Intermediate Health Impact Assessment: Traffic Speed on South Third St. Corvallis

Benton County Health Services

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Acknowledgments

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Community partners:

Corvallis School District Safe Routes to School

Oregon Department of Transportation

The Linn Benton Health Equity Alliance

The City of Corvallis Police Department

The City of Corvallis Public Works Department

Willamette Neighborhood Housing Services

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Executive Summary

Health Impact Assessment (HIA) is an informational tool designed to help decision-makers consider the health implications of proposed policies, especially those that do not appear to have direct connections to health, and identifies appropriate actions to manage those effects. The Benton County Health Services (BCHS) undertook an intermediate HIA to examine the impacts traffic speed have on important determinants of health: active transportation, traffic safety, social networks, and access to goods and services.

Review of the Literature

Traffic speeds impact many aspects of a community. Most importantly, it can impact quality of life and health outcomes. Lower traffic speeds are associated with greater rates of active transportation (i.e. walking, bicycling, and public transportation). Active modes of travel can play an important role in increasing rates of physical activity, and there continues to be a growing body of evidence linking transportation and land use patterns to physical activity and obesity and their costs . Perceptions of risk of being injured by motorized traffic effect decisions to drive, walk, bicycle, or use public transportation . Furthermore, measures of the built environment that are correlated with physical activity include the presence of bicycle and pedestrian infrastructure, proximity to destinations, greater street network density, and greater land use mix, and the quality of the urban design.

Research has also shown higher traffic volumes and speeds result in higher numbers of pedestrian accidents. Most of the risk of severe injury while cycling or walking as a pedestrian is not intrinsic to the activity; vehicles impose it on cyclists and pedestrians .

Traffic speed and volumes are also related to quality of life factors such as: social connections, neighborhood pride, and property values. As speeds and volumes increase, these quality of life factors decrease .

Access to goods and services are also impacted as traffic speeds are increased. Street connectivity and traffic speeds can influence residents' access to parks, compared to residents with a high-speed road on their way to their closest park, residents with slower traffic routes to parks are more likely to use parks . It has also been found that customers who frequent businesses that arrive by modes other than

automobile (walking, bicycling, and public transit) to be competitive consumers. Those walking and bicycling to a business spent similar amounts or more, on average than those who arrived by automobile

Baseline Assessment

BCHS analyzed baseline conditions to determine the extent to which traffic speeds impact active transportation, traffic safety, social networks, and access to goods and services in south Corvallis. Key findings are summarized below.

- The average Body Mass Index (BMI) for south Corvallis adults is 26.5 kg/m2, compared to 25.5 kg/m2 for adults living in all of Corvallis
- Only about 7% of south Corvallis residents travel by bicycle and 1.6% walk to work
- Lincoln Elementary student rates of walking and bicycling to school are consistently lower compared to other 509J District schools that participate in Safe Routes to School.
- Many Lincoln elementary school parents surveyed indicated that volume (53%) and speed of traffic (55%) are issues that affect their decision to allow their children to walk or bike to school
- Overall, south Corvallis residents live in close proximity to many destinations with the exception of grocery stores.
- The rate of pedestrian and bicycle collisions on arterial roads are higher in south Corvallis, when compared to all of Corvallis

Impact Analysis

BCHS finds that a reduction in traffic speeds will likely be beneficial to the community of south Corvallis. A reduction in traffic speeds will have positive impacts on rates of walking and bicycling; traffic safety, particularly for pedestrians and bicyclist; social networks; and access to goods and services.

BCHS finds that children, older adults, Latino residents and low-income residents experience disparate impacts in regards to traffic safety. Children and older adult pedestrians and bicyclist are more likely to die and suffer more severe injuries when involved in a collision with a motor vehicle. Latino and low-income residents are also more likely to be involved in a collision with a motor vehicle as they experience a greater exposure to traffic (i.e. are more likely to walk, bicycle, or take public transportation due to income restraints).

Overall, a reduction in traffic speed is likely to contribute to a reduction in disparate health outcomes.

Recommendations

- Lower the posted speed limit along S. 3rd between Avery Avenue and Tunison Avenue to 25 mph.
- Extend current median with trees
- Enhance and expand bicycle and pedestrian paths on both east and west sides of the south Corvallis neighborhood.
- Develop and expand wider sidewalks– provide a greater buffer between pedestrians and vehicles
- Explore color painted bike lanes
- Explore posting signage that notifies motorist they are entering a community.
- Future analysis of business sales and visits for businesses adjacent to Highway 99/South Third Street
- Future assessment of local motorist perceptions and attitudes regarding traffic speed along this segment of the roadway. This may support media campaign regarding unsafe speeds.
- Monitor bicycling and walking rates by age and race/ethnicity.

Defining Health Impact Assessment

A Health Impact Assessment (HIA) is "a combination of procedures, methods and tools by which a policy, program or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population" (WHO 1999).

The process of an HIA typically includes six steps (National Research Council, 2001, p. 47)

1. **Screening-** determines whether a proposal is likely to have health effects and whether the HIA will provide information useful to the stakeholders and decision-makers.
2. **Scoping-** establishes the parameters of health effects that will be included in the HIA, the populations affected, the HIA team, sources of data, methods to be used, and alternatives to be considered.
3. **Assessment-** involves a two-step process that first describes the baseline health status of the affected population and then assesses potential impacts.
4. **Recommendations-** suggest design alternatives that could be implemented to improve health or actions that could be taken to manage the health effects, if any, that are identified
5. **Reporting-** documents and presents the findings and recommendations to stakeholders and decision-maker
6. **Monitoring-** evaluates the effectiveness of the HIA and health impacts of the implemented proposal.

Introduction

Health is shaped by the places we live, work, learn, and play. In the interest of highlighting this relationship, Benton County Health Services (BCHS) undertook this HIA to provide an additional assessment of health and safety factors that ODOT speed investigations traditionally do not consider yet are often impacted by the speed, traffic volume, and design of a road.

Context

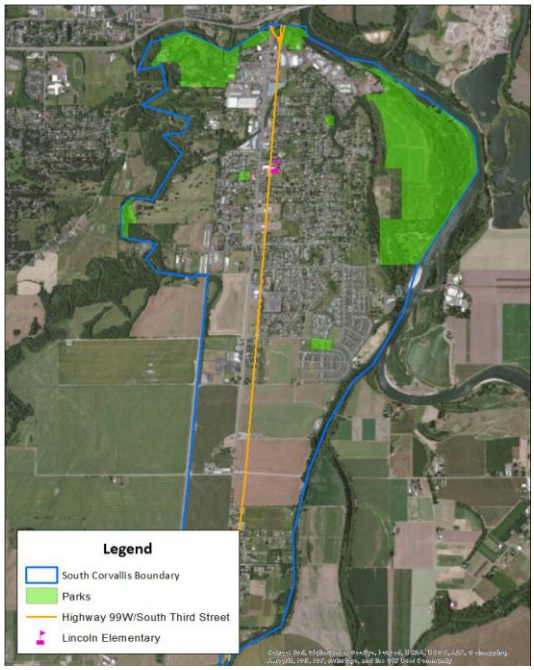
To fully understand the impact current traffic speeds, and a potential change in traffic speed have on the community of south Corvallis this section describes the historical and current land-uses for this area of Corvallis.

South Corvallis is a small community with many assets and a community of residents that deeply care about their neighborhood(s). In a former life, south Corvallis was once the city's industrial center, but

now includes a mix of housing, retail strips, and industrial sites. *Lincoln Elementary School*, K-5, serves as the community hub with a school garden, soccer fields, playground and after-school programming.

South Corvallis also enjoys a number of parks that include:

- *Willamette Park and Natural Area* (287 acres) located on the east next to the Willamette River
- *Avery Park and Natural Area* (75.3 acres) located at the northwestern end of south Corvallis
- *Tunison Park* on the west side of Highway 99W/South Third Street
- *Lily Park* on the northeastern side of Highway 99W/South Third Street
- *Rivergreen Park* in the Willamette Landing subdivision in the southernmost part of southeast Corvallis



In addition to city funded parks, the privately-owned *Corvallis Indoor Sports Park* is located at the northern end of south Corvallis.

South Corvallis also boasts urban agriculture on the east side of Highway 99W/South Third that includes *Luke Beene Farm* and *Rainshine CSA*. Additionally, *First Alternative Co-Op,* a local grocery store, has a location in the northeast corner of south Corvallis and the *South Corvallis Food Bank* is also located along Highway 99W/South Third Street .

South Corvallis families have access to the *Lincoln Health Center,* which provides family healthcare for primarily low-income families.

Although south Corvallis has many resources, neighborhoods within south Corvallis are physically isolated from each other and other areas of town. This is primarily due to the constrained northern segment of Highway 99W/South Third Street. The northern segment of south Corvallis lacks alternative north-south streets and has generally poor connectivity.

South Corvallis has relatively few jobs compared to housing, and high levels of through traffic [1]. This physically isolates south Corvallis from the rest of the community and the many residents who depend

on public and alternative transportation to access the greater proportion of critical services and amenities located in other areas of the city.

Highway 99/South Third Street is a four-lane arterial road designated as a truck route that bisects the neighborhood[2]. The width of the road and the high traffic volumes and speeds create a barrier for families, especially those who travel by foot or bicycle, or rely on public transportation, living on the west side who wish to travel to parks, school and grocery store.

The overpass located at the north end of the community (MP 84.31) is the start of this community. In this section of road, the posted speed is 25 mph which extends to 100 feet south of Avery Ave (MP 85.10). The portion of highway that was investigated in the current speed study includes 100 feet south of Avery Ave (MP 84.51) to 100 feet south of Tunison Ave (85.10). This section is 0.59 miles in length and is bordered by a mix of businesses, residential neighborhoods and a local elementary. The average daily traffic in 2011 was 21,067. This straight segment of road is level and has no speed radar in place[3].

Significance

On a local level, the significance of a change in traffic speed is great. Highway 99W/South Third Street is currently and historically has been a concern for the people living in south Corvallis [4][5][6][7]. The concern of safety and access has been an issue that south Corvallis residents have engaged and organized around.

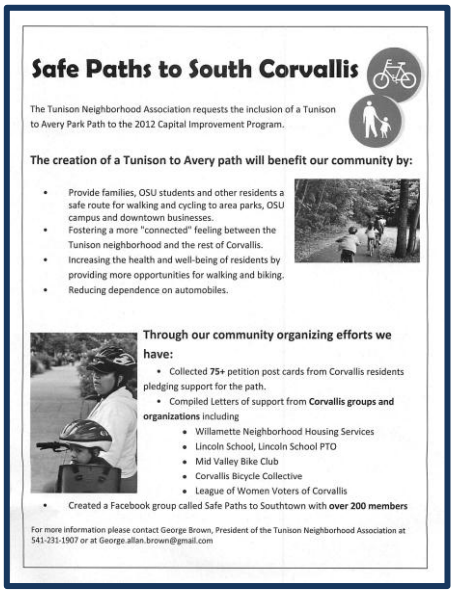
Nearly two decades ago, the *South Corvallis Area Refinement Plan*[8] was finalized after 16 months of work by the Citizens Advisory Committee (CAC) and the south Corvallis community. The plan was created to update and refine comprehensive plan polices and map designations for south Corvallis to address issues related to community design and isolation. The plan set a new direction for positive change in south Corvallis, proposing a community of pedestrian-friendly places with easy access to goods and services along Highway 99W/South Third Street. Most importantly this plan was created as a step toward a preferred future that was defined by the south Corvallis community. However, due to lack of resources and competing interests for the highway the city has been unable to implement many of the recommendations outlined in the plan.

In 2004, Corvallis began a *Safe Routes to School* [9] program that enjoys the support of the Corvallis Police Services, the City of Corvallis Transportation Department, the Corvallis Sustainability Coalition, and the Benton County Health Services. Since the inception of the program, Safe Routes to School has been working on community planning and advocacy for Safe Routes to Schools infrastructure and

encouragement to help more children to safely walk and bicycle to school. Lincoln School is one of six elementary schools that actively participate in the program. At Lincoln, the Parent Teacher Association (PTA) coordinates on-site Safe Routes to School programming. Infrastructure funds through Safe Routes to School also provided financial support for the installation of two covered bike racks at the front of the school.

The *Lincoln Site-Counsel* has also been instrumental in improving safety for active travel to and from school for the elementary students. With their help, the school put in a paved path on school grounds so that students coming from the east side of Highway 99W/South Third Street are able to ride their bicycles and walk to school without having to approach the highway.

More recently, *Safe Paths to Southtown* is a growing neighborhood movement calling for the action of dedicated bike paths to south Corvallis as a way to address concerns of safety and accessibility related to walking and biking within and through south Corvallis. Furthermore, organizations within south Corvallis like the *Tunison Neighborhood Association* and *Willamette Neighborhood Housing Services* have been devoted to supporting advancements of safe travel for pedestrians and bicyclists within south Corvallis. Both organizations have an invested interest in the safety and accessibility of the transportation system in south Corvallis as they represent residents living within the area.



Safe Paths to South Corvallis

The Tunison Neighborhood Association requests the inclusion of a Tunison to Avery Park Path to the 2012 Capital Improvement Program.

The creation of a Tunison to Avery path will benefit our community by:

- Provide families, OSU students and other residents a safe route for walking and cycling to area parks, OSU campus and downtown businesses.
- Fostering a more "connected" feeling between the Tunison neighborhood and the rest of Corvallis.
- Increasing the health and well-being of residents by providing more opportunities for walking and biking.
- Reducing dependence on automobiles.

Through our community organizing efforts we have:

- Collected **75+** petition post cards from Corvallis residents pledging support for the path.
- Compiled Letters of support from **Corvallis groups and organizations** including
  - Willamette Neighborhood Housing Services
  - Lincoln School, Lincoln School PTO
  - Mid Valley Bike Club
  - Corvallis Bicycle Collective
  - League of Women Voters of Corvallis
- Created a Facebook group called Safe Paths to Southtown with **over 200 members**

For more information please contact George Brown, President of the Tunison Neighborhood Association at 541-231-1907 or at George.allan.brown@gmail.com

Since 2010, the Benton County Health Services has been working with the south Corvallis community on issues related to childhood obesity through the Robert Wood Johnson Foundation *Healthy Kids Healthy Communities* grant. With this work, Highway 99W/South Third Street has repeatedly been identified as a barrier and safety concern for residents living in south Corvallis, particularly for those who are the most vulnerable to a lack of resources.

This HIA builds upon work done by the entire south Corvallis community and BCHS through the Healthy Kids, Healthy Communities grant. It also provided an opportunity to build relationships with organizations BCHS has not worked with in the past, and will act as a platform to bolster meaningful relationships with new partners in order to continue to improve the health and well-being of Benton County residents.

Purpose

The following section provides a brief overview of the concept of speed, the role of speed studies in determining a posted speed limit and the local context leading up to the current speed study on Highway 99W/South Third Street.

At the solicitation of the Bicycle and Pedestrian Advisory Committee (BPAC), the City of Corvallis Public works submitted a written request to ODOT that a speed investigation be conducted on Highway 99/ South Third Street from Avery Avenue to Tunison Avenue[10]. With this request BPAC stressed it was important that the study take place when the school zone was in effect. The City of Corvallis requested that the speed zone on this stretch of highway be set at a continuous 25 miles per hour (mph). The current speed limit is 35 mph on this segment of the highway; however the segment that connects to the north of Avery Avenue is 25 mph. The segment of Highway 99W/South Third Street under investigation runs parallel to Lincoln Elementary School, which includes a school zone of 20 mph when school is in session from 7 am to 5 pm.

Traffic speed is an important yet complex topic [11]. In addition to transportation engineers, many other stakeholders are interested and concerned with speed- such as enforcement agencies, safety advocates, property owners, users of the transportation system, and community residents. Individual vehicle speeds are selected by drivers who interpret and respond to signals, both explicit and implicit, in the driving environment. The roadway alignment, cross section, roadside, advisory speeds and speed limits are all elements of the driving environment that are thought to influence speed selection[12]. Speeds have fuel consumption, emissions and traffic noise consequences. However, most of the focus and agency actions related to traffic speed involve consideration of mobility and safety[13].

Roadway geometry is one of the informal information sources that drivers interpret when selecting a speed[14]. However, roadway geometry can provide mix speed cues. The planning and design of most roads and streets begins with the selecting of a “design speed”. The topography, anticipated operating speed, adjacent land use and functional classification are considered and as high a design speed as practical is selected, except for local streets[15]. The selected design speed is used explicitly to determine road features such as minimum sight distances, minimum width of selected roadway cross section features, roadside clearance, maximum gradient[16].In addition to highway geometry, landscape, development, perceived conflicts and intersections also contribute to the driver’s selection of speed.

Speed limits are set in one of two ways: 1) determined specifically for a particular road or segment on the basis on an engineering study and displayed as a posted speed on a regulatory sign, or 2) a statutory speed limit that applies in the absence of a posted speed. Statutory speed limits are set forth in state laws. Posted speeds are only meaningful if the majority of motorists comply voluntarily and that occurs only if a speed limit is reasonable[17]. An engineering study made in accordance with established traffic engineering practices is conducted as part of setting a posted speed (MUTCD 2B.13). A universal process for these does not exist- however consistently the 85th percentile speed is a dominant factor in establishing posted speeds. The (MUTCD) indicates that posted speeds "should be within 5 mph of the 85th-percentile speed of free-flowing traffic"[18]. This method results in speed limits that are not only acceptable to a large majority of the motorists, but also fall within the speed range where accident risk is lowest[19]. The posted speed is thus set at the speed in which 85 percent of the drivers travel. Findings from traffic engineering studies suggest that a subjective lowering of the posted speed (i.e. citizen request) will not result in lowered traveled speeds. Past studies have observed that changes in posted speeds have little effect on operating speeds[20].

Table 1. Primary factors used to establish posted speeds

Factor	Percent time used	
	By state agencies	By local agencies
85th percentile speed	100	86
Roadside development	85	77
Accident experience	79	81
10 mph pace	67	34
Roadway geometrics	67	57
Average test run speed	52	34
Pedestrian volumes	40	50

*Source: Parker *1985) Synthesis of Speed Zoning Practices, Report No. FHWA/RD-85/096, Federal Highway Administration, Washington, DC.*

As mandated by Oregon state legislature, the following characteristics are evaluated in a speed investigation: traffic volumes, crash history, highway geometry, roadside culture and density. However, the most weighted factor used to establish a speed zone is the 85th percentile speed (the speed at or below which 85 percent of the vehicles are traveling) [21].This is due to the belief that the majority of drivers are considered reasonable and should be accommodated.

ODOT must follow a specific protocol to conduct speed investigations. Therefore, the BCHS, along with community partners, undertook this HIA as an opportunity to provide an assessment that specifically investigates the impacts traffic speed has on health outcomes and health inequities. It is the goal of this HIA to provide complimentary information on health impacts and health inequities that are not currently factored into the process of determining an appropriate and safe speed that accommodates all users.

The primary goals of the HIA are as follows:

- Provide recommendations to maximize health benefits and minimize health risks related to speed limit and other health outcomes for all residents along South Third Street/ Highway 99 in south Corvallis.
- To engage community members and stakeholders in a HIA process on a decision that affects them.
- Address community needs and concerns through a comprehensive approach.

Report Overview

Baseline Conditions

The baseline conditions provide a general overview of the south Corvallis community. It describes health status and outcomes, in addition to demographics and existing vulnerabilities. Data specific to south Corvallis were used when available and some data is available only at the county level, limiting a complete description of the south Corvallis population.

Scoping

Decision

The primary decision assessed by this current HIA is whether to adopt a 25 MPH speed limit from Avery Avenue to Tunison Avenue in south Corvallis. The decision-makers include Oregon Department of Transportation and City of Corvallis Public Works department.

Potential impacts

Active transportation, traffic safety, social networks, and access to goods and services are the focus of this HIA. Traffic speeds have an impact on many aspects of a community. Traffic speeds can influence residents' health outcomes and overall sense of well-being. Traffic speeds are related to pedestrian and bicyclist injuries and fatalities, rates of walking and bicycling, and interactions between neighbors.

Boundary of analysis

The assessment of impacts is limited to south Corvallis. With certain data, boundaries are set to approximate Corvallis city limits and are used as a comparison for data available for south Corvallis. And still other data are only available at the county level.

The entire population of south Corvallis is considered in the analysis.

Vulnerable populations

Through the HIA process, BCHS identified vulnerable populations within south Corvallis that may be more at risk of negative influences on health. These subgroups included low-income residents, Latino residents, youth, and older adults.

Assessment

The assessment portion of this HIA includes a literature review, baseline assessment, and identification of potential health impacts.

The baseline assessments were conducted for south Corvallis when relevant data were available and include the entire area of south Corvallis and its population as whole as well as vulnerable populations. Limitations, gaps in data, and uncertainties are explicitly noted. The analysis of potential health impacts is based on relationships established in the research, current conditions, and GIS analysis.

It is important to acknowledge data gaps in order to increase transparency and aid the interpretation of the findings. Notable gaps in available data for this current HIA include:

- Tract-level local health data (morbidity/mortality) linked to built environment data
- Data on most types of morbidity by neighborhood
- Data on physical activity by neighborhood

BCHS has limited capacity to utilize GIS analysis. As well as show the connection between built environment and health outcomes, especially at levels smaller than the county. These types of analysis would strengthen this HIA project, and expanding the capacity to do so is something to consider for the future.

Recommendations

Recommendations are based on the findings from the assessment and on the best available evidence from research literature.

Baseline Conditions

This section provides a general overview of the south Corvallis community. It describes health status and outcomes, in addition to demographics and existing vulnerabilities.

Demographics

South Corvallis is home to approximately 7,045 residents, representing one of the most diverse neighborhoods in Corvallis[22]. Although South Corvallis is predominately White (90.2%), there is a higher proportion of Latino residents (10.4 percent) in South Corvallis as compared to Corvallis as a whole (7.4 percent). Furthermore, there is a greater proportion of youth ages 0-18 (20.4 percent) and households receiving SNAP (58.8 percent).

For households in south Corvallis the median income is $40,709 compared to a median household income of $36,328 for all of Corvallis (Map 1). Although median household income is higher for south Corvallis, individuals tend to have a lower income as indicated by a per capita income of $20,210 (Table 2). Approximately 23 percent of the south Corvallis population falls below the federal poverty line; this is compared to 25.4% of the entire Corvallis population (Map 2).

Table 2. South Corvallis and Corvallis population characteristics

	South Corvallis	Corvallis
Total Population	7,045	65,485
White	90.2%	86.3%
Per Capita Income	$20,210	$24,446
Population below federal poverty line	22.6%	25.4%
Proportion of Carless Housing Units	4.5%	9.6%

Source: Us Census Bureau, American Community Survey 2007-2011

Health Data

Benton County and Corvallis have many community assets and natural amenities. However, making healthy choices at the individual and community level requires knowledge and understanding, as well as freedom to act on informed decisions[23]. Healthy living is highly dependent on contextual factors such as education, income and poverty, availability of transportation options, and access to healthy foods[24]. People who are limited by their environments and circumstance often experience and report poorer health than those who have greater opportunities for health[25].

It is the goal of the BCHS to improve the health and well-being of all Benton County residents. To achieve this goal the BCHS created a community health improvement plan (CHIP) that addresses the following five areas: housing and transportation; obesity; food security; health care and community health; and mental and behavioral health.

As a way to move Benton County's CHIP forward, this HIA helps to address several goals within the improvement plan.

- Encourage physically active lifestyles
- Improve utilization of alternative transportation
- Decrease the prevalence of overweight and obesity across the lifespan
- Improve safety for pedestrians and bicyclists on public roads
- Expand trails, bike lanes and connections among all communities

Overall, 64% of Benton county adults are meeting the CDC recommendations for physical activity[26]. Among Benton County youth, only 26.5% of 8th graders meet current CDC physical activity recommendations. Furthermore, Benton County 8th and 11th graders participate less in daily physical education (49% and 6% respectively) than the rest of Oregon (55% and 19% respectively)[27]. Although the above numbers suggest that Benton County as a whole is fairly active, it hides the disparities that may exist among different populations, such as residents with an economic disadvantage, and racial and ethnic minorities. However, data describing physical activity stratified by race/ethnicity and income is not currently available. In addition to stratified data by race/ethnicity and income, future data collection at the neighborhood, census tract, and census block levels will strengthen our understanding of physical activity levels for south Corvallis residents.

Table 3. Percent of Benton County youth meeting CDC recommendations for physical activity, 2007-2008*

Year	8th Grade		11th Grade		Healthy People 2020
	Benton	OR	Benton	OR	
2007-2008*	26.5%	31.4%	22.1%	23.4%	20.2%

Source: Oregon Healthy Teens Survey, 2007-2008

The percentages of overweight and obese youth and adults for Benton County compared to the state of Oregon are shown in table 4. Following nationally accepted definitions, overweight for children and adolescents is defined as a BMI at or above the 85th percentile and lower than the 95th percentile, and obesity is defined as a BMI at or above the 95th percentile. For adults, a BMI of 25-29.9 kg/m^2 is considered overweight and a BMI of 30 kg/m^2 is considered obese[28].

Table 4. Percent of Benton County adults and youth who are overweight or obese

Indicator	Benton County	Oregon
Adults overweight[1]	35.4%	36.1%
Adults obese[1]	20.8%	24.5%
8th grade overweight[2]	11.7%	15.2%
8th grade obese[2]	6.6%	10.7%
11th grade overweight[2]	12.6%	14.2%
11th grade obese[2]	8.0%	11.3%

Source: 1) Oregon Behavioral Risk Factor Surveillance System 2006-2009, 2) Oregon Healthy Teen Survey 2007-2008

For south Corvallis the average BMI for adults is 26.5 kg/m^2, compared to 25.5 kg/m^2 for adults living in all of Corvallis. As illustrated in Map three, a greater proportion of residents with higher BMIs cluster in areas of lower-incomes. Such distribution patterns are indicative of environmental constraints, and limited access to resources that facilitate a healthy weight status[29].

Scoping

The overall purpose of the scoping phase is to create a work plan and research strategy that supports the HIA goals. The following section discusses the description of the HIA scope, community engagement process, rationale for the health determinants assessed, vulnerable populations, and assessment methodology.

Description of Scope of Current HIA

The decision assessed by this HIA is whether to adopt a 25 MPH speed limit from Avery Avenue to Tunison Avenue in south Corvallis. The decision-makers include Oregon Department of Transportation and City of Corvallis Public Works department.

The assessment of impacts related to a change in traffic speed is limited to the geographic area of south Corvallis. South Corvallis extends from Crystal Lake Drive to Rivergreen Avenue and is bordered by the Willamette River to the east and the Southern Pacific Railroad to the west. With certain data, boundaries are set to approximate south Corvallis, while other data are available only at the county level. The entire population of south Corvallis is considered in the analysis, with special attention given to subgroup within the population including low-income residents, Latino/Hispanic residents, older adults, and youth.

Vulnerable populations

The Benton County Health Services aims to support the health and well-being of all residents in Benton County. In this regard, BCHS is committed to eliminate health disparities among vulnerable populations. Populations that experience a disproportionate burden of disease, disability and death include racial and ethnic populations, children and teens, older adults, people with disabilities, and individuals/families with social or economic disadvantage[30]. This section describes the distribution of vulnerable populations in South Corvallis.

South Corvallis is in many ways uniquely different from the rest of Corvallis. For example, more residents in south Corvallis identify as Latino as compared to all of Corvallis. In addition, South Corvallis is also home to more youth and low-income residents earning less than 185% of the Federal Poverty Level.

This HIA examines disparities based on four vulnerable population groups: *low-income residents*, *Latino residents*, *youth*, and *older adults* the proportion of the population represented by these groups is displayed in table five.

The Elementary School, Lincoln K-5, is one of two dual immersions schools in Corvallis. Approximately 37% of students are Latino. Lincoln is also one of four Title 1 schools in the School District, 68.7% of the students receive free or reduced lunch. Furthermore, 58.8% of south Corvallis households with children under the age of 18 receive Supplemental Nutrition Assistance, compared to 41.2% of households throughout Corvallis[31].

Table 5. Vulnerable Populations in South Corvallis

Category	Indicator	Percent of population
Race & Ethnicity	White	90.2%
	Latino	10.4%
Low Income	Population below federal poverty line	22.6%
	Single parent female-headed households	12.5%
Youth	Aged 0-17	20.4%
	University Students	20.6%
Older Adults	Aged 65+	6.5%

Source: U.S Census Bureau, American Community Survey 2007-2011

Rationale for Chosen Health Determinants

Determinants for the following HIA were selected based on several criteria. Recommendations from the technical advisory group were combined with findings from previous needs assessments, empirical studies and availability of existing and future data. Furthermore, the determinants were chosen to complement the ODOT speed study and consider health impacts that are not traditionally included within speed investigations.

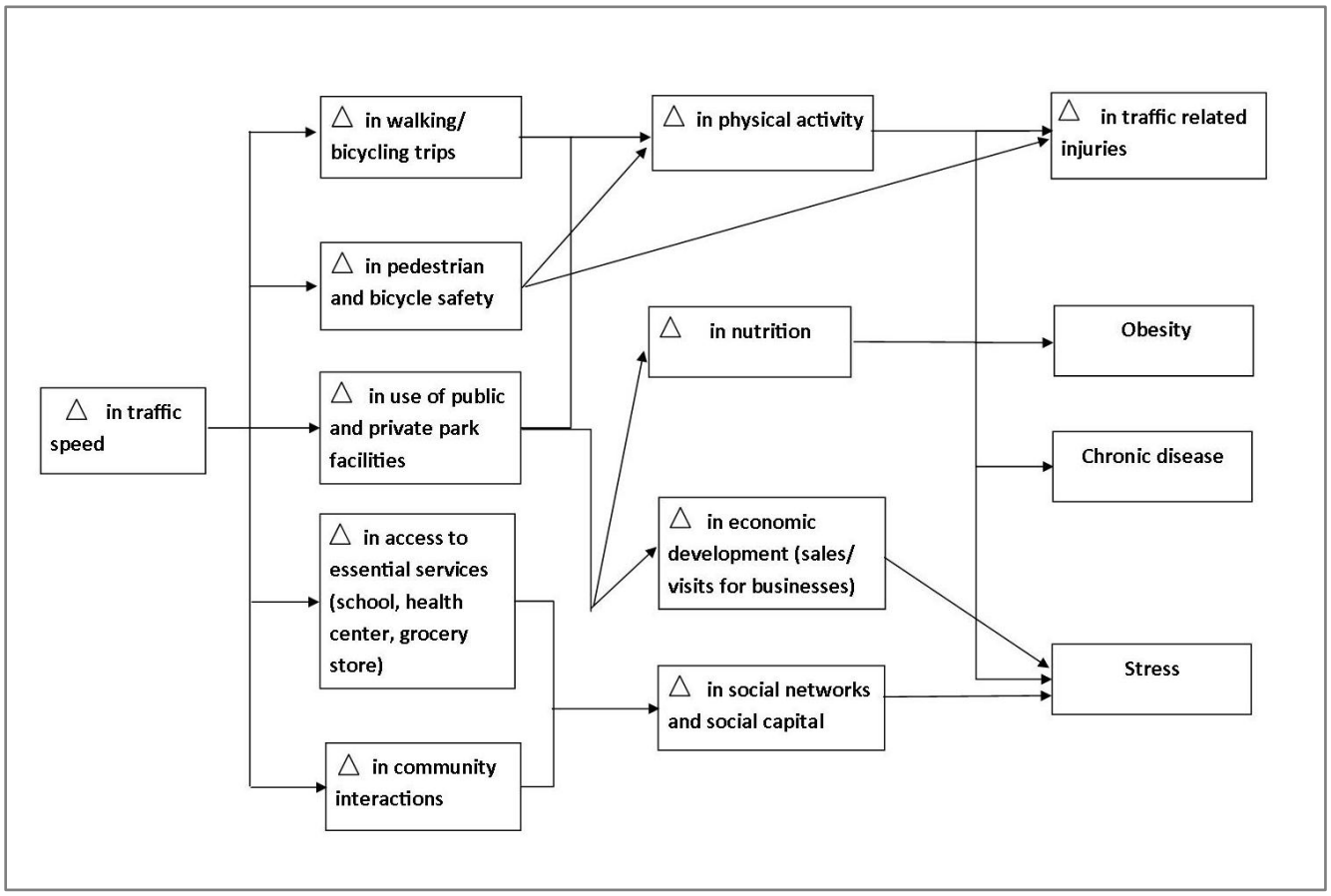
The health determinants examined in this HIA include

- Active transportation
- Traffic safety
- Social networks
- Access to goods and services.

Pathway Diagram

The following pathway diagram is an illustration of the potential relationships between health determinants and health outcomes that are relevant to this HIA. This was developed during the scoping process with the Technical Advisory Group and public health professionals in the region.

Figure 1. Conceptual diagram of the impact of traffic speed on health outcomes.



Community Engagement Process

Stakeholder participation is an important component of the HIA process. Broad inclusion of stakeholders enhances the expression of HIA core values: democracy, equity, sustainable development, and the ethical use of evidence, as described by the World Health Organization[32]. This section provides a brief overview of the multiple ways in which stakeholders were involved in the development of this HIA.

The decision to conduct an HIA stemmed from residents' concerns regarding the accessibility and safety of South Third Street/Highway 99, particularly for those who are the most vulnerable to lack of

resources that support health and wellbeing. Community stakeholders' information and voice provided direction for the prioritization of research questions, collection and interpretation of data, and feedback/edits of final document. The following section describes the multiple strategies that were implemented to actively involve diverse stakeholders throughout the multiple stages of this HIA.

The **BCHS Healthy Kids, Healthy Communities initiative** (locally known as *Creciendo en Salud*) funded by the Robert Wood Johnson Foundation focuses on policy and systems changes to improve access to active living and healthy eating resources in neighborhoods throughout Benton County. Since 2010, the *Creciendo en Salud* partnership has been actively working to address issues related to traffic and alternative forms of transportation in south Corvallis. Community resident perceptions and experiences with active transportation in their neighborhood was collected in a variety of ways, including a mail survey, focus groups with local mothers, a walk ability assessment of Highway 99W/South Third Street neighborhoods surrounding Lincoln Elementary, and a community forum on transportation. Findings from these data collection activities are presented in the assessment section of this HIA. In general, families report difficulty accessing area resources due to perceptions of lack of safety walking and biking in their community.

The **Healthy Streets Planning Initiative** is a comprehensive City planning effort to treat storm water, develop alternative transportation routes, expand urban green space, and improve community health. Funding from the Environmental Protection Agency (2012-2014) and collaboration with community agencies supports the process to create a more accessible transportation system that also protects water quality in our urban streams and rivers. Recently, the Healthy Streets campaign in collaboration with *Creciendo en Salud*, hosted a Tunison neighborhood forum with south Corvallis parents. The community forum incorporated questions on pedestrian and bicycle access, safety, and traffic. In addition, S. Corvallis residents' comments on traffic and storm water concerns were solicited via an online interactive map posted on the City website. City staff from this initiative were actively involved throughout the HIA process, served on the technical advisory group and provided data presented in the analysis portion of the report.

The **Safe Routes to School Program** provides education and encouragement training to Lincoln elementary staff and families to support active transportation and safe travel to and from school. The SRTS program is coordinated by the Corvallis School District 509J. Features of the program include skill-

based pedestrian and bike safety education, community –wide opportunities and safe routes for students to walk and bike. In addition, the program solicits parent/caregiver feedback on walking and biking challenges/opportunities for families via a parent survey. The Safe Routes to School coordinator provided data for the baseline assessment on walking and biking among children in the neighborhood, as well as parent/caregiver perceptions of safety.

Following HIA practice standards[33], BCHS formed a technical advisory committee to ensure adequate and fair representation of diverse interests and priorities among HIA stakeholders. The technical advisory group members include representatives from partner organizations such as:

- Corvallis Police Department
- Cascades West Council of Governments
- Corvallis Area Metropolitan Planning Organization
- Corvallis City Council
- Lincoln Elementary School
- First Alternative Food Cooperative
- City of Corvallis Public Works department
- Corvallis Parks and Recreation
- Willamette Neighborhood Housing Services
- Tunison Neighborhood Association
- Oregon Department of Transportation
- Benton-Linn Healthy Equity Alliance

BCHS and the technical advisory group met three times throughout the process of the HIA (January, March, and August, 2013). In scoping this HIA, the technical advisory group prioritized health determinants, pathways, and research questions. The advisory group also provided feedback on the feasibility and practicality of the HIA recommendations.

Assessment

The following is a discussion of the assessment methodology, existing community conditions and potential health impacts.

Methods

In comparison with more comprehensive HIA efforts, this HIA is not as extensive and is therefore referred to as an intermediate HIA (Table 6).

Table 6. HIA Spectrum

Rapid	Intermediate	Comprehensive
• Short timeline • Table Top HIA • Literature Review Based • Limited Community Engagement • Primary Research: Minimal to None	• Table Top/Partially Engaged HIA • Literature Review and Primary Data Collection • Moderate Community Engagement • Primary Research: Moderate	• Long Timeline • Fully Engaged HIA • Literature Review and Primary Data Collection • Fully Community Engagement • Primary Research: Extensive

Source: Oregon Health Authority Center for Health Protection

Research was conducted using a mixed methods approach that includes the following: review of peer-reviewed literature, secondary data analysis, and a structured community forum with south Corvallis residents. BCHS developed five research questions based on a preliminary literature review, the availability of data, and input from the technical advisory group. The research questions were used to guide data collection, an analysis of existing conditions, and a structured literature review corresponding research questions, and sources of data. Displayed in table 7 are the health determinants, along with each corresponding research question, and sources of data.

Secondary Data

Several sources of existing data were used in the development of this HIA. The following is a description of the data and contributing source.

- **ODOT Crash Analysis Data**: Pedestrian and bicyclists collisions in Benton County from 2007-2011
- **Pedestrian and Bicycle Injury Reports:** Provided by the Corvallis Police Department report data included are from 2008-2012
- **Safe Routes to School Data**: Student travel tallies and parent surveys from program years 2008-2012
- **Focus groups:** community forum conducted with south Corvallis parents in 2013 for the Corvallis Health Streets project. Storm water flooding and traffic safety concerns were discussed and specific street segments identified on a neighborhood map. In addition, 5 community discussions were completed with 30-45 Latina mothers in April-May 2010 to assess strengths, opportunities, weaknesses and threats to accessing healthy eating and active living resources in their neighborhoods.
- **Survey Data:** A mail survey developed by the Creciendo en Salud/Willamette Neighborhood Housing Association to assess quality of life and access to healthy living resources in South Corvallis. The survey was sent to 320 families living west side of Highway 99W/South Third Street in June 2010. Approximately 131 surveys were completed with a 41% response rate.
- **US Census Data**: American Community Survey five year estimate (2007-2011) data for the city and census tract level. Data describes recent population demographics and characteristics.
- **Walkability Assessment of South 3rd:** Walkability assessments of seven streets surrounding Lincoln elementary were conducted in May 2010 by neighborhood residents. During the walkability assessment, residents worked in teams of three to complete the assessment tool and photograph notable characteristics of street. In addition to identifying area resources on the street segment, characteristics of the route were noted (views from street, noise-level, presence of sidewalks, bike lanes, traffic speed, bus stop etc).
- **Oregon Healthy Teen (OHT) and the Behavioral Risk Factor Surveillance System (BRFSS):** State wide surveys that provide county level data on health behaviors such as physical activity, obesity, nutrition, mental health, and injury.

- **GIS Data:** Maps and data on walking and bicycling infrastructures, as well as access to park services and grocery stores complied and made available by the Oregon Health Authority Environmental Public Health Tracking group.

Table 7. Health determinants, research questions and data sources for the HIA

Health Determinant	Research Question(s)	Data Sources
Active Transportation (walking & biking)	Will a reduction in traffic speed increase rates of bicycling and walking among south Corvallis residents', especially among vulnerable populations?(i.e. low-income residents, Latino/Hispanic residents, youth and older adults)	BCHS Community Health Assessment, Safe Routes to School Parent Survey, Willamette Neighborhood Housing Services Survey
Traffic safety	Does a reduction in traffic speed decrease both the number and severity of bicycle, pedestrian or other injuries among S. Corvallis residents, especially in vulnerable populations (i.e. low-income residents, Latino/Hispanic residents, youth and older adults)?	BCHS Community Health Assessment, Safe Routes to School Parent Survey, Willamette Neighborhood Housing Services Survey, Corvallis Police Department Pedestrian and Bicycle accident reports, ODOT crash analysis, Tunison Neighborhood Community Forum
Social networks	Does traffic reduction in traffic speed increase neighbor interaction?	Willamette Neighborhood Housing Services Survey
Access to services, including parks	Are S. Corvallis residents more likely to use park and recreation service if they can walk and bike?	
	Will businesses adjacent to S. Third see an increase in business (visits and sales) if traffic speeds are reduced?	

Structured Literature Review

BCHS employed a structured literature review approach for each health determinant. BCHS used search terms related to each determinant and research question. English-language literature from 1997 to 2013 from the United States, Canada, Europe and Australia were included. Existing references lists, review articles, and grey literature were examined. We included quantitative findings for health outcomes where available and qualitative literature for health outcomes with minimal existing quantitative evidence. Each article was evaluated using a scoring criterion and determined to be of low, medium, or high quality. The assessment findings are based on weighing the quality of studies, the quantity of the effect, and the consistency of findings[34] [35].

Table 8. Strength of evidence categories

+	Limited evidence	Few case studies, theoretically supported
++	Some evidence	Limited research, some case studies, gray papers
+++	Moderate evidence	Rigorous, peer reviewed research
++++	Strong evidence	Multiple rigorous, peer reviewed research studies with similar findings

Source: Clark County Public Health Department

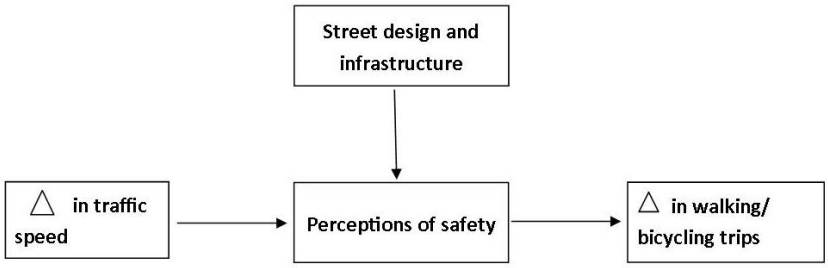
Analysis

The following section is organized by health determinant and discuses current conditions, and potential impacts related to each research question.

Active Transportation (Walking and Bicycling)

Findings from the structured literature review suggest that perceptions of safety are an important mediator of the relationship between traffic speed and walking/bicycle trips (for both adults and youth). BCHS found that community design and available infrastructure influences both perceptions of safety and vehicle speed. These relationships are highlighted in the following analysis regarding active transportation.

Figure 2. Conceptual diagram of the modified relationship between traffic speed and walking/bicycling trips with the influence of community design & infrastructure and perceptions of safety.



Research Question One:

Will a reduction in traffic speed increase rates of bicycling and walking among south Corvallis residents, especially among vulnerable populations?

A Review of the Literature

At a national level, the estimated costs of obesity and overweight are approximately $142 Billion; this includes healthcare costs, lost wages due to illness and disability, and future earnings lost by premature death[36]. Active modes of travel can play an important role in increasing rates of physical activity, and there continues to be a growing body of evidence linking transportation and land use patterns to physical activity and obesity and their costs[37].

Walking and bicycling for transport can provide valuable daily physical activity, and people who live in areas that are more conducive to walking and bicycling are more likely to engage in these forms of active transportation[38]. The role of physical activity in prevention of weight gain is well-documented, including strong evidence establishing an inverse relationship between physical activity and body mass index (BMI)[39]. Physical activity, such as walking and biking, contributes to a decreased risk of many chronic disease and health conditions[40]. Studies have shown that both children and adults that use active modes of travel (walking and bicycling) participate more in daily physical activity [41] [42].

Children who walk to school are more physically active than their non-active commuting peers [21].

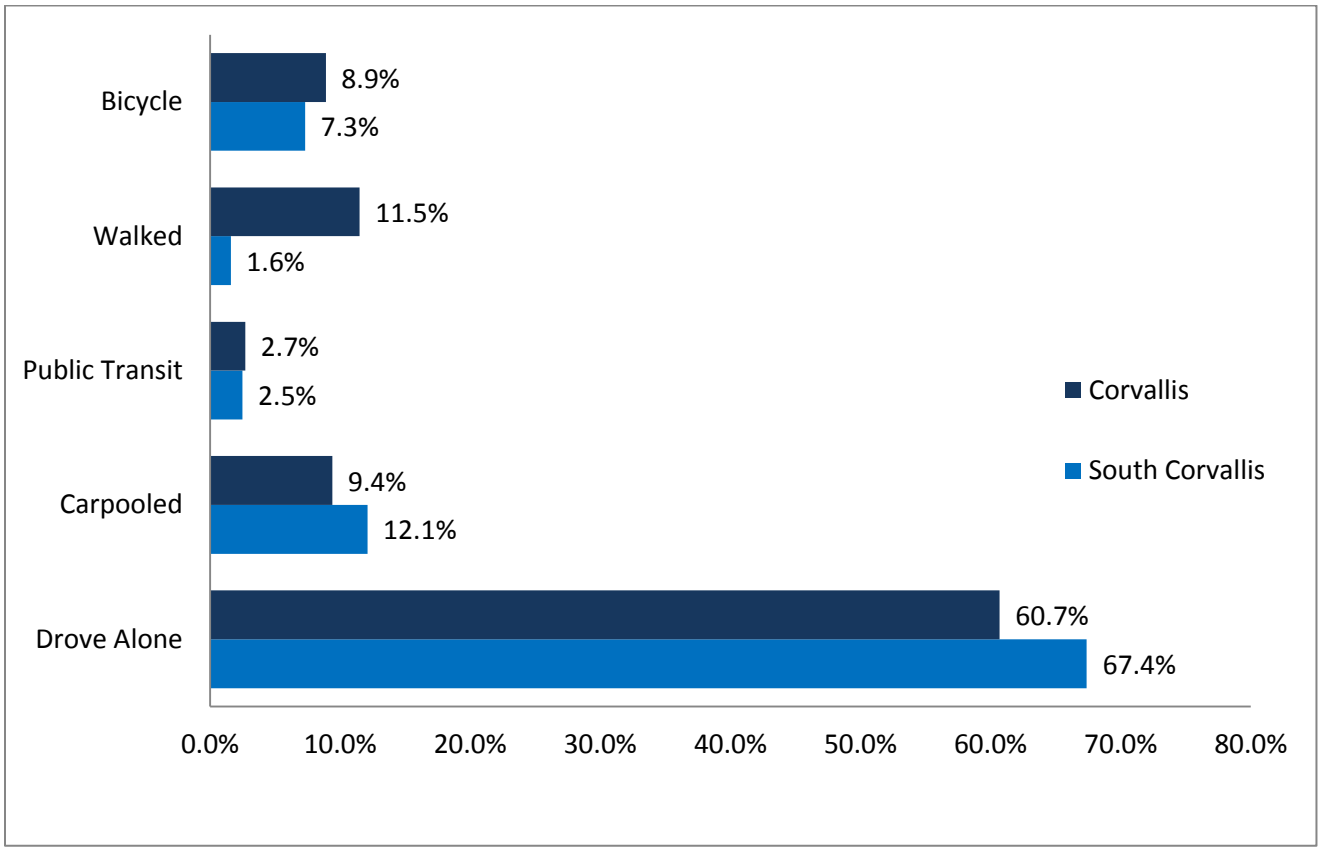
Pucher and colleagues found at both state and city levels a statistical significant positive relationships between active travel and physical activity, and statistical significant negative relationships between active travel and diabetes[43]. Furthermore, a prospective study evaluating the relationship between

levels of physical activity during work, leisure time, cycling to work, and sports participation and all-cause mortality, found that bicycling to work decreased risk of mortality in approximately 40% of participants, even after adjusting for leisure time physical activity[44].

Baseline Assessment

In south Corvallis, the vast majority of residents drive alone to work. Only about seven percent travel by bicycle and 1.6% walk to work (Figure 3). The share of residents in south Corvallis that use active travel to work, which includes walking, bicycling, or public transportation, is lower compared to all of Corvallis. One potential explanation is that Corvallis has a large student population that possibly contributes to the differences seen between south Corvallis and other areas of Corvallis, for areas that are closer to campus there are more residents using active forms of transportation to work (Map 4). Also, residents living in south Corvallis may work in a place that is too far away to walk, bicycle or take public transportation. A limitation to the available data is it does not show the proportion of the south Corvallis population that uses active transportation to travel to other places, like school and the grocery store. Therefore, the available data provides an incomplete picture of the proportion of residents in south Corvallis that use active modes transportation.

Figure 3. Worker commutes for Corvallis and south Corvallis



Source: U.S Census Bureau, American Community Survey 2007-2011

Results from the Willamette Neighborhood Housing Survey of south Corvallis residents indicate that 50% of respondents ride their bicycles. The following table shows the reported reasons for bicycling (Table 9). For those that stated "other" as their reason for bicycling they indicated riding a bicycle was "faster than the bus" and "gas prices are high and bicycling is convenient w/ taking kids to school"[45].

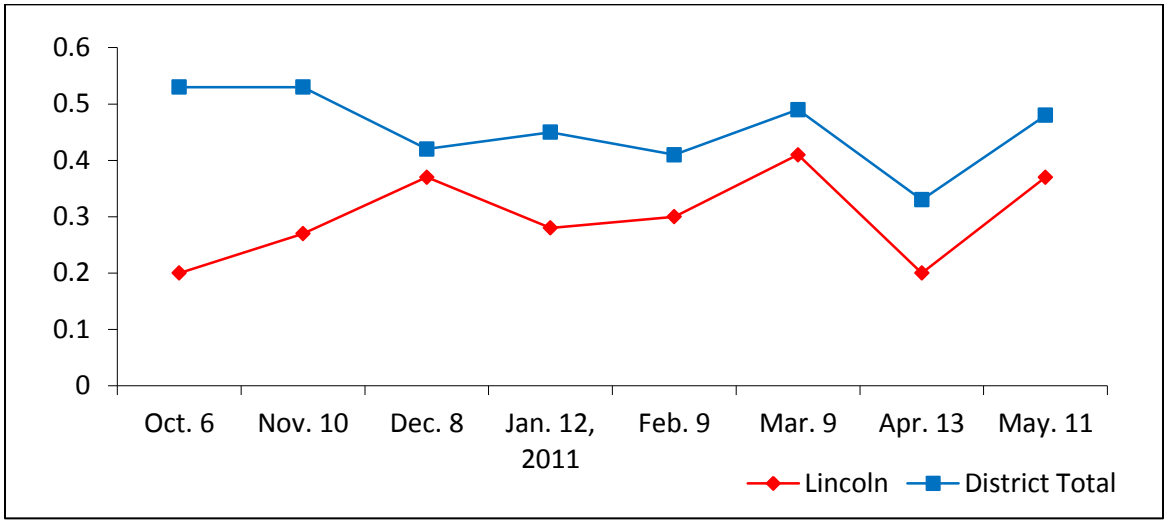
Table 9. Percent of south Corvallis residents' reason for bicycling

Why do you bike?	
Transportation	75%
Health Benefits	65%
Environmental Concerns	41%
Recreation	65%
Other	4%

Source: Willamette Neighborhood Housing Services, 2013

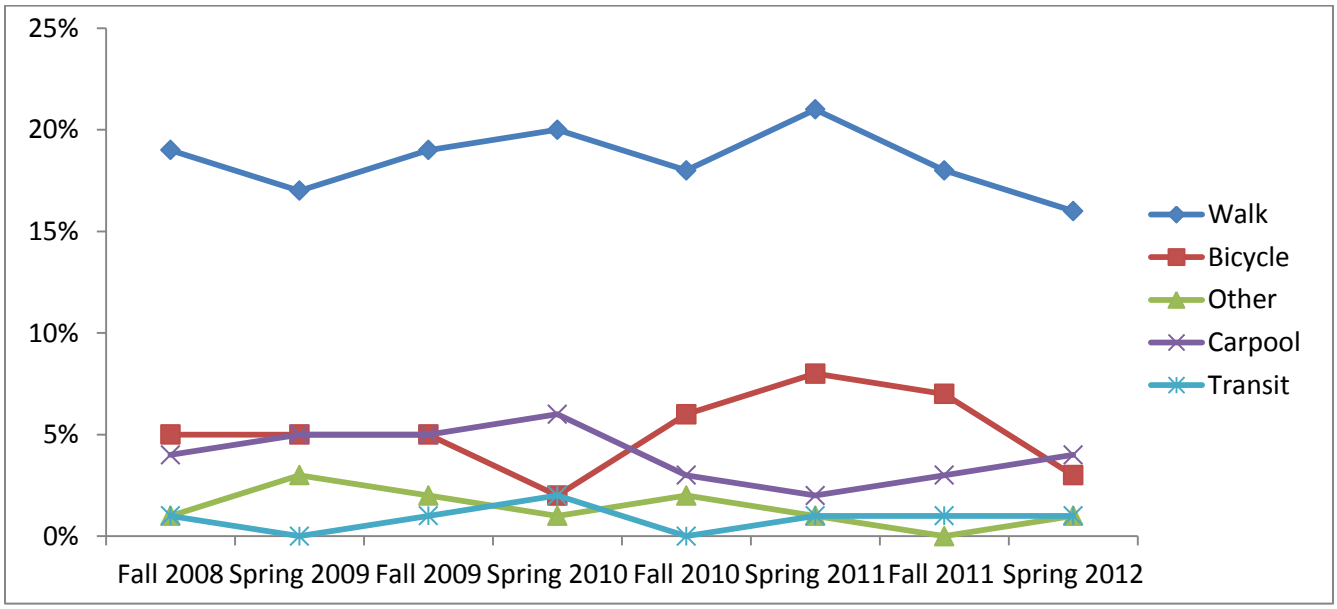
Although data on mode of transportation among children is limited, Safe Routes to School participation rates from Lincoln School does provide local data for walking and biking to school. In the spring of 2012, 3% of Lincoln elementary students bicycled to school and 16% of students walked[46]. Furthermore, on designated walk and bike to school days Lincoln's rates are consistently lower compared to the rest of the Corvallis School District (Figure 4). Since the beginning of the program, rates of walking and bicycling have remained fairly consistent at Lincoln, however walking is continuously a preferred mode of travel for a majority of students (Figure 5).

Figure 4. Lincoln Elementary School walk and bike to school day rates, 2010-2011



Source: Corvallis Safe Routes to School Program, 2010-2011

Figure 5. Lincoln Elementary School Student Mode of Travel to School 2008-2012



Source: Corvallis Safe Routes to School, 2008-2012

Public transit is an active mode of transportation because of the physical activity (such as walking) necessary to access transit stops. In south Corvallis, most residents live within ¼ mile of a transit stop, with the average distance to a stop being 0.19 miles for south Corvallis residents (Map 5). Map four illustrates the broad coverage in south Corvallis with a few households on the eastern and western borders living 0.5-1.0 miles from a transit stop. Although south Corvallis residents have considerable access to public transportation, only 2.5% of residents use public transportation to travel to work (Figure 3). Again, the data available only provides information on residents' modes of travel to work, leaving out modes of travel to school, grocery store and other errands.

The Role of Perceptions of Safety

A Review of the literature

Research suggests that an individual's perception of their environment is just as important as the condition of the physical environment itself[47] [48] [49] [50]. Perceptions of risk of being injured by motorized traffic effect decisions to drive, walk, bicycle, or use public transportation [51] [52].

Neighborhood vehicle speeds influence actual and perceived safety, which in turn impacts rates of walking and bicycling[53] [54]. For example, a study in Quebec, Canada found that perceptions of high traffic volume in the neighborhood were associated with a decreased likelihood of walking. The same study also found that perceptions of greater safety were associated with an increased likelihood of walking, but only among mothers[55]. In other words, individuals are less likely is to walk or bike if they perceive the area as unsafe.

Parental perceptions of safety are especially important for rates of walking and bicycling among children. A study in Houston, Texas found that Latino mothers perceived their neighborhoods as more dangerous than their children did[56]. The mothers' major concerns regarding neighborhood safety were traffic volume and speed. The study also found that mothers' perceptions of neighborhood safety predicted children's levels of physical activity more so than the children's perceptions of safety[57].

Improving safety from vehicles has the potential to attract many new bicycle riders. Studies in Seattle, WA and Baltimore, MD observed that safety from cars was an important motivator for many residents - 44% of non-bicycle owners stated they would ride more than once per week, and 59% of bicycle owners who never rode stated they would ride more if safety was improve[58]. As more people perceive the environment to be safe for walking and bicycling, more people will walk and bicycle. For bicyclists, a

decrease in bicycling rates leads to increased risk and increased risk leads to a decrease in bicycle use, this idea supports the safety in numbers theory. With more bicyclists and pedestrians using the road motorists tend to drive more slowly, and when there are few bicyclists and pedestrians using the road motorists drive faster.

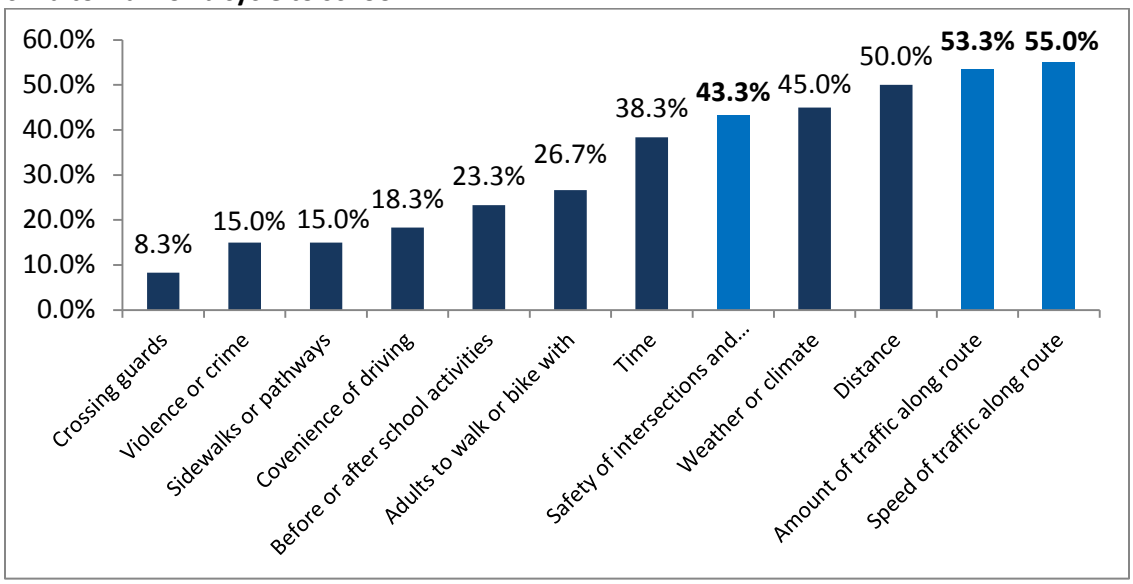
Baseline Assessment

Current local data suggest that residents in South Corvallis perceive Highway 99W/ South Third Street as unsafe for walking and biking [59] [60] [61].

> "South 3rd is dangerous – cars drive too fast and will weave in and out of traffic to drive fast."
>
> -Community Resident, Corvallis Healthy Streets, 2013

South Corvallis parents have expressed several concerns regarding safety. For example, many stated that they "*feel children are not safe crossing* (Highway 99W/South Third Street) *on their own*" and that there is "*a lot of traffic by Lincoln* (elementary school)"[62]. In a survey conducted by Corvallis Safe Routes to School, many Lincoln elementary school parents surveyed indicated that volume (53%) and speed of traffic (55%) are issues that affect their decision to allow their children to walk or bike to school (Figure 6). In addition, parents also identified safety of intersections and crossings (both 43%) as factors that affect their decision to allow or not allow their child to walk or bicycle to school.

Figure 6. Factors that affect Lincoln Elementary School parent's decision to allow or not allow their child to walk or bicycle to school



Source: Corvallis Safe Routes to School, 2008-2012

In 2010, Willamette Neighborhood Housing Services conducted a survey with residents living in south Corvallis; they found that 37% of respondents with children indicated that less traffic would make it safer for them to walk in their neighborhood (Table 10)[63]. Also, when asked what would make it safer for you to bike in south Corvallis, 25% or respondents answered "reduced traffic speeds"[64].

Table 10. What would make it safer for you to walk in your neighborhood?

Response	Households with Children (n=31)	All households (n=131)
Crosswalks	30% (8)	25% (28)
Less traffic	37%(10)	32%(36)
Sidewalks	26%(7)	18%(21)
Wider sidewalks	26%(7)	18%(21)
Streetlights	33%(9)	34%(39)

Source: Health Kids Healthy Communities/Willamette Neighborhood Housing Services, 2010

The Role of Street Design and Infrastructure

A Review of the Literature

In the evolution of modern transportation planning, the pedestrian environment was ignored in favor of the automobile allowing destinations to be much farther apart. Additionally, high-speed traffic broke up the fine-grained pedestrian network and imposed barriers to free movement on foot and bicycle[65]. Researchers in transportation and urban planning have long understood the impact network and neighborhood design, and land use has on transportation choices (automobile, public transit, walking, and bicycling)[66]. Research suggests that approximately 83% of all trips are short, for non-work purpose, and occur relatively close to home. The majority of non-work trips are within walking and bicycling distance and the choice to use motorized or non-motorized transport to make these short trips is heavily influenced by the environment in which they take place[67].

Measures of the built environment that are correlated with physical activity include the presence of bicycle and pedestrian infrastructure, proximity to destinations, greater street network density, and greater land use mix, and the quality of the urban design. These measures are associated with physical activity met through walking and bicycling for both active travel and recreation. Perceptions are connected to street design and infrastructure not only through the presence of features but the context of the features as well. The environment must also engage the interest of the user, some aspects of the environment that contribute to a positive pedestrian experience include: visible activity; street trees and other landscape elements; and lighting[68].

Research suggests that both perceived and objective measures of land use, recreational facilities, and walking and bicycling infrastructure have positive associations with physical activity[69].

Safe connections between home, school, and other destinations are necessary for children to bicycle and walk and, critically, for parents to feel that their child is safe in doing so [70]. Local governments can increase connectivity for children pedestrians and cyclists by providing direct walking and bicycling routes, and because of the short distances children often travel this is especially import on local streets. In addition to perceptions, the presence of safety related infrastructure (traffic and pedestrian lights) has an association with a change in active transportation among younger girls. Furthermore, walking tracks and intersection density are also associated with a change in active transportation for both adolescent boys and girls[71].

Design and infrastructure play an important role in motorist perceptions as well, and often are the determining factor in the speed motorists' drive. Posted speed limit and enforcement is necessary but does not always lead to behavior change among motorists[72]. The feel and appearance of the road dictates the speed at which motorists feel most comfortable driving at.

People who are aware of safe and convenient places to walk and bicycle are more likely to do so than people who are not aware of such places[73]. Environments that offer features conducive to walking and bicycling support both behaviors by providing for pedestrian and bicyclist comfort and safety, connecting people with varied destinations within a reasonable of time and effort, and offering visual interest in journeys throughout the network[74].

Baseline Assessment

Having destinations that are close to home is an important factor in walking and bicycling rates. For south Corvallis proximity to goods and services were determined by a proximity index created by the Oregon Environmental Public Health Tracking group, the index used marked crosswalks (both stripped and lined) as crossing points for Highway 99W/ South Third Street to determine proximity to a destination for households. Overall, south Corvallis residents live in close proximity to most destinations with the exceptions of grocery stores (see maps 5, 6, 13).

Table 11. Proximity to local resources in south Corvallis

Measure	Proximity (average distance)
Proximity to bus stops	0.19 miles
Proximity to parks	0.22 miles
Proximity to grocery stores	1.46 miles
Proximity to school	1.0 miles

Source: Oregon Environmental Public Health Tracking Group

For south Corvallis, 72% of all streets have a sidewalk on either side of the street (Map 7). For every one arterial or collector street there is 0.7 bike lanes or paths in south Corvallis, this is compared to 0.77 bike lanes or paths for every one arterial or collector street throughout all of Corvallis (Map 8). Although there is a bike lane through south Corvallis, many people ride along the sidewalk because they feel unsafe riding in the road (Highway 99W/South Third Street) indicating a need for more convenient and safe infrastructure.

"The sidewalks are not wide enough for a stroller and children."

-Community resident, HKHC Walkability Survey, 2010

Intersection density is a principal factor in the connectivity of a place. In general, the more intersections an area has the greater its connectivity. A greater amount of connectivity provides pedestrians and bicyclists with more direct routes and route options[75] [76]. The intersection density throughout Corvallis is 87.8 intersections/mi^2, a higher intersection density compared to south Corvallis (71.1 intersections/mi^2) (Map 9). By way of design, south Corvallis has less connectivity compared to the rest of Corvallis. In south Corvallis, the average distance between designated crosswalks along Highway 99W/South Third Street is 1,413 feet. Some areas have less than 600 feet between crosswalks and others have greater than 1,000 feet in between crosswalks (Map 10).In order for some residents to cross the road safely they must walk a distance to cross the road in order to reach a destination. This creates limited opportunities for pedestrians to easily access businesses on either side of Highway 99W/South Third Street.

As stated in the introduction the physical design of south Corvallis constrains the ability of residents living in the area to easily travel from one destination to the next, this is also indicated by the measures discussed in this section. However, based on current data available, BCHS is unable to state whether a significant difference exists between south Corvallis and Corvallis when comparing walking and bicycling infrastructure.

Table 12. Environmental measures of walkability and bikeability for south Corvallis and Corvallis

Measure	South Corvallis	Corvallis
Sidewalk to street ratio	0.72	--
Intersection density	71.7	87.8
Bike lane/paths to street ratio	0.70	0.77
Average distance between crosswalks along arterials	1,413 ft	--

Source: Oregon Environmental Public Health Tracking Group, 2013

The street design and infrastructure of Highway 99W/ South Third Street plays an important role in influencing the perceptions of residents living in south Corvallis. A focus group conducted with south Corvallis residents highlighted several structural concerns for the intersection near the school, at Highway 99W/South Third Street and Alexander Avenue. The expressed concerns may be preventing or limiting some families' ability to access resources include:

- "No sidewalks"
- "Too much traffic"
- "No crosswalk"
- "No traffic lights"
- "Lights don't function" (at crosswalk)
- "Cars don't stop and children aren't safe"

They also stated that the "*speed limit on HWY 99 by Lincoln has good law enforcement*" as they noted that local residents generally know not to speed in the school zone when school is in session. However, the school zone is not in effect during weekends, summer months and holidays. Although the presence of law enforcement does help to create a sense of safety, law enforcement alone does not ensure safety, there are other factors which may override their presence.

Impact Analysis

Benton County Health Department finds a reduction in traffic speed will positively impact perceptions of safety among residents that live along Highway 99W/South Third Street. BCHD also finds that if traffic speeds were increased it would negatively impact perceptions of safety among residents that live along

Highway 99W/South Third Street. This analysis is based on strong evidence in the literature that relates perceptions of safety to walking and bicycling rates. Both traffic speed and volume are large contributors to perceptions of safety, it is because of this strong relationship that BCHD finds a reduction in traffic speeds will also positively impact rates of walking and bicycling among south Corvallis residents.

The role of infrastructure and street design is an important element in influencing both traffic speed and perceptions of safety. Based on evidence in the literature and current design and infrastructure conditions in south Corvallis, BCHD finds that changes in design and infrastructure elements to support more pedestrians and bicyclists will positively impact perceptions of safety and walking and bicycling rates among south Corvallis residents. This is analysis is based on strong evidence found in the literature. Environments that support fast and efficient vehicle travel are not enjoyable, safe, or interesting for pedestrians and bicyclists[77].

Traffic Safety

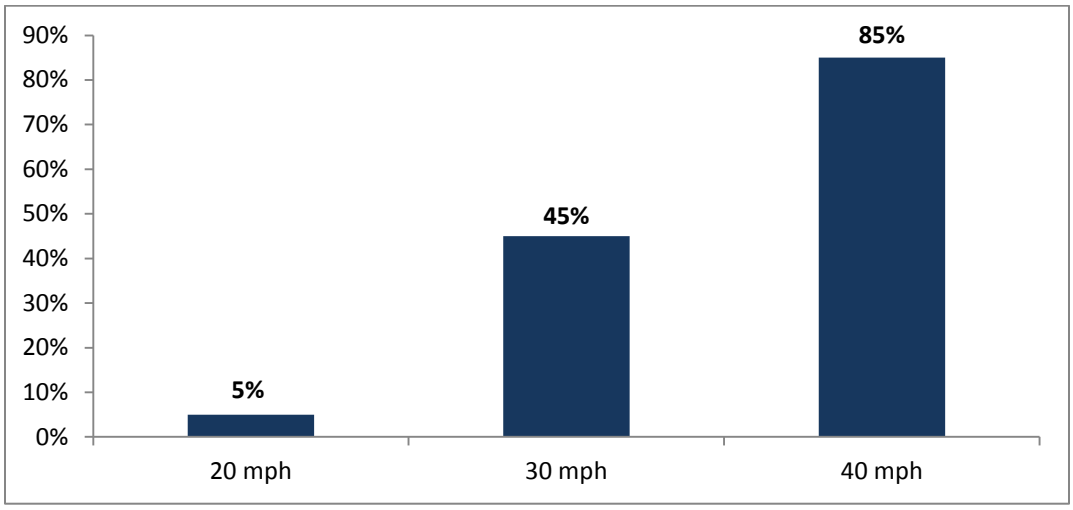
Research Question Two:

Does a reduction in traffic speed decrease both the number and severity of bicycle, pedestrian or other injuries among S. Corvallis residents, especially in vulnerable populations?

A Review of the Literature

The relationship between pedestrian crashes and traffic characteristic has been explored; showing higher traffic volumes and speeds result in higher numbers of pedestrian accidents[78]. Cyclists and pedestrians are rarely killed in collisions with vehicles traveling at speeds below 20 mph. This is supported by research conducted by the United Kingdom Department of Transportation, demonstrating a pedestrian has a five-percent chance of dying if struck by a vehicle traveling 20 mph, compared to an 85% chance of dying if struck by vehicle traveling 40 mph—a considerable difference (Figure 7) [79] [80].

Figure 7. Pedestrian Chance of Death if hit by a motor vehicle



Source: U.K Department of Transport

Most of the risk of severe injury while cycling or walking as a pedestrian is not intrinsic to the activity; vehicles impose it on cyclists and pedestrians[81]. An overall reduction in mean speed has the potential to reduce pedestrian injuries and fatalities by 20% and 75%, respectively[82]. Furthermore, a higher number of collisions occur on main arterials (such as S.3rd/99W), presumably because they typically have higher speeds and higher traffic volumes[83].

Risk of injury and fatality are even greater for children and older adults[84 85]. For children, some of the increased risk comes from their difficulty judging both the distance of the gap between vehicles and the speed at which the vehicles are moving in order to safely cross a street[86]. Studies have found that children (and adults) may have more difficulty judging speeds that exceed 35 mph, and may shift to relying more on distance than on speed for faster moving vehicles. Since children have more difficulty coordinating their own movements with that of vehicles, this puts them at increased risk for being involved in a collision[87]. Furthermore, because children often use sidewalks and streets for play areas they have a higher exposure to traffic and are more likely to be injured as pedestrians[88].

The findings from the literature suggest that cycling and walking are benign activities that often take place in dangerous environments. Targeting the causes of incidence to reduce exposure to motor vehicle volume for all road users, has the potential for a greater reduction in the total number of transportation fatalities in a population[89].

Baseline Assessment

In Benton County, unintentional injuries, which include motor vehicle traffic accidents, are one of the top ten causes of death for residents with approximately 19.4 deaths per 100,000 people[90]. Mortality due to motor vehicle crashes in Benton County in 2001 (9.12 percent) were below the *Healthy People 2010* target (9.2 percent). However, the number of fatalities more than doubled between 2001 and 2002[91].

For south Corvallis, the number of traffic collisions involving pedestrians and bicyclists is generally lower when compared to all of Corvallis (Table 13). However, when examining collisions on arterial roads alone, the rate of car to pedestrian/bike collisions is higher in South Corvallis (83.0 per 100 street miles- see table 14). This is important to note being that Highway 99W/South Third Street is an arterial road and the main route for all road users in and out of south Corvallis.

Table 13. Rate of Pedestrian and Bicycle Collisions for all roads in south Corvallis and Corvallis 2008-2012.

Traffic Collision Measure *(All Roads)*	S. Corvallis	Corvallis	Unit	Year(s)
Car-to-Bicycle	10.7	15.1	per 100 street miles	2008-2012
Car-to-Pedestrian	3.8	6.8	per 100 street miles	2008-2012
Car-to-Pedestrian/Bicycle (combined rate)	14.5	21.9	per 100 street miles	2008-2012

Source: Corvallis Police Department, Oregon Department of Transportation, Oregon Environmental Public Health Tracking

Table 14. Rate of Pedestrian and Bicycle Collisions for arterial roads south Corvallis and Corvallis 2008-2012.

Traffic Collision Measure *(Arterials Only)*	S. Corvallis	Corvallis	Unit	Year (s)
Car-to-Bicycle	64.5	54.9	per 100 street miles	2008-2012
Car-to-Pedestrian	18.4	26.7	per 100 street miles	2008-2012
Car-to-Pedestrian/Bicycle (combined rate)	83.0	81.6	per 100 street miles	2008-2012

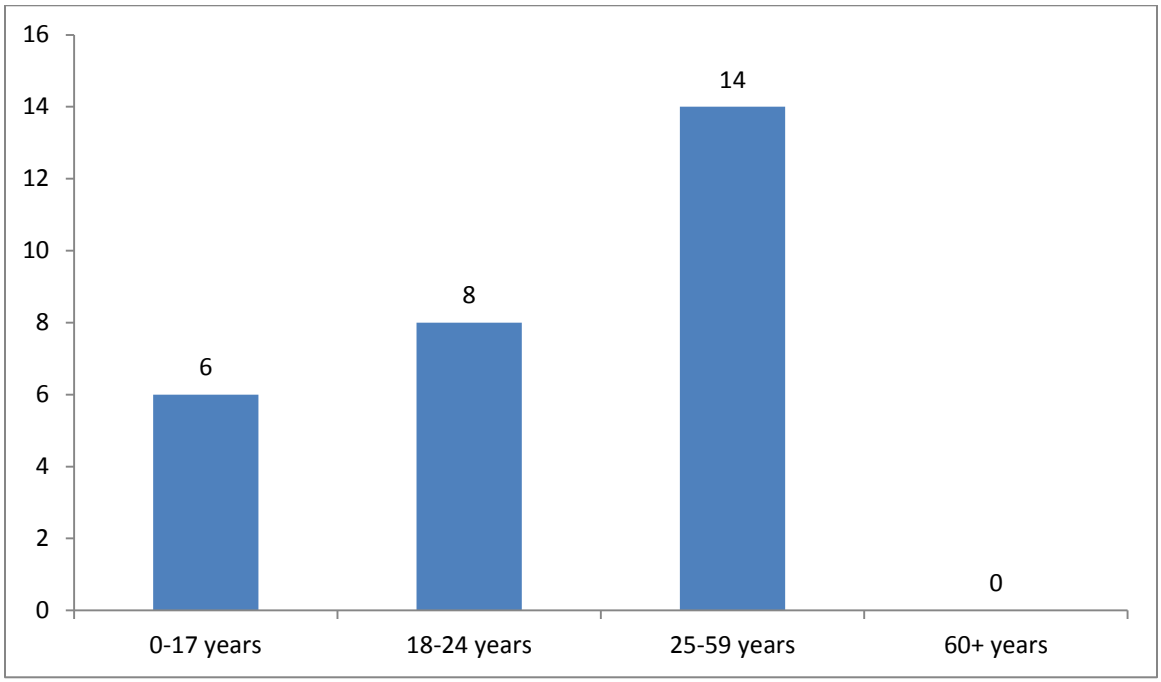
Source: Corvallis Police Department, Oregon Department of Transportation, Oregon Environmental Public Health Tracking

Although this HIA does not specifically consider traffic volume it is important to recognize its role in pedestrian and bicycle injuries, particularly because Highway 99/ South Third Street is a high volume arterial road[92]. In south Corvallis, the average daily traffic (ADT) is 19,300 vehicles, compared to 12,300 vehicles for similar roads throughout all of Corvallis (Map 11). It should also be noted that a majority of the motor vehicle trips are concentrated in the mid-northern section of Highway 99W/South Third Street, this means that there is a greater potential to educate motorist and control traffic speeds locally.

Disparities

Currently, data on specific disparities by race/ethnicity in pedestrian and bicycle injuries within south Corvallis are not available due to limitations in data collection. From 2003-2012 28 injuries have occurred among pedestrians and bicyclists along south 3rd, as reported to the Oregon Department of Transportation. Approximately, half of all injuries occur among adult ages 25-59 years of age. Fewer injuries among children may be due to the low number of children who walk or bike to school due to perceived safety concerns. It is widely documented in the literature that youth and older adults are particularly vulnerable pedestrians and bicyclists [93] [94]. Furthermore, children from lower-income families have especially high pedestrian injury rates, which may be due to both a greater exposure- walking more because of less access to a car- and children in general facing greater risk for pedestrian injury[95].

Figure 8: Count of pedestrian/bicyclist injured in crash with motorist by age along S.3rd in Corvallis, 2003-2012



Source: ODOT, Highway 091, all road-types, MP 84-86.5, 01/01/2003 to 12/31/2012.

Additionally, populations that are racial or ethnic minorities tend to have higher pedestrian and bicycling injury and fatality rates compared to their white counterparts. According to 2001 data from the Centers for Disease Control and Prevention the fatality rates for Hispanic bicyclists was 23% higher compared to white bicyclists[96].

The differences in rates can potentially be explained by a higher exposure as low-income persons and racial and ethnic minorities often have limited access to vehicles, and therefore walk or bicycle to places, and live near roads with higher vehicle speeds and traffic volumes[97]. For south Corvallis, overall there is a small proportion of the population that has limited access to a personal vehicle— 4.5 percent of all households are carless and 33.7% percent have a single car (Map 12).

Impact Analysis

Benton County Health Services finds that a reduction in traffic speed will positively impact the number and severity of pedestrian and bicyclist injuries that occur within south Corvallis. BCHS also finds that if traffic speeds are increased it would negatively impact the number and severity of pedestrian and bicyclist injuries that occur within south Corvallis. These finding are based on strong evidence in the research indicating that lower vehicle speeds are associated with less severe injuries and lower rates of fatalities among pedestrians and bicyclists, while higher vehicle speeds are associated with more severe injuries and greater rates of pedestrian and bicyclist fatalities (*Cite all Sources supporting this*).

Limited Evidence: Few case studies, theoretically supported
Some Evidence: Limited research, some case studies, gray papers
Moderate Evidence: Rigorous, peer reviewed research
Strong Evidence: Multiple rigorous, peer reviewed research studies with similar findings

Furthermore, a reduction in traffic speed will have a greater impact on the youth and older adults that live in south Corvallis as research indicates both populations tend to have higher pedestrian and bicyclists collision rates relative to their share of the population[98] [99].

Social Networks

Neighborhood environments consist of not only physical characteristics, but also social (interactions between neighbors)[100]. Social networks affect health through a variety of mechanisms, including the provision of social support (perceived and actual); social influence; social engagement; person-to-person contacts; and access to resources (e.g. money, jobs, information)[101].

Research Question Three:

Does slower vehicle traffic increase neighbor interaction?

A Review of the Literature

Streets constitute a significant part of the public open space and are seen as the most important symbol of the public realm. People depend on streets for interactions with other people and social activities, among many others. Streets that cater to a wide spectrum of needs have been positively associated with economic growth, physical health, and a sense of community[102].

Research has shown that as traffic volumes increase, quality of life factors that lead to healthy and strong communities (e.g. social connections, neighborhood pride and property value) decrease. The provision of road space to enable high-volume, high-speed car travel comes at a cost to other road users and local residents in terms of community disruption, noise pollution, social isolation, urban sprawl, restrictions on children's independent mobility and opportunities for outdoor play and social interactions[103]. Heavy traffic is associated with reduced street-based activities and social interactions between neighbors[104]. Residents' sense of their home territories often shrink as traffic grows heavier and faster, forcing them to retreat into the backs of their homes and away from the street and areas in the front of the home[105].

In addition to lower traffic speeds, overall neighborhood walkability has been positively associated with a greater sense of community[106]. For residents who drive everywhere they have fewer chances to form bonds with neighbors. Inadequate social networks are a risk factor for depression; residents of low-walkability neighborhoods might have more depressive symptoms[107].

Furthermore, bicycling and walking contributes to social inclusion because it provides an affordable and convenient form of personal mobility that is accessible to people who do not own or have access to a vehicle[108].

Baseline Assessment

Social cohesion and community inclusion are some protective factors associated with depression and suicide. Others include access to mental health care; school, social and family support for seeking help; discussing problems with friends or family; and emotional health. To date, no known assessment of social cohesion and/or community inclusion has been conducted among residents of south Corvallis. Data available at the county level suggests that mental health and wellbeing is a concern for all Benton County residents. In 2006-2009 64.8% of Benton County adults reported having good mental health[109]. In addition, 19% of Benton County 11th grade students reported feeling so sad or hopeless almost every day for two weeks or more in a row, compared to 23.4% of Oregon 11th grade students[110]. Moreover, social isolation, lack of social support, and depression are also import risk factors for cardiovascular disease[111].

Impact Analysis

Benton County Health Services finds a reduction in traffic speeds will likely have a positive impact on social interactions among residents living in south Corvallis. BCHS also finds that if traffic speeds are increased it would likely have a negative impact on social interactions among residents living in south Corvallis. These findings are based on moderate evidence in the research indicating that lower traffic speeds are associated with greater interaction between neighbors and a greater sense of community and space[112] [113]

Currently there is no data available at the community level measuring interactions between south Corvallis residents, and therefore determining a future impact on social interactions is limited.

Access to Goods and Services

Research Question Four:

Does a reduction in traffic speed influence access to resources for recreation?

A Review of the Literature

Parks provide a free venue for people to be physical activity, and a space for social interactions to occur among neighbors and park users. Equally important as the presence of a park is the accessibility of the space. People living closer to parks tend to visit more often, with people living in 1/4 mile radius visiting the most[114]. More walkable neighborhoods and access to parks correlate with higher levers of physical activity and lower BMI[115].

Street connectivity and traffic speeds can influence residents' access to parks. A study conducted by Kaczynski et Al., found that compared to residents who had a high-speed road on their way to their closest park, residents with slower traffic routes to parks were more likely to use parks[116]. This suggests that ensuring direct and safe access to parks through street network design and traffic calming strategies may be an important factor in facilitating park visitation and active park use[117].

Baseline Assessment

For south Corvallis proximity to parks was determined by a proximity index created by the Oregon Environmental Public Health Tracking group, the index used marked crosswalks (both stripped and lined) as crossing points for Highway 99W/ South Third Street to determine proximity for households. On average south Corvallis residents must travel 0.22 miles from their home to reach a park, with some clusters in south Corvallis having better access to parks than other (Map 13).

Although most residents in south Corvallis live within walking distance of at least one park, many have expressed an inability to access the larger destination parks that are located along the eastern and western edges of south Corvallis due to traffic concerns on south Third. Future neighborhood assessment activities should include questions regarding park utilization and accessibility.

Impact Analysis

Benton County Health Services finds that a reduction in traffic speed will positively impact access to resources for recreation. BCHS also finds that if traffic speeds increased it would negatively impact access to resources for recreation. These findings are based on limited evidence in the research indicating that residents that have routes to parks with slower traffic speeds are more likely to use parks [118] [119].

Limited Evidence: Few case studies, theoretically supported
Some Evidence: Limited research, some case studies, gray papers
Moderate Evidence: Rigorous, peer reviewed research
Strong Evidence: Multiple rigorous, peer reviewed research studies with similar findings

Research Question Five:

Will businesses adjacent to S. Third see an increase in business (visits and sales) if traffic speeds are lowered?

A Review of the Literature

As mentioned in previous sections, creating environments that are more conducive to walking and bicycling provides many benefits. They create a greater a sense of community, increased opportunities for physical activity, and decrease rates of injuries and accidents among pedestrians and bicyclists (cite all sources). Emerging research suggests that investments in and changes to the pedestrian and bicycling infrastructure also have beneficial economic effects on local businesses[120] [121].

A study conducted in Portland, Oregon found customers that arrive by modes other than automobile (walking, bicycling, and public transit) to be competitive consumers. Those walking and bicycling to a business spent similar amounts or more, on average than those who arrived by automobile. Additionally, customers that walked to the business or arrived by bicycle were more frequent patrons[122].

Specifically, the study found that bicyclists spent the most per trip and the most per month when looking at convenience stores alone. For restaurants and drinking establishments, the study found pedestrians to spend the most per trip, and bicyclists spent the most per month. In places like San Francisco and Portland, business owners thought infrastructure supporting bicyclists had a positive impact on their business and sales [123] *[124]*

New York City has also seen an increase in retail activity in areas with protected bike lanes, curbside seating, and enlargements of squares. The city's department of transportation (DOT) found an increase of as much as 49% in retail sales at locally based businesses since bike lanes and other traffic calming features were implemented [125].

Understanding the consumer patterns of residents that walk or bicycle to patronage businesses presents an exciting opportunity for unique marketing. A greater understanding of consumer patterns will also help to understand the impact changes to the built environment and transportation infrastructure have on the economic livelihood of local businesses[126].

Baseline Assessment

The economic impacts of local businesses are an important factor related to traffic speed, street design, and available infrastructure. The economic impacts on local businesses related to changes in street design and infrastructure is a valuable concern when considering such changes. Providing evidence that supports pedestrian and bicyclist friendly environments are good for business can have the potential to garner support from local businesses. Currently data on purchasing behavior among pedestrians and bicyclist at local businesses is needed to provide a baseline assessment for this research question. In addition, future assessment of business owners' perceptions of traffic calming features along S.3rd is also necessary to further evaluate the impact on local business.

Impact Analysis

Benton County Health Services finds that a reduction in traffic speeds will likely have a positive impact on businesses adjacent to Highway 99W/South Third Street. BCHS also finds that if traffic speeds are increased it would likely have a negative impact on businesses adjacent to Highway 99W/South Third Street. These findings are based on limited evidence in the research indicating that lower traffic speeds and more pedestrian and bicyclist traffic are associated with more frequent visits to businesses by pedestrians and bicyclists. The research also indicated pedestrians and bicyclist spend more money on average at certain types of businesses (restaurants, convenience stores, and drinking places[127] [128].

Recommendations

Speed management is a strategy for controlling speed through a comprehensive, interdisciplinary and coordinated approach that encompasses behavioral, enforcement and engineering elements[129]. Speed limits are not the only tool that agencies can draw on to manage operating speeds. Roadway geometry and the frequency of enforcement also play a role in driver judgments and choices regarding speed. During the development of this HIA the speed study was completed by ODOT, and recommended to retain the existing 35 mph posted speed. Although the speed study decision point was made, BCHS recognizes that this HIA process helped to establish relationships key stakeholders and provides evidences for future work throughout Benton County.

Below are recommendations based on the evidence-based studies and peer reviewed literature summarized in this report that could increase pedestrian and bicyclist safety and encourage safe walking and bicycling along Highway 99W/South Third Street as part of an active daily lifestyle for south Corvallis residents.

Benton County Health Services recommends the speed limit from Avery Avenue to Tunison Avenue be lowered to 25 mph. This recommendation is based on a structured literature review indicating that lower traffic speeds provide safer environments for pedestrians and bicyclists, increase rates of walking and bicycling, increase social interactions, and increase access to goods and services. This recommendation is supported by input from community residents that have expressed a continued concern over the safety of the Highway 99W/South Third Street corridor. The consideration of the vulnerable populations that live within south Corvallis was also an important factor in making this recommendation-- a lower speed would help to promote walking and bicycling among children and decrease the severity and number of injuries among bicyclist and pedestrians[130].

BCHD recognizes that lowering the posted speed limit is not the only solution to reducing traffic speeds and promoting active transportation, increasing access to goods and services, and increasing social interactions. Road designs that reduce risky driving behaviors, rather than designs that accommodate such behaviors, increase perceptions of safety within a community and has the potential to increase the utilization of more divers forms of transportation (i.e. walking and bicycling)[131]Therefore BCHD is also recommending structural changes be made to Highway 99W/South Third Street to increase positive health outcomes in south Corvallis, and to create a pedestrian and bicyclist-friendly environment[132].

- **Extend median with trees**[133]— creates a more welcoming environment for pedestrians and bicyclist and visually encloses road way helping to reduce traffic speeds. According to the South Corvallis Area Refinement Plan, this recommendation will also help to reduce turning conflicts and enhance the free flow of traffic[134].

- **Bicycle and Pedestrian Path**— provide an alternative walking and bicycling route so active transport appeals to a wider audience

- **Wider sidewalks**– provide a greater buffer between pedestrians and vehicles[135] [136]

- Explore color **painted bike lanes—**visually enclose the road making it appear narrower to motorist and therefore help to reduce traffic speeds while making the bicyclist right of way more visible.

The HIA Technical Advisory Group also recommends:

- Planned development that involves controlled entrances and exits for businesses.
- Additional traffic lights
- Tunison to Avery pedestrian and bicycle path
- Extend the school zone to include the crosswalk south of Lincoln Elementary

- Explore posting **signage** that notifies motorist they are entering a community.

The BCHD is also recommending that future analysis of business sales and visits for businesses adjacent to Highway 99/South Third Street be conducted to provide a better understanding of baseline conditions. This will also help to help evaluate any future structural or policy changes made that impact travel on Highway 99W/South Third Street.

Lastly, BCHS also recommends monitoring bicycling and walking rates by age and race/ethnicity. Having this data available will help to provide a better understanding of who is walking and bicycling, and help to guide future efforts so that walking and bicycling is more accessible to all residents.

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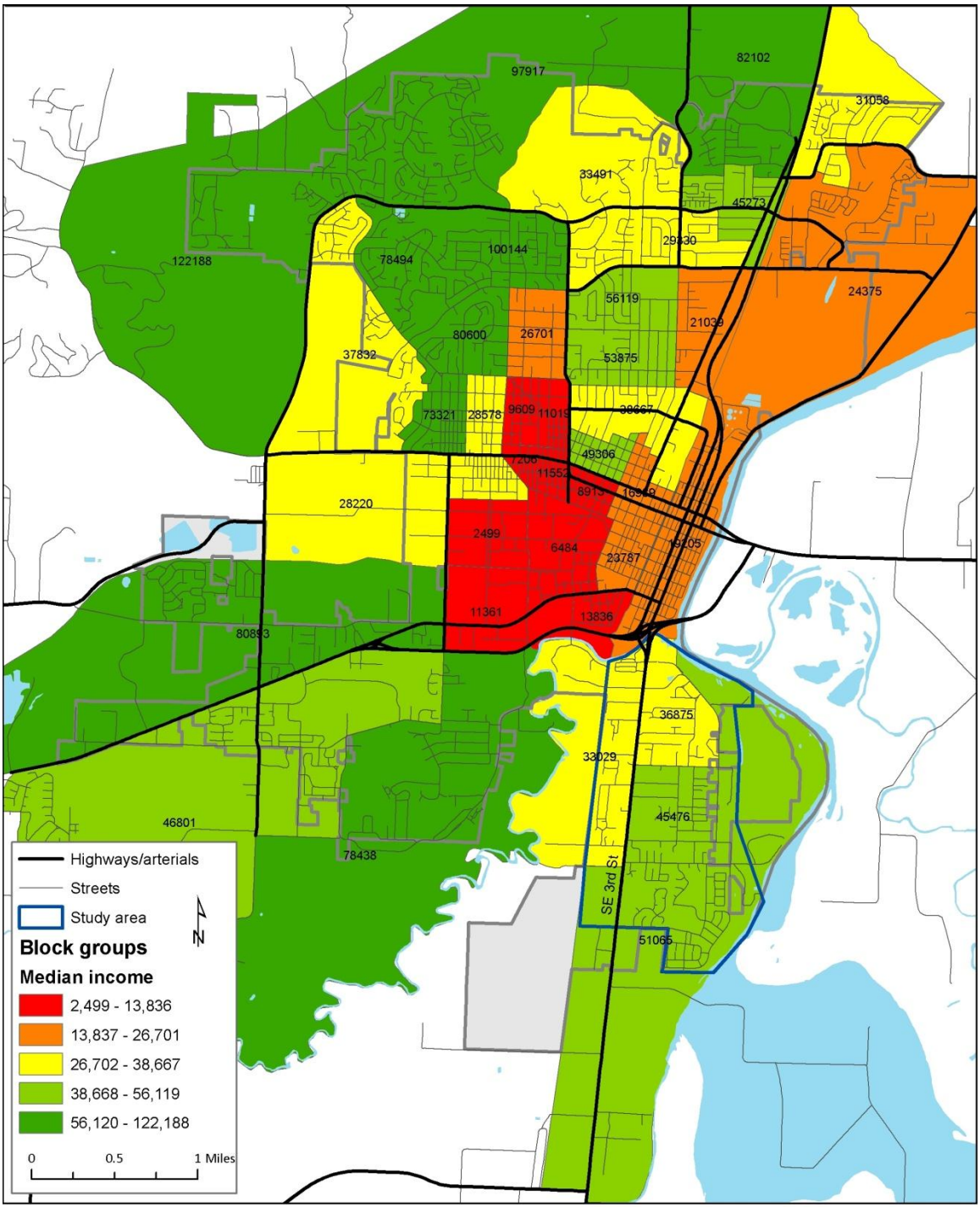
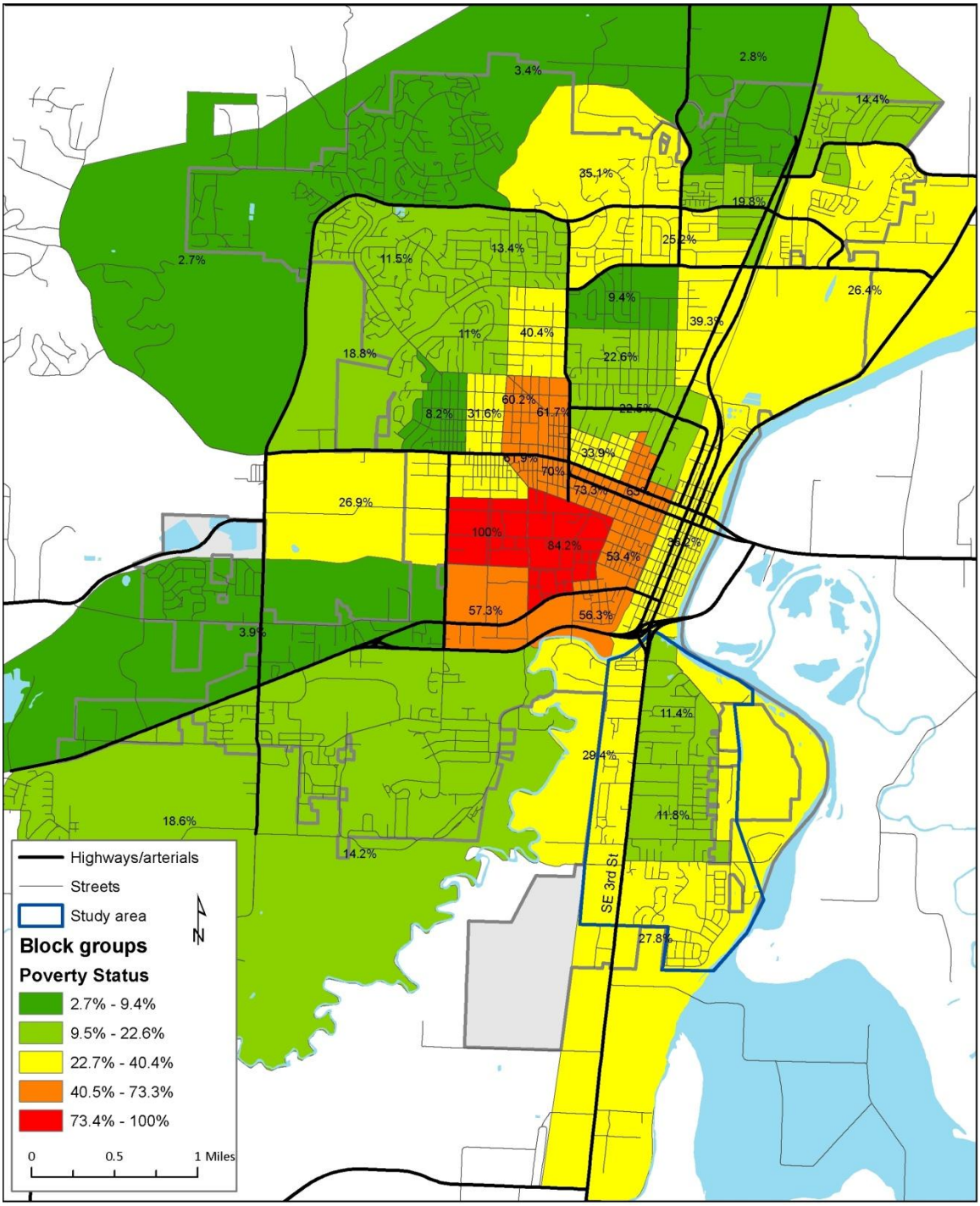
Appendix One: Maps

Map 1. Median Household Income for Corvallis



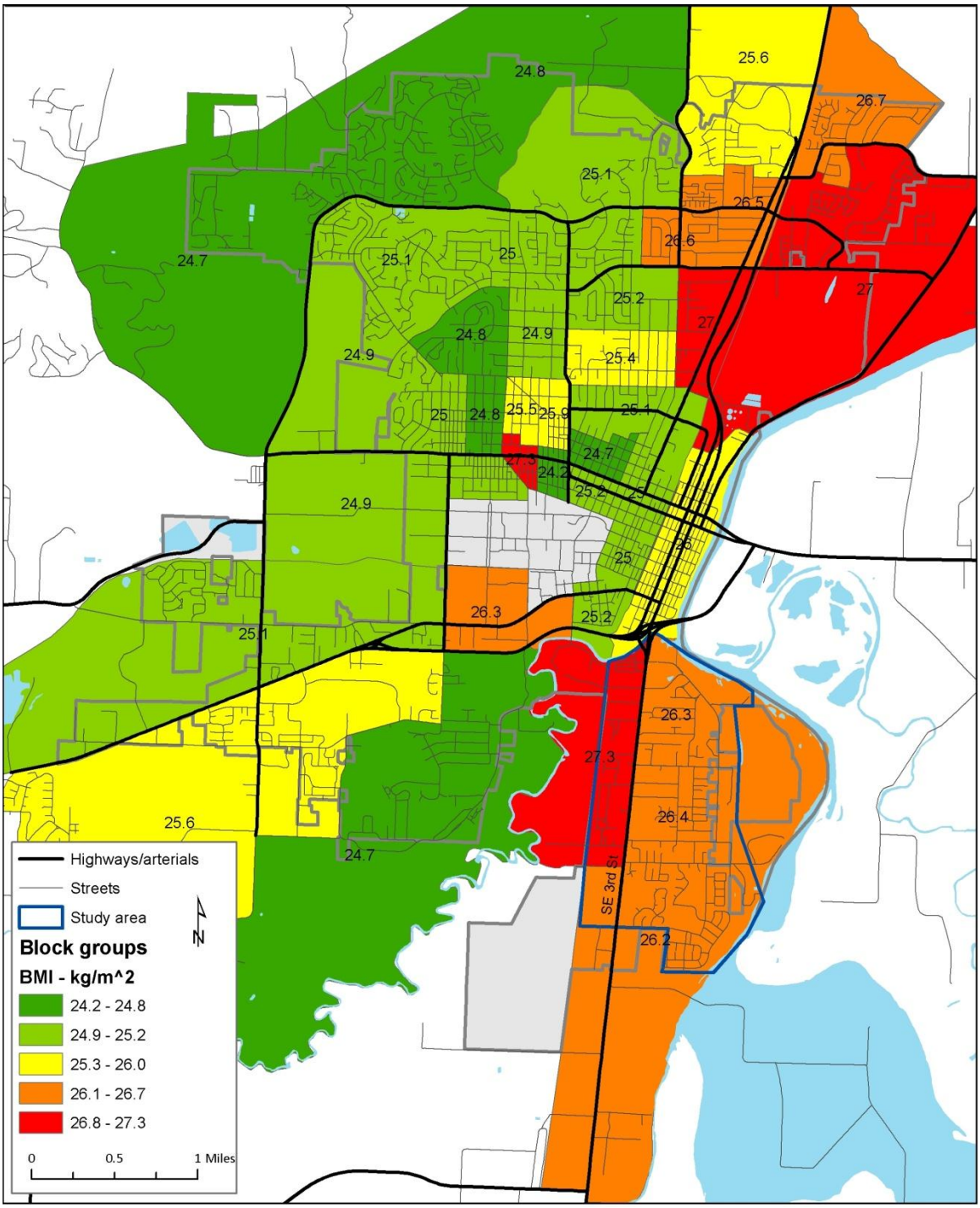
Source: US Census Bureau, American Community Survey 2007-2011

Map 2. Income by Poverty Status for Corvallis



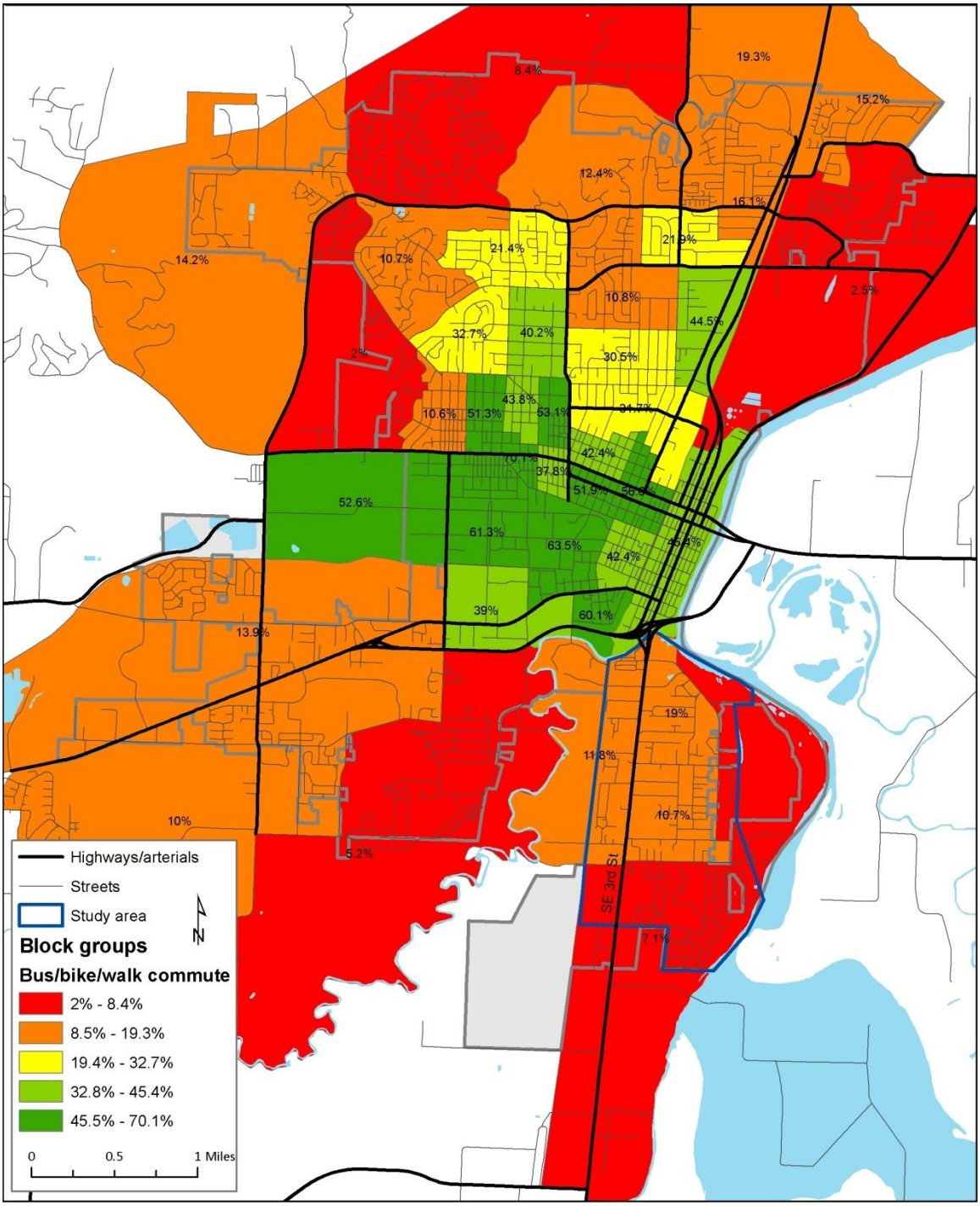
Source: US Census Bureau, American Community Survey 2007-2011

Map 3. Adult Body Mass Index for Corvallis



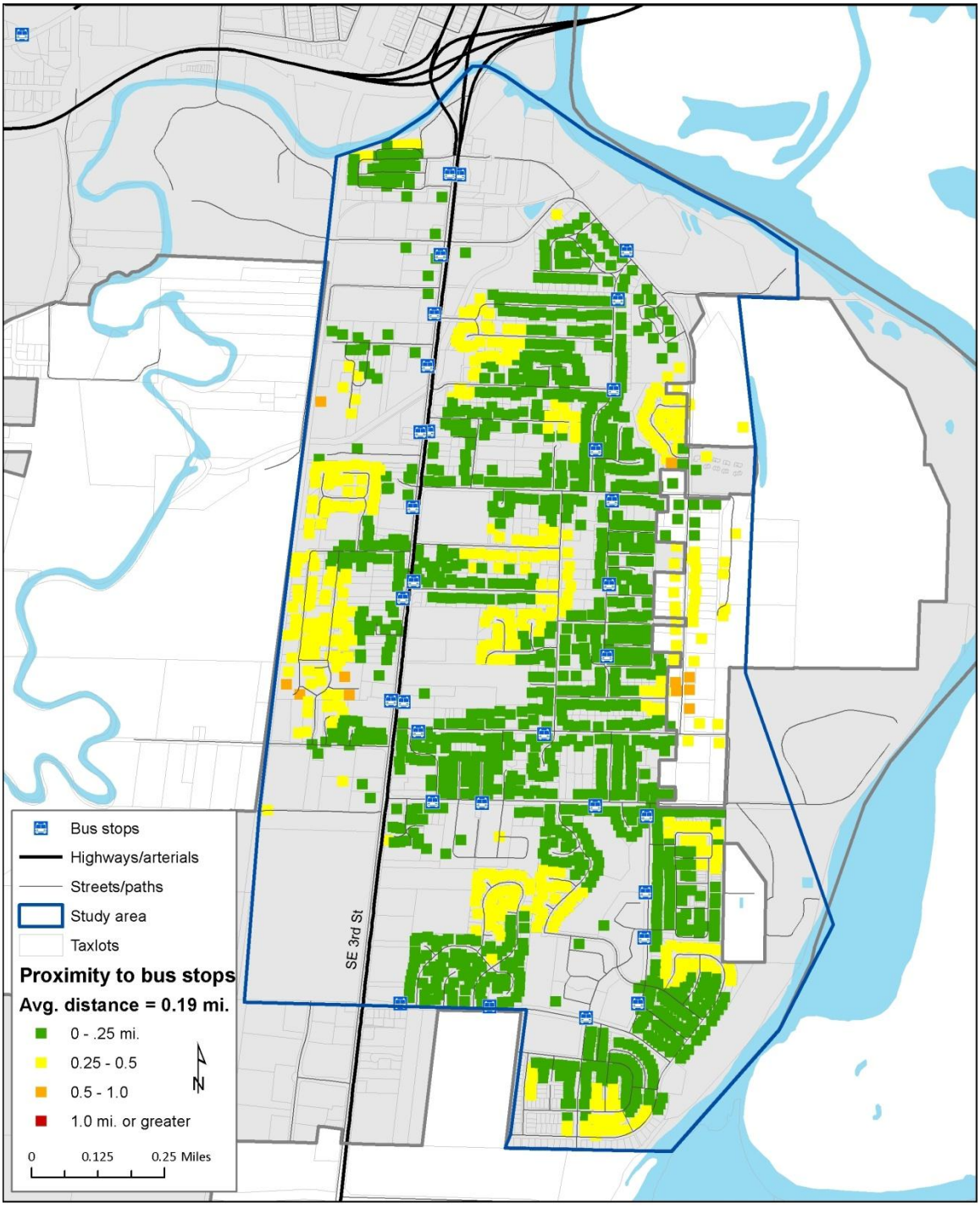
Source: Oregon Environmental Public Health Tracking Group, 2013

Map 4. Worker Commute by Bus/Bike/Walk for Corvallis



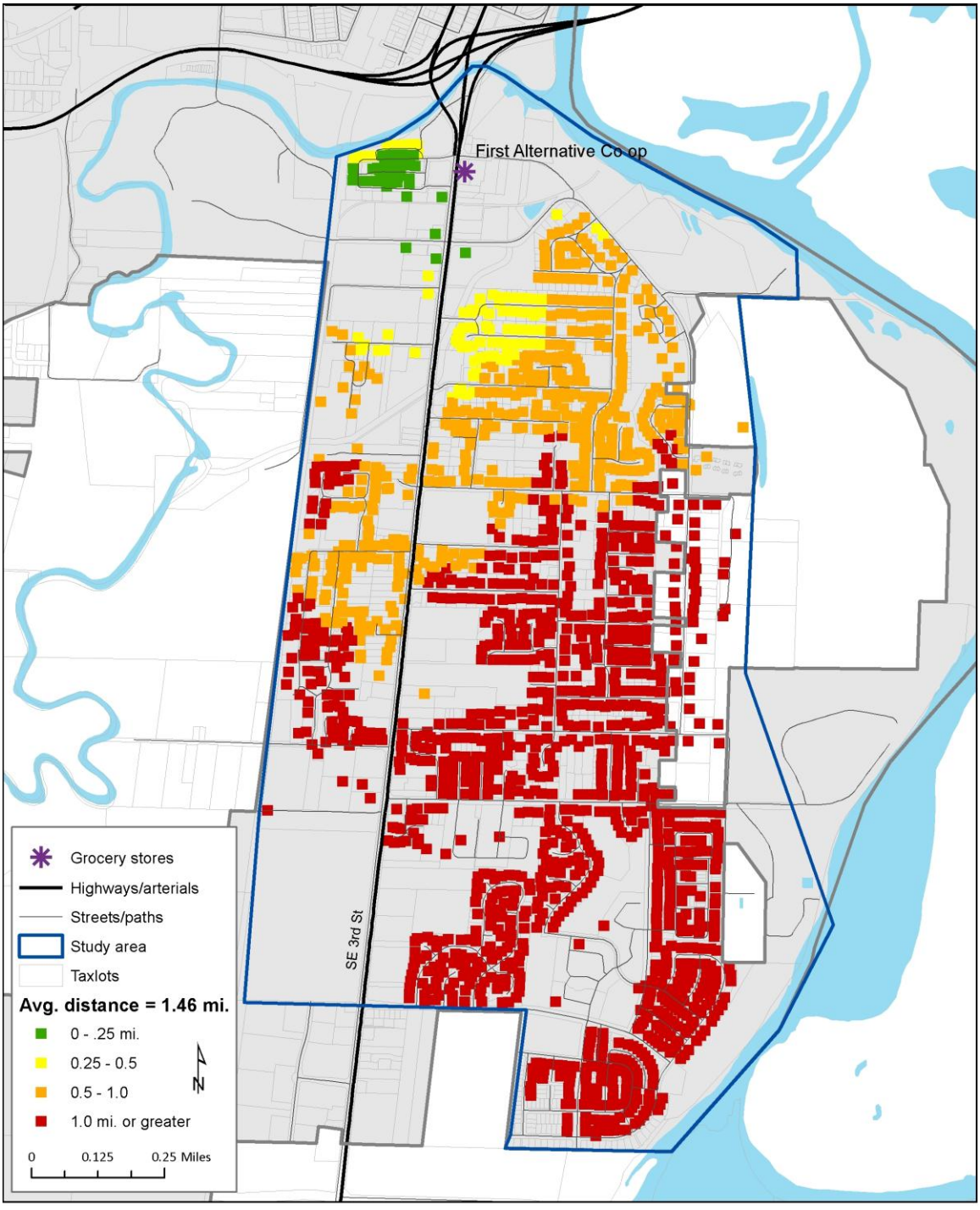
Source: US Census Bureau, American Community Survey, 2007-2011

Map 5. Average Walking Distance from Home to Bus Stop for South Corvallis



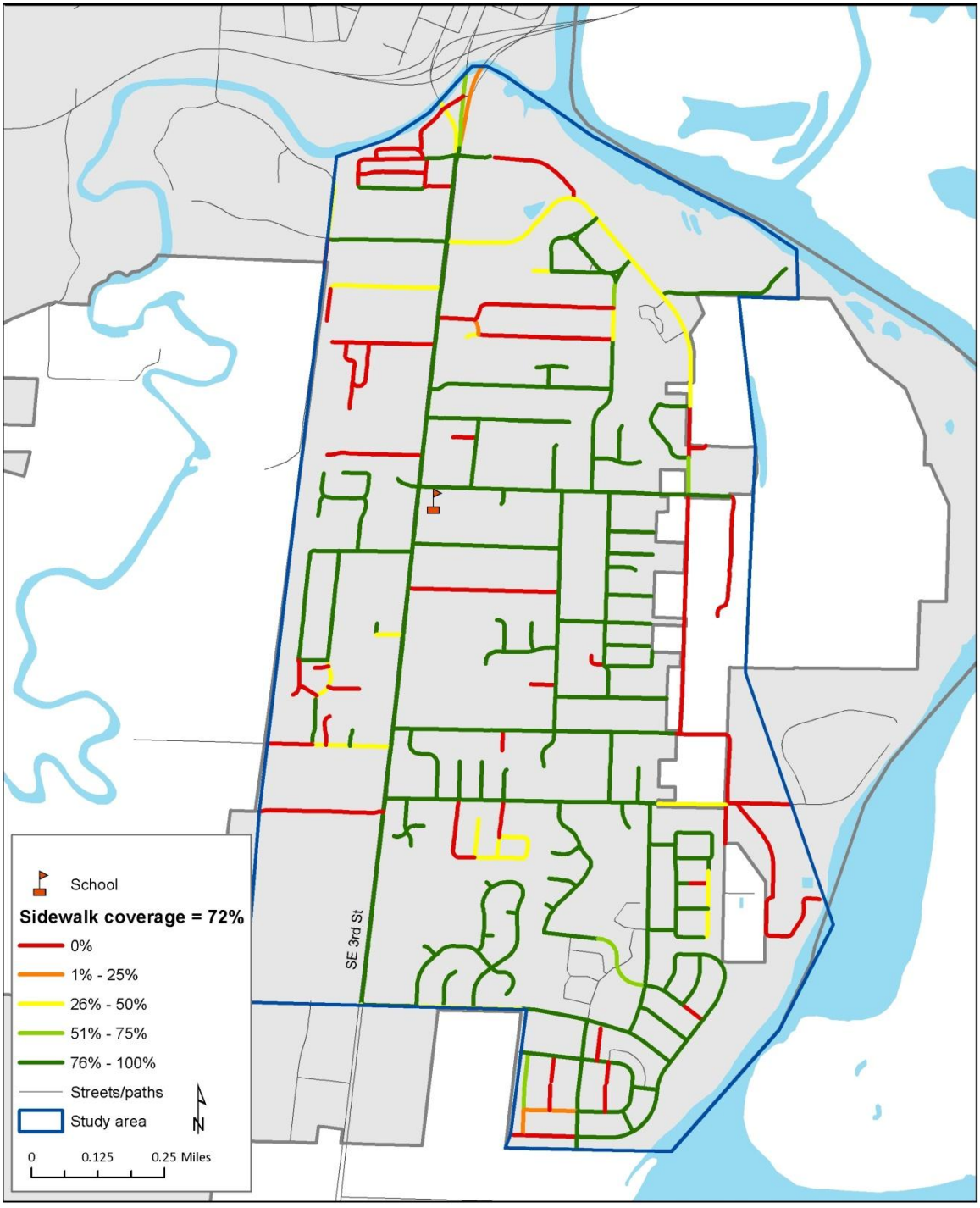
Source: Oregon Environmental Public Health Tracking Program, 2013

Map 6. Average Walking Distance from Home to Grocery Store South Corvallis



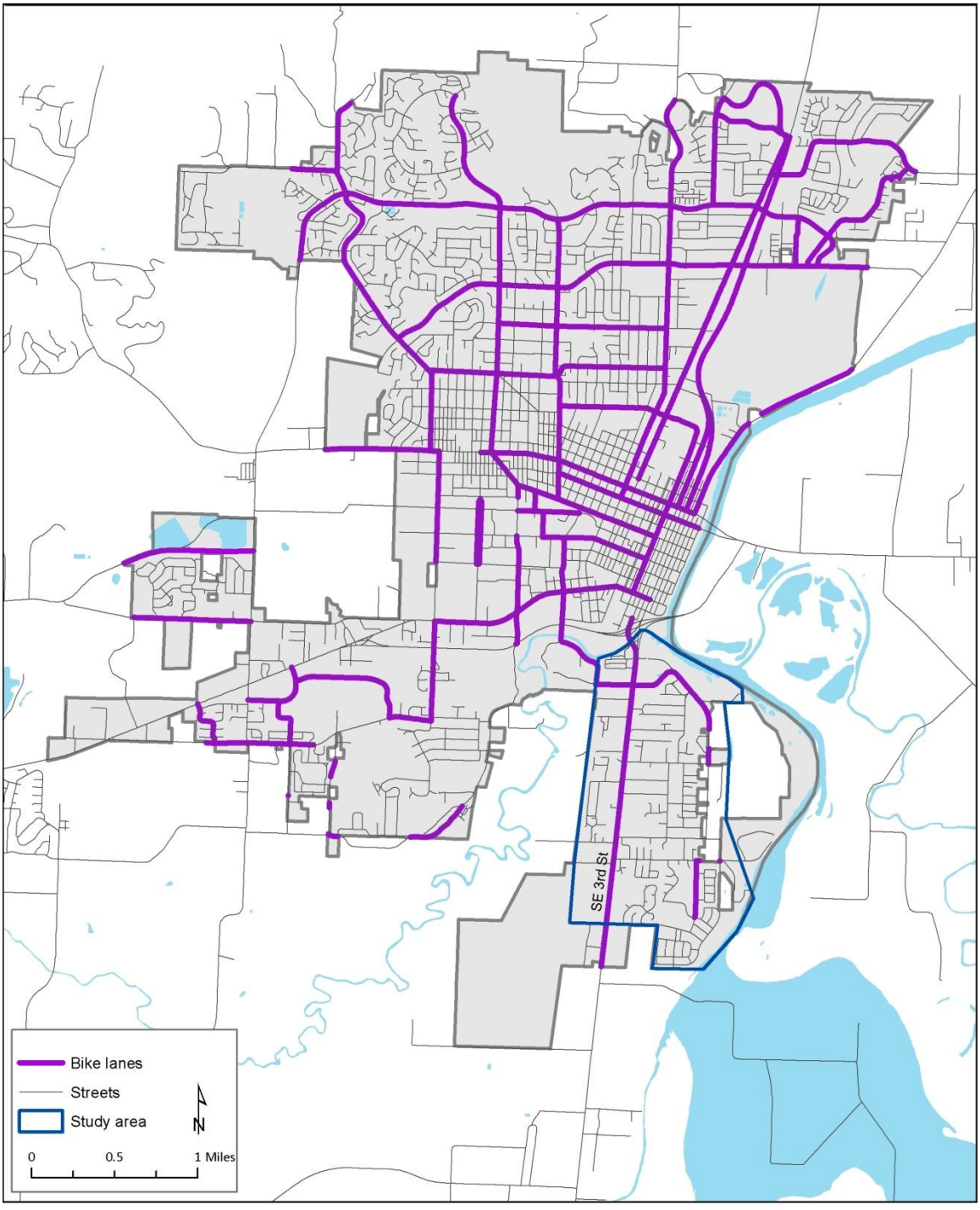
Source: Oregon Environmental Public Health Tracking Program, 2013

Map 7. Sidewalk Coverage: Percent of Streets with Sidewalks on Either Side for South Corvallis



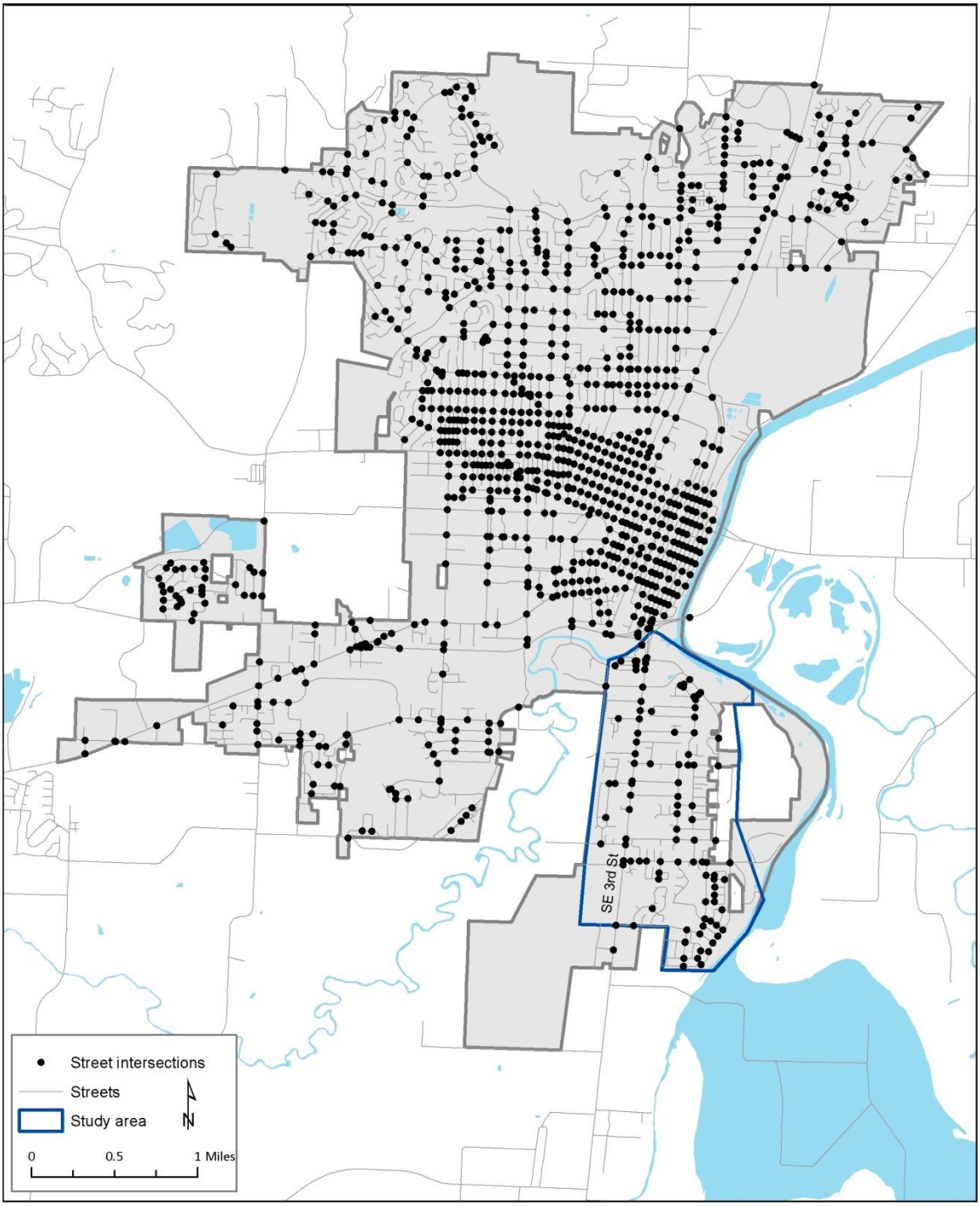
Source: Oregon Environmental Public Health Tracking Group, 2013

Map 8. Bike Lanes/Paths for Corvallis



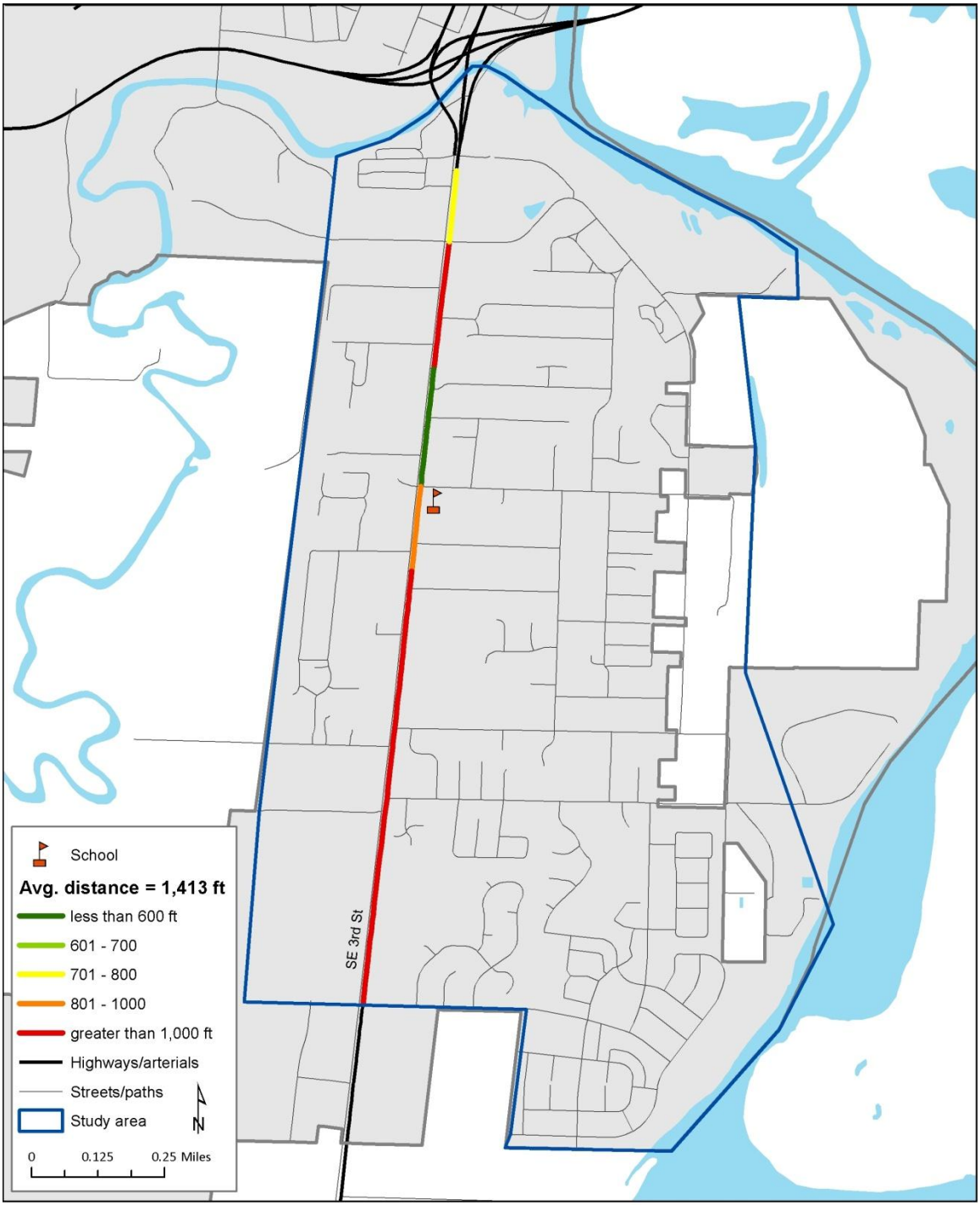
Source: Oregon Environmental Public Health Tracking Group, 2013

Map 9. Street Intersection Density for Corvallis (non-thru streets excluded)



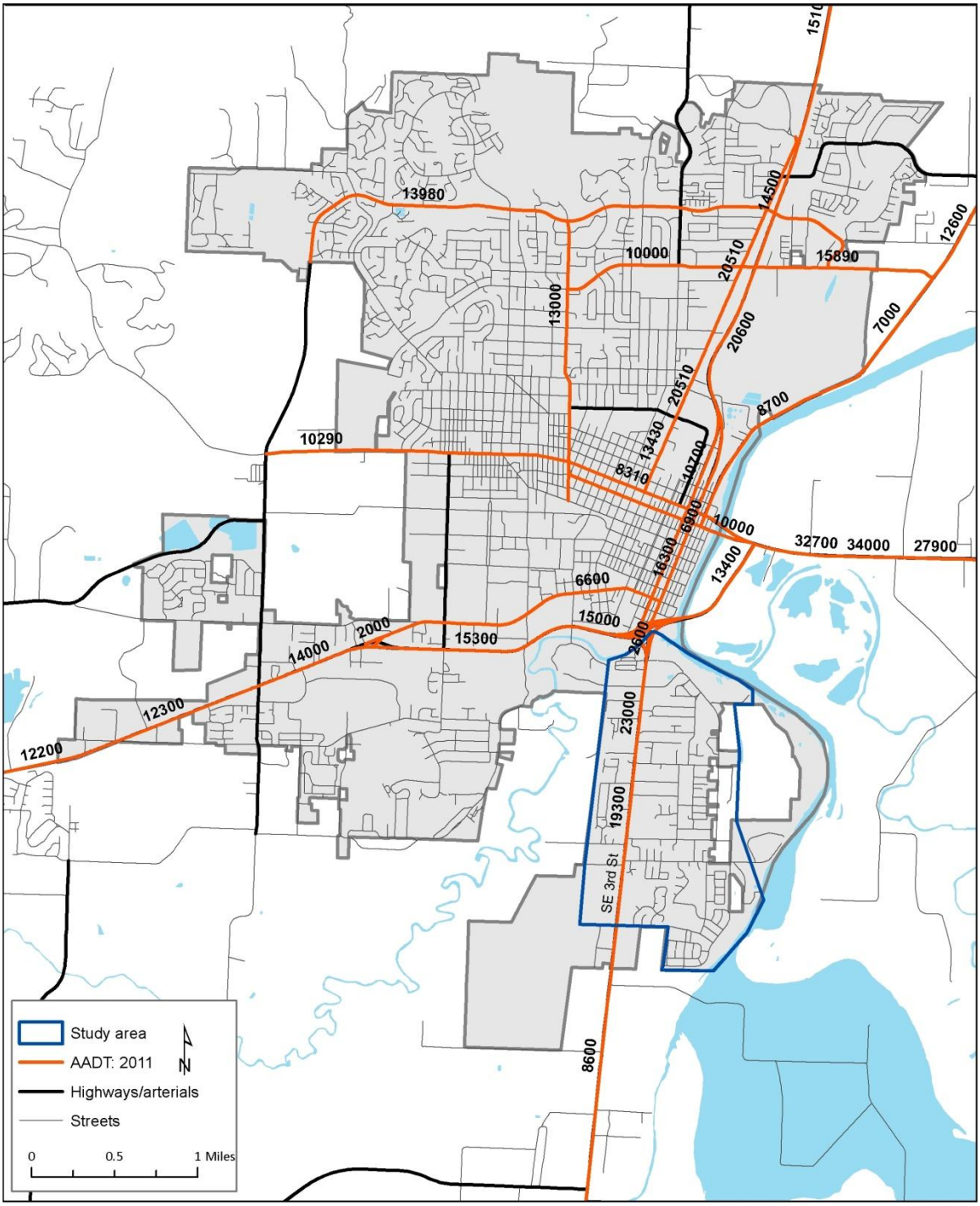
Source: Oregon Environmental Public Health Tracking Group, 2013

Map 10. Distance Between Crosswalks in South Corvallis



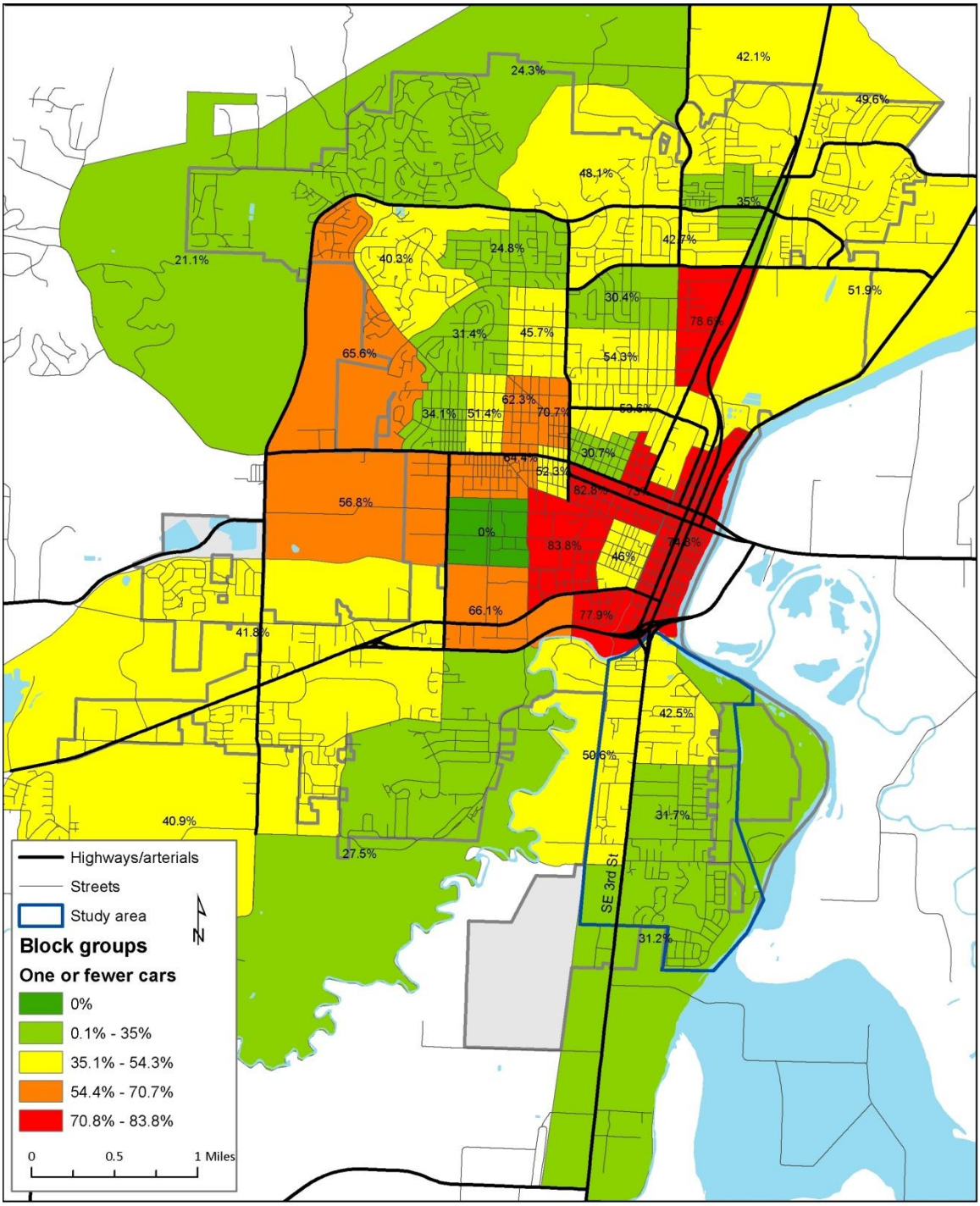
Source: Oregon Environmental Public Health Tracking Group, 2013

Map 11. Average Auto Daily Traffic for Corvallis Arterials and Highways



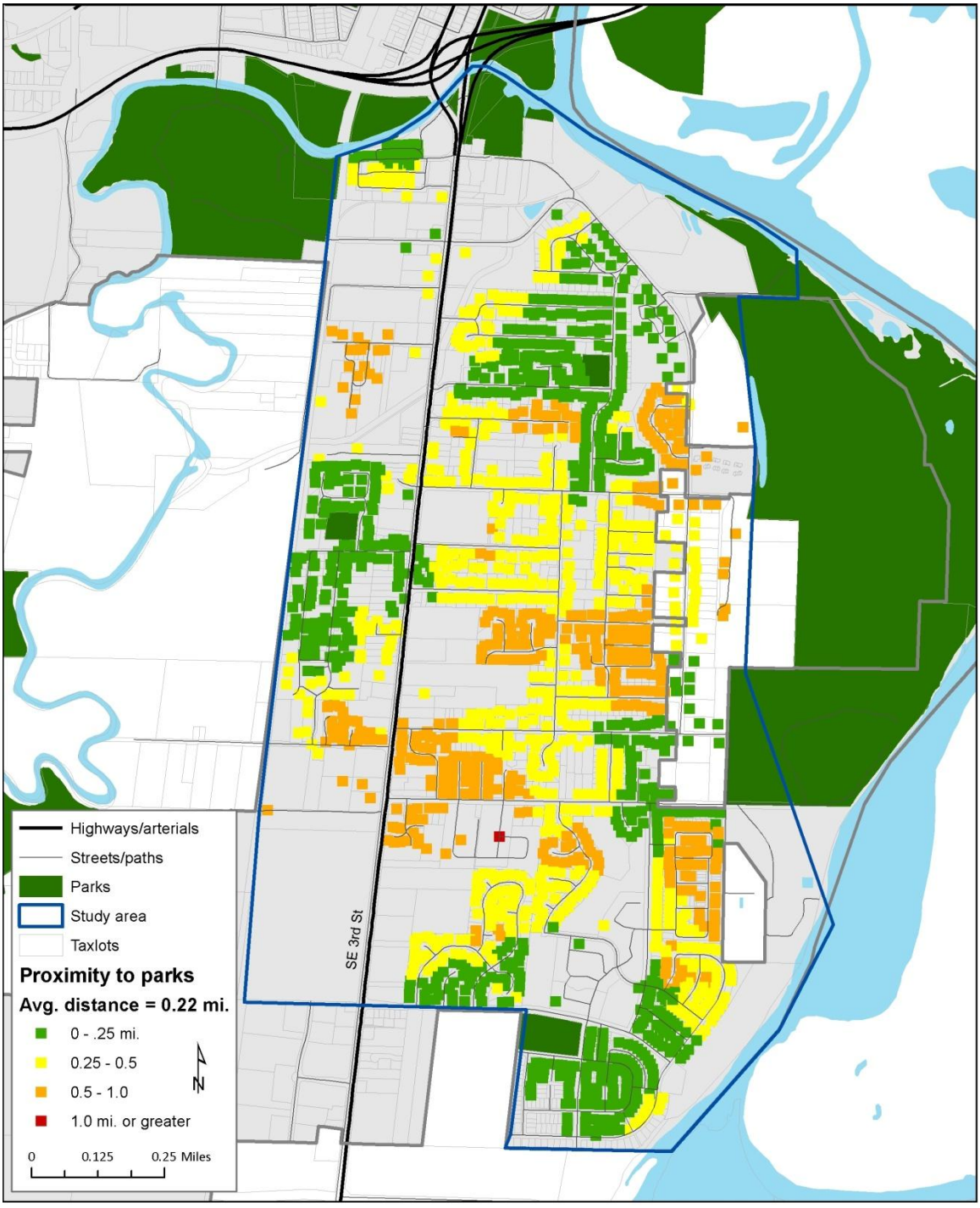
Source: Oregon Department of Transportation, Oregon Environmental Public Health Tracking Group, 2011

Map 12. Household with One or Fewer Cars in Corvallis



Source: US Census Bureau, American Community Survey, 2007-2011

Map 13. Average Walking Distance from Home to Park for south Corvallis



Source: Oregon Environmental Public Health Tracking Group, 2013