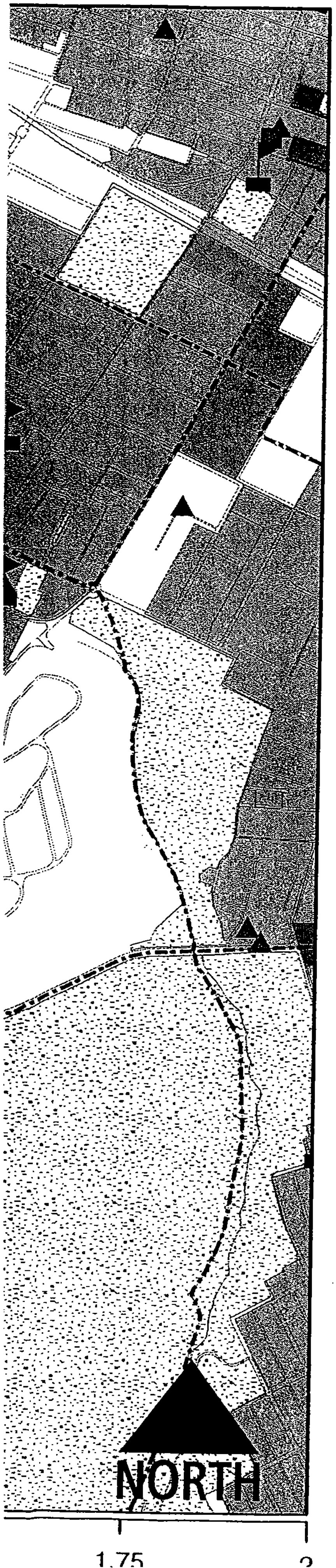
2. **How would you rate your neighborhood for each of the ten features below?** (Circle one number for each question.)

		Poor		Average		Excellent
a.	**Access to amenities** *(parks, entertainment, etc.)*	1	2	3	4	5
b.	**Community organizations** *(YMCA, religious ctr., etc.)*	1	2	3	4	5
c.	**Community stability** *(long-term residency)*	1	2	3	4	5
d.	**Convenience of shopping** *(grocery, retail, etc.)*	1	2	3	4	5
e.	**Living close to work** *(local job opportunities)*	1	2	3	4	5
f.	**Neighborhood appearance**	1	2	3	4	5
g.	**Neighborhood interaction / sense of "community"**	1	2	3	4	5
h.	**Neighborhood safety**	1	2	3	4	5
i.	**Quality of local schools**	1	2	3	4	5
j.	**Ties to surrounding neighborhoods and region**	1	2	3	4	5

3. **How would you rate your neighborhood overall?** (Check one box.)

- ❑ Excellent
- ❑ Good
- ❑ Average
- ❑ Below Average
- ❑ Poor


2
1.75
1.5
1.25
1
0.75
0.5
0.25
0



Carefully review the map and legend on this page and answer the questions below.

1. **Find the symbol for the main intersection on the map. Draw a circle around it.**

2. **Using the map scale, how many schools are there on the map <u>within 0.5 mile</u> in a straight-line (as the crow flies) from the main intersection?** (Check one box.)
   - ❑ 0
   - ❑ 1-2
   - ❑ 3 or more

3. **Which of the following statements best describes the neighborhood on this map?** (Check one box.)
   - ❑ A mid to high-income, culturally diverse, urban neighborhood
   - ❑ A low-income, culturally diverse, urban neighborhood
   - ❑ A mid to high-income, non-diverse, urban neighborhood
   - ❑ A low-income, non-diverse, urban neighborhood
   - ❑ Not enough information on this map

Using the map, rate each neighborhood attribute on the scale to the right by circling the number that best represents this neighborhood from 1 (poor) to 5 (excellent). If you don't know or think that there is not enough information to rate an attribute, circle NA.

4. **How would you rate <u>the neighborhood on this map</u> for each of the 10 features below?** (Circle one number for each question.)

	Poor		Average		Excellent	
a. **Access to amenities** *(parks, entertainment, etc.)*	1	2	3	4	5	NA
b. **Community orgs.** *(YMCA, religious ctr., etc.)*	1	2	3	4	5	NA
c. **Community stability** *(long-term residency)*	1	2	3	4	5	NA
d. **Convenience of shopping** *(grocery, retail, etc.)*	1	2	3	4	5	NA
e. **Living close to work** *(local job opportunities)*	1	2	3	4	5	NA
f. **Neighborhood appearance**	1	2	3	4	5	NA
g. **Neighborhood interaction / sense of community**	1	2	3	4	5	NA
h. **Neighborhood safety**	1	2	3	4	5	NA
i. **Quality of local schools**	1	2	3	4	5	NA
j. **Ties to surrounding neighborhoods / region**	1	2	3	4	5	NA

5. **Based on the map, how would you rate this neighborhood overall?** (Check one box.)
   - ❑ Excellent
   - ❑ Good
   - ❑ Average
   - ❑ Below Average
   - ❑ Poor
   - ❑ Don't know / Not enough information

Legend

- Low to Mid-Density Residential
- High-Density Residential
- Commercial Zone
- Park / Green Space
- Main Community Intersection
- Street
- Bike Path
- Historical Site
- Library
- Police Station
- School

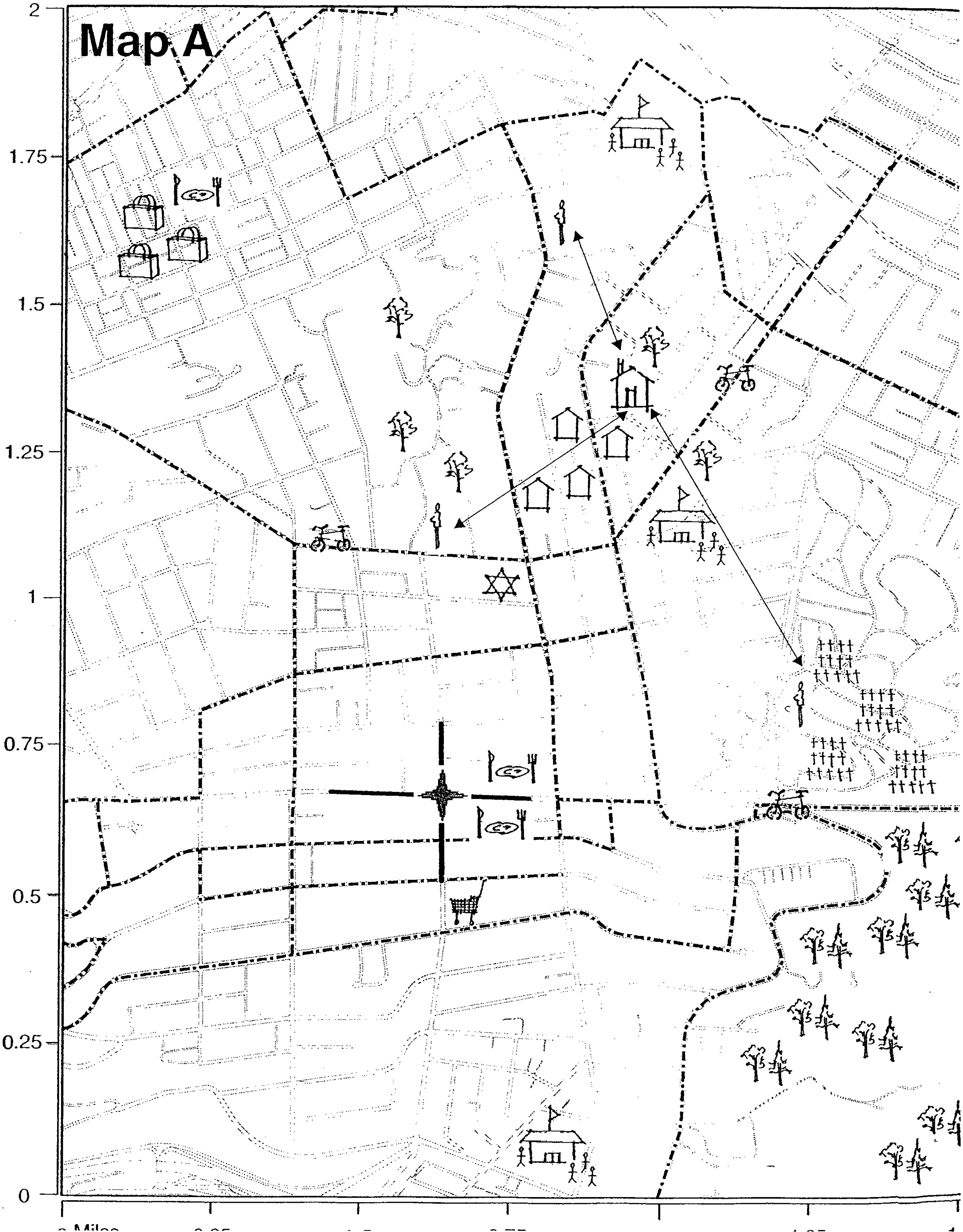
Part 2

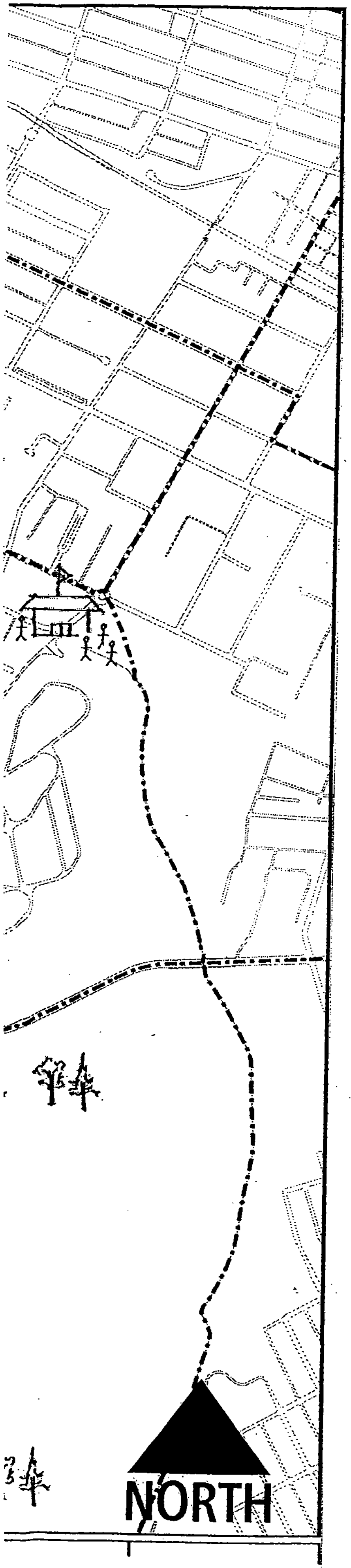
This section of the survey includes a set of four maps of an urban neighborhood in the eastern U.S. created by four different individuals. Each map includes unique symbols created by the resident map-makers, and all of the symbols represent the same type of place on each map. For example, a book symbol represents a library on all four maps. The places that these map-makers identify on their maps include their homes, friends' and family members' homes, places that they visit often, landmarks, and spaces of special significance in the community. They also include some of the positive and negative attributes of the community. All of the symbols on each map represent places that each resident personally thought was important in the neighborhood, but not all of the symbols represent places that they visit often.

On a separate page is a symbol key that identifies each symbol on all the maps in this section. Keep this symbol sheet handy to refer to as you review each map and answer the questions associated with each map. Not all the symbols appear on all four maps, only the symbols that represent places that are important to each map-maker show up on their maps.

Carefully review the symbol sheet and each map. Some of the questions in this section are similar to those in the previous section, but now we would like you answer each page of questions based on the information from the map on the same page. Some of the questions may be difficult to answer based only on the information on the maps, but take your best guess.

[CONTINUE]


Map A
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0



Carefully review the neighborhood map on the left and the symbol key (separate shee The symbols on the map are places that are important to <u>this specific map-maker</u>. Thi map is based on one individual's perception of his or her neighborhood. Answer the questions below based on the information on the map to the left.

1. **Find the symbol for this map-maker's home on the map. Draw a circle around it.**

2. **Using the map scale, approximately how far is it in a straight line (as the crov flies) from this map-maker's home to the main intersection?** (Check one box.)

   - ☐ Less than 0.5 mile
   - ☐ Between 0.5 mile and 1 mile
   - ☐ Between 1 mile and 1.5 miles
   - ☐ Greater than 1.5 miles

Listed below are the same 10 characteristics from the previous section. Based on the types of features on this map and their locations, rate each attribute on the scale to the right by circling the number that you think best represents this map-maker's perceptior of his or her neighborhood. <u>Take your best guess.</u>

3. **How do you think the <u>ORIGINAL MAP-MAKER</u> rated his neighborhood for each of the 10 features below?** (Circle one number for each question.)

	Poor		Average		Excellei
a. **Access to amenities** *(parks, entertainment, etc.)*________	1	2	3	4	5
b. **Community orgs.** *(YMCA, religious ctr., etc.)*________	1	2	3	4	5
c. **Community stability** *(long-term residency)*________	1	2	3	4	5
d. **Convenience of shopping** *(grocery, retail, etc.)*________	1	2	3	4	5
e. **Living close to work** *(local job opportunities)*________	1	2	3	4	5
f. **Neighborhood appearance** ________	1	2	3	4	5
g. **Neighborhood interaction/ sense of "community"**____	1	2	3	4	5
h. **Neighborhood safety**________	1	2	3	4	5
i. **Quality of local schools**________	1	2	3	4	5
j. **Ties to surrounding neighborhoods and region**____	1	2	3	4	5

On average, community map-makers ranked convenience, local employment, and safety as the most important attributes of a neighborhood.

4. **Of these three attributes below, how important do you think each one is to <u>this map-maker</u>?** (Rank the three attributes from 1= most important to 3= least important.

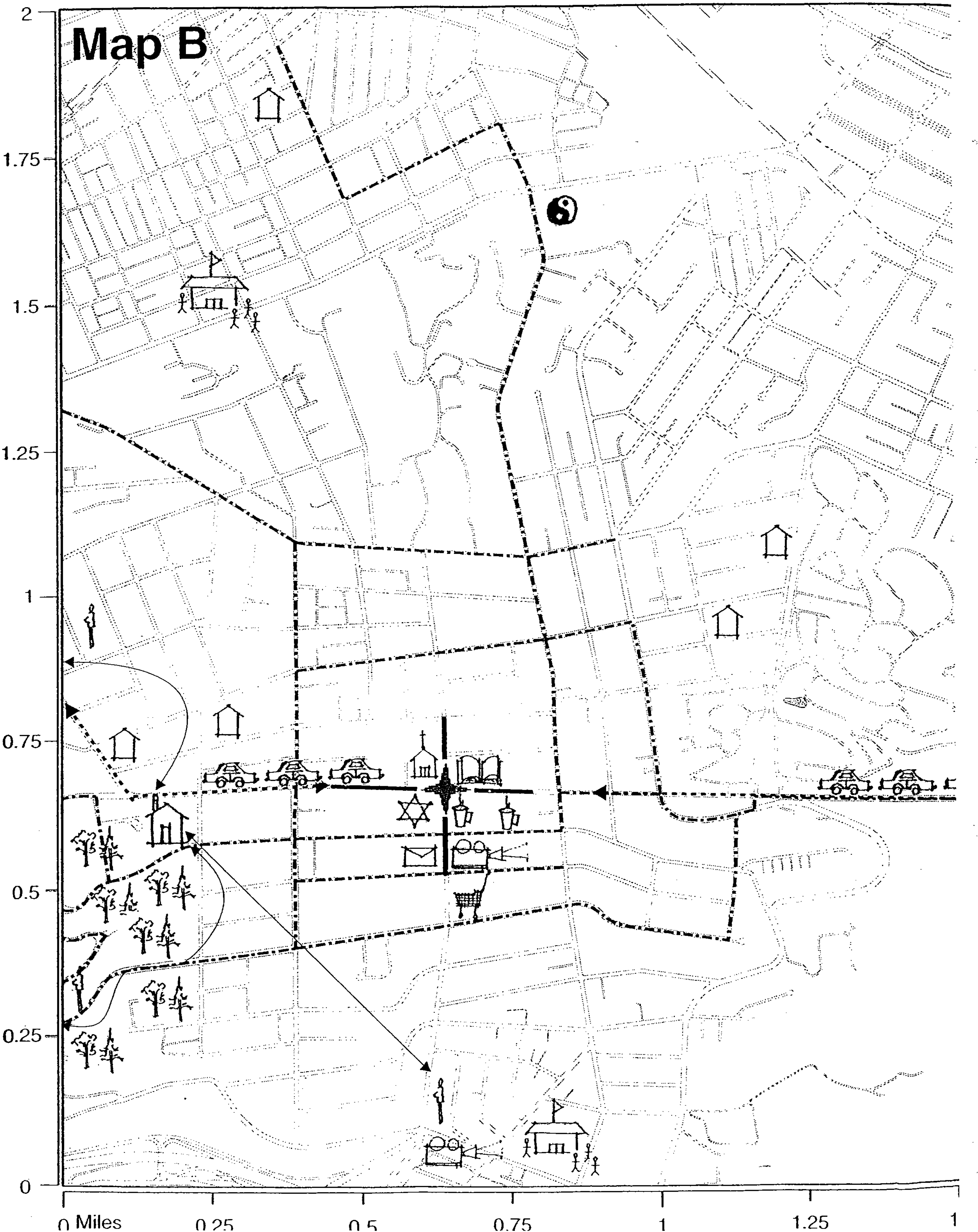
   ________ Convenience of shopping

   ________ Living close to work / Neighborhood employment

   ________ Neighborhood safety

5. **Based on this map, would you want to live in this neighborhood?** (Check one box.)

   - ☐ Yes
   - ☐ No



Map B
2
1.75
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0 Miles
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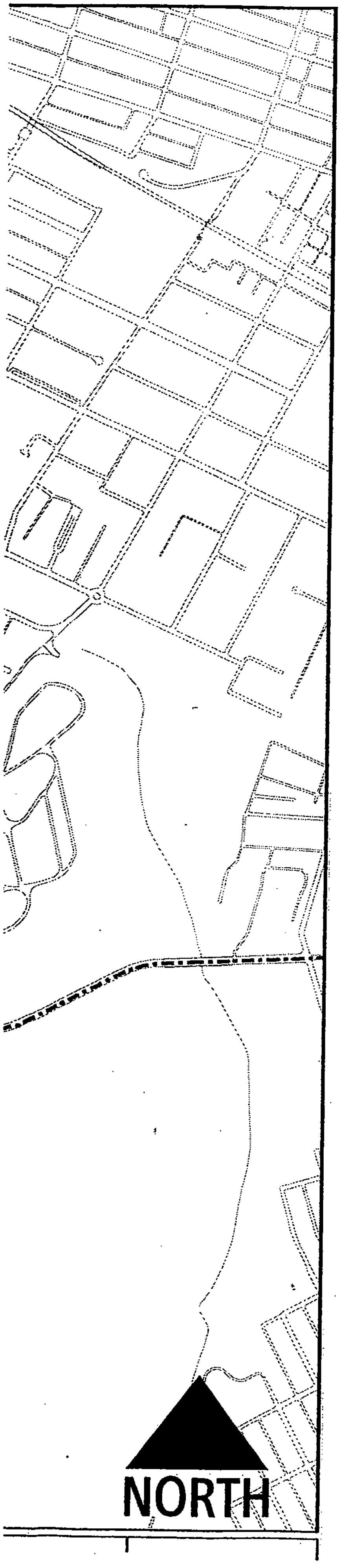
1
1.25
1



Carefully review the neighborhood map on the left and the symbol key (separate sheet). The symbols on the map are places that are important to <u>this specific map-maker</u>. This map is based on one individual's perception of his or her neighborhood. Answer the questions below based on the information on the map to the left.

1. **Find the symbol for this map-maker's home on the map. Draw a circle around it.**

2. **Using the map scale, approximately how far is it in a straight line (as the crow flies) from this map-maker's home to the main intersection?** (Check one box.)

   - ❑ Less than 0.5 mile
   - ❑ Between 0.5 mile and 1 mile
   - ❑ Between 1 mile and 1.5 miles
   - ❑ Greater than 1.5 miles

Listed below are the same 10 characteristics from the previous section. Based on the types of features on this map and their locations, rate each attribute on the scale to the right by circling the number that you think best represents this map-maker's perception of his or her neighborhood. <u>Take your best guess.</u>

3. **How do you think the <u>ORIGINAL MAP-MAKER</u> rated his neighborhood for each of the 10 features below?** (Circle one number for each question.)

	Poor		Average		Excellent
a. **Access to amenities** *(parks, entertainment, etc.)*________	1	2	3	4	5
b. **Community orgs.** *(YMCA, religious ctr., etc.)*________	1	2	3	4	5
c. **Community stability** *(long-term residency)*________	1	2	3	4	5
d. **Convenience of shopping** *(grocery, retail, etc.)*________	1	2	3	4	5
e. **Living close to work** *(local job opportunities)*________	1	2	3	4	5
f. **Neighborhood appearance** ________	1	2	3	4	5
g. **Neighborhood interaction/ sense of "community"**____	1	2	3	4	5
h. **Neighborhood safety**________	1	2	3	4	5
i. **Quality of local schools**________	1	2	3	4	5
j. **Ties to surrounding neighborhoods and region**______	1	2	3	4	5

On average, community map-makers ranked convenience, local employment, and safety as the most important attributes of a neighborhood.

4. **Of the these three attributes below, how important do you think each one is to <u>t</u> <u>map-maker</u>?** (Rank the features from 1= most important to 3= least important.)

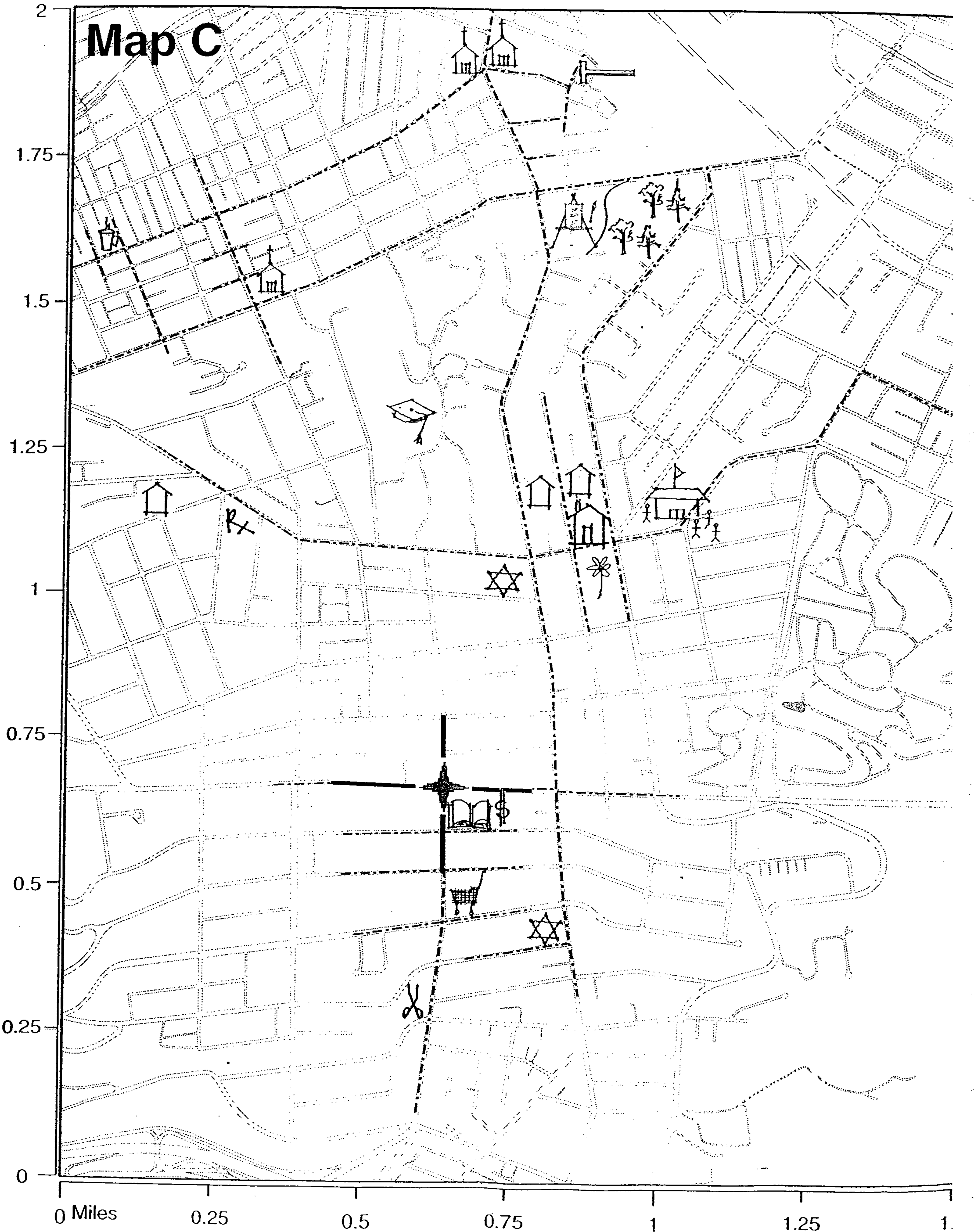
   ________ Convenience of shopping

   ________ Living close to work / Neighborhood employment

   ________ Neighborhood safety

5. **Based on this map, would you want to live in this neighborhood?** (Check one box.)

   - ❑ Yes
   - ❑ No


Map C
2
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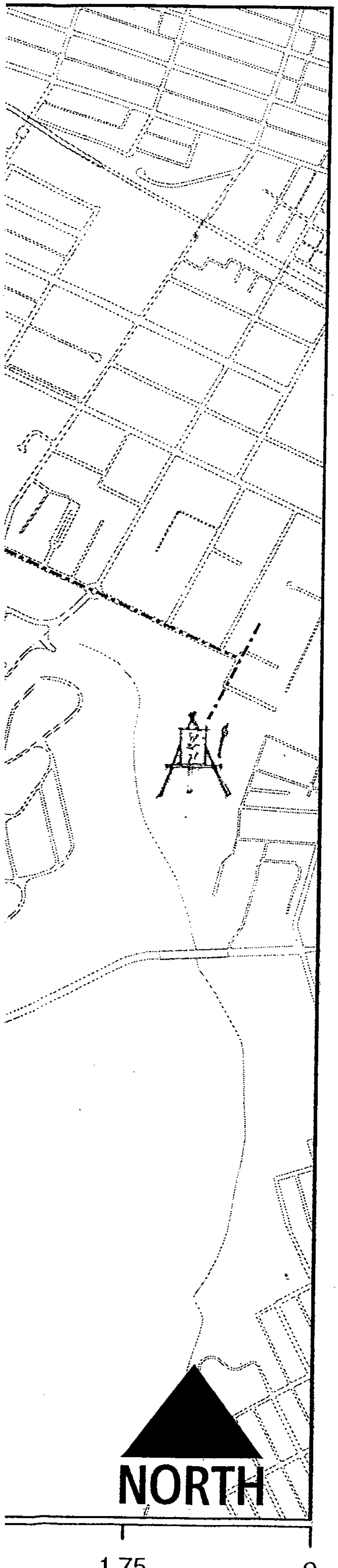


Carefully review the neighborhood map on the left and the symbol key (separate sheet). The symbols on the map are places that are important to this specific map-maker. This map is based on one individual's perception of his or her neighborhood. Answer the questions below based on the information on the map to the left.

1. **Find the symbol for this map-maker's home on the map. Draw a circle around it.**

2. **Using the map scale, approximately how far is it in a straight line (as the crow flies) from the map-maker's home to the main intersection?** (Check one box.)

   - ☐ Less than 0.5 mile
   - ☐ Between 0.5 mile and 1 mile
   - ☐ Between 1 mile and 1.5 miles
   - ☐ Greater than 1.5 miles

Listed below are the same 10 characteristics from the previous section. Based on the types of features on this map and their locations, rate each attribute on the scale to the right by circling the number that you think best represents this map-maker's perception of his or her neighborhood. Take your best guess.

3. **How do you think the ORIGINAL MAP-MAKER rated his neighborhood for each of the 10 features below?** (Circle one number for each question.)

	Poor		Average		Excellent
a. **Access to amenities** *(parks, entertainment, etc.)*	1	2	3	4	5
b. **Community orgs.** *(YMCA, religious ctr., etc.)*	1	2	3	4	5
c. **Community stability** *(long-term residency)*	1	2	3	4	5
d. **Convenience of shopping** *(grocery, retail, etc.)*	1	2	3	4	5
e. **Living close to work** *(local job opportunities)*	1	2	3	4	5
f. **Neighborhood appearance**	1	2	3	4	5
g. **Neighborhood interaction/ sense of "community"**	1	2	3	4	5
h. **Neighborhood safety**	1	2	3	4	5
i. **Quality of local schools**	1	2	3	4	5
j. **Ties to surrounding neighborhoods and region**	1	2	3	4	5

On average, community map-makers ranked convenience, local employment, and safety as the most important attributes of a neighborhood.

4. **Of these three attributes below, how important do you think each one is to this map-maker?** (Rank the features from 1= most important to 3= least important.)

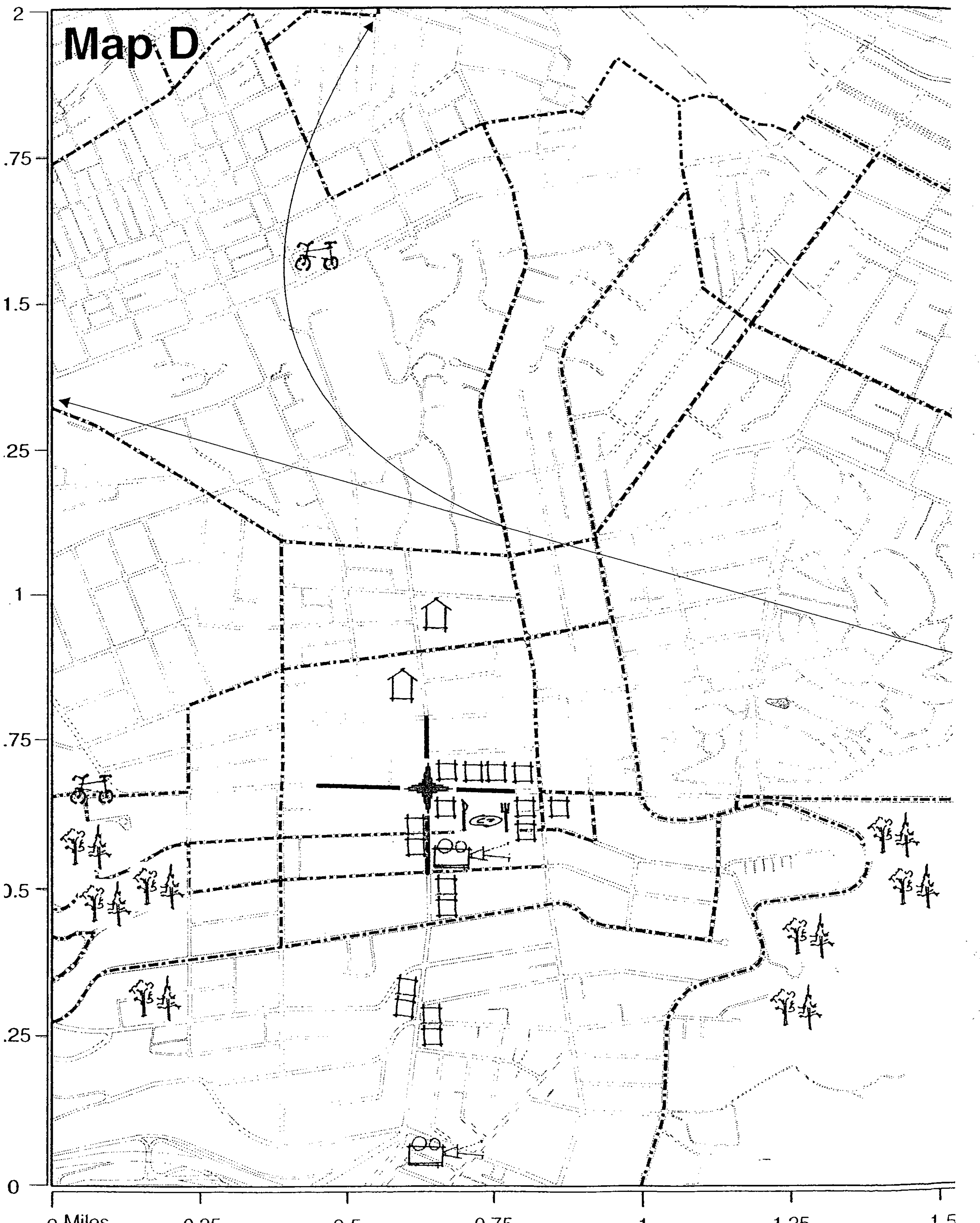
   ______ Convenience of shopping

   ______ Living close to work / Neighborhood employment

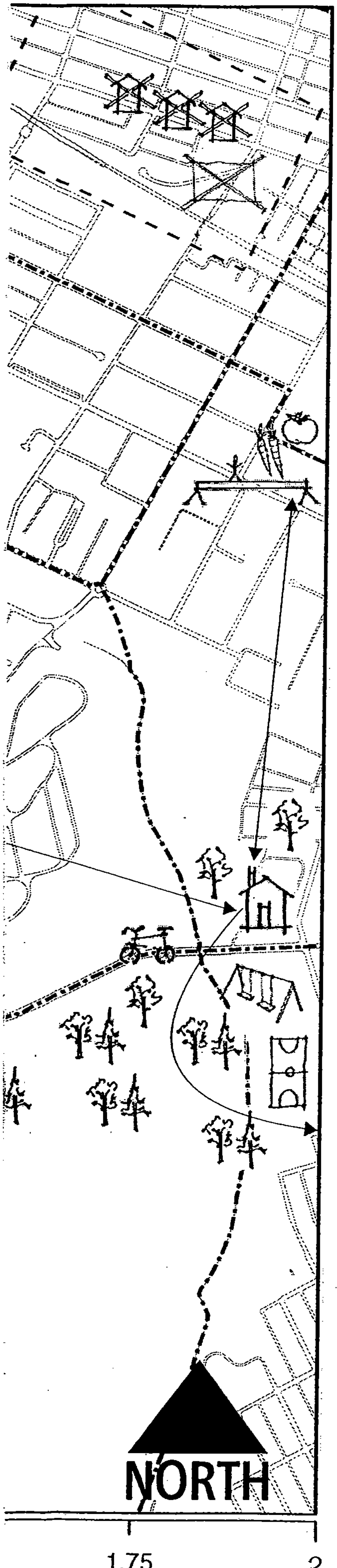
   ______ Neighborhood safety

5. **Based on this map, would you want to live in this neighborhood?** (Check one box.)

   - ☐ Yes
   - ☐ No



Map D
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
0 Miles
0.25
0.5
0.75
1
1.25
1.5



Carefully review the neighborhood map on the left and the symbol key (separate sheet). The symbols on the map are places that are important to this specific map-maker. This map is based on one individual's perception of his or her neighborhood. Answer the questions below based on the information on the map to the left.

1. **Find the symbol for this map-maker's home on the map. Draw a circle around it.**

2. **Using the map scale, approximately how far is it in a straight line (as the crow flies) from the map-maker's home to the main intersection?** (Check one box.)

   - ❑ Less than 0.5 mile
   - ❑ Between 0.5 mile and 1 mile
   - ❑ Between 1 mile and 1.5 miles
   - ❑ Greater than 1.5 miles

Listed below are the same 10 characteristics from the previous section. Based on the types of features on this map and their locations, rate each attribute on the scale to the right by circling the number that you think best represents this map-maker's perception of his or her neighborhood. Take your best guess.

3. **How do you think the ORIGINAL MAP-MAKER rated his neighborhood for each of the 10 features below?** (Circle one number for each question.)

	Poor		Average		Excellent
a. **Access to amenities** *(parks, entertainment, etc.)*________	1	2	3	4	5
b. **Community orgs.** *(YMCA, religious ctr., etc.)*__________	1	2	3	4	5
c. **Community stability** *(long-term residency)*___________	1	2	3	4	5
d. **Convenience of shopping** *(grocery, retail, etc.)*________	1	2	3	4	5
e. **Living close to work** *(local job opportunities)*_________	1	2	3	4	5
f. **Neighborhood appearance** ______________________	1	2	3	4	5
g. **Neighborhood interaction/ sense of "community"**____	1	2	3	4	5
h. **Neighborhood safety**_________________________	1	2	3	4	5
i. **Quality of local schools**_______________________	1	2	3	4	5
j. **Ties to surrounding neighborhoods and region**______	1	2	3	4	5

On average, community map-makers ranked convenience, local employment, and safety as the most important attributes of a neighborhood.

4. **Of the these three attributes below, how important do you think each one is to th map-maker?** (Rank the features from 1= most important to 3= least important.)

   ________ Convenience of shopping

   ________ Living close to work / Neighborhood employment

   ________ Neighborhood safety

5. **Based on this map, would you want to live in this neighborhood?** (Check one box.)

   - ❑ Yes
   - ❑ No

Part 3

This is the final section of the survey. Think about all the maps you have seen until now, and where it is indicated, answer the questions in this section based on the information on all five maps. You may refer back to each map as many times as necessary.

[CONTINUE]

All of the maps that you have seen so far in this survey describe the same neighborhood. Carefully re-examine all five maps together, and answer the questions below based on the information on all of the maps.

1. **Based on the information on all of the maps, which of the following statements best describes this neighborhood?** (Check one box.)

   - ❑ A mid to high-income, culturally diverse, urban neighborhood
   - ❑ A low-income, culturally diverse, urban neighborhood
   - ❑ A mid to high-income, non-diverse, urban neighborhood
   - ❑ A low-income, non-diverse, urban neighborhood
   - ❑ Not enough information on all of the maps

Listed below are the same neighborhood characteristics from the previous sections. Using all of the maps, rate each attribute on the scale to the right by circling the number that best represents the feature in this neighborhood from 1 (poor) to 5 (excellent). If you don't know or think that there is not enough information available on the maps to rate an attribute, circle NA.

2. **Using all five maps, how would you rate this neighborhood for each of the 10 features below?** (Circle one response for each question.)

	Poor		Average		Excellent	
a. **Access to amenities** *(parks, entertainment, etc.)*	1	2	3	4	5	NA
b. **Community organizations** *(YMCA, religious ctr., etc.)*	1	2	3	4	5	NA
c. **Community stability** *(long-term residency)*	1	2	3	4	5	NA
d. **Convenience of shopping** *(grocery, retail, etc.)*	1	2	3	4	5	NA
e. **Living close to work** *(local job opportunities)*	1	2	3	4	5	NA
f. **Neighborhood appearance**	1	2	3	4	5	NA
g. **Neighborhood interaction/sense of community**	1	2	3	4	5	NA
h. **Neighborhood safety**	1	2	3	4	5	NA
i. **Quality of local schools**	1	2	3	4	5	NA
j. **Ties to surrounding neighborhoods / region**	1	2	3	4	5	NA

3. **Based on the information on all five maps, how would you rate this neighborhood overall?** (Check one box.)

   - ❑ Excellent
   - ❑ Good
   - ❑ Average
   - ❑ Below Average
   - ❑ Poor

4. **All of the maps in this survey describe a real neighborhood in the eastern U.S. Which Pittsburgh neighborhood do you think this neighborhood most closely resembles?** (Write the name of the neighborhood in the space below. If you do not know, leave the space blank.)

   ____

5. **Think about the different types of maps you have seen so far. Which map do you think best describes the neighborhood overall?** (Check one box.)

- ☐ The computer-generated map in Part 1
- ☐ Map A
- ☐ Map B
- ☐ Map C
- ☐ Map D

Think about all four maps from Part 2. Each of these maps was developed by an individual resident of the same urban neighborhood. Look carefully at the descriptions of the map-makers below and match the description on the right with the maps from the previous section. <u>Take your best guess.</u>

6. **Which map-maker do you think made each map?** (Match the items below. Draw a line to connect each pair. Each map corresponds with only one map-maker.)

Map A	**Map-Maker 1:** 61-year old female with a graduate / professional degree, lived in the neighborhood for 2 years, household income greater than $100,000/year.
Map B	**Map-Maker 2:** 74-year old male with a college degree, lived in the neighborhood for 55 years, household income between $50,000 and $100,000/year.
Map C	**Map-Maker 3:** 48-year old male with a graduate / professional degree, lived in the neighborhood for 18 years, household income greater than $100,000/year.
Map D	**Map-Maker 4:** 19-year old female college student, lived in the neighborhood all her life, household income between $50,000 and $100,000/year.

Think about some of the local planning decisions that are made in your own neighborhood and community. Now think about the type of person from your own community that you would most prefer to have represent you and your neighborhood in local planning and decision making.

7. **Based on the description of each map-maker in question 6 above, which of these map-makers would you most prefer to have as a community representative?** (Check one box.)

- ☐ Map- maker 1
- ☐ Map- maker 2
- ☐ Map- maker 3
- ☐ Map- maker 4
- ☐ None of the above

8. **Why would you prefer the map-maker you selected in question 7 above as a community representative?** (Write your answer in the space below.)

____

____

____

9. **About how often do you use the following types of maps or geographic information?** (Check one box for each type of map.)

	Never	Daily	Weekly	Monthly	Yearly
a. Local or regional street maps	☐	☐	☐	☐	☐
b. A national or world atlas	☐	☐	☐	☐	☐
c. Travel guides and maps	☐	☐	☐	☐	☐
d. Real estate information	☐	☐	☐	☐	☐
e. Educational maps (Books, TV, etc.)	☐	☐	☐	☐	☐
f. News or current affairs maps	☐	☐	☐	☐	☐
g. National Geographic maps	☐	☐	☐	☐	☐

10. **What type of information would you most prefer to have to participate in the following planning projects or make the types of decisions described below?** (Check one box for each type of decision.)

	Booklet / written description	Pamphlet of pictures or photos	Map / geographic information	Data table / statistical information
a. Siting a new recreation center	☐	☐	☐	☐
b. Community environmental planning	☐	☐	☐	☐
c. Township budget-making	☐	☐	☐	☐
d. Moving to a new neighborhood	☐	☐	☐	☐
e. Rezoning the school district	☐	☐	☐	☐
f. Locating a community waste facility	☐	☐	☐	☐
g. Public hearing for siting a power line	☐	☐	☐	☐

11. Is there a correct balance between business/industrial development and concern for the environment? (Check one box.)

- ❑ Too much emphasis on business
- ❑ Some emphasis on business
- ❑ Correct balance between business and the environment
- ❑ Some emphasis on the environment
- ❑ Too much emphasis on the environment

12. Do environmental policies and regulation impact economic development? (Check one box.)

- ❑ Significantly help economic development
- ❑ Somewhat help economic development
- ❑ No impact
- ❑ Somewhat hurt economic development
- ❑ Significantly hurt economic development

13. Are long-term consequences adequately considered by today's policy makers? (Check one box.)

- ❑ Too little long-term emphasis
- ❑ Adequate consideration of the long-term
- ❑ Too much long-term emphasis

14. How often do you participate in the following types of community or neighborhood activities, meetings, or events? (Check one box for each question.)

	Never ▼	Rarely ▼	Occasionally ▼	Often ▼
a. Public environmental hearings	❑	❑	❑	❑
b. City / town planning meetings	❑	❑	❑	❑
c. Community organization meetings	❑	❑	❑	❑
d. Public awareness campaigns	❑	❑	❑	❑
e. Local school-related events	❑	❑	❑	❑

15. To what degree do you consider yourself to be active or involved in your neighborhood or community? (Check one box.)

- ❑ Not at all involved
- ❑ Somewhat involved
- ❑ Very involved

16. Have you ever participated in a public or civic protest of a political, social, or economic issue? (Check one box.)

- ☐ Yes
- ☐ No

17. Do you vote in elections for your local officials? (Check one box.)

- ☐ Yes
- ☐ No

Demographic Questions

Now we would like you to answer some questions about yourself and your neighborhood.

1. What is the zip code where you currently live? (Write your answer in the space below.)

____________ Zip code

2. How many years in total have you lived in this zip code? (Does not need to be consecutive. Write your answer in the space below.)

____________ Years

3. Do you own or rent your home? (Check one box.)

- ☐ Own
- ☐ Rent
- ☐ Other (please explain) ________________________

4. What is your age? (Write your answer in the space below.)

____________ Years

5. What is your gender? (Check one box.)

- ☐ Male
- ☐ Female

6. **Approximately what is your total annual household income?** (Check one box.)

- ❑ less than $10,000
- ❑ between $10,000 and $25,000
- ❑ between $25,000 and $50,000
- ❑ between $50,000 and $100,000
- ❑ more than $100,000

7. **What is your highest level of education?** (Check one box.)

- ❑ Some high school but no degree
- ❑ High school degree
- ❑ Some college but no degree
- ❑ Trade school
- ❑ College degree
- ❑ Graduate or Professional degree

8. **What do you consider to be your ethnic background?** (Check one box.)

- ❑ White or Caucasian
- ❑ Hispanic or Latino
- ❑ Black or African-American
- ❑ Asian or Asian American
- ❑ Other (please specify) ____________________

Please return your completed survey to the survey moderator and sign-out.

If you have any questions about this study, please feel free to ask them now or anytime throughout the study by contacting:

Shalini Vajjhala
Engineering and Public Policy
Carnegie Mellon University
Baker Hall 129
5000 Forbes Avenue
Pittsburgh, PA 15213
412.860.5708

Thank you very much for participating in this survey!