Travel Patterns in Mixed Use Neighborhoods

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Washington State Transportation Commission
Innovations Unit

Linda Zemotel
Research Associate

Kristen Nielsen
Research Assistant

G. Scott Rutherford
Director

John M. Ishimaru
Senior Staff Member

University of Washington, JD-10
University District Building
1107 NE 45th Street, Suite 535
Seattle, Washington 98105-4631

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Editor Stephanie MacLachlan
Production Coordinator Ron Porter
Graphic Design Mary Marrah
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Abstract

This working paper, *Travel Patterns in Mixed Use Neighborhoods,* summarizes Phase I of a research effort by the Innovations Unit of the Washington State Transportation Commission. The study is based on previous Innovations Unit research, described in the 1992 report, *Land Use-Transportation Linkage* (Kestle et al. 1992), the focus of which was the impact of land use policies on transportation systems.

This working paper describes surveys conducted in four neighborhoods in the state of Washington (three in King County and one in Spokane) to gather data on travel behavior in neighborhoods that have a good mix of housing, shopping, and services; in other words, mixed use neighborhoods.

The survey consisted of telephone interviews to determine household characteristics and the subsequent collection of travel diaries to assess household travel habits by mode and purpose. Preliminary results indicate the preponderance of trips for family and personal business on both weekdays and weekends. Although auto is the dominant mode, results indicate the potential for shared rides in all neighborhoods and for the walk mode in the in-city neighborhoods.

Directions for future research are suggested, including the study of the potential for reducing vehicle miles traveled (VMT) in mixed use neighborhoods; the relationships among mixed use development, household demographics, and travel behavior; the possibility of substituting walking for auto use; and methods for alleviating weekend traffic congestion based on a better understanding of the components of weekend travel.

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The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Washington State Transportation Commission or the Washington State Department of Transportation. This report does not constitute a standard, specification, or regulation.

I. Introduction and Research Approach

Problem Statement

The land use-transportation linkage has long been a concern of urban planners. As more people have moved to the suburbs, increasing regional traffic congestion and air pollution, attention is focusing on the physical design of neighborhoods that decreases reliance on single-occupancy vehicles (SOVs) and reduces overall travel needs.

A 1992 report by the Innovations Unit of the Washington State Transportation Commission entitled *Land Use-Transportation Linkage* focused on the impact of land use policies on transportation systems (Kestle et al. 1992). Among the issues discussed by the authors were concepts to link higher residential densities, varied land uses, and site design elements with transportation. This research project builds on that effort. Its primary purpose is to address one of the research needs cited in the 1992 report: namely, to quantify the relationship between mixed land use neighborhoods and travel behavior.

This project uses the broadest definition of mixed use development: simply put, two or more distinct land uses throughout a neighborhood. Referring to suburban development, the Urban Land Institute noted in a 1991 publication that the intent of zoning has been to separate incompatible land uses for the purpose of protecting property values (Ewing 1991). However, developers and planners have questioned whether the physical separation of land uses is desirable; on the contrary, some feel that mixing land uses may reduce the dependence on auto travel by making more services available within walking distance. This project explores that possibility by using survey methods to collect data about the actual number and type of trips made by residents of mixed use neighborhoods.

The recent emphasis on growth management in Washington state has also increased awareness of the importance of the linkage between land use and transportation facilities and services. The Growth Management Act (GMA), for example, passed by the Washington State Legislature in 1990 and amended in 1991 and 1992, mandates that fast-growing counties and cities across the state develop comprehensive plans that include "a transportation element that implements, and is consistent with, the land use element" (Growth Management Act 1992). The GMA encourages cities, counties, and regions to actively direct, or at least influence, growth. The results of this project, which show how people move about in mixed use neighborhoods, will enhance our understanding of the physical attributes of neighborhoods that influence travel behavior.

Study Objectives

The goal of the project was to quantify the relationship between mixed use development and residents' travel patterns within and outside their neighborhoods. The project is being developed in several phases. Phase I, the results of which are documented in this

report, is designed to accomplish the following objectives:

- determine the mode split in mixed use neighborhoods. In other words, calculate the distribution of trips among transportation modes (e.g., single-occupancy motor vehicle, shared ride, transit, bicycle, and walking); and

- relate trip purpose to mode choice.

Phase II of the project, now underway, is addressing the following objectives:

- determine VMT (vehicle miles traveled) for households within each neighborhood; and

- compare the VMT findings for the neighborhoods with values calculated from existing regional travel data.

Both phases focus on the potential for reducing SOV dependence and overall travel in mixed use neighborhoods.

Future phases of the project may address the following objectives:

- based on differences in mode split, trip purpose, and VMT for the mixed use neighborhoods, determine whether demographic or spatial characteristics can be correlated with particular travel behaviors; and

- compare these findings for the neighborhoods against values calculated for the regions in which they are located.

Report Organization

The remainder of this report is divided into four chapters, each of which is described briefly below.

Chapter II: Recent Literature. This report overviews recent research to identify ideas about land use planning that can be applied at the neighborhood level.

Chapter III: Data Collection Methodology. The research project centered around the collection of data about household travel behavior. Three hundred households in each of four neighborhoods in Washington state completed travel diaries for two days. These households were recruited by telephone, at which time the interviewers asked respondents some general questions about their travel habits and household characteristics. In addition, shoppers in each neighborhood provided information about their trips in short interviews. Chapter III describes the project methodology in detail.

Chapter IV: Descriptive Analysis. After the survey data were collected, the Statistical Package for the Social Sciences (SPSS), a software package, was used to produce summary statistics. Frequency distributions summarizing responses for each category of a given variable, and contingency tables indicating the relationship between two or more variables, were run. Chapter IV summarizes the survey data and interprets the results in terms of the potential for shared motorized travel and for non-motorized travel in each neighborhood.

Chapter V: Future Research. The Phase I results suggested a number of areas in which additional research would be valuable. Nine such areas are identified in Chapter V.

II. Recent Literature

The purpose of this overview of recent literature is to introduce the reader to a range of analyses relating to travel patterns in mixed use neighborhoods. Mixed use neighborhoods are characterized by a mix of land uses, including retail and service establishments, and are also usually denser and more diverse in terms of residential housing types than suburban developments. While attention to the topic of travel patterns in mixed use neighborhoods is relatively recent, there is a variety of literature on related subjects, including traditional neighborhood development (TND) and transit-oriented development (TOD).

Traditional neighborhood development, also called neo-traditional development (NTD), seeks to recreate the traditional, grid-based street layout of historic small towns, with shops, services, and multi-family housing located in a pedestrian-oriented downtown. Transit-oriented development (TOD) also clusters retail and higher-density housing around a pedestrian-friendly core, but that core would also contain a major transit stop. Transit-oriented development is often, but not necessarily, designed with a gridded street network. In both types of development, there are more opportunities for walking and for combining separate trips into a single, more efficient, linked trip than in developments with highly segregated land uses and few pedestrian amenities.

Planning: Local Examples

Recent planning efforts in western Washington, including the Puget Sound Regional Council's *Vision 2020 Plan* (1990) and the City of Seattle's draft comprehensive plan (1993), advocate the concentration of residential and business growth in high-density mixed use centers.

The need for such planning at the regional, county, and city levels has been articulated in state legislation that sets out clear expectations for the integration of land use and transportation planning. Beyond the Growth Management Act, already mentioned, the Commute Trip Reduction Law, passed in 1991, requires employers with more than 100 employees to develop policies and programs to reduce SOVs and vehicle miles traveled (Badgett et al. 1992).

In Seattle, the planning department, as required by the Growth Management Act, has produced its draft comprehensive plan, which is currently undergoing public review. The framework for this comprehensive plan is the "urban villages" concept, articulated by Mayor Norm Rice in a 1992 speech.

> To accommodate growth and protect our existing neighborhoods and our open spaces, we need to create 'urban villages' ... places where people could live, work, shop, play and go to school, all within walking distance (City of Seattle 1993).

The city's comprehensive plan designates categories of urban villages that recognize the differences in neighborhoods and establish goals for housing densities, new employment, and private and public development. Four categories are envisioned: 1)

urban centers with their urban center villages; 2) hub urban villages; 3) residential urban villages; and 4) neighborhood villages. Target residential and employment densities in Seattle's draft plan are indicated in table 1.

Recent Studies of the Potential for Mixed Use Developments

The recent interest in traditional neighborhood development, expressed by both academics and developers, has stimulated research into the relationship between the built form of neighborhoods and the travel behavior of their residents. As traffic congestion increases, planners and communities as a whole look for alternatives to SOV commuting and automobile dependency.

Researchers are studying neighborhood forms and development patterns, such as neo-traditional development and transit-oriented development, to see how they affect travel behavior. Insights regarding the effect of mixed uses on neighborhood travel can be gained from a study of these related neighborhood forms. The following discussion begins by looking at recent analyses that address related developments, such as mixed use suburban office centers or transit-oriented development (TOD). This is followed by a discussion of a Portland study that modeled travel behavior in transit-oriented or neo-traditional developments, and analyzed their potential as an alternative to expanded freeway development. The chapter concludes with a discussion of several recent quantitative analysis studies.

Recent Analyses

A recent series of articles published by the Urban Land Institute provided an overview of traditional neighborhood development (Bookout 1992a; 1992b; 1992c; 1992d; 1992e). Written to introduce developers and planners to TND concepts, the articles covered design, building codes, standards, and marketing issues. The series cited a study model that predicted a 57 percent reduction in internal VMT for a TND, compared to a more conventional planned unit development with curvilinear streets and cul-de-sacs; the reduction was due to more direct routes between destinations within the neighborhood. However, the series also described the relative lack of built TNDs, and noted the central fact that *"empirical data on the traffic impacts of TND await the full coming into being of one or more developments based on the concept"* (emphasis added) (Bookout 1992b).

Consistent with this conclusion was a recent analysis by Kestle that described ten research publications that quantified the relationships between land use and transportation (Kestle 1992). Kestle summarized the literature as follows: "Quantitative research may play a significant role in the evolution of research in these fields, but basic inadequacies of data and definitional problems plague the recent and ongoing studies."

Kestle defined "mixed use" by citing the traditional, zoning-based, definition: any building or complex of buildings conceived as a single development that includes more

Table 1. Proposed Target Densities of Urban Villages in Seattle (source: City of Seattle 1993)

Category	Residential Density (units per gross acre)	Employment Density (jobs per gross acre)
urban center villages	15-50	25-50+
hub urban villages	8-20	25-50
residential urban villages	7-15	no new targets
neighborhood villages	6-10	no new targets

than one distinct type of use. A typical example of a mixed use development is an apartment or office building with retail on the first floor. Kestle also pointed out that the definition has broadened to include mixed use zones, with two or more uses (for example, a site with small-scale, multi-family housing, a daycare, and a small library in separate buildings but all part of a unified development).

In the last decade, city planners have become aware of the transportation benefits of locating retail outlets and services at employment centers, and of locating housing close to such mixed use developments. Kestle cited Robert Cervero, who concluded in his 1988 book *America's Suburban Centers*, that a mix of land uses was a major factor in supporting mass transit and in deterring personal automobile use. While Cervero's findings were based on suburban office centers, the factors that influence mode choice, such as a mix of uses and pedestrian-friendly urban design, could be applied to other types of development as well (Cervero 1988).

Kestle also found that land use policies to control mixed use developments are difficult to analyze, because "while many zones are termed 'mixed use,' or allow a broad mix of land uses, the actual composition of built projects is not easily monitored." Nor is the mix of uses easily influenced by the zoning code. In fact, it may be difficult to build mixed use residential projects under existing zoning requirements because codes tend to be protective of single-family zones. Typically, as the residential density permitted decreases, fewer non-residential uses are permitted. Consequently, those neighborhoods with the lowest density, which are often the farthest from urban centers, also have the fewest services nearby.

Kestle also addressed site design, as related to travel behavior. Site design refers to the way buildings are oriented on a site and how they relate to surrounding buildings and adjacent development. Site design encompasses features such as setbacks (required distances between buildings and the street), pedestrian-oriented, ground-level facades, and the presence or absence of large parking lots.

While analyzing the effect of site design on travel behavior can be difficult, this topic is generating considerable interest. Kestle noted three recent books that address site design effects. *Public Streets for Public Use* (1987), edited by Anne Vernez Moudon, is a comprehensive review of the historical evolution of streets. The book's essays trace the evolution of public rights-of-way from small-scale, mixed use, open spaces to the large, open trafficways that characterize typical U.S. street grids. *Accommodating the Pedestrian*, by Richard Untermann (1984), underscored the importance of pedestrian and bicycle networks in cities. *The Pedestrian Pocket Book: A New Suburban Design Strategy*, edited by Doug Kelbaugh (1989), described the "pedestrian pocket" approach to community planning and design. Kelbaugh, and others, including architect Peter Calthorpe, advocated a return to the "pedestrian pocket," compact communities with traditional (rectilinear) street systems, and transit-oriented designs, as opposed to most suburbs' sprawling, curvilinear patterns. Such pedestrian-oriented developments could be in cities or in suburban areas, with transit connections to major employment centers.

Mixed use development concepts often include higher residential and non-residential densities that are considered more supportive of public transit and more conducive to walking. In *Public Transportation and Land Use Policy*, Boris S. Pushkarev and Jeffery M. Zupan (1977) offered several reasons that transit use increases with rising residential density. First, auto ownership decreases with density because auto storage is less convenient and more costly, and because alternative modes, including walking, are available. Even more important than residential density, according to these authors, is the density of non-residential activity centers, where density supports better transit and allows shorter walking distances between uses. "High residential density by itself does little for transit if there is no dominant place to go" (Pushkarev and Zupan 1977).

Some scholars, including Anthony Downs, author of *Stuck in Traffic: Coping with Peak-Hour Traffic Congestion* (1992), are skeptical about the potential for manipulating

land use patterns to influence travel behavior and reduce congestion.

In *Stuck in Traffic,* Downs discussed both supply-side remedies that increase the transportation network's carrying capacity, and demand-side approaches. In addition to such demand-side remedies as transportation demand management strategies, Downs also presented four demand-side approaches that involve changing housing or employment locations: 1) increasing residential densities; 2) changing the jobs-housing balance, i.e., the intermingling of housing and employment opportunities in a community; 3) concentrating jobs in large clusters; and 4) developing local growth-management policies. In particular, the strategy of increasing residential density is often a part of transit-oriented developments.

Downs listed four benefits of increasing residential density:

- fewer total movements required by the population;
- the lower cost of building infrastructure trunk lines such as sewer and water mains;
- the increased feasibility of using public transportation for commuting; and
- the increased feasibility of building relatively low-cost housing (low-cost housing becomes more feasible because low-rise apartments are less expensive to build than either high-rise apartments or low-density, single-family homes).

Downs stressed that it is very difficult to increase a city's average density because there is very little vacant land in most urban areas. Some demolition and redevelopment occur over time, but the majority of new construction takes place on the periphery of developed areas. Downs did note that overall density is not as important as concentrating denser uses near the downtown area and around transit stops. Nevertheless, he cautioned against relying on this land use strategy alone to solve congestion problems.

Traditional neighborhood developments (TNDs) often incorporate a mixture of land use, site design, and demand management strategies to address transportation issues. An example of a mixture of strategies is found in the neighborhood concept being considered in the following Portland study of land use and TDM alternatives.

Portland, Oregon: LUTRAQ

Because there are so few traditional neighborhood developments (TNDs) or transit-oriented developments (TODs) in existence, opportunities to study them are limited. For this reason, modeling has been used to predict their impact on transportation behavior and systems. One such effort was the Portland LUTRAQ project that analyzed development alternatives in an actual setting (Cambridge Systematics et al. 1992).

The LUTRAQ Alternative/Analysis of Alternatives: An Interim Report, was prepared by a team of consultants for 1,000 Friends of Oregon, a public interest group involved in land use and environmental issues. LUTRAQ (land use, transportation, air quality) is a national demonstration project designed to evaluate the impacts of alternative suburban land use development on automobile dependency, mobility, air quality, energy consumption, and individuals' "sense of community." The project analyzed alternatives to the proposed Western Bypass freeway around the Portland metropolitan area, to see whether alternative development patterns could reduce travel demand and increase the use of alternative modes, thereby obviating the need for the freeway. According to the report's authors, the goal of the study was to "determine whether redirecting urban (and suburban) growth to patterns which reduce automobile dependence and support alternative modes of transportation can solve some of these problems in the western suburbs of Portland, Oregon; in particular the need for a proposed Western Bypass freeway" (Cambridge Systematics et al. 1992).

The LUTRAQ alternative consisted of a traditional neighborhood development designed to reduce suburban sprawl and

avoid the need for freeway expansion. The alternative developments featured housing, shops, and services clustered around a pedestrian-oriented center that included a transit stop. An important feature of the alternative was the incorporation of transportation demand strategies, such as increased parking costs, subsidized transit, and preferential HOV treatment.

The report presented the results of a modeling exercise, which showed the predicted differences in travel patterns between the LUTRAQ alternative and the bypass alternative:

The Western Bypass alternative included a four-lane, limited access highway as well as improvements to area arterials, extension of the Westside Light Rail network, and expanded bus service in the corridor.

The LUTRAQ alternative included transit-oriented development, significant expansion of light rail and express bus service, and TDM measures, including parking charges for all SOV commuters and a full transit subsidy for all employees in the study area. The LUTRAQ alternative proposed both entirely new developments and redevelopment, or infill, of vacant or underutilized sites in existing developments.

Simulation of the LUTRAQ alternative for the year 2010 predicted the following travel changes compared to the Western Bypass alternative:

- an increase in the transit mode split for work commutes by 45 percent (from 8.8 percent to 12.8 percent);
- an increase in the walking or bicycle mode split for all trips by 22 percent (from 3.7 percent to 4.5 percent); and,
- a reduction in the number of vehicle trips per household by 7.7 percent (from 7.68 trips to 7.09 trips).

The model simulations indicated that the LUTRAQ alternative would encourage mode shifts to walking, bicycling, and transit, and from SOVs to carpools for commuting. These predicted shifts are largely due to the presence of transit-oriented developments within the study area. Walking, biking, and transit mode splits would be even higher in the TODs of the study area. According to the report, the non-auto modes in TODs would account for 20 percent of all home-based trips and 26 percent of all work trips. Although these figures are high, they are comparable to those observed in pedestrian-friendly areas of Portland. The implication is that TOD principles could be effective in reducing automobile reliance.

Other Quantitative Studies

While the LUTRAQ report studied transportation behavior outcomes for different types of developments, another recent study, *Comparative Assessment of Travel Characteristics for Neotraditional Developments* (McNally and Ryan 1993) modeled the street attributes of such developments, namely two hypothetical street networks, one suburban and one TND. The modelers defined TNDs as having a traditional street network composed of a regular grid; the suburban network was defined as having cul-de-sacs and curvilinear streets, with fewer direct routes. The study focused on street geometry; land use characteristics such as density and mixed use were not incorporated into the model.

Model results indicated that VMT values were 10.6 percent lower and mean trip length was 15.5 percent shorter for the TND than for the suburban development. The lower values were attributed to the TND network's greater efficiency (the product of more interconnected alternative routes) and more entrance points to the neighborhood. The number of trips generated was approximately the same for the two types of development. The model did not account for the mix of land uses in the TND, only for the differences in the street networks.

A recent compilation by Calthorpe Associates (1992) presents the results of several studies examining travel behavior in transit-oriented developments based on analyses of both existing data and simulations of hypothetical neighborhoods. Although the

title of the Calthorpe report, *Transit-Oriented Development Impacts on Travel Behavior,* implies exclusive reference to TODs, the results are also applicable to mixed use developments.

One paper within the report, *The Effect of Neotraditional Neighborhood Design on Travel Characteristics,* analyzed 1980 travel data collected by the San Francisco Bay Area Metropolitan Transportation Commission (Friedman et al. 1992). The authors created two data subsets, one representing a "traditional" community with some of the attributes of a TND, the other representing a typical suburban tract development. The data indicated that suburban tracts had a 23 percent higher daily trip generation rate and a higher drive-alone rate than the traditional communities. The rate for walk trips in the traditional communities was 112 percent over that of suburban tracts. Since they did not have data from an existing TND, they could only hypothesize that a TND's total daily trip generation and its walk mode share would be similar to those of traditional communities. Further, they speculated that the bicycle mode share would be higher than either that of traditional or suburban communities, and that the transit share would be higher than that of the suburban tracts and lower than that of the traditional communities.

Another paper in the Calthorpe report, *Traditional Neighborhood Development: Will the Traffic Work?* modeled a traditional neighborhood development and a conventional suburban development (Kulash et al. 1992). The model predicted a 43 percent reduction in VMT for local trips in TNDs as compared with the typical suburb.

Also supporting the view that traditional neighborhoods produce lower VMT than typical suburban developments is John Holtzclaw's *Explaining Urban Density and Transit Impacts on Auto Use* (1992), included in the Calthorpe report. Holtzclaw's conclusions were based on an analysis of two communities in the San Francisco Bay area. One is characteristic of standard suburban development and the other typifies a traditional mixed use development.

Calthorpe concludes that the results "paint a consistent picture" of overall reductions in VMT, reductions in the automobile mode split, increases in transit ridership, and increases in walking and bicycling mode shares.

Another recent research effort, *Getting Around a Traditional City, a Suburban PUD, and Everything In-Between,* studied six communities to determine how different styles of land use planning can affect travel behavior (Ewing et al. 1993). The communities ranged from traditional to urban sprawl. The traditional community featured corner stores, rear alleys, accessory apartments, a mass transit system, and streets forming a very dense grid. The community selected to typify urban sprawl had only large-lot, single-family homes; one convenience shopping center; and one major road funneling all traffic to the turnpike or interstate.

The authors concluded that the households in the sprawling suburb accounted for two-thirds more VMT per person than households in the traditional development. Another important finding was that the availability of neighborhood services resulted in shorter auto trips and fewer vehicle hours of travel. This finding is especially significant because it indicates the potential transportation benefit of TNDs, even if the automobile remains the dominant mode in many communities. In addition, land uses could be arranged to make auto trips more efficient by facilitating linked trips.

Summary

Recent literature points to an interest in analyzing the effects of TOD and TND on travel behavior. A number of research projects have been carried out, including those that model and analyze developments with characteristics of TND. As the concepts and principles underlying TND are translated into actual developments, opportunities to assess their impact on travel behavior will increase.

III. Data Collection Methodology

A survey was conducted in order to quantify travel behavior in four mixed use neighborhoods. Data pertaining to household travel habits and household characteristics were collected in three King County neighborhoods and in one Spokane neighborhood.

The neighborhood survey design was based on the Puget Sound Transportation Panel (PSTP), "the first application of a general-purpose urban travel panel survey in the United States" (Murakami and Watterson 1990). The PSTP collected travel data that could be used in long-range travel behavior forecasting. To do this, the same individuals are interviewed at different points in time to determine how travel habits change as households change. The first wave of the panel survey was conducted in the fall of 1989, the second wave in the fall of 1990, the third wave in the fall of 1992, and a fourth wave in the fall of 1993. The panel consisted of 1,713 households in the four-county central Puget Sound metropolitan region.

The neighborhood survey for this project was similar to the PSTP. Both surveys consisted of two parts: a telephone survey and a travel survey. During the telephone survey, respondents were asked about household demographics, bus usage, and their usual means of transportation to work. At the same time, interviewers recruited households to participate in a written travel survey. They asked all household members age 15 or older to record all their trips for two consecutive days on travel diary forms; those consenting to the travel diary element of the survey were later mailed the proper materials.

Unlike the PSTP, the neighborhood survey was designed to collect data at only one point in time; it was not intended as a panel survey (i.e., repeated over subsequent years). The neighborhood survey was conducted during November and December of 1992. It consisted of 1,208 households in four Washington neighborhoods. Using the PSTP's telephone questionnaire, travel diary form, and instruction sheet as prototypes, the neighborhood survey adapted these instruments to obtain detailed travel information.

The remainder of this chapter describes three aspects of the survey process: 1) the procedure for selecting survey sites; 2) the survey techniques used; and 3) the characteristics of the survey respondents.

Survey Sites

Selection Criteria

Neighborhoods were selected for the study based on two primary criteria: regional distribution and mixed land use. Because the project was designed to encompass the entire state, including both urban and suburban locations, neighborhoods in both the Seattle area in western Washington and in the Spokane area in eastern Washington were considered. For this research, the term "mixed use" was defined broadly: areas characterized

by more than one distinct land use (e.g., residential, retail, or business) and offering opportunities to use alternative transportation such as walking, transit, and bicycling.

Many neighborhoods considered could have been chosen. The neighborhood had to have a mixture of housing types, to include single-family homes, apartments, and condominiums (both owner-occupied and rented). Originally, a neighborhood could only be considered if shopping, services, and recreational facilities were located within one-half mile of all residences. This one-half mile criterion was used because this is considered the maximum distance that North American pedestrians will walk (Vernez Moudon 1990). However, to collect enough data for this project, this constraint had to be relaxed to include households somewhat beyond this half-mile limit.

Budget constraints on data collection resulted in the selection of one suburban and three in-city locations. Because the project was administered in Seattle, one suburban and two in-city locations were chosen for western Washington and one in-city location was chosen for eastern Washington.

The following neighborhoods were selected :

- Seattle's upper Queen Anne Hill area (in-city, western Washington),
- Seattle's Wallingford area (in-city, western Washington),
- downtown Kirkland (suburb, western Washington), and
- Spokane's Gonzaga University area (in-city, eastern Washington).

The first step in organizing the study was to calculate each neighborhood's population. These calculations were based on census tract and census block data. Census tracts are "small, homogeneous, relatively permanent areas defined by the Census Bureau (average population 4,000)." A census block is "an area bounded on all sides by visible features such as streets, roads, streams, railroad tracks and occasionally by nonvisible boundaries such as city, town, and county limits. [A census] block is the smallest geographic tabulation area. Average population size is 85" (Seattle Public Library n.d.).

Neighborhood boundaries as defined for this project did not coincide with the census tract boundaries. Instead, each neighborhood included all or parts of various census tracts. To determine the actual population, the number of households, and the number of housing units in each neighborhood, 1990 census tract figures and/or census block figures were aggregated. Figures 1 through 4 indicate the relationships of the neighborhoods to their census tracts.

The following section describes the four neighborhoods. These brief profiles are based on information from various sources. In addition to census tract and census block data for population characteristics, maps provided the physical dimensions of the neighborhoods, and local directories supplied information about the extent and types of shopping, services, and recreational facilities in each.

Neighborhood Descriptions

Upper Queen Anne Hill

This neighborhood is located just a few miles northwest of downtown Seattle (see figure 5). Queen Anne Hill is a convenient residential location in central Seattle. The study area is approximately one-half mile square. This neighborhood is the smallest of the four surveyed. In this area, the Census Bureau reports 2,298 housing units, 2,180 households, and a total population of 4,308 (1990).

Most of this neighborhood lies within one of the "residential urban villages" proposed in Seattle's draft comprehensive plan. Such villages are intended to "provide future housing opportunities in primarily residential mixed-use neighborhoods, with services available within walking distance, and opportunities for limited employment activity" (City of Seattle 1993). The purpose of this designation is to direct growth by providing such neighborhoods with services and amenities that

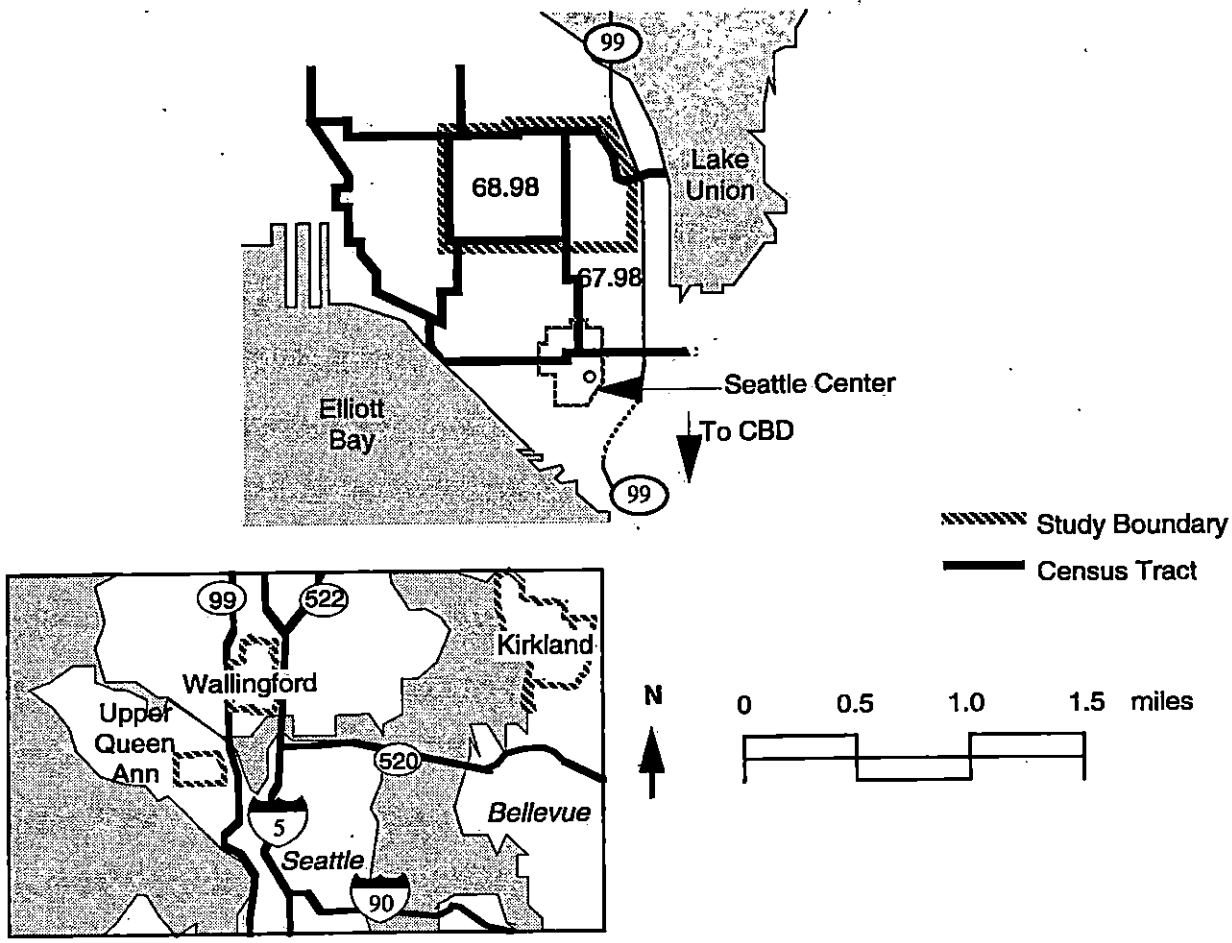

Figure 1. Relationship of upper Queen Anne Hill neighborhood to census tracts

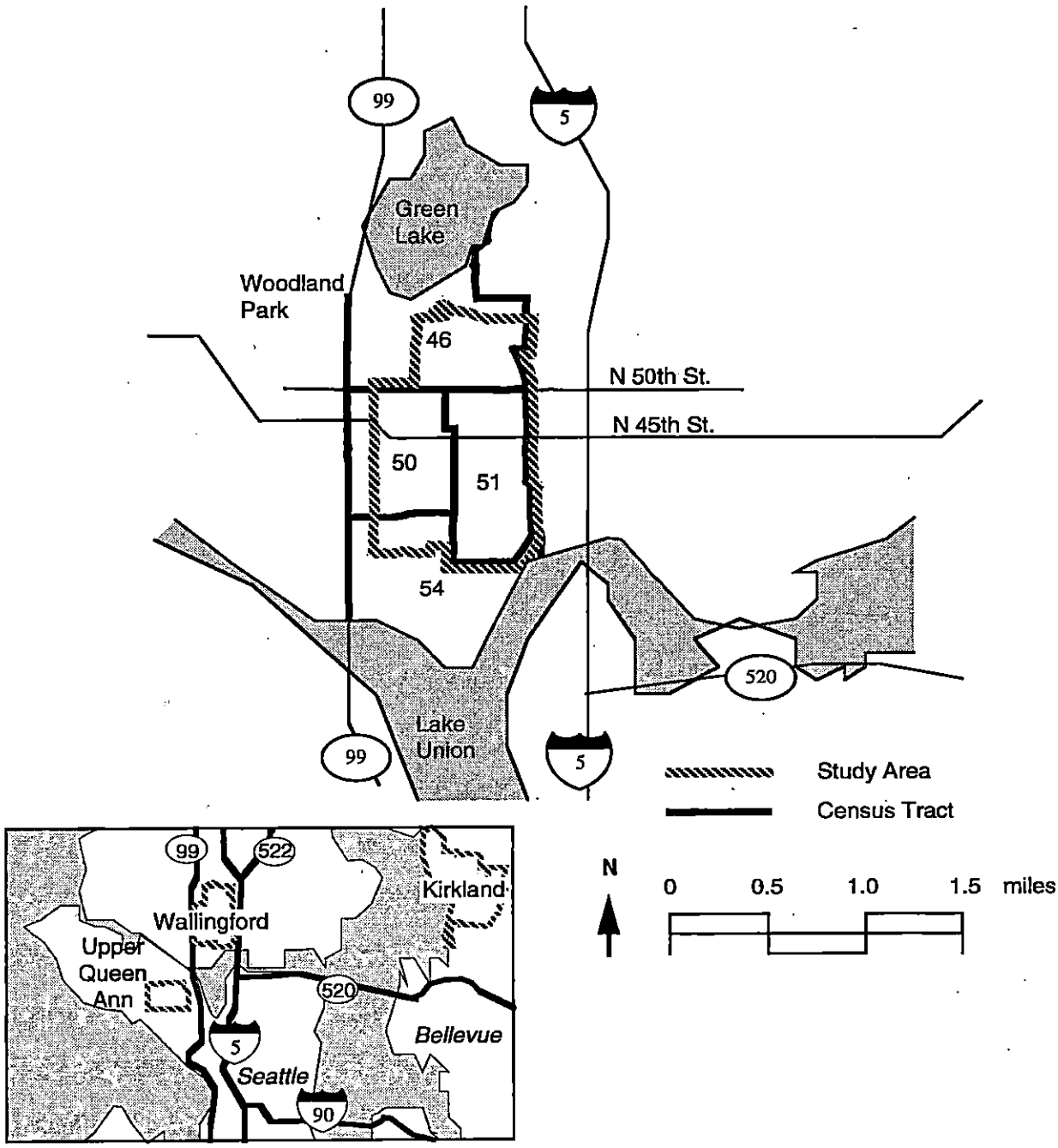

Figure 2. Relationship of Wallingford neighborhood to census tracts

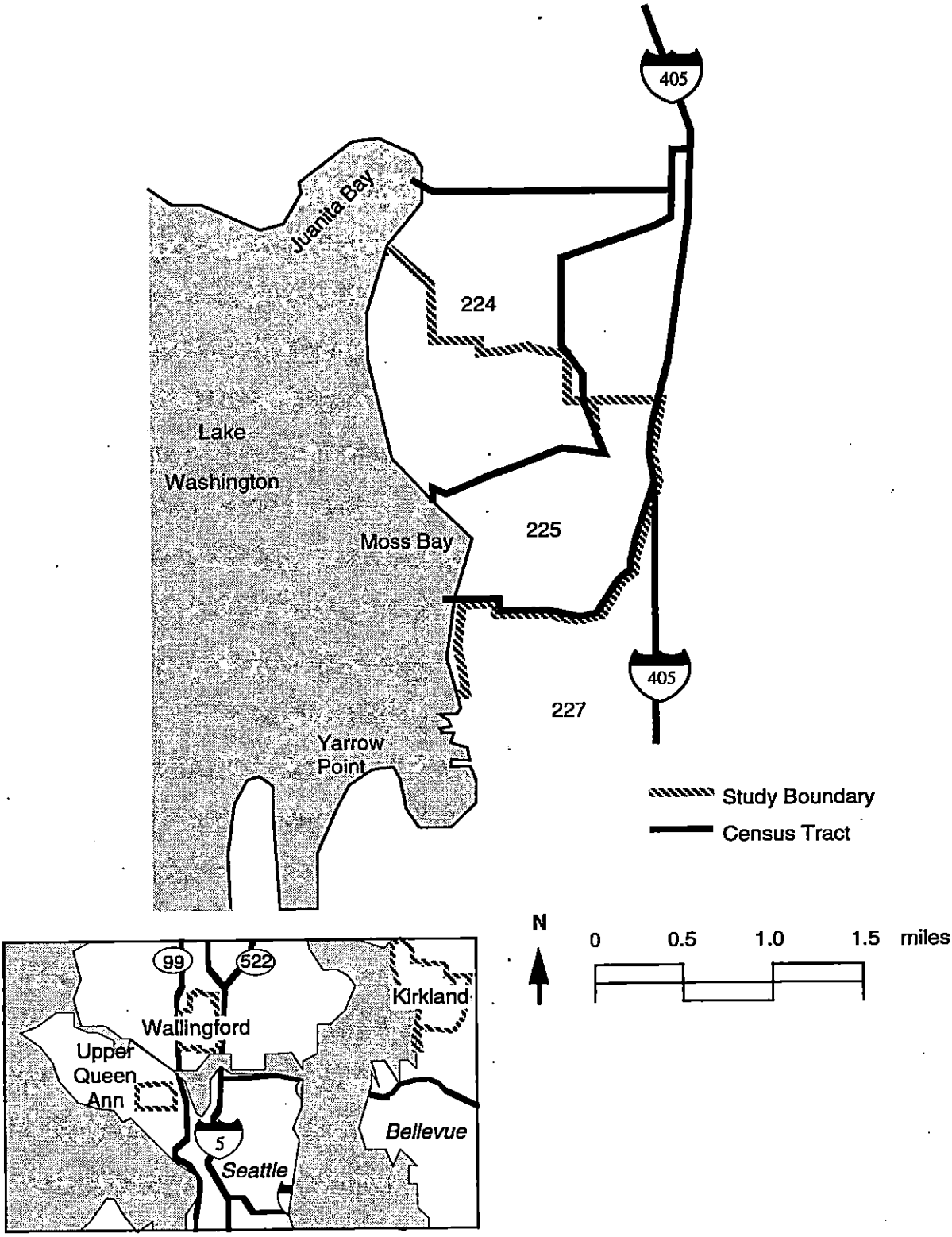

Figure 3. Relationship of Kirkland neighborhood to census tracts

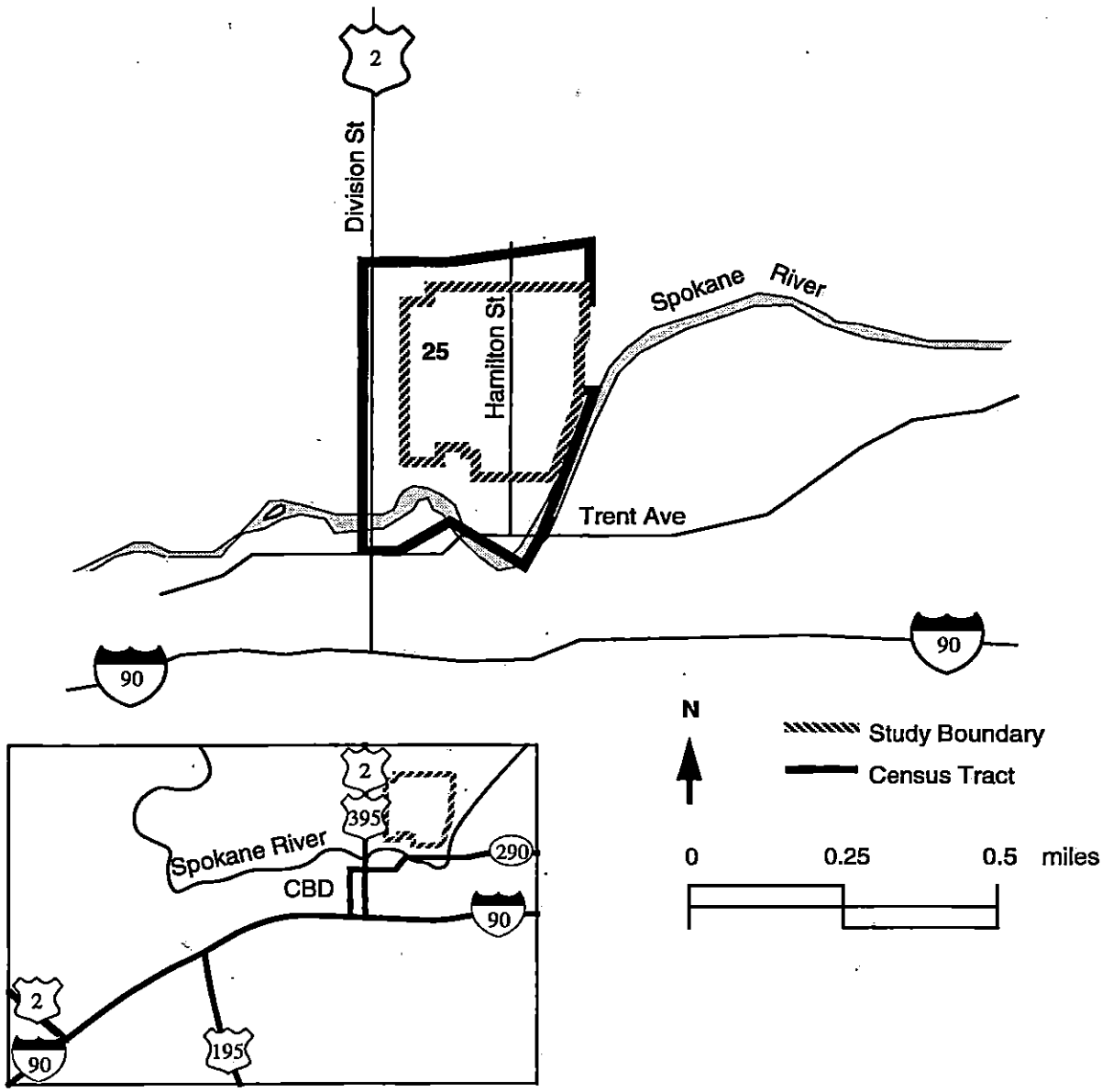

Figure 4. Relationship of Spokane neighborhood to census tract

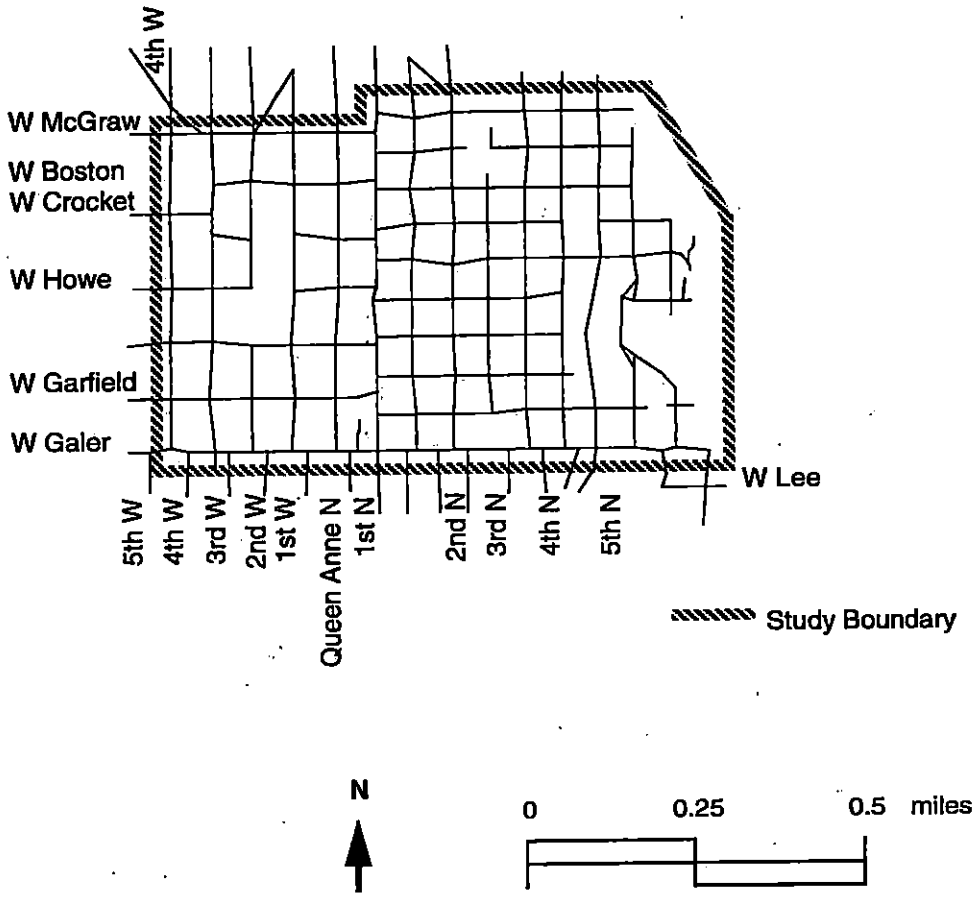

Figure 5. Upper Queen Anne Hill neighborhood streets and study boundaries

make in-city living more convenient and desirable.

The neighborhood centers around Queen Anne Avenue, which begins near the western edge of the Seattle Center, extends north up the hill, and continues through the neighborhood. Queen Anne Avenue is the main shopping street; it features two supermarkets and a variety of retail shops, banks, medical offices, services, and restaurants.

There are a number of public spaces on Queen Anne Hill. An area of several blocks includes a field house, a pool, and a playground. Within or very near the study boundaries are a public library, schools, and churches.

Wallingford

The Wallingford neighborhood is focused around North 45th Street and Wallingford Avenue, (see figure 6). Its location, just west of Interstate 5 and within a few miles of the University of Washington and downtown Seattle, makes it a convenient residential neighborhood. A part of the neighborhood has been designated in the draft Seattle Comprehensive Plan as a residential urban village (City of Seattle 1993).

The area considered for this research extends approximately 0.75 mile (1.2 km) east-west and approximately 1.25 miles north-south (2 km). According to 1990 census tract and census block data, the area includes 4,500 housing units, 4,381 households, and a total population of 9,233.

Wallingford offers a wide range of recreational choices. The study area includes tennis courts, play fields, a public library, movie theaters, and parks. The community center houses studio facilities for a professional ballet company and a senior center. The neighborhood contains several churches and schools.

The neighborhood has a wide variety of shopping areas. The main shopping area along North 45th Street offers restaurants, drug stores, banks, medical offices, and an assortment of small specialty shops. At the intersection of North 45th Street and Wallingford Avenue are a supermarket and the Wallingford Center, a development that includes shops, restaurants, and apartments.

Downtown Kirkland

This suburban neighborhood is located in downtown Kirkland (see figure 7). The neighborhood is bordered by Lake Washington on the west. Prominent characteristics include a renovated downtown shopping and recreation area, and a mix of housing types.

From the waterfront on the west, the area extends approximately one mile east (1.6 km) to Interstate 405. The north-south distance is approximately 1.25 miles (2 km) with an additional half mile (0.8 km) of residential area extending south along the lakefront. According to the 1990 Census, the total number of housing units is 3,971, the number of households is 3,752, and the total population is 7,781.

The City of Kirkland has preserved two open spaces in the downtown area. One is a park and marina on Lake Washington; the other is a park just a few blocks away. The second park has tennis courts and playing fields; it is also the site of a public library, a senior center, and a planned performing arts center.

The downtown has been renovated into an attractive shopping area offering restaurants and specialty shops in addition to banks, professional offices, hair salons, hardware and clothing stores, cleaners, and supermarkets. Many of the restaurants and coffee shops offer outdoor seating.

Gonzaga University Neighborhood

This Spokane neighborhood is dominated by Gonzaga University, a private institution with approximately 2,600 students (see figure 8). The university forms the southern boundary of the study area.

The neighborhood is a rough square that extends north-south approximately 0.8 mile (1.3 km) and east-west about 0.8 mile

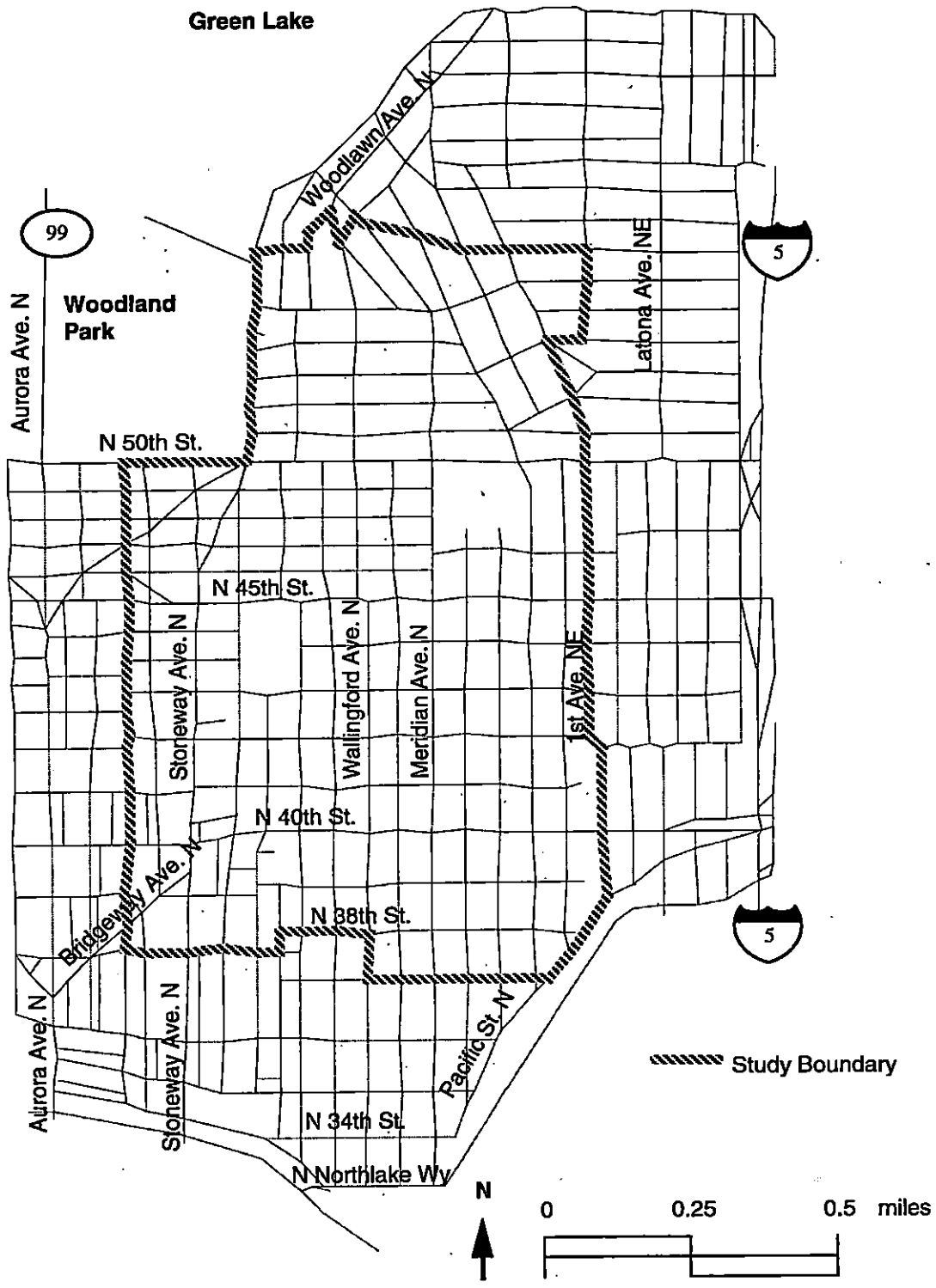

Figure 6. Wallingford neighborhood streets and study boundaries

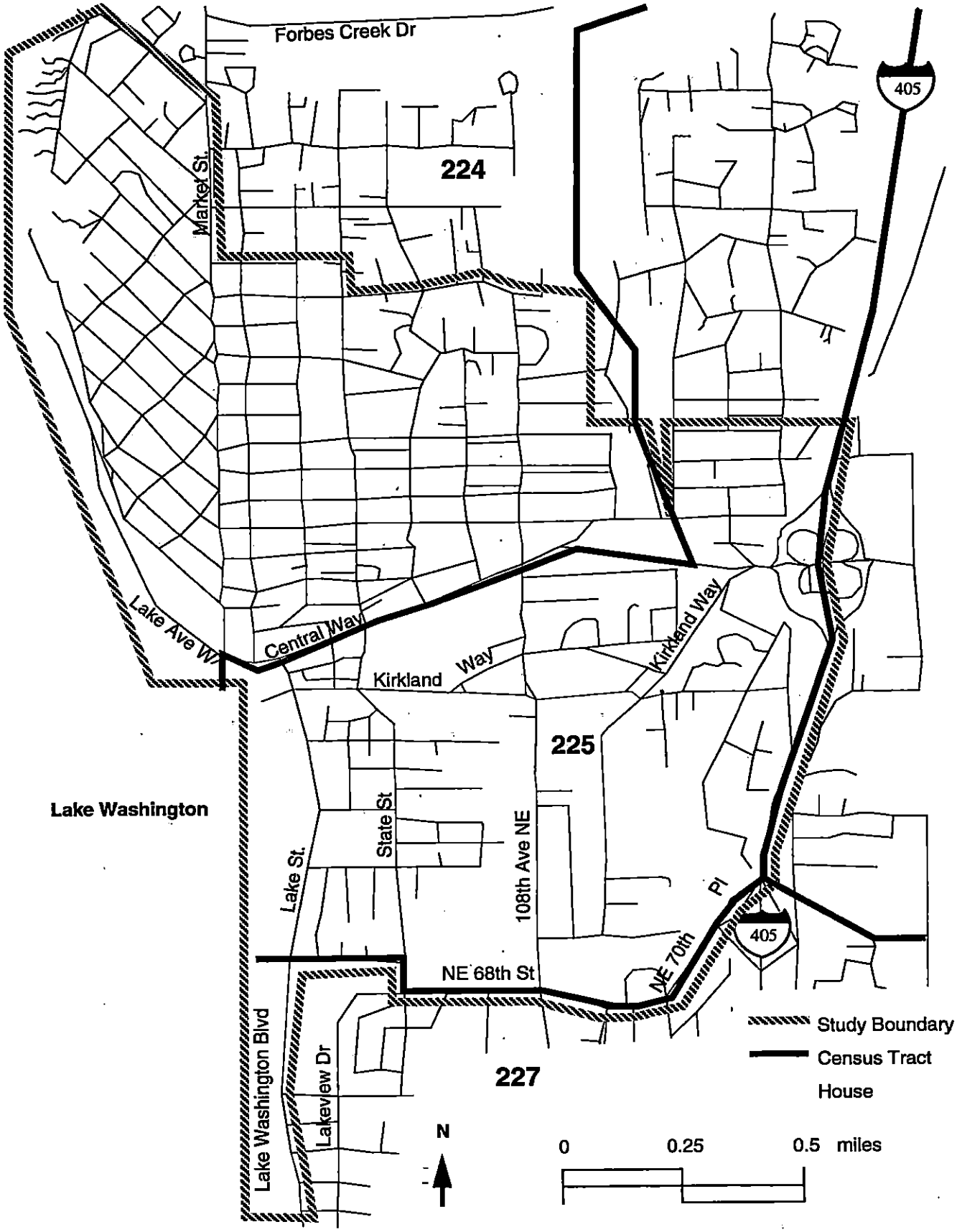

Figure 7. Kirkland neighborhood streets and study boundaries

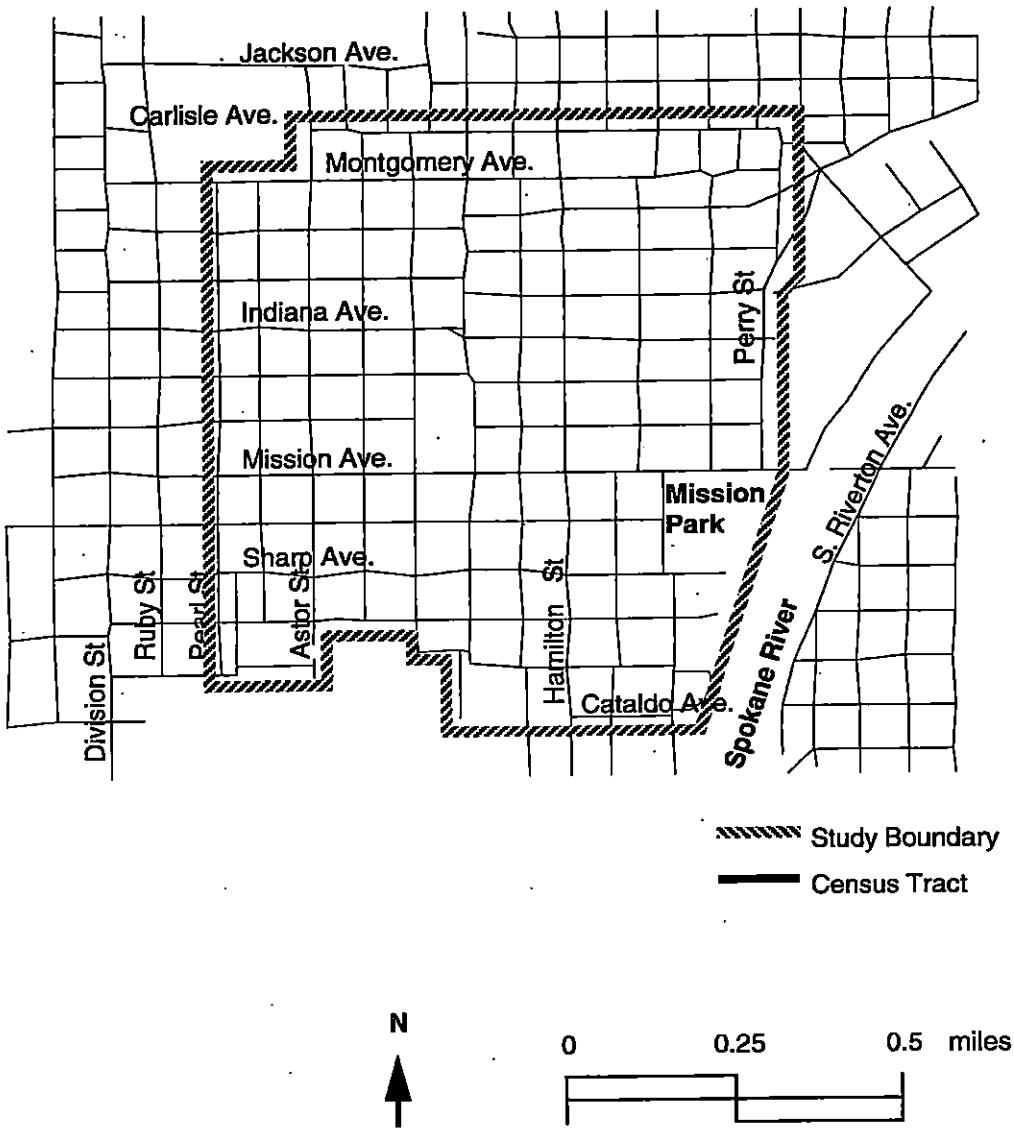

Figure 8. Gonzaga University neighborhood (Spokane) streets and study boundaries

(1.3 km). The 1990 Census reports 2,408 housing units, 2,209 households, and 5,439 people.

Mission Park, which offers open space, is located at Superior Street and Mission Avenue along the neighborhood's eastern boundary. South of the park are two retirement communities. Neighborhood services are concentrated along Hamilton Street in the eastern section of the neighborhood. Located there are restaurants, a bank, a pharmacy, a copy center, video stores, book stores, and hair salons. Located on Mission Avenue at Hamilton Street, the intersection identified as the shopping focal point, are a supermarket and a bank.

Survey Techniques

Overview

The overall purpose of this survey was to determine household travel behavior in four neighborhoods. Like the panel survey conducted by the Puget Sound Regional Council, this neighborhood survey consisted of a telephone survey and a mail-out/mail-back travel survey. They were conducted during November and December of 1992.

A major difference between the PSRC panel survey and this neighborhood survey was the sampling technique. The Council used a sample stratified by usual mode of travel to work—transit, carpool, or drive alone. In order to obtain sufficient numbers for analysis of each group, "transit and carpool households were over-sampled relative to their proportions in the regional population, in order to be able to analyze their behavior properly" (Murakami and Watterson 1992).

Each of these three samples was then further stratified by county of residence. Participants were recruited by telephone random digit dialing, by contacting respondents on previous transit surveys, and by requesting volunteers on randomly selected bus runs (Murakami and Watterson 1990).

In contrast, the neighborhood survey in this project used random samples of households within the boundaries of each neighborhood. The consequence of this sampling difference is that the PSRC study and this project are not directly comparable. The PSRC is developing compensating weighting factors to correct the sample to make it representative of the population (Neil Kilgren, personal communication, 23 September, 1993). Weighting the PSRC data sample would make it possible to compare the PSRC findings with the results from this project.

Telephone Survey

Purposes

The telephone survey was an interview with the head of the household about characteristics of the household members. Then, the head of household was asked to participate in the travel survey, which required that all household members age 15 or older report their trips for two consecutive days.

The telephone survey served two purposes: 1) to elicit household demographic information, and 2) to recruit household members age 15 or older to keep travel diaries.

A telephone survey, rather than a mail survey, was used for several reasons. Because the survey was begun in November and had to be completed before the holiday season when travel patterns may be atypical, the time period for collecting the data was short, and telephone interviewing was viewed as a faster way to recruit participants. Also, the interviewers could underscore the importance of having all household members age 15 or older participate in completing travel diaries and having all of them complete the diaries for the same two days.

Sample Selection

The 1990 census counts of housing units and households in each neighborhood were used as a first estimate in designing a sampling procedure. Note that the numbers of households are smaller than the numbers of

housing units because households consist of occupied housing units only (see table 2).

The selection process had to be based on address, rather than name or phone number, to ensure that the household was actually located within the study area boundaries. For this purpose, a "reverse directory," arranged by street, with each house number, resident name, and telephone number listed for that street, was used. After defining which streets constituted each neighborhood, a random sample was selected by choosing every "nth" listing under those streets to ensure that everyone listed had an equal chance of being selected. An on-line directory from Metromail, advertised to be not more than 60 to 90 days out of date, provided corresponding telephone numbers. This directory is the National Consumer Data Base (NCDB) which is used primarily as a source of names and addresses for direct mailings (NCDB 1992). This was the best data base available because it included the census tract designation for each entry, and because the neighborhood lists were created according to the particular census tracts in each neighborhood.

The project used a sample size that was somewhat different from the sample size originally calculated. The number of households obtained from the reverse directory could have been different from the numbers obtained from the census data for the following reasons: 1) people with no telephone or unlisted telephone numbers would have been excluded; 2) people who had recently moved to the area would have been excluded; 3) people who live in a variety of group quarters would have been included because the directory makes no attempt to differentiate them, as does the Census; 4) people who have requested that their names be removed from commercial mailing lists would have been omitted; and 5) the procedures used to compile the directory simply were not accurate enough to provide the names of all people living in the area, resulting in fewer households than are reported in the Census.

In addition, the sample selected from the reverse directory could include housing units on both sides of a street. A census block consists of only those households that fall within its boundaries, i.e., only on one side of the street. For all housing units to fall within the designated census blocks, a requirement to select only odd or even house numbers on outside blocks had to be imposed. Because this was not done, the sample would differ from the census numbers in this respect also.

For the above reasons, the number of households in the NCDB for each neighborhood was different from the number of households enumerated by the Census Bureau for that same neighborhood. Nevertheless, the samples from the NCDB were used since they were the best available.

After excluding the households with unpublished telephone numbers, the remaining households were selected at random for the telephone survey. Note that this procedure differs from the method used by the PSRC.

Table 2 compares the theoretical sample size calculated from the Census with the actual sample size obtained from the NCDB. The biggest discrepancy between the sample sizes is in the Kirkland neighborhood. The reason for this difference is unclear, but it is possible that in a growing suburban area like Kirkland, the data base simply cannot keep up with the new entries (Mary Doher,

Table 2. Comparison of Population Characteristics between the Census and NCDB

	Queen Anne	Wallingford	Kirkland	Spokane
Housing units from Census	2,298	4,132	3,971	2,408
Households from Census	2,157	4,003	3,772	2,209
Households from NCDB	1,897	3,592	2,405	2,228

personal communication, 15 October, 1993). However, of the addresses and telephone numbers available, households were selected to form a random sample.

Telephone Questionnaire Design

The questionnaire was patterned on the one used by the PSRC. The questions used to elicit household demographic information included location of residence, duration of residence, number and age categories of household members, sex of household members age 15 or older, employment or school attendance of household members age 15 or older, and household income. A copy of the questionnaire is provided in appendix A.

To learn about household travel habits, the questionnaire included questions about attitudes toward traffic congestion, the distance to the nearest bus stop, auto availability, bicycle availability, bus, carpool, or vanpool use, and the frequency of walk trips for work, shopping, or recreation. The primary intent of these questions was to show respondents that their travel habits and views were important, and that their willingness to accept and complete the travel diaries was even *more* important in capturing their travel behavior.

Implementation

The University of Washington contracted with a marketing research firm, Decision Data Inc., of Kirkland, Washington, to collect the data. This firm was responsible for the following tasks: selecting random samples in each neighborhood; making the telephone contact; asking the survey questions; asking respondents to accept the travel diaries; coding the resulting data; and producing data files.

Travel Diaries

Sample Selection

After the interviewers asked general questions about work status and travel behavior, they asked respondents whether all those age 15 or older in their households would be willing to complete travel diaries. Everyone who participated in the telephone survey was given the opportunity to accept and complete travel diaries, which involved recording each trip made over a two-day period. A trip was defined as direct non-stop travel from one "stop" to another "stop."

Diary Design

The travel diary form was similar to the one used by the PSRC. A copy of the travel diary form and the instructions that accompanied it are included in appendix B.

This project made some minor changes to the PSRC forms because of the project goal of capturing as many non-auto trips in each neighborhood as possible. The travel diary form had a column for the participant to record the transportation mode for the trip. The category "bicycle" was added as an example to remind people that this was an acceptable answer. The travel diary also included a column for recording trip purpose. As an example, "recreation" was added to capture bicycle and pedestrian trips with no purpose other than exercise or pleasure.

The instruction sheet was also revised for this project from the PSRC version. An instruction entitled "Trips for fun or exercise" was added to remind people that leaving the house to walk or to bike for fun or exercise was a legitimate trip and should be noted on the diary form.

The most important change from the PSRC instruction sheet was the definition of "What is a trip?," which was added to redefine a trip as a stop, rather than as a series of stops. This redefinition made it seem logical to use a new line to record each stop. Two stops for the same purpose were to be recorded separately. In addition, every stop, regardless of how short, was to be recorded as a trip. This differed from the PSRC survey wherein a series of trips of less than five minutes for the same purpose was collapsed into one trip. Because the project sought to capture as many walking trips as possible, and because less than five minutes might elapse between stops for the same purpose, this instruction was

intended to ensure that as few trips as possible would be lost or combined.

Implementation

From the information about the names of household members and the home addresses obtained from the telephone interviews, the marketing research firm prepared packets which were sent to the households that had agreed to complete the travel diaries.

The packet sent to each household contained the following materials:

- a cover letter,
- an example diary for each specific area,
- an instruction sheet,
- a half-page with "right" and "wrong" examples,
- a postage-paid return envelope,
- a two-dollar bill for each participant, and
- two travel diaries for each participant.

The packet mailed to the households is shown in appendix C.

All correspondence, including envelopes, was specially printed for this survey and was labeled *University of Washington Transportation Panel.* The packet was mailed in an oversized envelope addressed to the household contact. Packets with large, colorful stamps were mailed first class.

The cover letter welcoming the respondents was printed on University of Washington letterhead and was signed by the principal investigator. The letter was personalized with the household contact's name in the salutation.

The sample diary was printed on pale colored paper with "SAMPLE" screened across it. For each of the four areas, a separate diary was printed with examples specific to that area. Each area was color-coded for easier packet assembly.

Each household member received two diaries and a two-dollar bill. Each diary was personalized with the household member's name, the date the diary was to be filled out, and an identification number.

Packets were mailed one to two days after telephone recruitment. All participants in each household were to complete the travel diaries for the same two days. To obtain a distribution of days, including weekends, each household received diaries with one of the following pairs—Monday and Tuesday; Tuesday and Wednesday; Wednesday and Thursday; Thursday and Friday; Friday and Saturday; Saturday and Sunday; or Sunday and Monday. Forty percent of the diaries sent to the households specified Saturday or Sunday for completion. Here the intent was to capture more discretionary travel, which was believed to include more non-motorized trips. In addition, because the PSRC's transportation panel did not include weekend travel, this research project offered an opportunity to build on the Council's work.

Participants who did not return their diaries within one week were contacted by the marketing research firm by telephone and by postcard. The follow-up call was essential because a variety of problems had to be solved. In 68 cases, households had lost their diaries, and new packets had to be sent. Other households had completed the diaries, but had not returned them; these respondents simply had to be reminded to mail them. Other households had forgotten to complete them or had procrastinated and needed to be urged to complete them on a different date. In some households where this had happened, the respondent thought that it was too late because of the date on the diaries. This highlights the importance of a call-back procedure to answer questions and encourage completion. In this instance, although dating the diaries was important in controlling the distribution across days of the week and in creating a sense of urgency to complete the diary, it confused some respondents.

As the diaries were received at the marketing research firm's office, data entry began. Appendix D describes the consultant's data entry procedure.

Shopper Survey

Sample Selection

In addition to the telephone survey and travel diaries, the data-gathering effort included interviews with people who had traveled to the main shopping area identified in each neighborhood. The intent here was not simply to find the mode split. Rather, the purpose of these interviews was to learn something about those who do walk (for example), information about their reason for making the trip, home location, and some demographic information.

Since most of the budget was allocated to the telephone survey and travel diary collection, the amount spent on the shopper survey was limited to only that necessary to complete 100 interviews with people who had walked to the area, and 150 interviews with people who had made non-walking trips.

It was estimated that the interviewers would have to approach 1,000 shoppers to find 100 or 10 percent who had walked to the area. This percentage was obtained from an earlier study that indicated that approximately 10 percent of all trips in the City of Seattle were walking trips. (Puget Sound Council of Governments 1990). Thus, enough budget was allocated for the interviewers to obtain 100 interviews from shoppers who had made walking trips, and 150 interviews from shoppers who had used some other transportation mode.

Shopper Questionnaire Design

The survey used a simple, one-page questionnaire to elicit information about trip origin, purpose, transportation mode, and household demographics. A copy of the questionnaire is in appendix E. The interviewers also asked two open-ended questions. If the respondent was an auto driver or passenger, then the interviewers asked "What would make you use your car less often for a trip like this?" If the respondent had not arrived by car, he or she was asked "Are there any improvements the community could do to make your trip here easier?" These open-ended questions were designed to give respondents a chance to express their ideas.

Interviewers conducted "shopper intercepts" in the major shopping and service area of each neighborhood. Interviewers moved along the street, approaching people by introducing themselves and requesting their participation in the survey.

Interviewers were stationed at the following locations: in Kirkland, at various sites along Kirkland Avenue and Lake Street; in Queen Anne Hill, along Queen Anne Avenue; in Spokane, along Hamilton Street in the vicinity of Mission Avenue; and in Wallingford, along North 45th Street in the vicinity of Wallingford Avenue.

Survey Response Characteristics

Response Rates

Table 3 shows the numbers of households sampled and the disposition, or results, of the calls for each neighborhood.

A few observations should be made about table 3. In each neighborhood, households with unpublished telephone numbers were eliminated from the survey. (This was obviously unavoidable because respondents were recruited by telephone). These households ranged from over two hundred in the Queen Anne neighborhood to nearly six hundred in the Kirkland neighborhood.

The difference in the total numbers called and the number of eligible households reached is accounted for by business numbers, numbers not-in-service, duplicate numbers for a household, and numbers out of the study area.

Another important issue involved those households that were never reached after at least five attempts at various times of the day. These numbers ranged from eight percent in Spokane to fourteen percent in Wallingford.

Table 3. Disposition of the Sample

	Queen Anne	Wallingford	Kirkland	Spokane
Households in directory	1,897	3,592	2,405	2,228
Households with unpublished numbers	220 (12%)	488 (14%)	583 (24%)	264 (12%)
Total sample	1,677	3,104	1,822	1,964
Total numbers called	1,089	1,132	1,192	1,795
Eligible households called	951	914	1,026	1,278
Eligible households reached	831	785	892	1,175
Agreed to complete diary	448	438	438	518
Returned diary	337	349	338	374
Households in sample	301	304	301	302

Table 4. Trips Surveyed by Day of the Week (%)

	Queen Anne	Wallingford	Kirkland	Spokane
Monday	14	13	12	12
Tuesday	12	12	12	13
Wednesday	13	12	13	14
Thursday	12	11	13	13
Friday	14	14	14	13
Saturday	19	21	20	20
Sunday	16	17	16	15

After households were reached by telephone and interviewed, 54 percent in Queen Anne, 56 percent in Wallingford, 49 percent in Kirkland, and 44 percent in Spokane agreed to complete travel diaries. Of those households, 75 percent in Queen Anne, 80 percent in Wallingford, 77 percent in Kirkland, and 72 percent in Spokane actually completed and returned them.

Each neighborhood sample contains slightly over 300 households. This number is different from the actual number of returned diaries, since the marketing research firm's contract specified that only 300 household diaries had to be coded.

The percentage of trips by day of the week corresponds well to the intent of getting 40 percent of the trips as weekend trips. Table 4 shows the actual distribution of surveyed trips. Note that weekend trips account for 35 percent to 38 percent of the total number of trips in the data set.

Comparing the Sample with the Census

As noted previously, the telephone questionnaire was used to recruit households to keep travel diaries for two days, *and* to obtain demographic information on each household. Such demographic information is

important for two purposes: 1) to make generalizations about the travel behavior of different types of households; and 2) to compare the samples with published census data. In the following sections, the second purpose will be discussed for each neighborhood. Tables listing characteristics obtained from the Census and from the sample are included.

To compare the study sample with published census information to determine whether the sampled households were representative of the neighborhood, several characteristics were selected for analysis. These characteristics have some comparability in terms of how they are reported by the Census Bureau and values that can be calculated from the sample data. They include the following: average household size, median age, median income, and gross density.

Average household size was calculated by using values for the number of persons in households and the number of households. These numbers were easily obtained from the Census of Population and Housing Summary Tape File 1A (1991). This is a machine-readable data file that contains 100 percent population and housing unit counts. Sample values for each neighborhood were obtained from the telephone survey.

Census values for median age and median household income were obtained from the Census of Population and Housing Summary Tape File 3A (1991). This machine-readable data file contains sample data weighted to represent the total population. Counts for number of persons, number of households, and number of housing units are found in both File 1A and File 3A, but may differ because of the weighting process. In the 100 percent tabulations in File 1A, the count of households always equals the count of occupied housing units. In the sample tabulations in File 3A, the numbers may be different because of weighting.

Census and survey values are generally comparable when it comes to median age, but some explanation is necessary. In the Census, all individuals' ages are reported without reference to their residence in households or group quarters. For this survey, an effort was made to eliminate from the sample anyone living in group quarters. Group quarters were excluded because such arrangements do not constitute households, the unit of analysis for this study. In census tract 68.98, for example, the total number of persons (in households and in group quarters) is 2,539, while the number of persons in households is 2,433. This could account for some, although probably minor, differences.

Also, median age calculated from the Census is the value for individuals 15 years of age or older. This was necessary in order to compare the Census with the study sample since in the telephone survey, exact ages were asked only of those who would complete travel diaries, i.e., household members 15 years of age or older.

Median household income is expressed in the Census as a specific value. In the telephone survey, the respondent was asked only to give the income range for the household. It was felt that asking for a range, rather than a specific figure, would result in an acceptable response rate for this sensitive variable. The response rates were as follow: Kirkland, 89 percent; Queen Anne, 92 percent; Spokane, 95 percent; and Wallingford, 93 percent. Based on the income range containing the median response, an estimated median income value was calculated assuming an equal distribution throughout the age range.

Density is expressed as gross density. That is, the number of housing units (both occupied and unoccupied) per gross acre of land within the neighborhood boundaries. The number of housing units was obtained from census tract or census block data. Gross acreage consists of both residential and non-residential uses, such as street rights-of-way, parks, and commercial uses. The area for each census tract was obtained from the Census. The area of each neighborhood was calculated using geographic information system (GIS) software.

Included in the tables that follow are some characteristics of the sampled households calculated from the responses to the telephone survey. They include the average

number of employed people in each household and the average number of motor vehicles (car, company car, van, truck, or motorcycle) in working condition available to household members.

The values for comparison to the sample data were obtained from Summary Tape File 3A. The average number of vehicles per household was calculated by using the number of vehicles available per occupied housing unit. The number of occupied housing units generally, but not always, corresponds to the number of households. The average number of employees per household was calculated by dividing the number of persons 16 years and over who were employed at the time of the Census by the count of households. Age 16 had to be used, instead of age 15 as in the telephone survey, because this is how the Census reports employment status.

Upper Queen Anne Hill

Figure 9 maps the locations of the households included in the neighborhood sample. The sample consisted of 301 households, comprising 666 individuals. The map also shows that the neighborhood lies entirely within census tract 68.98 and contains about one-third of census tract 67.98.

Characteristics for the Queen Anne Hill neighborhood are shown in table 5. Median age for the individuals in the survey is the upper value for the range reported in the Census. The value for gross density seems reasonable because all of the sample is in census tract 68.98, and one-third in census tract 67.98.

Median household income in the sample is higher than the median income reported in the Census. One possible reason could be that the respondents are older. Another could be that people who tend to answer surveys have more education, which correlates with higher income (Fowler 1984; Rea and Parker 1992). Unfortunately, respondents were not asked about their education.

Wallingford

Figure 10 indicates the locations of the 304 households surveyed, and their positions within the census tracts. The neighborhood includes all of census tract 51, most of census tract 50, three-quarters of census tract 46, and one-third of census tract 54.

Table 6 compares the neighborhood survey values to the Census. Median age falls within the interval in three of the four census tracts. Median income is within the range in two of the four census tracts, and is higher than in the other two. Gross densities are similar for the census tracts (with the exception of census tract 46). This lower density (3.7) can be accounted for by the large amount of open space in this tract.

Downtown Kirkland

Figure 11 locates the 301 households surveyed in this suburban neighborhood. About three-quarters of census tract 225 is included in the neighborhood, over one-half of census tract 224, and fewer than 200 households from census tract 227.

Table 7 lists the characteristics of the neighborhood obtained from the survey and from the Census. Median age is older in the sample than in any of the census tracts that constitute the neighborhood. The median incomes in the census tracts fall within the sample's median income range. Gross density figures are considerably lower than those calculated for the Queen Anne Hill and Wallingford neighborhoods. However, the value for the total sample is higher than those for the three census tracts. This indicates that the sample encompassed the high-density areas of the census tracts.

Gonzaga University Neighborhood (Spokane)

The households in the university neighborhood in Spokane are mapped in figure 12. The neighborhood includes about 90 percent of census tract 25. Table 8 describes the neighborhood in terms of characteristics from the survey and from the census.

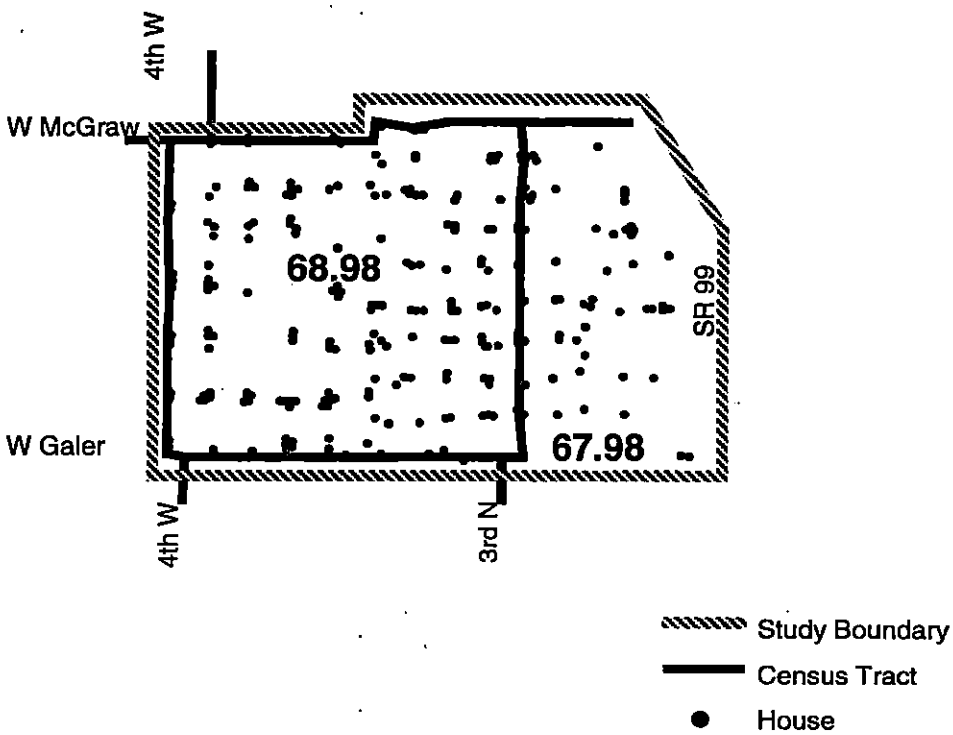

Figure 9. Upper Queen Anne Hill neighborhood sample households, study boundaries, and census tracts

Table 5. Characteristics of the Queen Anne Neighborhood

	Census Tract 68.98	Census Tract 67.98	Total Sample
Persons in households	2,433	4,364	666
Households	1,177	2,646	301
Total persons	2,539	4,365	666
Average household size	2.1	1.6	2.2
Average number of employees/household	1.3	1.1	1.4
Average number of vehicles/household*	1.3	1.4	1.7
Median age, all persons age 15 and over	35-39**	35-39**	39***
Median household income	$31,731 (1989)	$32,000 (1989)	$45,000† (1992)
Gross density	6.9	9.2	7.6

Table 6. Characteristics of the Wallingford Neighborhood

	Census Tract 46	Census Tract 50	Census Tract 51	Census Tract 54	Total Sample
Persons in households	2,994	2,702	3,392	3,721	645
Households	1,348	1,399	1,560	2,012	304
Total persons	2,995	2,702	3,392	3,821	645
Average household size	2.2	1.9	2.2	1.8	2.1
Average number of employees/household	1.3	1.4	1.4	1.3	1.3
Average number of vehicles/household*	1.7	1.4	1.6	1.4	1.6
Median age, all persons age 15 and over	35-39**	35-39**	35-39**	30-34**	37***
Median household income	$38,222 (1989)	$28,262 (1989)	$36,496 (1989)	$29,668 (1989)	$38,100† (1992)
Gross density	3.7	7.8	7.5	7.1	6.7

* For census tracts, value is calculated for occupied housing units rather than for households

** Persons living in households and persons living in group quarters are included

*** Only persons living in households are included

† Estimated from an income range (see discussion on page 26)

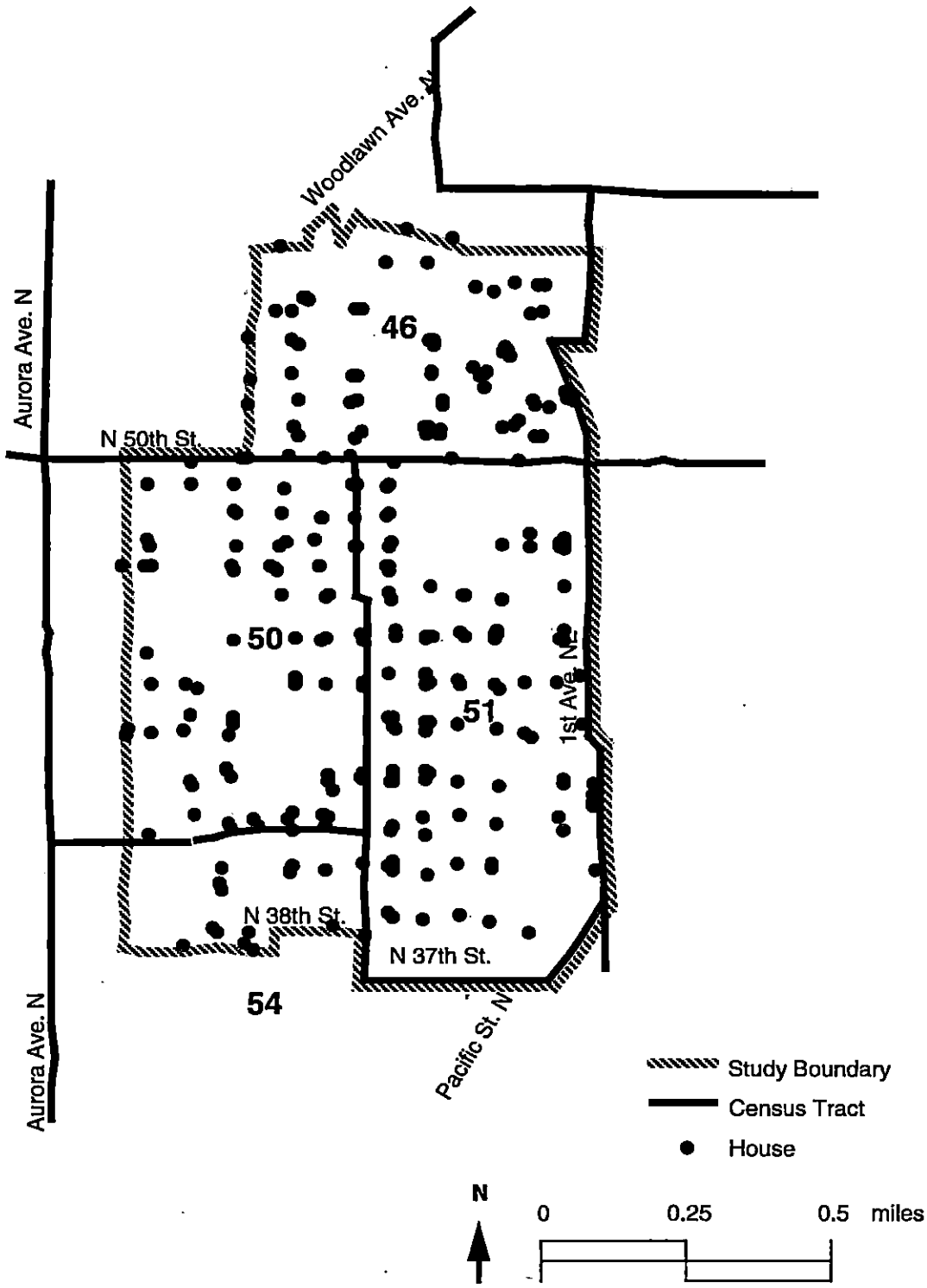

Figure 10. Wallingford neighborhood sample households, study boundaries, and census tracts

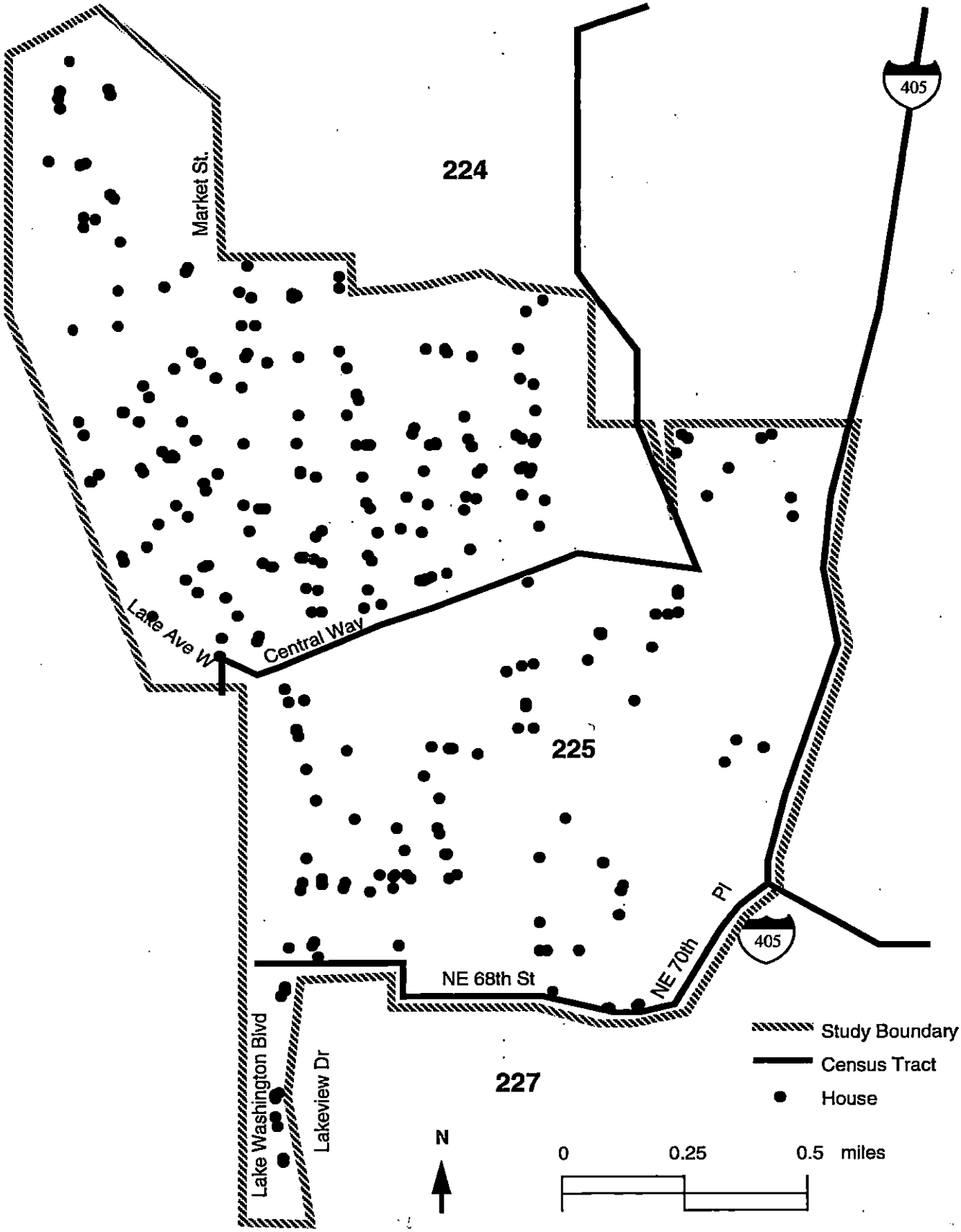

Figure 11. Kirkland neighborhood sample households, study boundaries, and census tracts

Table 7. Characteristics of the Kirkland Neighborhood

	Census Tract 224	Census Tract 225	Census Tract 227	Total Sample
Persons in households	6,658	5,453	7,164	599
Households	2,884	2,613	3,126	301
Total persons	6,665	5,453	7,610	599
Average household size	2.3	2.1	2.3	2.0
Average number of employees/household	1.4	1.2	1.5	1.0
Average number of vehicles/household*	1.9	1.9	1.9	1.9
Median age, all persons age 15 and over	35-39**	35-39**	35-39**	47***
Median household income	$39,184 (1989)	$36,559 (1989)	$43,603 (1989)	$41,200† (1992)
Gross density	2.7	2.8	2.1	3.3

* For census tracts, value is calculated for occupied housing units rather than for households
** Persons living in households and persons living in group quarters are included
*** Only persons living in households are included
† Estimated from an income range (see discussion on page 26)

The median age in the sample is considerably higher than in the census tract. One possible reason is that the number of individuals living in group quarters is included in the Census's calculation, but not in the calculation used to determine median age for this study. The only information given by the census data about the ages of these 1,145 people living in group quarters is that about 95 percent of them are between the ages of 18 and 64. In a university neighborhood, it seems logical to assume that many of them are young students. This would render a median age lower than in the sample, which sought to exclude people living in group quarters. Median income is higher in the sample than in the census tract, again, possibly explained by the fact that more highly educated people tend to answer surveys. One obvious reason for the sample's higher density is the elimination of the land area of the university from the calculation.

Comparing the Neighborhoods

The surveys were conducted in all four neighborhoods, using the same methods, and during the same time period; therefore, the most valid comparisons are among the neighborhoods—relating their travel patterns to their unique characteristics. Table 9 provides summary data on some demographic characteristics of the households surveyed.

Queen Anne and Wallingford, the in-city neighborhoods in western Washington, are the most similar. The suburban western Washington neighborhood of Kirkland has the oldest median age, the lowest density, the smallest average number of employed persons per household, and the highest average number of motor vehicles per household. Spokane, the in-city university neighborhood in eastern Washington, has the youngest median age, and lowest median household income.

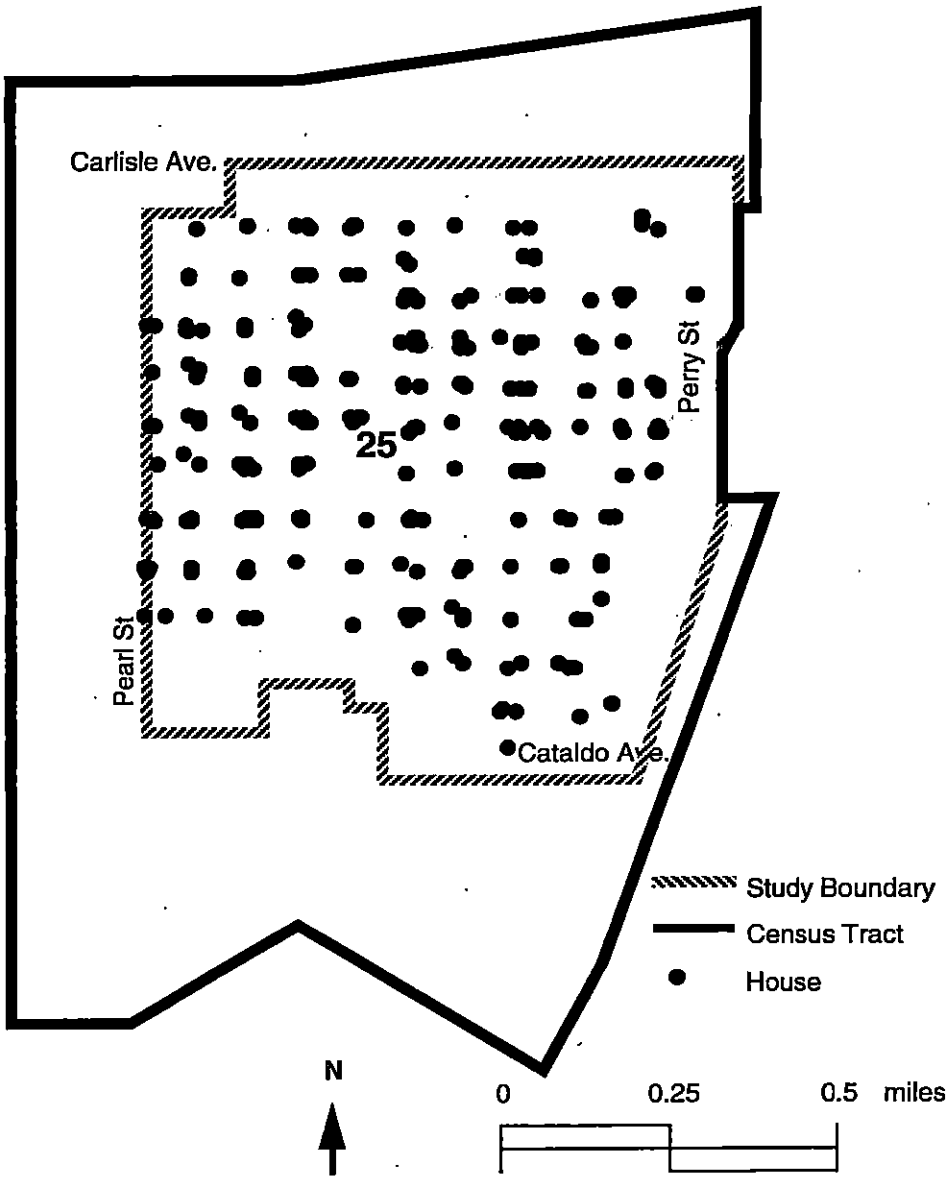

Figure 12. Spokane neighborhood sample households, study boundaries, and census tract

Table 8. Characteristics of the Spokane Neighborhood

	Census Tract 25	Total Sample
Persons in households	5,276	622
Households	2,596	302
Total persons	6,421	622
Average household size	2.0	2.1
Average number of employees/household	1.0	1.1
Average number of vehicles/household*	1.2	1.7
Median age, all persons age 15 and over	25-29**	32***
Median household income	$14,128 (1989)	$18,600† (1992)
Gross density	3.6	5.4

* For census tracts, value is calculated for occupied housing units rather than for households
** Persons living in households and persons living in group quarters are included
*** Only persons living in households are included
† Estimated from an income range (see page 26)

Table 9. Demographic Characteristics of the Households Surveyed

	Queen Anne	Wallingford	Kirkland	Spokane
Average household size	2.2	2.1	2.0	2.1
Average number of employees/household	1.4	1.3	1.0	1.1
Average number of vehicles/household	1.7	1.6	1.9	1.7
Median age persons in households age 15 and over	39	37	47	32
Median household income	$45,000	$38,100	$41,200	$18,600
Gross density	7.6	7.2	3.1	5.4

IV. Neighborhood Travel Data Analysis

Definitions Used in the Travel Diary

In the following tables, trips to a destination (other than to home) are classified according to purpose and mode. **Note that the numbers in the tables are percentages and that the total of all the cells in each table is 100 percent.**

"Trip purpose" is broken into four classifications: 1) earning a living; 2) family and personal business; 3) school and church; and 4) social and recreation. These categories correspond to those used in the *1990 Nationwide Personal Transportation Survey* (Hu and Young 1992).

In the travel diary, 15 purposes were actually coded to correspond with the purposes used in the Puget Sound Regional Council Panel Survey. These 15 purposes were recoded as follow:

1. earning a living = work, work-related business, and work-related appointments;
2. family and personal business = shopping, professional services, family/personal business, eating or drinking, and personal service appointments;
3. school and church = school, college, and church;
4. social and recreation = visit friends, pleasure trip, and other social/ recreation.

Another category, "home," recorded the return trips ending at the respondent's home. These numbers are *not* included in the tables because the intent of this analysis was to show the relative proportions of activities people engage in during their day away from their homes. These activities are described by purpose and transportation mode used to access it.

The variable "mode" consists of "auto - drive alone," "auto - >1 occupant," "bus," "walk," "bike," and "other" in the tables. The 16 modes in the travel diary have been recoded as follow:

1. auto - drive alone = single-occupancy vehicle (SOV);
2. auto - >1 occupant = car, van, or truck with the driver and at least one passenger; vanpool; and carpool;
3. bus = public bus;
4. walk;
5. bike = non-motorized bicycle;
6. other = para-transit, taxi, motorcycle, school bus, ferry/car, ferry/foot, monorail, boat, train, and airplane.

Distribution of Weekday Trips

Table 10 describes weekday travel as recorded by respondents in the four neighbor-

Table 10. Weekday Travel (%)

Mode	Trip Purpose				
	Earning a Living	Family and Personal Business	School and Church	Social and Recreation	Total
Queen Anne					
Auto-Drive Alone	18.7	18.6	1.0	3.1	41.4
Auto->1 Occupant	5.9	19.0	1.4	5.0	31.3
Bus	2.8	1.2	0.7	0.4	5.1
Walk	5.9	10.4	0.9	3.1	20.3
Bike	0.2	0.3	0.1	0.1	0.7
Other	0.7	0.2	0.2	0.1	1.2
Total	34.2	49.7	4.3	11.8	100.0
Wallingford					
Auto-Drive Alone	19.8	16.1	1.3	4.1	41.3
Auto->1 Occupant	5.2	19.3	0.8	4.6	29.9
Bus	3.8	0.9	1.5	0.4	6.6
Walk	4.2	10.6	1.5	3.6	19.9
Bike	0.7	0.6	0.2	0.4	1.9
Other	0.1	0.2	—	0.1	0.4
Total	33.8	47.7	5.3	13.2	100.0
Kirkland					
Auto-Drive Alone	22.0	28.8	0.6	5.1	56.5
Auto->1 Occupant	4.6	20.2	0.4	6.6	31.8
Bus	1.6	0.5	—	0.3	2.4
Walk	2.2	4.2	0.2	2.3	8.9
Bike	—	—	—	—	—
Other	0.1	0.1	—	0.2	0.4
Total	30.5	53.8	1.2	14.5	100.0
Spokane					
Auto-Drive Alone	13.8	18.6	4.2	4.7	41.3
Auto->1 Occupant	5.0	23.0	2.0	7.2	37.2
Bus	1.0	0.3	0.3	—	1.6
Walk	2.8	6.2	6.3	2.0	17.3
Bike	0.4	0.4	1.4	0.2	2.4
Other	—	0.2	—	—	0.2
Total	23.0	48.7	14.2	14.1	100.0

hoods. Travel consists of trips made anywhere by the participants, within or outside the neighborhood.

The values in the tables were obtained as follows. Each participant was asked to keep a travel diary for two consecutive days, and was assigned the specific day for completing the diary. For this analysis, the first day was selected and, if it was a weekday, the recorded trips were aggregated by trip purpose and mode. Only the first day was included in the calculations; this was to ensure that each individual would be represented just once (many of the respondents were assigned two weekdays rather than one weekday and one weekend day).

Trips back to the respondents' homes were eliminated; therefore, the trips summarized in the tables are to destinations *other* than back home. This total number of trips was considered as 100 percent, and each purpose/mode combination was assigned its percentage of the total. For example, if 1,000 trips in the neighborhood were to destinations other than to home, and 100 trips were walking for family and personal business, the tabulation of "walk, family & personal business" would read as "10" for ten percent.

Upper Queen Anne Hill

Table 10 lists the percent distribution of destinations (other than to home) for the approximately 1,200 weekday trips recorded on first day travel diaries by respondents from the Queen Anne neighborhood.

The largest percentages are driving alone to earn a living and sharing a vehicle for family and personal business. Each of these categories accounts for about 19 percent of the trips, and "earning a living" accounts for a little over a third of the trips. Family and personal business by all modes comprise about 50 percent of the trips.

Wallingford

Table 10 lists the percent distribution of destinations (other than to home) for the approximately 1,100 weekday trips recorded on first day travel diaries by respondents from the Wallingford neighborhood.

Since it has been shown that Wallingford and Queen Anne demographic characteristics and neighborhood physical environments are similar, it is not surprising that the mode choice is also similar, with just slightly more bus and bike trips.

Downtown Kirkland

Table 10 lists the percent distribution of destinations (other than to home) for the approximately 1,200 weekday trips recorded on first day travel diaries by respondents from the Kirkland neighborhood.

The most obvious feature of the table is the high number of automobile trips for all purposes, with driving alone accounting for well over 50 percent of auto use. Again, these figures correspond to what one would expect in a suburban neighborhood.

Gonzaga University (Spokane)

Table 10 lists the percent distribution of destinations (other than to home) for the approximately 1,100 weekday trips recorded on first day travel diaries by respondents from the Spokane neighborhood.

In this university neighborhood, the combination of trips for earning a living and for school and work are similar to the proportions of work trips in the other neighborhoods. Distributions of trips for family and personal business and for social and recreation purposes correspond to the percentages in the other neighborhoods, i.e., approximately 50 percent for family and personal business trips and twelve to fourteen percent for social and recreation trips.

Summary

A simple summary of the tables indicates some trends worthy of further investigation. Table 11 gives percentages of trips to all destinations by auto, bus, walk, and bike modes in each of the four neighborhoods.

Although the auto is the predominant mode, a considerable number of these trips are made by at least two people traveling together. In many cases, these shared trips are being made to drop children off. It would be useful to know whether other household errands are being combined with these trips.

One objective of the research project was to determine the mode split in mixed use neighborhoods. The finding that about 20 percent of the trips made by residents in the two in-city neighborhoods are walk trips is worth exploring. These walk trips should be studied separately to determine how important a role they actually play in a person's travel budget.

For this analysis, no attempt was made to differentiate between short walking trips from store to store and a walk trip made to a more distant location. Some respondents, although not all, even recorded their walk trips to or from the bus. These trips are included in the values for walk trips and inflate the values by about one percent. Also, the walk trip was studied as an isolated trip without regard to its relation to other trips with which it may have been linked. Further data analysis could characterize the nature of the walk trip.

An unexpected finding is the small proportion of bus trips reported. However, when only work trips are analyzed, the bus becomes a more important mode. For this analysis, the number of trips with work as their destinations were calculated for each neighborhood. Then, the numbers of trips from home *directly to work with no intervening stops* were compiled according to mode.

Table 12 displays the results of this analysis. A home-to-work trip with no intervening stops is defined as a trip that begins at home and goes directly to the workplace with no stops along the way. This is different from a trip that begins at home but includes stops along the way, for example, to drop children off at a daycare center or to run errands before work. In addition, a trip classified as a work trip may have been, for example, a trip from a restaurant at lunch back to the workplace. The total number of work destinations includes counts of all three types of work trips.

The first row of the table shows that in all neighborhoods, home-to-work trips with no intervening stops, comprise over fifty percent of the total number of trips to work from the three types of destinations as described above. These numbers are listed to indicate the magnitude of the direct home-to-work trips.

Table 11. Summary of Selected Weekday Travel Modes (% of trips to all destinations)

	Queen Anne	Wallingford	Kirkland	Spokane
Auto-Drive Alone	41	41	56	41
Auto->1 Occupant	31	30	32	37
Bus	5	7	2	2
Walk	20	20	9	17
Bike	1	2	—	2

Table 12. Bus Usage for Home to Work Trips (%)

	Queen Anne	Wallingford	Kirkland	Spokane
HW * trips as % of total work destinations	53.8	53.8	51.9	62.8
Bus trips as % of HW* trips	14.7	19.9	4.7	5.9

* Home to work with no intervening trips

The second row of the table indicates the percentages of these trips actually completed by transit. The values range from a high of nearly 20 percent in Wallingford, which is well-served by transit, to a low of less than 5 percent in the suburban neighborhood of Kirkland.

Of course, there may be many work locations that are not well-served by transit, or there may be jobs that require that employees use their personal autos for work. After eliminating the work trips that will always be auto-dependent because the job requires using one's personal vehicle, the destinations of the other work trips can be mapped to estimate the potential for greater transit use.

The data can be further analyzed to determine the characteristics of households that do make bus trips. In addition, the locations of activities of households not using the bus (as work location) can be determined to estimate the potential for greater transit use.

Distribution of Weekend Trips

Table 13 describes weekend travel made by the survey respondents in the four neighborhoods. Again, the tables show the percentage of travel made by purpose and mode, with the sum of all cells in each table totaling 100 percent.

Weekend travel consisted of both Saturday and Sunday trips. If the first diary kept by the respondent was a Saturday or a Sunday, then the trips from that day were included in these tables.

Upper Queen Anne Hill

Table 13 displays summary statistics that capture the over 700 weekend trips made by Queen Anne respondents as reported in their first day travel diary (if that day was a Saturday or Sunday).

It is logical that weekend travel would be predominantly for family and personal business and for social and recreational purposes. On weekends, the auto becomes even more important than during the week, and ride sharing becomes the most common mode.

Wallingford

Table 13 displays summary statistics on the over 600 weekend trips made by the Wallingford respondents as reported in their first day travel diary (if that day was a Saturday or Sunday).

Patterns are similar to those of the Queen Anne neighborhood. Again, family and personal business and social and recreational trips account for nearly 90 percent of the travel with shared ride trips contributing the most to the total.

Downtown Kirkland

Table 13 displays summary statistics on the over 600 weekend trips made by the Kirkland respondents as reported in their first day travel diary (if that day was a Saturday or Sunday).

Ninety percent of this travel, for personal business and recreation, uses the automobile. Most of this auto travel was done with at least one other person, which is not surprising given that people have much more leeway in arranging their weekend trips.

Gonzaga University Neighborhood (Spokane)

Table 13 displays summary statistics on the over 600 weekend trips as reported by respondents in their first day travel diaries (if that day was a Saturday or Sunday).

Eighty-two percent of the trips are for personal business and recreation; the other 18 percent are for work, school, and church. As in the other neighborhoods, sharing a ride with at least one other person is the most common arrangement.

Table 13. Weekend Travel (%)

Mode	Trip Purpose				
	Earning a Living	Family and Personal Business	School and Church	Social and Recreation	Total
Queen Anne					
Auto-Drive Alone	5.2	16.3	0.9	5.4	27.8
Auto->1 Occupant	1.7	27.7	1.4	16.4	47.2
Bus	1.8	1.1	—	0.5	3.4
Walk	1.6	12.3	0.8	5.4	20.1
Bike	—	0.3	—	0.8	1.1
Other	—	0.1	—	0.3	0.4
Total	10.3	57.8	3.1	28.8	100.0
Wallingford					
Auto-Drive Alone	7.4	17.9	1.3	5.8	32.4
Auto->1 Occupant	1.1	25.3	0.3	16.0	42.7
Bus	1.6	1.5	0.2	1.4	4.7
Walk	0.8	11.3	0.5	5.2	17.8
Bike	—	0.2	—	0.6	0.8
Other	0.8	0.3	—	0.5	1.6
Total	11.7	56.5	2.3	29.5	100.0
Kirkland					
Auto-Drive Alone	6.6	21.7	1.0	8.4	37.7
Auto->1 Occupant	1.1	33.1	1.7	15.1	51.0
Bus	—	1.1	—	—	1.1
Walk	0.6	4.4	0.3	4.3	9.6
Bike	—	—	—	—	—
Other	—	—	—	0.6	0.6
Total	8.3	60.3	3.0	28.4	100.0
Spokane					
Auto-Drive Alone	7.4	17.9	1.9	5.5	32.7
Auto->1 Occupant	1.0	33.2	2.9	17.7	54.8
Bus	0.6	0.6	—	—	1.2
Walk	1.4	3.9	2.6	2.7	10.6
Bike	0.2	0.3	—	0.2	0.7
Other	—	—	—	—	—
Total	10.6	55.9	7.4	26.1	100.0

Table 14. Summary of Selected Weekend Travel Modes (% of trips to all destinations)

	Queen Anne	Wallingford	Kirkland	Spokane
Auto-Drive Alone	28	32	38	33
Auto->1 Occupant	47	43	51	55
Bus	3	5	1	1
Walk	20	18	10	11
Bike	1	1	—	1

Table 15. Perceptions of Neighborhood Traffic Congestion

	Queen Anne	Wallingford	Kirkland	Spokane
Critical	11%	19%	23%	21%
Serious, but not critical	53%	58%	60%	51%
Not a serious problem	36%	23%	17%	27%

Summary

Table 14 indicates that proportions of weekend trips are somewhat different from those recorded for weekdays. Percentages of trips by automobile increase by only one percent in Kirkland to nine percent in Spokane. The percentages of single-occupancy vehicle trips declines as people are able to travel together for such activities as shopping and recreation.

Note that these numbers are only proportions of trips distributed by mode and purpose, and are not meant to describe the actual number of trips made on weekdays versus weekend days. Conclusions can be made about how people are using their automobiles for weekend travel, but not necessarily how much they are using them.

The proportions of walk trips remain stable in the Queen Anne, Wallingford, and Kirkland neighborhoods, but decline in the Spokane neighborhood. Further analysis of these groups of trips to determine the potential for substituting walking for auto use by comparing the locations of activities reached by each mode would be useful.

Other Issues from the Survey

In addition to questions about household demographics that will be used to analyze the trip records, the interviewers asked a series of questions about attitudes and travel habits. Some of these responses provide interesting insights into travel behavior.

The following question elicited information about perceptions of traffic congestion: "One topic that has received a lot of attention recently is traffic congestion. How would you describe traffic congestion problems in your area?" Table 15 summarizes the responses.

On average, nearly three-quarters of the respondents in each neighborhood thought that traffic congestion was serious or critical. Nevertheless, the respondents still reported using their autos for most of their trips.

In the telephone survey, respondents were asked about the employment status of household members age 15 or older. The respondent was asked if each household member considered himself or herself primarily as being employed, as a student, or neither.

Two questions elicited perplexing responses from those considered to be employed outside the home. First, people were asked: "Does your job require that you have a car at work?" In the Queen Anne neighborhood, of the 70 percent employed, 34 percent answered "yes" to this question. In Wallingford, of the 63 percent employed, 27 percent said that they needed their cars at work. In Kirkland, of the 57 percent employed, 42 percent said that they needed their cars at work. In Spokane, of the 40 percent who considered themselves primarily as employed, 27 percent indicated that they needed their cars at work.

On the surface, these numbers indicate that there is a significant number of people who would not be able to use public transit or ridesharing for their work commutes, regardless of any incentive or disincentive. However, further study would be necessary to determine whether these people actually need their cars for work, or whether they are rationalizing their car use for commuting. The responses did not specify, for example, the frequency with which a car was needed. Alternatively, the question may have been interpreted to mean that a car was needed to run errands before, during, or after the work trip. Such an interpretation is supported by the responses to another question: "Do you need the car before or after work to pick up children?" The results were similar among the four neighborhoods: 11 percent in Kirkland; 12 percent in Spokane; 14 percent in Wallingford; and 15 percent in Queen Anne. This is often given as a reason for using a car for commuting, and the issue merits further investigation.

V. Directions for Future Research

Report Summary

Recent publications describing "neo-traditional neighborhood development," "transit-oriented development," and "pedestrian pockets" that combine mixed land use with pedestrian- and bicycle-friendly street design provided the background for this project. These types of developments are currently being proposed by planners to reduce vehicle miles traveled (VMT), to decrease single-occupancy vehicle (SOV) trips, and to shift mode split toward non-motorized trips.

The findings of this phase of the research project are descriptive; they indicate the mode split and trip purposes in the four neighborhoods surveyed for weekday and weekend trips. Although the automobile accounts for the highest proportion of trips in each neighborhood, shared auto trips account for approximately 35 to 50 percent of that number for weekdays and approximately 60 percent for weekends. In the three in-city neighborhoods in Seattle and Spokane, walk trips account for at least a tenth of the trips to destinations other than home.

In all neighborhoods, family and personal trips account for the largest proportion of weekday travel, followed by trips for earning a living. On the weekend, trips are made for family and personal business; they are followed in frequency by social and recreational trips.

These findings raise a number of questions for future research. The next section describes these topics briefly.

Future Activities

The issue of *Travel Patterns in Mixed Use Neighborhoods* includes many different facets of studying the impact of land use policies on travel behavior. The richness of the data set offers numerous possibilities for detailed research of existing neighborhood travel patterns. Nine research topics that would enhance the understanding of the land use-transportation linkage are discussed as follows. Phase II of this project will focus on the first topic, VMT.

1. **VMT.** Some studies have found that overall VMT decreases in neo-traditional neighborhoods (Calthorpe Associates 1992; McNally and Ryan 1993). Since the neighborhoods surveyed have characteristics of neo-traditional neighborhoods, actual observations, rather than the results from simulations, will be used to test this hypothesis. Geographic information systems could determine the locations of trips and, can, therefore, be used to calculate VMT for individuals and households. These values could then be compared to existing regional data.

2. **Trip Chains.** The investigations of mode choice and purpose used the trip as the unit of analysis. However, it is obvious that many people schedule their activities by combining a number of trips into what

transportation planners call trip chains. An analysis of the number, length, and types of trip chains per individual or household could indicate whether people living in neighborhoods with many facilities and services nearby can organize their travel more efficiently to decrease the number or length of trips.

3. **Demographics and Land Use.** After quantifying travel behavior with the results obtained for mode choice, trip purpose, trip frequency, and trip length, a logical next step would be to correlate household and individual demographic characteristics with observed travel patterns. Since the selection of the four neighborhoods was based on their mixed land use characteristics, variables describing the land use patterns in each neighborhood, such as proximity to shopping or open space, could be developed and added to the list of variables attempting to explain travel in mixed use neighborhoods.

4. **Regional Comparisons.** The methodologies developed by the Puget Sound Regional Council to examine the travel habits of residents in the four-county region formed the basis for this experimental design. Since the Council's methods were similar to those used for this project, it would be possible to adjust the data sets to compare travel behavior in the mixed use neighborhoods with other areas in the region, such as the City of Seattle or suburban cities in King County.

5. **Bus Use.** An issue highlighted by the study findings is the small proportion of bus trips reported by household members as compared to other modes. To determine the importance of bus use in the neighborhoods, more detailed analysis is necessary. For example, data analysis could determine the demographic characteristics of individuals who use the bus. Specific individual trips, as going from home directly to work, may show higher bus use than is indicated by analyzing the data set as a whole. In addition, spatial analysis could determine the location of household activities and the modes used to reach them to see if there is potential for more transit trips.

6. **Shared Auto.** The analysis divided automobile trips into SOV and shared ride trips. A further analysis could classify trips by the number and relationships of individuals riding together. Many of the trips are being made to transport other family members. Combining trips for several purposes, such as to perform household errands after dropping a child off at school, could increase automobile efficiency. Such an investigation would require an understanding of both the trip chaining process and spatial travel patterns.

7. **Walk Trips.** The project began by selecting four study neighborhoods that were relatively pedestrian-friendly. The results indicated that walking accounted for many of the trips. Further analysis of the data set could contrast short walking trips, as from store to store, with walking trips to more distant locations. Trip chaining again becomes important in differentiating a simple walk trip, as from home to work, from a series of linked trips for several purposes. An important benefit of this research would be determining the potential for substituting walking for auto use by comparing the locations of activities reached by each mode.

8. **Weekend Travel.** A major difference between this data set and the data collected by the Puget Sound Regional Council is the inclusion of weekend travel. This is important because the relative proportions of trip purposes and modes are different for weekend vs. weekday travel. Unsurprisingly, weekend travel purposes are predominantly family, personal business, social, and recreational in nature. Ridesharing is an even larger proportion of weekend automobile travel. Because congestion is no longer confined to weekday peak periods, an understanding of weekend travel is important in order to make the transportation system more efficient.

9. **Auto Dependency.** Further analysis would be necessary to validate the

responses made by many commuters about their work trips. Many respondents appeared to indicate that they must drive to work either because their jobs require that they have a car at work, or because they need their vehicles before or after work to transport their children. Further study of this apparently auto-dependent subpopulation would be useful.

Conclusion

These recommendations list some of the broad research issues uncovered by preliminary analysis of the neighborhood data sets. The detailed data collected in this research project should go a long way toward answering questions about the potential of mixed use neighborhoods for reducing traffic congestion.

Acronyms

GIS	Geographic information system
GMA	Growth Management Act
HOV	High-occupancy vehicle
LUTRAQ	Land use, transportation, air quality
NCDB	National Consumer Data Base
NTD	Neo-traditional development
PSRC	Puget Sound Regional Council
PSTP	Puget Sound Transportation Panel
PUD	Planned unit development
SOV	Single-occupancy vehicle
SPSS	Statistical Package for the Social Sciences
TDM	Transportation demand management
TND	Traditional neighborhood development
TOD	Transit-oriented development
VMT	Vehicle miles traveled

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About the Innovations Unit

The Innovations Unit is an advisory group to the Washington State Transportation Commission that conducts technology and policy research on emerging transportation developments and opportunities in Washington State. The goals of the Innovations Unit are to

- provide long-range program development support to the Transportation Commission,
- generate unfiltered visions of a wide range of future short-term and long-term transportation technology and policy options, and
- establish a research methodology that fosters development of innovative transportation concepts.

The Innovations Unit has three objectives representing successively more detailed and focused studies:

Objective 1. Monitor emerging technologies and strategies. Compile and synthesize up-to-date information about emerging and innovative transportation technologies, strategies, and policies.

Objective 2. Research selected topics of Commission interest. Conduct detailed background research of specific technology and policy issues, under the direction of the Commission's Policy Development Subcommittee. Produce a series of white papers outlining technology and policy implications germane to the Washington State transportation system.

Objective 3. Support in-depth technology and policy research. Conduct and/or coordinate detailed research of key enabling technologies, strategies, and policies.

The research activities of the Innovations Unit emphasize early, preparatory studies of emerging potential transportation solutions, and include interaction with elected officials, public agencies, university researchers, the private sector, and members of the public. Its activities are intended to complement and support in-depth applied research and implementation by the Washington State Department of Transportation (WSDOT), and reinforce ongoing State Transportation Policy Plan activities.

Appendix A:

Telephone Questionnaire

UNIVERSITY OF WASHINGTON TRANSPORTATION PANEL SURVEY

(This is an annotated version of a computer assisted interview)

Hello, I'm calling from Decision Data on behalf of the University of Washington, Department of Civil Engineering. We are conducting a study of travel patterns and needs in your neighborhood and would like to ask you some survey questions. The interview averages only 6 minutes, and your participation is voluntary. Your name will be kept confidential, and no one outside of the study team will have access to your identity.

May I ask you the survey questions? Great!

First, I need to verify that you live in the Queen Anne Hill neighborhood.
(if not, SO5 and terminate politely)

Are you the head of household and 18 years of age or older?
(if not, ask for head of household)

---------- SCREEN OUTS ----------

1	Not interested in subject	4	Illness
2	No one over 18 in HH	5	Outside of area
3	Communications barrier		

#1 (Do not ask)

1. Household interview (first person)
2. Person interview

#2 How long have you lived at your current residence?

1. less than 1 year
2. 1 to 5 years
3. 6 to 10 years
4. 11 to 20 years
5. more than 20 years
(F10) Don't know/Refused

#3 One topic that has received a lot of attention recently is traffic congestion. How would you describe traffic congestion problems in your own area? Would you say they are...

[Read List]

1. Critical
2. Serious, but not critical
3. Not a serious problem
(F10) Don't know/Refused

#4 About how far from your home is the nearest bus stop?

DO NOT READ

1. within 2 blocks
2. 3 to 5 blocks
3. more than 5 blocks
4. within 1/4 mile
5. over 1/4 mile and less than 1/2 mile
6. more than 1/2 mile and less than 1 mile
7. over 1 mile
8. Other [List! Ctrl F5]
(F10) Don't know/Refused

#5 How many people in your household, age fifteen or older, ride a local bus at least four times a week ? Please count a round-trip as two rides.

0. None
1. 1 person
2.
3.
4.
5.
6.
7.
8. 8 or more

#6. How many household members are employed outside of the home?

0. None
1. 1
2. 2
3. 3
4. 4
5. 5 or more
6. DK/Refused

#7 How many, if any, in your household carpool or vanpool to work? Please count family members riding together also.

0. None
1. 1
2. 2
3. 3
4. 4
5. 5 or more
6. Don't know/Refused

#8. Do you ever walk to work?

1. Yes
2. No

#9. On the average, how many days a week do you walk to or from work?

#10. How many times a week do you walk for recreation or exercise?

#11. How many times a week do you walk from home for shopping or personal business?

#12 How many cars, vans, pick-up trucks, or motorcycles in working condition are available for use by members of your household? Please include company cars.

#13. How many bicycles are available for use in your household by individuals who are 15 years of age or older?

#14 As you may know, transportation and congestion are major issues in our area. The University of Washington is conducting studies which will help in planning for our future needs. As part of these studies, the University is establishing a panel of residents in four neighborhoods. Your neighborhood is one of these.

It is important that the information we gather be truly representative of the transportation patterns of households in your neighborhood. We would like to include your household.

All we ask is that you have all members of your household age 15 and older keep a record of their local trips for 2 days. We will send you travel diaries and instructions. It only takes about 5 minutes a day, and it's interesting to see what trips you make.

As a token of appreciation for contributing to this important community project, we mail $2 along with the diaries for each person participating on the panel.

#15 Would you be willing to be a part of this University project?

[If needed: That's what we do need -- people with all types of activity, from a lot to a very little. It is important that we do include people like yourself.]

1. yes -------- Great!
2. no (TERMINATE POLITELY) (Go to Q44)

#16 First, I need to get some more information on your household and your household's transportation needs.

Including yourself, how many people are currently living in your household? ___

How many of these are age 18 or older? ___

How many are between 6 and 17? ___

How many are under age 6? ___

How many are 15 years of age or older? ___

#17 Now, may I have the name of each individual 15 or older so we can address the travel diary to each person.

Let's start with you. What is your name?

Name _____

#18 Sex:

1. Male
2. Female

#19. And what is your/his/her age?
(enter 99 for "refuse")

#20. (if refused, ask "Could you tell me if it's in the range of.....)
(otherwise just enter appropriate category)

1. 15-17
2. 18-24
3. 25-34
4. 35-44
5. 45-54
6. 55-64
7. 65-98
8. Refused

#21 Are you currently employed outside the home or do you attend school? (If both, ask, "Do you consider yourself primarily a student?")

1. employed
2. student (Go to Q32)
3. neither (Go to Q36)

#22 What is your occupation? That is, what type of work do you do?

_____

#23 What is your work address? [At least get closest intersections]

_____

#24 And in which city is that located?

_____

#25 How many days do you normally work?

#26 How do you usually get to and from work?

1. car/carpool/vanpool
2. bus
3. car/bus combination
4. motorcycle
5. bicycle
6. walk
7. Other [List! Ctrl F5]

#27 Do you drive alone, drive but with others, ride with others, or take turns?

1. drive alone
2. drive but with others (Go to Q29)
3. ride with others (Go to Q36)
4. take turns (Go to Q29)
5. don't know/refused (Go to Q29)

#28 In the past 6 months or so, have you regularly taken the bus to or from work?

1. yes
2. no

#29 Does your job require that you have a car at work?

1. yes
2. no

#30 Do you need the car before or after work to pick up children?

1. yes
2. no

#31 How many days a week?

#32 What is the name of the school you are currently attending?

_____

#33 and the City? _____

#34 How do you usually get to and from school?

1. car/carpool/vanpool
2. bus
3. car/bus combination
4. motorcycle
5. bicycle
6. walk
7. Other [List! Ctrl F5]

#21 Are you currently employed outside the home or do you attend school? (If both, ask, "Do you consider yourself primarily a student?")

1. employed
2. student (Go to Q32)
3. neither (Go to Q36)

#22 What is your occupation? That is, what type of work do you do?

_____

#23 What is your work address? [At least get closest intersections]

_____

#24 And in which city is that located?

_____

#25 How many days do you normally work?

#26 How do you usually get to and from work?

1. car/carpool/vanpool
2. bus
3. car/bus combination
4. motorcycle
5. bicycle
6. walk
7. Other [List! Ctrl F5]

#27 Do you drive alone, drive but with others, ride with others, or take turns?

1. drive alone
2. drive but with others (Go to Q29)
3. ride with others (Go to Q36)
4. take turns (Go to Q29)
5. don't know/refused (Go to Q29)

#28 In the past 6 months or so, have you regularly taken the bus to or from work?

1. yes
2. no

#29 Does your job require that you have a car at work?

1. yes
2. no

#30 Do you need the car before or after work to pick up children?

1. yes
2. no

#31 How many days a week?

#32 What is the name of the school you are currently attending?

_____

#33 and the City? _____

#34 How do you usually get to and from school?

1. car/carpool/vanpool
2. bus
3. car/bus combination
4. motorcycle
5. bicycle
6. walk
7. Other [List! Ctrl F5]

#35 Do you drive alone, drive but with others, or ride with others?

1. drive alone
2. drive but with others
3. ride with others
4. take turns

#36 How many times a week do you ride the bus?

Please count a round trip as two rides.

#37 Do you have a transit pass?

1. yes
2. no

#38. Do you currently have a valid driver's license?

1. yes
2. no

#39. (For first person only)

Before we go on to the other members who will fill out the diary, let me verify your correct mailing address. Is it
(Computer inserts address from datafield on screen 1)

#40. (for first person only)

Let me verify your phone number. Was it: (Computer inserts phone number from datafield on screen 1)

#41 **(For 1st Person Only)**

Is your total annual household income above or below $35,000 per year?

1. below $35,000
2. above $35,000
3. don't know (just your best estimate will do) (Go to Q44)
4. Refused (Go to Q44)

#42. Please stop me when I reach the income category that best describes your households annual income:

1. Less than $10,000
2. 10 - $15,000
3. 15 - $25,000
4. 25 - $35,000
5. Don't know (just your best estimate will do)
6. Refused

#43. Please stop me when I reach the income category that best describes your households annual income:

1. 35 - $45,000
2. 45 - $55,000
3. 55 - $75,000
4. $75,000 or more
5. Don't know (just your best estimate will do)
6. Refused

#44.
(Go to Q17 for next person in household)

or

Thank you for agreeing to be in the University of Washington Transportation Panel. We'll mail the travel diaries for your household within a day or two, and should have them within a week.

Are there any questions you would like to ask me about the travel diary or about the University of Washington Transportation Panel?

Appendix B:

Travel Diary and Instructions

Driver or Rider?	Circle "D" or "R" to show whether you were a driver or rider to the stop.
How many total in group?	Include yourself. If you and a friend take the bus shopping, record "2", but if you took the bus and met each other at the shopping center, record "1". If you carpool, record the total number in the carpool, but if you take the bus, do not count the total number on the bus.
WHO?	Please list the relationship -- such as husband, daughter, co-worker, friend, friend's child -- of the people with whom you were travelling.

WHAT IS A TRIP? Every stop you make should be recorded on a separate line. So, if you walk from home to Safeway, to the drug store and then back to home, you would record this on three separate lines.

TRIPS FOR FUN OR EXERCISE: If you leave the house to walk or bike for fun or exercise and return directly home, record this on one line.

CARPOOLS/VANPOOLS: If you ride in a carpool/vanpool, you do not need to show the stops to let off or pick up riders. If you are the driver of a carpool/vanpool, please write down all your stops.

PARK-AND-RIDE USERS: List as two trips: the first is the trip to the park and ride lot, and the second is the trip to your next destination.

WALKING TO THE BUS: Walking to a nearby bus stop does not need to be shown as a separate trip.

BUS RIDERS: Do not count transfers as another trip.

STAYED HOME: If you did not go anywhere on the day, please check the box on the right hand side of the diary.

★ **Please list ALL trips you make.** ★

★ **Please write each stop on a SEPARATE LINE.** ★

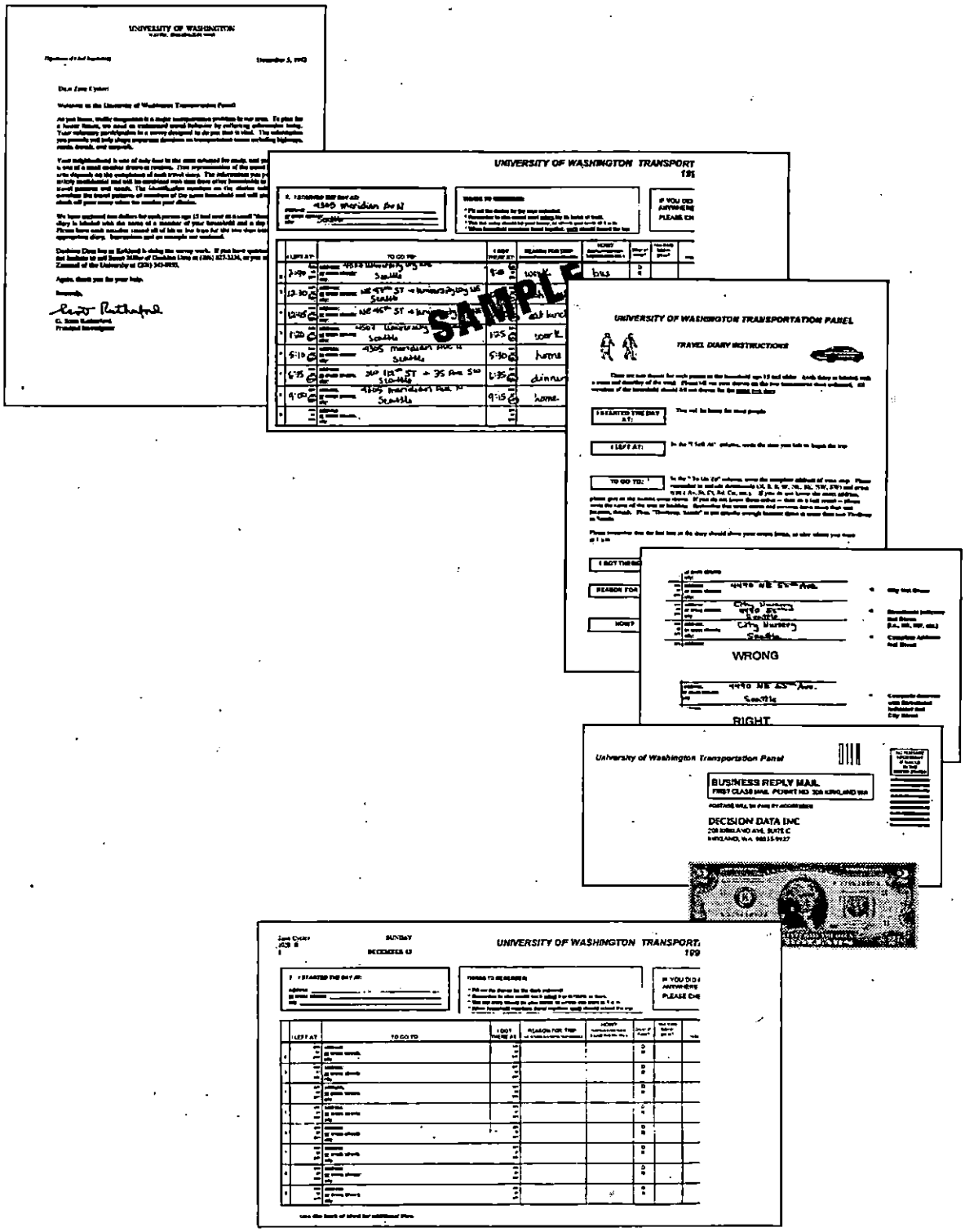
QUESTIONS?

If you have any questions, please call us collect, in Kirkland, at (206) 827-3234.
Susan Miller will be glad to answer your questions.

DECISION DATA INC 200 Kirkland Avenue, Suite C Kirkland, WA 98033

Appendix C:

Travel Diary Packet



UNIVERSITY OF WASHINGTON

UNIVERSITY OF WASHINGTON TRANSPORT

SAMPLE

UNIVERSITY OF WASHINGTON TRANSPORTATION PANEL

TRAVEL DIARY INSTRUCTIONS

WRONG

RIGHT

University of Washington Transportation Panel

BUSINESS REPLY MAIL

DECISION DATA INC

UNIVERSITY OF WASHINGTON TRANSPORT

Appendix D:

Data Entry Procedure

DATA ENTRY

The data captured in the diaries consisted of a sequence of trips. Rather than just recording the data received from respondents verbatim, some editing of recorded trips was conducted during data entry in order to make the definition of "trip" somewhat more consistent. The following is the definition of trip used for this study.

TRIP DEFINITION

Any trip that was movement from one "stop" to another "stop" was considered a trip. Distance or length of time it took between stops was not a factor in determining a trip. Note that this differs from the PSRC Transportation Panel trip definition.

Trips from store to store were considered as individual trips, unless the stores were in a mall.

Movement between buildings on a college campus or at a work-place site were not considered individual trips. Only the trip to and from the campus/work site was entered.

For Queen Anne, Wallingford and Kirkland, all trips in the Puget Sound area (King, Snohomish, Pierce and Kitsap Counties) were entered. For Spokane trips in Spokane County and into Idaho as far as Couer d'Alene were entered.

Walks to bus stops were considered trips. Transit transfers were not considered separate trips. If the panelist did not indicate a walk to a bus stop, no attempt was made to add such a trip.

For car/van pools all stops that a driver panel member made were considered trips. If the panel member was a rider in the pool then the stops were not considered trips.

The stops a person made on the job off the primary job site as part of their employment were included (as work related) if the panelist reported them.

Walks for pleasure and recreation were included as trips. Round trips from home (or some location) which did not have stops were considered one trip.

DATA ENTRY PROCEDURE

Typically, survey data collection and data entry are sequential rather than simultaneous tasks. Following data collection, it is usual to have a trained employee review the completed interview data for completeness and clarity and correct the data as required. The verified surveys are then submitted for data entry when fielding is complete. This procedure was found not to work for these travel diaries.

The travel diary data seems to be error prone in part because addresses themselves are complex (i.e., they have many components which respondents do not conscientiously record). Also, the list of trips can be long. Respondents seem to forget to record a trip or can't remember the details at the end of the day and may drop it or record partial data. This type of missing data and incompletely recorded data comprised the most common mistakes. But in many other cases, the error was more complex and was detected because something was illogical. This was usually that the sequence of trips did not make sense, or the trips of different family members were not consistent.

There was a very high rate of error provided in the diaries received back from the panel members. Approximately 1/2 of the diaries had errors of one sort or another. Of these, approximately 1/3, or 1/6 of the total of all diaries, required that the respondents be called back to provide, correct or clarify information. The remaining diaries were corrected in-house (addresses looked up, time of a trip added based upon record in another diary, trip added that was on spouse's diary, etc.).

The need to correct so much of the diary data forces the data entry process to be an interactive one. Our procedure was as follows.

1) As the diaries were received, they were sorted and logged in. They were then examined and checked for completeness of all answers, especially addresses, by one of 3 supervisors (these were individuals who had worked on Waves 2 and 3 of the PSRC Transportation Panel diaries in 1990 and 1992). There was also some attempt to see if the overall diary "made sense" and if the household's diaries were consistent. Diaries were then separated into four batches: 1) those which looked valid, 2) those with problems which could be solved in-house (a diary with a missing location which might be found in the telephone book, e.g. DaVinci's in Kirkland), 3) those which required a call back, and 4) those requiring a new set of diaries.

2) Corrections were attempted with those diaries from the second batch. Those which could not be corrected were put into batch 3 while those which were corrected were added to batch 1.

3) The apparently valid diaries (batch 3) were immediately given to other personnel for immediate data entry. The reason for this is that significant numbers of "logic" errors were discovered during the data entry process. Therefore, this step must be done immediately if problems are to be found and corrected (by call backs to the respondent).

Catching inconsistencies between trips or diaries requires that the researcher read and understand the whole day's diary and the whole household's set of diaries. This is

necessarily done as a part of the data entry. It would not be cost effective to duplicate this effort at the check-in stage, even though check in was done by experienced individuals. Because the "data entry" step is really a combination of verification and data entry, it must be done immediately so that panel members can be recontacted to clarify and/or provide missing data before too much time passes since the recorded events.

Diary data were entered directly from the diary forms rather than from a "coding sheet." Not only would transcription be extremely inefficient, but one would lose the context which was very important in finding errors.

Problems Encountered with Diary Data

Problems that the panel members had in filling out the diaries could be classified into four categories:

1. trips do not make sense
2. incomplete location information
3. inclusion of inappropriate trips
4. inclusion of out of area trips

Trips do not make sense

Quite a variety of errors were detected simply because they were internally inconsistent or illogical. These ranged from simple to complex. Some simple problems included circling both "driver" and "rider", forgetting to include a starting location or putting the starting location on line 2, and forgetting to add the final return home. The more complex problems involved the relationships between distance and time, relationships between trips and so on. For example, sometimes the respondent would enter the time spent at a location (i.e., the arrival and departure time at the destination). This could be detected if the time was significantly too long for the trip. Another common problem was circling the wrong time of day (am/pm). This could generally be figured out from the times of other trips. Occasionally, respondents would list trips in the wrong order (many of these diaries are apparently filled out at the end of the day rather than when the trips are actually made) so that the sequence of trips did not make sense. In many instances missing trips or trips out of order were detected because of the inconsistency in the number of passengers or the relationships of passengers from trip to trip or the mode of transportation used on successive trips. For example, diaries implying that a car was abandoned, that an individual walked home from a very long distance away, or that an child reappeared at an inappropriate time or place, all gave rise to suspect trip sequences. Other problems were detected by comparison of the diaries of different persons within the household. This usually involved trips recorded by one individual and not by another although sometimes it was more complicated than this.

Respondents were called in order to make corrections to the diaries if necessary although in many cases (about 2/3 of the diaries with problems) the diaries could be corrected without calling the respondents.

PROBLEM	SOLUTION
Forgot trip home at the end of the day.	Added with as much information as possible only if it was obviously correct.
One member neglects to enter trip that other members included.	Used information from other members. Called if necessary.
Entered time spent at place rather than time in transit.	Attempted to figure out times. Called if necessary.
Sequence of trips doesn't make sense.	Called person to straighten out.
Number of individuals on trip doesn't make sense.	Tried to figure out from other information. Called if necessary.
Circled both D and R (driver and rider).	Tried to figure out from other information. Called if necessary.
Neglected to enter "Why?"	Tried to figure out from other information. Called if necessary.

Incomplete location information

Many problems were found in the diaries when the trip information was being entered, and these problems were usually solved. If there was a non-distinctive place listed, such as "Mercer Island" or "friend's house," the panel member who filled out the diary was called to obtain a more complete location. In the case of a non-distinctive place and one street name ("McDonald's on Bellevue Way"), the address was looked up in a computer list or telephone book. If a place name and city, such as "Azteca Restaurant, Kirkland" were given, the address was also looked up in the phone book. When the "Address where started" box was left blank, other trips were checked to see if the person started at home and if there was a home address on the diary. Occasionally, times started and/or arrived were missing from some trips data and were reconstructed if possible. Otherwise, the person was called to get the missing times which were then entered if they were remembered or left blank if the person could not remember.

Locations were considered acceptable if they were unique. For example, we accepted place names of schools, colleges, shopping centers or malls, post offices in a small towns, and names of a large buildings. If the trip was to a location outside of the 4 county area, the name of the city, without an address, was accepted.

PROBLEM	SOLUTION
Non-distinctive place and incomplete address or absence of address.	Called person to get address or intersection.
Place name and incomplete address or absence of address.	Looked up in computer list or in the phone book.
"I Started the Day At" left blank.	Checked other trips to see if they started at home.
Neglected to enter times.	Reconstructed if possible. Otherwise, called person to get times. If they could not remember, times were left blank.

Inclusion of inappropriate trips

In some cases trips listed on the diaries were deleted. Trips between buildings at one site, such as on the campus of the University of Washington or at one of the large Boeing facilities, were eliminated. Where bus transfers were listed as separate trips, those trips were condensed into one trip with the appropriate total time spent in transit. Individual trips to different stores within one mall were entered as one trip. If the home address was entered as the first trip, the diary was straightened out so that all information for one trip was on the same line.

PROBLEM	SOLUTION
Trips between buildings on a campus.	Did not record as separate trips.
Trips between buildings at a large work site.	Did not record as separate trips.
Transfers on bus listed as separate trips.	Recorded all transfers to one destination as one trip.
Entered home as entry of first trip, causing aspects of one trip to be on two lines.	Straightened out trips.
Individual trips to different stores in one mall listed as separate trips.	Entered as only one trip.

Out of area trips

For Kirkland, Queen Anne and Wallingford, respondents who were out of the study area for both assigned days were asked to redo both diaries. When trips that were out of the 4 county area (King, Snohomish, Pierce and Kitsap counties) were listed on a diary, only the trip that took the person out of the area and the trip that brought the person back into the 4 county area were recorded. The trips that started from and ended within counties other than King, Pierce, Snohomish and Kitsap were excluded.

For Spokane, the same type of rules were applied using the area definition as Spokane County and Idaho to Couer d'Alene.

PROBLEM	SOLUTION
Out of the study area on two days.	Asked to redo on two days within the area.
In the study area for only one day.	Diary was accepted
Trips outside the 4 county area.	Only recorded the trips that took them out of the area and then back into the area. Only required the name of city o county outside of the 4 county area.

Verification of data entry

After all diaries had been entered, the diaries were verified for correctness and consistency. Each diary was checked against the information that had previously been entered into the computer. This step was primarily to correct "keying" errors rather than data recording errors made by the respondents. Most of the errors in the original data entry were incorrect spellings due to the poor handwriting on the diaries.

This verification step also ensured that information from the diaries was interpreted consistently into the appropriate codes. For example, a panel member may have put "School" in the "Why?" column, so the information was originally coded as "3 - School." However, by reviewing the diary more closely, it could be seen that this person was not really going to school, but dropping off children at school and the coding should really be "6 - Personal.

Appendix E:

Shopper Questionnaire

UNIVERSITY OF WASHINGTON SHOPPING/SERVICES QUESTIONNAIRE

Department of Civil Engineering

Hello, I'm conducting a survey for the University of Washngton. I'm with Decision Data Research, and we're conducting a transportation survey for the Department of Civil Engineering. It will take only two minutes, and your participation is voluntary. May I ask you a few questions?

1. **First, what means did you use to get to this shopping area?**
   1 Walk from home
   2 Walk from other (workplace, friend's, store > 3 blocks, but not bus stop or parking spot)
   3 Drive to nearby parking spot
   4 Passenger in a car
   5 Bicycle
   6 Bus to area
   7 Motorcycle
   8 Other : List

2. **Did you have a motor vehicle available for this trip today?**
   1 Yes 2 No

3. **What is the purpose of this trip? (Probe to clarify)**
   1 Work
   2 Work-related business
   3 Shopping (commodities)
   4 Professional services (medical, legal, etc.)
   5 Family or personal business (bank, hair cut,etc)
   6 School (includes PTA)
   7 College (post high school)
   8 Church
   9 Visit friends or relatives
   10 Pleasure trip
   11 Other social & recreational (movie, going to gym)
   12 Home
   13 Eating or drinking
   14 Work related appointments
   15 Personal services appointments

4. **Where did you start this trip to this shopping area?**
   1 from Home
   2 from Work
   3 from School
   4 from College
   5 from Church
   6 from Friend's home
   7 from another store > 3 blocks away (shopping,)
   8 from Professional office (doctor, lawyer, etc.)
   9 from personal business place (bank, cleaner,etc)
   10 from Social or Recreation (gym, movies, community center, playfield, etc.)
   11 from Pleasure trip (boating, etc)
   12 from eating or drinking
   13 from work related appointment
   14 from personal services appointment

5. **(If NOT from HOME) What was the address or nearest intersection (of the place where you started the trip)?**

6 **What is the nearest intersection to your home?**

7 **How long have you lived at your current residence?**
____ (years) or ____(months)

These next questions are to help us group your answers with the answers of other people in the survey.

8. **How many cars, vans, company-owned cars, pick-up trucks, or motorcycles in working condition are available for use by members of your household?**

____

9. **Including yourself, how many people are currently living in your household?** ____

How many are 18 or older? ____
How many are between 6 and 17? ___
How many are under 6? ___

10. **What is your age?** ___ Age category:___

11 **How many of the people in your household work outside the home?** ___

12 **How many attend school?** ___

13 (IF AUTO DRIVER OR PASSENGER) **What would make you use your car less often for a trip like this?**

14 (IF NOT CAR MODE) **Are there any improvements the community could do to make your trip here easier?**

15 **Income category:** ___

16 **Thank You very much. That's all my questions. (Ask respondent to sign first name and phone)**

(Record Sex)

1 Male 2 Female

Date:_____ Time:_____

Location:_____

Interviewer:_____