2012

Health Impact Assessment of Phase I of the Downtown Crossing Project

Promoting Pedestrian and Bicyclist Physical Activity and Safety

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April 2012

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FOREWORD

The Downtown Crossing project has been the source of intense interest and debate among residents of New Haven. Residents of the surrounding communities and the City as a whole could benefit from the project's potential to support new development, create jobs, and expand the existing tax base. Furthermore, many residents welcome the possibility that a redeveloped Route 34 East could provide enhanced facilities for all road users, including vehicle users, pedestrians, and bicyclists. Others are concerned that changing the corridor could lead to increased congestion and decreased transportation access, or that the project will replace existing facilities without considering and addressing community concerns.

In the meantime, the City of New Haven has actively been seeking ways to promote health. Through efforts including those of the Health Matters! Commission and the New Haven Health Equity Alliance, the City has been growing efforts to improve the health of New Haven residents and to address determinants that contribute to good health in the City. Together with members of the New Haven Departments of City Plan, Health, Transportation, and Economic Development, as well as from the community data collaborative DataHaven, we formed a partnership organized around optimizing health impacts of the Downtown Crossing project. We used a tool called health impact assessment to guide our work.

Health impact assessment is a systematic, evidence-based process to project health impacts of public projects and policies. The collaborative process, which can use a diverse array of data sources, tools, and methodologies, is conducted while a project or policy is being considered so that the results of the evaluation can be used to optimize related health outcomes.

In conducting a health impact assessment of Phase I of the Downtown Crossing project, our goal was to contribute a health perspective to the project. We also worked to build capacity for consideration of health in this and future projects by introducing this new framework for considering health in all policies. This report presents a comprehensive description of our HIA process and findings.

We are grateful for the tremendous contributions of our Advisory Committee members as well as the numerous New Haven advocates who provided guidance and assistance throughout process of conducting this health impact assessment.

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Health Impact Assessment of Phase I of the Downtown Crossing Project

Promoting Pedestrian and Bicyclist Physical Activity and Safety

Executive Summary

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Background

Many New Haven residents don't get enough physical activity. Barriers to physical activity include lack of walking and bicycling facilities on city streets and fear of injury from motor vehicle crashes. These are important issues across the City, but especially in the area around Route 34 East, a short section of urban highway that connects Interstate 95 to downtown New Haven.

The Downtown Crossing Project

The City of New Haven plans to redevelop Route 34 East in a project called the Downtown Crossing project. The full Downtown Crossing project will replace Route 34 East with ten acres of developable land. The nearby frontage roads will be transformed into city streets, and local street connections at Temple and Orange Streets will be restored.

The first phase of the project, Phase I, focuses on converting the North and South Frontage Roads into city streets and rebuilding the area of Route 34 East between the Air Rights Garage and College Street. These improvements will be completed in the next few years, and will lay the groundwork for the rest of the Downtown Crossing project.

Health Impact Assessment (HIA) of Phase I of the Downtown Crossing Project

To contribute a health perspective to the Downtown Crossing project, we partnered with members of the City of New Haven government and the local organization DataHaven to think about ways to make it easier for people to walk, run or bicycle in a safe environment around the Route 34 East Corridor.

We used a tool called health impact assessment (HIA) to guide our work. Health impact assessment is a systematic, evidence-based approach used to predict health impacts of public projects like the Downtown Crossing project. Based on its findings, recommendations to optimize health impacts are proposed to decision makers during the design process.

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Baseline Conditions around Route 34 East

A large and diverse population of residents and workers who live or work around Route 34 East could be affected by the proposed Downtown Crossing project. Like residents and workers across the state and country, New Haven residents and workers face health conditions including obesity, high blood pressure, diabetes, and heart disease. These and other health conditions can improve with exercise.

Many area households do not own cars, so people commonly use public transit, walking and bicycling for transportation and commuting. Yet an environmental audit performed for this HIA confirmed that the streets around Route 34 East are not ideal for walking and bicycling.

Furthermore, in the past several years, residents have been affected by a relative concentration of motor vehicle crashes in the Route 34 East corridor, including two that resulted in pedestrian deaths.

This all suggests there is room for improvement around Route 34 East to make walking and bicycling safer and more accessible.

Recommendations to Promote Physical Activity and Safety

Given the existing conditions in New Haven and available evidence reviewed in the context of this HIA, we made the following recommendations related to Phase I of the Downtown Crossing project.

Walking and walking safety could be promoted by:

- ✓ **Prioritizing a connected street pattern**
- ✓ **Utilizing traffic calming features**
- ✓ **Increasing safety and the perception of safety**
- ✓ **Considering the needs of elderly, minority, and child populations**
- ✓ **Minimizing motor vehicle speeds**
- ✓ **Minimizing traffic volume**
- ✓ **Improving pedestrian crossings at intersections**
- ✓ **Improving sidewalks and other pedestrian facilities along streets**

Bicycling and bicycling safety could be promoted by:

- ✓ **Increasing the perception of safety**
- ✓ **Providing specialized bicycle facilities (like cycle tracks or bicycle lanes) along streets where appropriate for road traffic volume**
- ✓ **Locating bicycle facilities along most desirable routes for cyclists**
- ✓ **Maximizing connectivity of bicycle lanes and other bicycle facilities**
- ✓ **Increasing access to secure bicycle storage and shower facilities at destinations**
- ✓ **Implementing many cycling promotion strategies at the same time**
- ✓ **Minimizing cyclist-pedestrian crashes**
- ✓ **Minimizing cyclist-motor vehicle crashes along streets , near intersections, and at intersections**

Of note, health impact assessment is focused on assessing a project through the lens of public health. Since health is one of many potential outcome associated with a project, these recommendations must be considered in the context of competing considerations and limitations that affect a project's design.

Summary

This health impact assessment suggests the Downtown Crossing project could contribute to better health for residents of New Haven and the areas around the Route 34 East corridor through promotion of physical activity and protection against injury.

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For More Information

For more information about Health Impact Assessment:
Centers for Disease Control: http://www.cdc.gov/healthyplaces/hia.htm
Health Impact Project: http://www.healthimpactproject.org

For more information about the Downtown Crossing project:
The City of New Haven: http://downtowncrossingnewhaven.com

For more information about this Health Impact Assessment of Phase I of the Downtown Crossing project, including for a copy of the full HIA report, contact:
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INTRODUCTION

Urban Design and Health

The way cities are designed and built can have significant impacts on health. Compact land use, high levels of connectivity, and varied transportation options in urban environments can support healthy behaviors through minimized reliance on motor vehicle travel and promotion of physically active lifestyles.[1] Smart urban street design can lead to decreased injury and enhanced access to community services. Residents of pedestrian-oriented, mixed-use neighborhoods may benefit from enhanced social engagement, which in turn can have favorable effects on health.[2] As these intrinsic links become more apparent, health is increasingly being considered in the context of urban design projects, particularly those that relate to transportation infrastructure.

Urban Design and the Downtown Crossing Project

The Downtown Crossing project is a major transportation redevelopment project in the City of New Haven, Connecticut. It centers around redevelopment of a short section of urban highway, Route 34 East, that connects a major interstate highway on the eastern edge of the city, I-95, to downtown New Haven.

In accordance with healthy urban design principles, a primary vision for the Downtown Crossing project is to create a compact, walkable streetscape that safely accommodates all road users, including vehicle users, pedestrians, and bicyclists. It has been proposed that Route 34 East will be removed and replaced with ten acres of land that could be used for dense, mixed-use development. Plans include transformation of the adjacent frontage roads into urban boulevards and reintegration of local street connections at Temple and Orange Streets, severed when Route 34 East was built. These changes are planned to occur sequentially, over a decade and in several project phases.

Currently, the City of New Haven is developing plans for the initial phase of the Downtown Crossing project, Phase I. Phase I plans involve 1) conversion of the North and South Frontage Roads into urban boulevards, 2) reconfiguration of local street connections, and 3) reconstruction of the depressed highway bed at College Street to the grade level of the surrounding streets.

Overview of Health Impact Assessment

In order to more effectively raise considerations of health in the planning process of projects like the Downtown Crossing project, health advocates in the United States are increasingly adopting the process of health impact assessment (HIA). HIA is a systematic, evidence-based tool used to identify and characterize health impacts of public projects and policies. It involves engagement with health experts, decision-makers, and other community stakeholders, and employs a diverse array of tailored data sources, approaches, and methods to analyze the project or policy of interest. The synthesized knowledge is then utilized to provide decision-makers with targeted, practical recommendations that optimize desired health outcomes and mitigate undesired health outcomes associated with the proposed project or policy.

Health Impact Assessment involves several steps, including:

Screening
Screening involves identifying projects or policies for which HIA would be relevant and meaningful. A proposed plan is identified, and an assessment is conducted to determine the potential value that could be derived from application of the process. Careful consideration is given to project feasibility.

Scoping
Scoping includes determining the individuals or groups who will complete the HIA and advise its conduction. Next, it involves establishment of HIA goals and selection of health outcomes to be included. Due to resource limitations, many HIAs do not comprehensively evaluate all potential health outcomes associated with a policy or project, but rather focus on outcomes of greatest relevance and interest to stakeholders.

Assessment and Recommendations
Assessment begins with a description of baseline demographics and health conditions for populations that will be affected by the project. Next, baseline conditions, theory and available evidence are evaluated to project potential health impacts. Finally, the assessment step incorporates a review of the existing evidence base to identify potential strategies to optimize health impacts, which in turn inform focused recommendations for the planning team.

Reporting
Reporting involves development of an HIA report to summarize the key health impacts of the project as well as dissemination of the results and recommendations to interested stakeholders.

Monitoring
Finally, monitoring includes tracking how the HIA made an impact on the planning process, whether recommendations were adopted, and ultimately whether health was impacted.

More information about health impact assessment can be found through the Centers for Disease Control and Prevention,[3] the Health Impact Project [4] and Human Impact Partners[5]; practice standards are outlined in the National Research Council's report entitled "Improving Health in the United States: The Role of Health Impact Assessment".[6]

Raising Consideration of Health in the Downtown Crossing Project: Overview of this HIA of Phase I of the Downtown Crossing Project

The infrastructure components of Phase I of the Downtown Crossing project have the potential to directly affect health in New Haven through immediate changes to the physical environment. Additionally, Phase I will lay the foundation for later phases of the Downtown Crossing project so optimizing its design is essential.

A preliminary plan for Phase I developed by the City of New Haven was released publicly in the summer of 2011. Community members raised a number of concerns related to Phase I's potential impacts on the health and safety of vulnerable road users, defined as pedestrians and bicyclists.

As new HIA practitioners in a city where, to our knowledge, an HIA has never been conducted, our goals in conducting this HIA were two-fold:

- We sought to conduct a focused HIA of Phase I of the Downtown Crossing project in order to promote the health and safety of vulnerable road users.
- We also sought to build capacity for HIA in the city. We believed conducting an HIA on a relevant and timely New Haven project was one way to introduce HIA as a tool for considering health in all policies in the city. By directly engaging City of New Haven project experts, we hoped to familiarize and meaningfully engage this key set of decision-makers in the process of HIA so that they might recognize and consider the benefit of future HIAs. In order to more broadly build capacity, we also sponsored and led a two-day HIA training session. The session, attended by nearly 40 interested civic, community and academic stakeholders in the city, was designed to build HIA skills and to empower others to apply HIA to future projects and plans in the city.

Contents of this Report

This report contains a comprehensive description of the health impact assessment of Phase I of the Downtown Crossing project. It includes several components:

PHASE I OF THE DOWNTOWN CROSSING PROJECT: SUMMARY OF PLAN FEATURES

The Downtown Crossing project is a major transportation redevelopment project in the City of New Haven, Connecticut. It centers around redevelopment of a short section of urban highway, Route 34 East, that connects a major interstate highway on the eastern edge of the city to downtown New Haven.

Currently, the City of New Haven is developing plans for the initial phase of the Downtown Crossing project, Phase I. Phase I plans involve 1) conversion of the North and South Frontage Roads into urban boulevards, 2) reconfiguration of local street connections, and 3) reconstruction of the depressed highway bed at College Street to the grade level of the surrounding streets. This College Street grade enhancement is planned to create a new parcel of developable land adjacent to Air Rights Garage. Access tunnels are planned to be constructed below the new College street connection to carry vehicles from I-95 to Air Rights Garage.

This HIA focuses only on Phase I of the project, as plans for later phases of the Downtown Crossing project are still in development.

Downtown Crossing Project Timeline

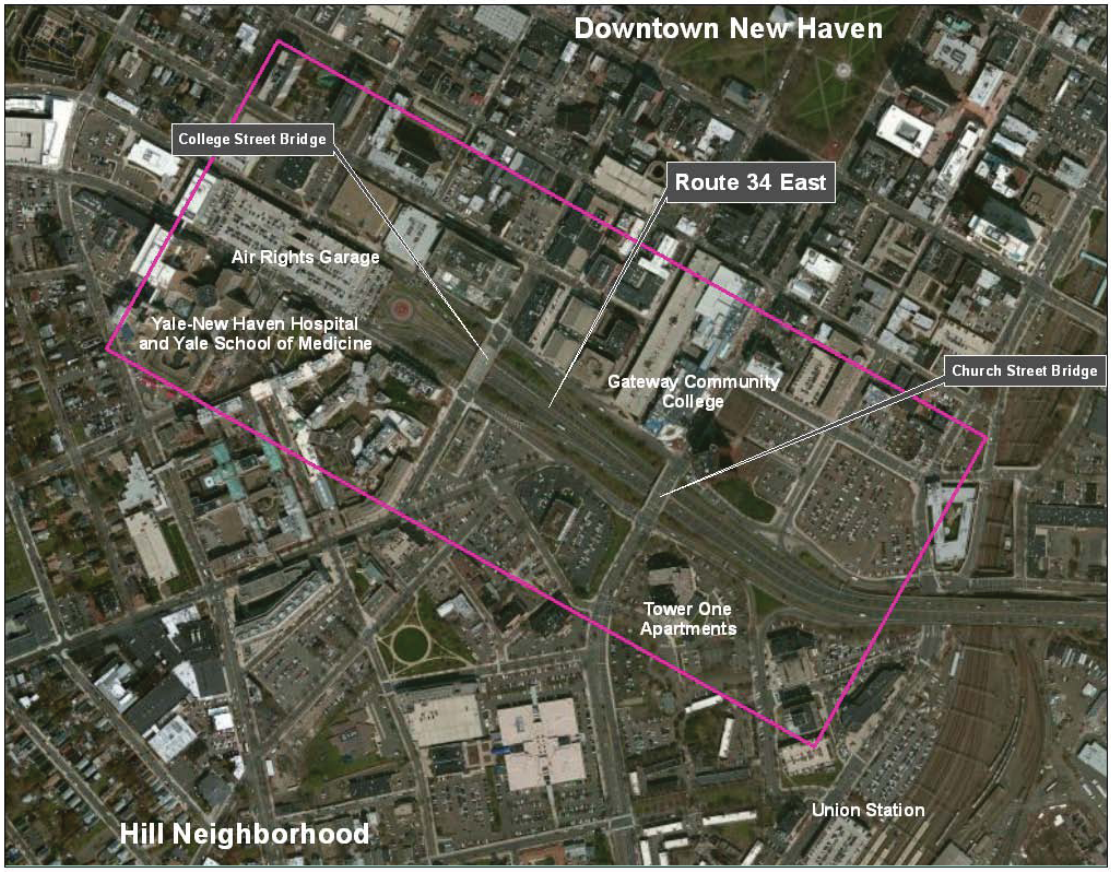
Information about the Downtown Crossing project and its timeline is available through the City of New Haven Downtown Crossing website at http://downtowncrossingnewhaven.com. As stated on the website, "The current study, which began in June 2010, includes preliminary design for the conversion of the Route 34 expressway from Union Avenue to Park Street into a network of city streets. A second phase of the study will address permitting, final design and construction phase services, and is scheduled to be completed by 2016. The overall project schedule calls for preliminary engineering to be completed in 2011and final design in 2013, leading to construction in 2014 and opening of the completed roadway improvements in 2016."

Downtown Crossing Project Area

The Downtown Crossing project is focused on redevelopment of Route 34 East, the highway segment bordered by I-95 to the east and the Air Rights Garage on the west. This area is distinct from the continuation of the road west of Air Rights Garage, commonly referred to as "Route 34 West."

Key features in the surrounding area include downtown New Haven, the Hill neighborhood, the Yale-New Haven Hospital medical center, the Tower One apartment complex, New Haven Union Station, and the recently constructed Gateway Community College (Figure 1).

Figure 1: Aerial view of the project area

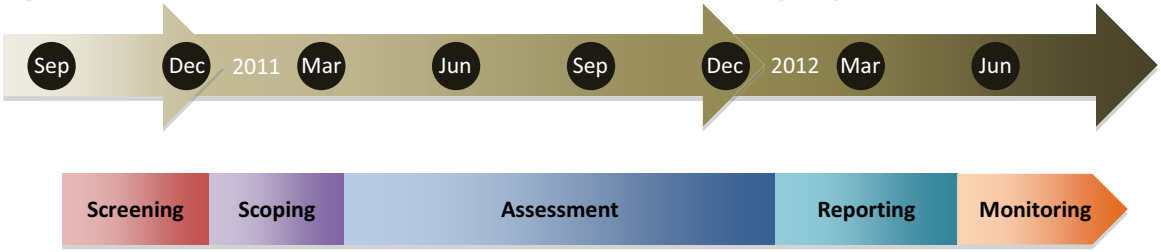


HEALTH IMPACT ASSESSMENT OF PHASE I OF THE DOWNTOWN CROSSING PROJECT: HIA PROCESS AND METHODOLOGY

HIA Timeline

This health impact assessment (HIA) was initiated in the fall of 2010 and continued through the spring of 2012, during consideration of plans for Phase I of the Downtown Crossing project. The HIA recommendations were finalized and made available for dissemination in the spring of 2012.

Figure 2: Timeline of the HIA of Phase I of the Downtown Crossing Project



HIA Steps

Screening: Identifying the value of conducting this HIA

In this first step of HIA, we (Drs. Filice and Furie) solicited feedback from community members, local organizations, and civic officials to determine the value of conducting a health impact assessment on Phase I of the Downtown Crossing project.

The Downtown Crossing project is a large, multi-year initiative that has the potential to have wide-ranging impacts on health in New Haven. In general, many New Haven residents are concerned about common health issues such as physical inactivity, obesity, and unintentional traffic injuries. The city has a large active commuting population, with a significant portion of its residents reporting walking or biking for transportation. Because of these population characteristics, a major transportation project with potential effects on physical activity and unintentional injury has the potential to significantly affect New Haven residents.

Recognizing that health had not yet been directly addressed in the Downtown Crossing project planning process, and given wide-ranging community interest in explicitly considering health in the planning process, we determined conducting an HIA related to the project could add value to the planning process and could provide useful and timely information to optimize health outcomes. The preliminary plan for Phase I of the Downtown Crossing project was in development at the time this HIA was initiated, making it a relevant target for this HIA.

Scoping: Designing the Assessment

In this second step of HIA, we assembled a project team that would complete the HIA and advise its implementation. We assumed primary responsibility for conducting the HIA. We chose to directly collaborate with New Haven government officials with the intention of establishing a precedent for HIA in city decision-making. Our goals in this approach were to foster familiarity amongst decision-makers

with HIA and lend transparency to the process with the aim of facilitating either direct or indirect participation in future HIAs in New Haven. To that end, we assembled an advisory committee composed of key project decision-makers from the City of New Haven, a data expert from the community data organization DataHaven, and academic advisors from the Robert Wood Johnson Foundation Clinical Scholars Program.

Scoping also includes identifying health impacts that will be addressed in the context of the HIA. Like residents in Connecticut and across the country, New Haven residents suffer from a number of common chronic health conditions.[7] Many of these chronic conditions can be improved through active lifestyles and behaviors. New Haven residents are also affected by traffic injuries due to motor vehicle crashes in the city[8] and along the Route 34 East corridor.[9,10] Pedestrian and cyclist injuries and fatalities, in particular, are of concern to local residents. Given this context, community members raised a number of concerns related to the preliminary Phase I plans, including concerns related to the project's potential impacts on health and safety of vulnerable road users. Because of stakeholder interest in these outcomes as well as relevance to New Haven residents, we elected to focus intensely on two primary health outcomes: physical activity and unintentional injury.

While Phase I, and later phases of this project, could be associated with a number of other relevant health determinants such as exposure to air pollution, safety from crime, access to jobs, land-use mix, housing quality, and social connectivity, these and other potential health outcomes were necessarily excluded due to resource limitations and because project plans related to these determinants were not fully formulated. Their exclusion does not diminish their importance; they will likely be relevant and important considerations in later phases of the project.

Assessment and Recommendations

One of the first steps in the Assessment phase of HIA is identification of the affected population(s). Although the Downtown Crossing project is physically adjacent to several socially and economically diverse communities whose residents could be affected by the project, it is also a major transportation corridor and its geographic location between two major New Haven destination centers (downtown and the Yale-New Haven Hospital medical complex) allows for residents of the entire city to be affected by this plan as well. As a result, we included both neighborhood-level data including data for residential Hill and Downtown neighborhoods (where available and applicable) and city-level data in the assessment.

Next, we gathered and analyzed available baseline demographic information related to the affected population(s) as well as relevant baseline health and community conditions. We used existing, publicly-available data for this portion of the assessment with one exception – we conducted a primary environmental audit to describe the "walkability" and "bikability" conditions in and around the corridor. Data sources and methodologies associated with describing baseline conditions are detailed in the Baseline Demographic and Health Section of this report.

We identified key redevelopment features of the preliminary Phase I plan, using publicly available presentation materials and documents as well as plan interpretation provided by advisory committee members.

We conducted a review of relevant public health, urban planning, and transportation planning research to 1) determine the association between proposed elements of the Phase I plan and pedestrian and cyclist physical activity and risk of unintentional injury and 2) identify evidence-based strategies to

increase levels of physical activity and reduce unintentional injury in the corridor. We hypothesized potential impacts based on a synthesis of analyses of existing conditions, review of the proposed Phase I plan, and a review of literature subjectively assessed to be relevant. We solicited additional data sources from members of our advisory committee. When available and relevant, we included evidence stratified by road user type, age, place, and gender. Due to the time and resource limitations of this health impact assessment, we used only existing data for this portion of the assessment. Using the compiled evidence, we identified roadway design features associated with positive health impacts related to physical activity and unintentional injury. These served as the basis for recommendations, specific to Phase I of the Downtown Crossing project, designed to optimize positive health impacts and mitigate negative health impacts. We intended that recommendations would inform decision-makers involved in designing the Downtown Crossing project.

Reporting

We documented the process and results of this health impact assessment in this report, which has been reviewed and approved by all members of the project's advisory committee.

Monitoring

At the time we wrote this report, the Final Phase I plans had not yet been released so Monitoring activities had not yet been conducted. The City of New Haven plans to conduct ongoing evaluations of the project. Additional monitoring could also be conducted by any project stakeholder, including those that initiated the HIA, HIA collaborators, or interested community members.

There are at least two potential approaches that could be used to monitor the effects of this health impact assessment. First, the final Phase I plan could be analyzed to determine whether recommendations made in this HIA were incorporated. Second, following completion of Phase I of the Downtown Crossing project, determinants of the health outcomes of interest (physical activity and unintentional injury) could be measured and compared to baseline conditions. These activities could lead to a better understanding of the short- and long-term effects of both the HIA process as well as the project itself.

ASSESSMENT OF BASELINE DEMOGRAPHIC AND HEALTH CONDITIONS IN NEW HAVEN AND THE PROJECT AREA

In the 1950s, the City of New Haven and the State of Connecticut designed and developed Route 34 to link the City of New Haven with communities west of New Haven. Hundreds of families and businesses were displaced to make way for the new highway, which divided the city in half. The road project continued into the 1970s but was never completed.[11] This project has had long-lasting effects on both the physical environment as well as the composition of the surrounding areas.

Demographics

Overview

The Route 34 East corridor runs between several distinct neighborhoods. The Hill neighborhood borders Route 34 East to the southeast, the Downtown neighborhood to the northeast, and the medical center to the southwest. Like residents of the city as a whole, the residents of these neighborhoods are demographically and economically diverse. Furthermore, because Route 34 East functions as a commuting corridor, its redevelopment is anticipated to impact not only those that live in the adjacent areas but also thousands of New Haven residents who traverse the area daily. Understanding the characteristics of the populations that live, work, and travel in and around the corridor is critical, as the project design could be tailored to address the health needs specific to those groups. For example, racial and ethnic minorities and economically disadvantaged populations are at higher risk for certain chronic health conditions that might be partially mitigated by increased opportunities for physical activity. Children and older adults may be at disproportionately high risk for unintentional injuries. Assessing the number of residents and workers in the area helps determine the potential number of people that will be affected by the project.

Methods

To assess basic demographic characteristics of the New Haven population in general, we used data from the U.S. Census Bureau State & County QuickFacts.[12] To assess the baseline demographic conditions of populations living in and around the corridor, we obtained data from the US Census Bureau's American Community Survey (ACS) with the American FactFinder.[13] We used five-year estimates from the period 2006-2010. ACS data was used to determine the population density (residents per square mile), percent of the population that self-identifies as white, black, or Hispanic, percent of the population over the age of 65, percent of the population under the age of 18, median household income, and percent of households without access to a motor vehicle in the areas immediately adjacent to and in communities surrounding the corridor. We used data from OnTheMap, a feature of the US Census Bureau's Labor Employer-Household Dynamics (LEHD) program[14] to determine the number of workers in the City of New Haven and in an approximate two-block buffer around the corridor. We evaluated the number of workers and worker density (number of workers per square mile) for the year 2009. We analyzed data at the census tract level (using 2010 census tract boundaries for ACS and 2000 census tract boundaries for LEHD) and mapped results using geographic information system software (ArcGIS 10, Esri, Redlands, CA).

Results

The City of New Haven is demographically different from the state as a whole, with a smaller proportion of white residents (43% vs. 78%), larger proportion of black residents (35% vs. 10%), and a larger proportion of residents of Hispanic or Latino origin (27% vs. 13%) There are more foreign-born residents (16% vs. 13%) and nearly a third of residents speak a language other than English at home (33% vs. 21%). Fewer residents own homes (31% vs. 69%), median household income is significantly lower ($39,000 vs. $68,000), and a far greater proportion of residents are below the poverty level (25% vs. 9%).[15]

The corridor is situated among a densely populated area of residents (Figure 3) and workers (Figure 4). Of the 79,518 individuals who worked within the City of New Haven in 2009, 15% (11,936) were employed within the two-block buffer around the corridor.

Figure 3: Population density (population per square mile) by census tract. Data from the ACS five year estimates, 2006-2010.

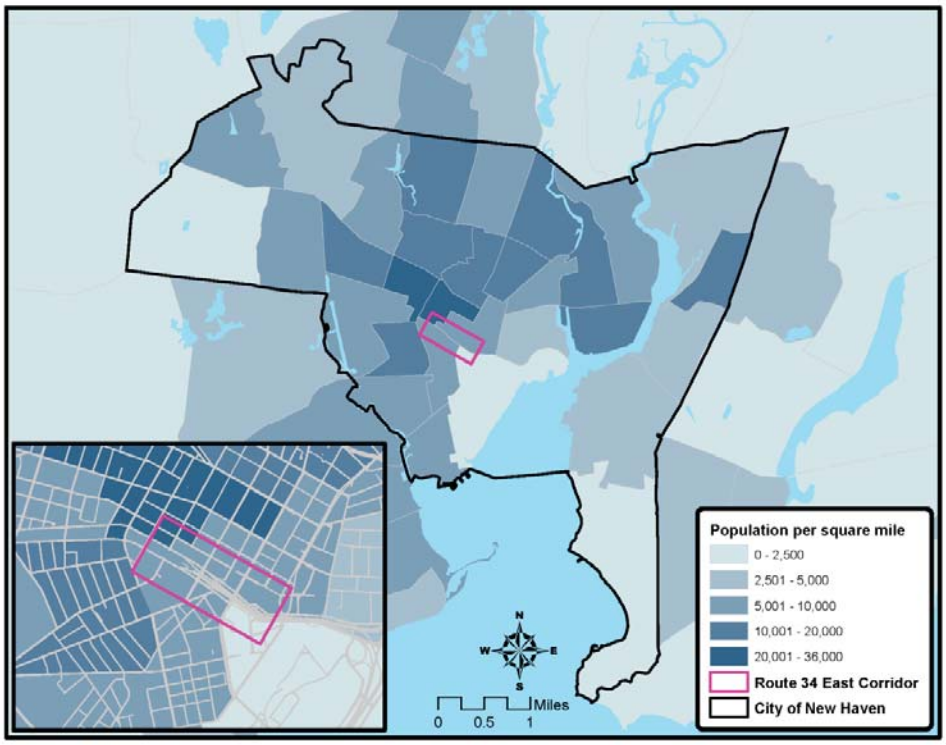
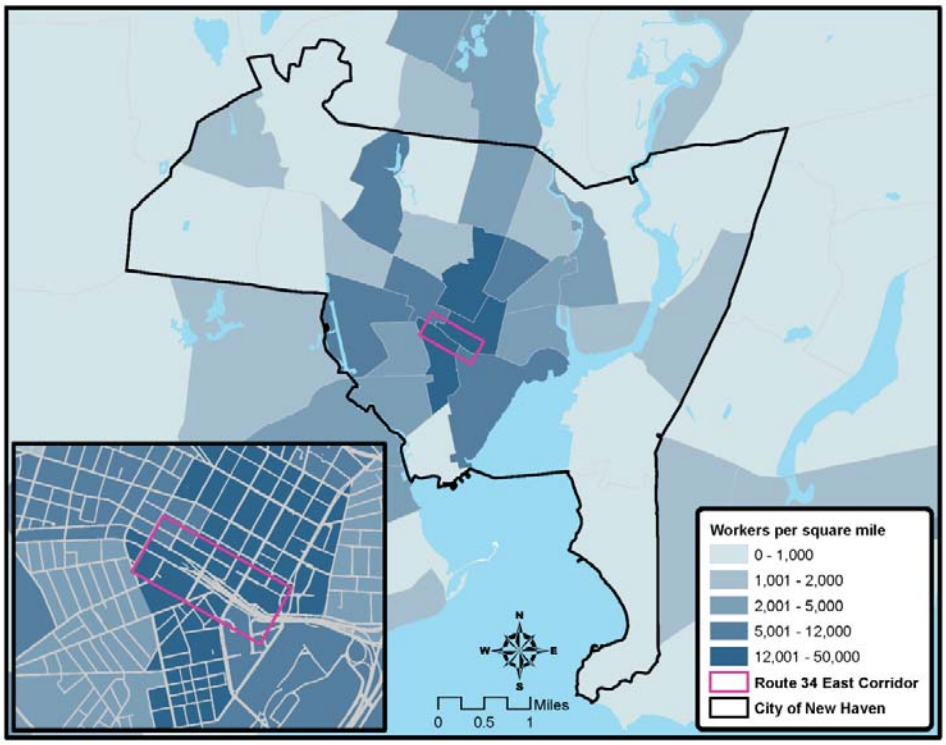


Figure 4: Worker density (workers per square mile) by census tract. Data from the LEHD program, 2009.



South of the corridor, the Hill neighborhood contains one of the highest percentages of individuals under the age of 18 in the New Haven area (Figure 5). Relative to other parts of New Haven County, a small percentage of individuals over the age of 65 live adjacent to the corridor (Figure 6). However, many elderly individuals live in the Tower One apartments, an assisted living facility that is situated at the southeastern corner of the corridor.

Census tracts south of the corridor have predominantly minority populations, with over 80% of individuals self-identifying as either black (Figure 7) or Hispanic (Figure 8). Census tracts north of the corridor also have high proportions of minority populations. Median household incomes in the areas adjacent to the corridor are low (Figure 9). All adjacent census tracts had median household incomes less than $55,000 and multiple had median household incomes of less than $35,000. Over 20% of households in census tracts close to the corridor reported not owning a vehicle (Figure 10), suggesting a dependency on public transit, walking, and biking for transportation.

Figure 5: Percent of population under the age of 18 by census tract. Data from the ACS five year estimates, 2006-2010.

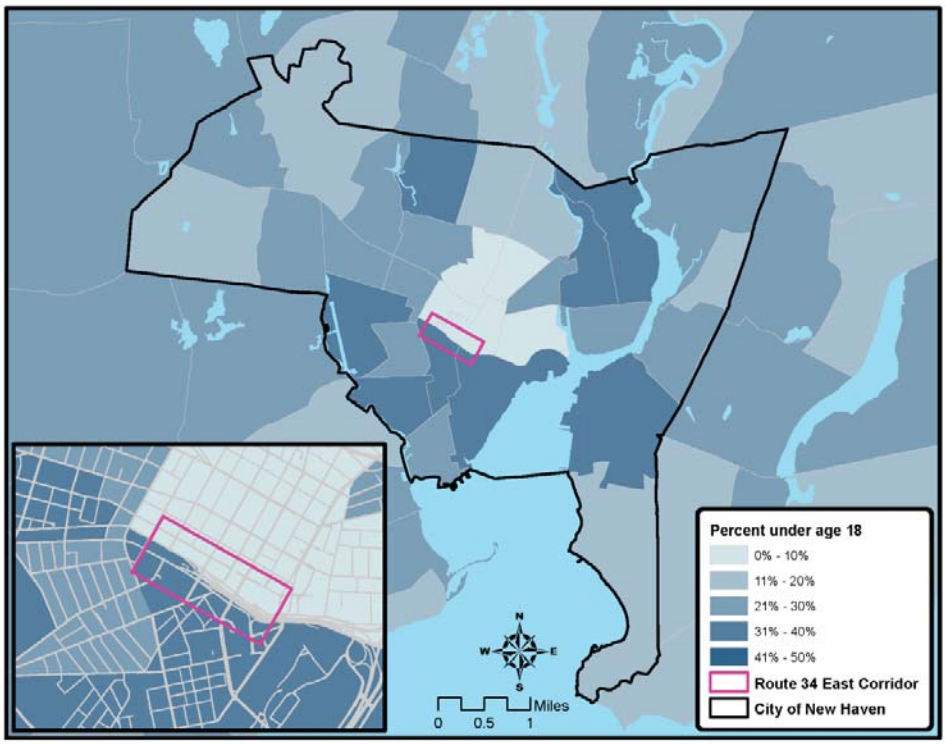


Figure 6: Percent of population over the age of 65 by census tract. Data from the ACS five year estimates, 2006-2010.

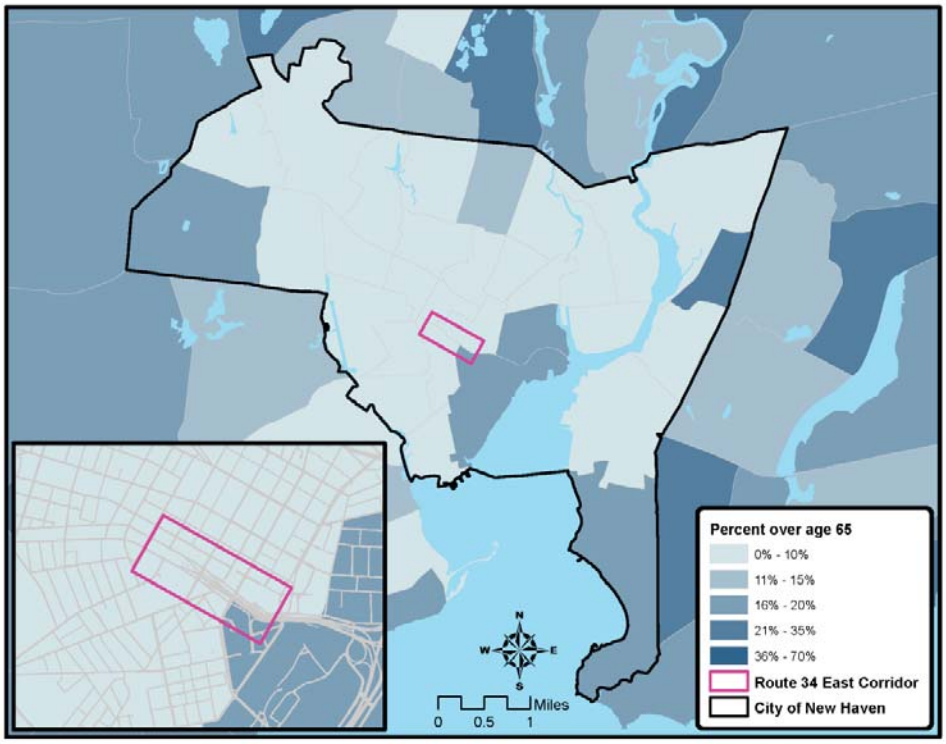


Figure 7: Percent of the population that self-identifies as black by census tract. Data from ACS five year estimates, 2006-2010.

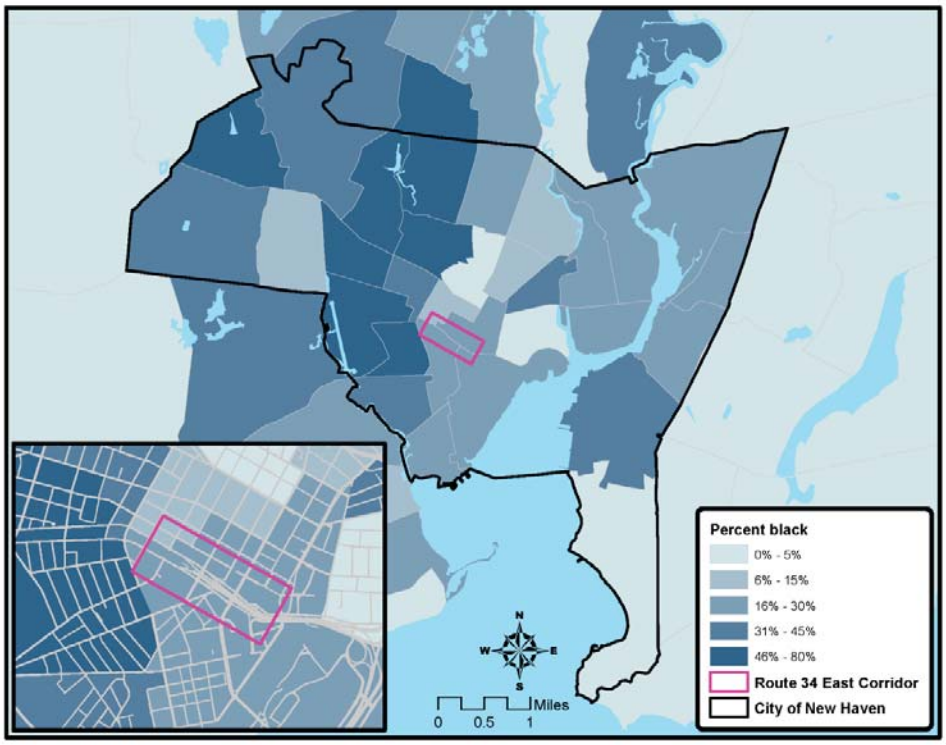


Figure 8: Percent of the population that self-identifies as Hispanic by census tract. Data from the ACS five year estimates, 2006-2010.

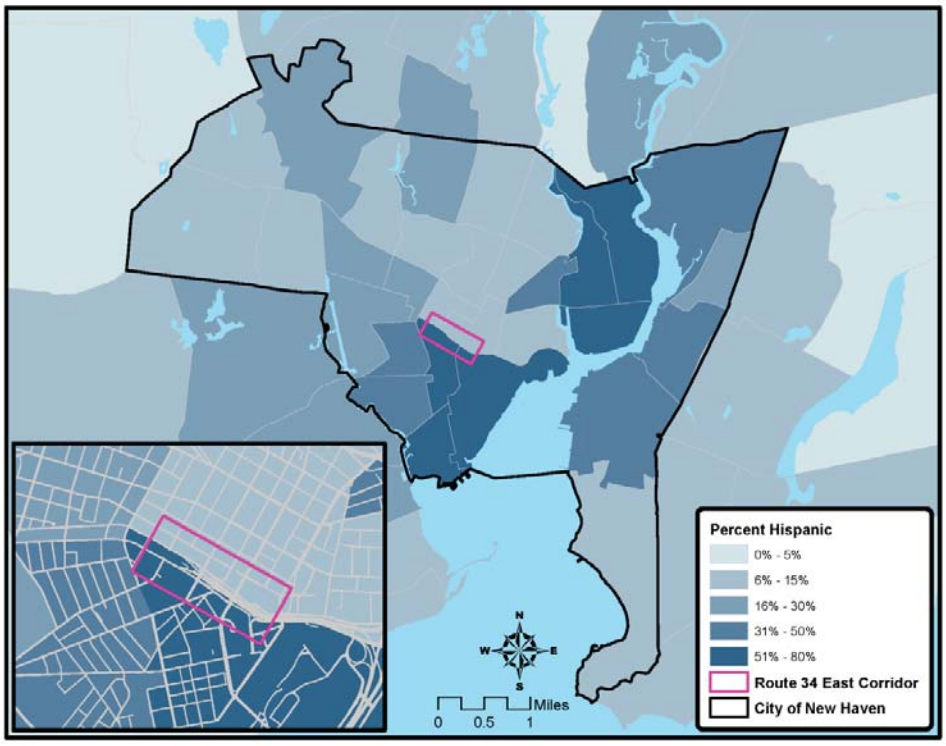


Figure 9: Median household income by census tract. Data from the ACS 5 year estimates, 2006-2010.

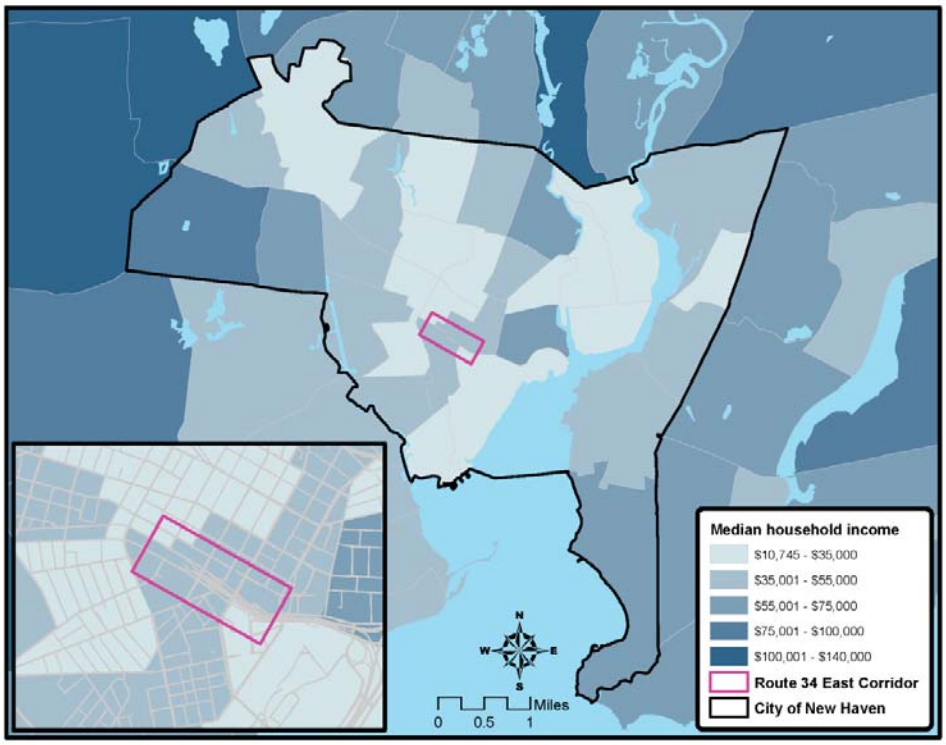
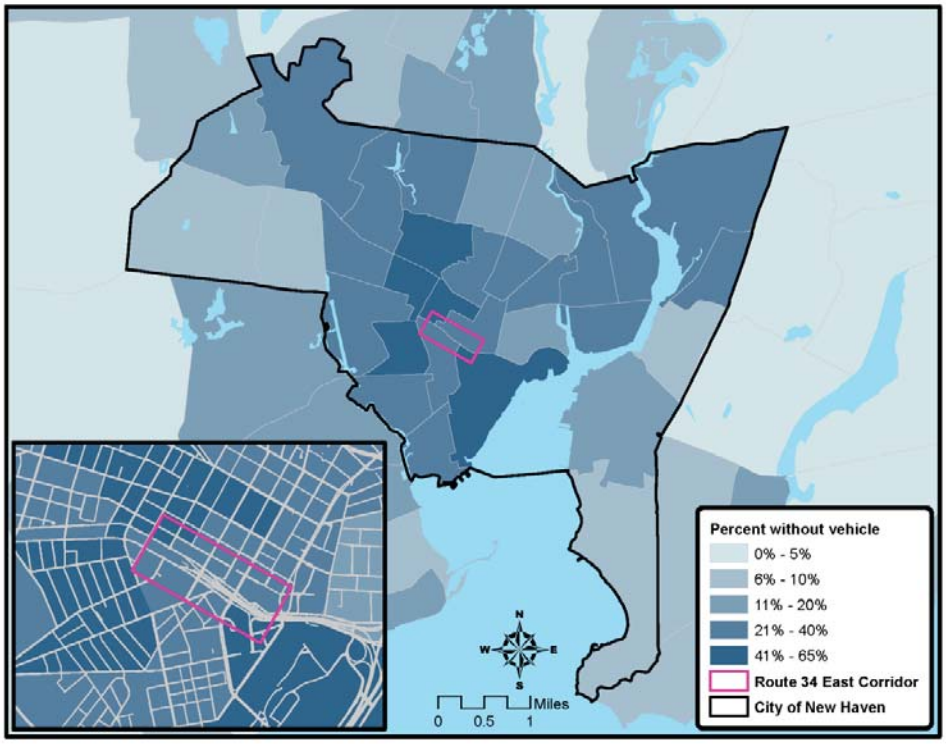


Figure 10: Percent of the population without access to a motor vehicle by census tract. Data from the ACS five year estimates, 2006-2010.



Health Conditions

Overview

Physical Activity and Health

Physical activity is undeniably linked to health. Among other benefits, it has been shown to:

- decrease mortality rates
- lower levels of heart disease and high blood pressure
- lower the risk of developing type II diabetes
- lower cholesterol levels
- relieve symptoms of anxiety and depression; and
- prevent obesity and improve body fat distribution.[16]

Despite the benefits of physical activity, many Americans still do not get recommended[17] amounts of exercise. It is estimated that nationwide, over a third of all adults do not meet physical activity guidelines. On a related note, 1 in 3 U.S. adults is obese, and almost 1 in 5 youth.[18] Environmental design strategies could help individuals meet physical activity guidelines, thereby promoting health.[19] Assessing the prevalence of baseline health conditions, specifically those related to physical activity, among individuals using the corridor provides insight into the need for an environment that encourages exercise.

Unintentional Injury and Health

Unintentional injuries, including those due to motor vehicle crashes, are the number one cause of death for Americans between the ages of 1 and 44. Motor vehicle crashes kill more people ages 5-34 than any other cause of death.[20] Most of the motor vehicle-related fatalities involve drivers or passengers in motor vehicles. However, pedestrians, cyclists and others who share the road are vulnerable as well. Over 51,000 U.S. pedestrians were injured and 4,000 pedestrians were killed in motor vehicle crashes in 2009; of the under-14 age group, pedestrian fatalities accounted for nearly a fifth of all traffic fatalities. That same year, 51,000 cyclists were injured and 630 cyclists were killed in motor vehicle crashes nationally.[21]

Methods

To assess baseline physical activity and associated health conditions of residential populations living near the corridor, we used data collected by the Community Alliance for Research and Engagement (CARE), a Yale School of Public Health program fostering rigorous community-based research and research translation in New Haven. In 2009, CARE organized a health assessment,[7] the Neighborhood Health Surveys and Asset Mapping survey, of six of New Haven's highest-risk neighborhoods – Dixwell, Dwight/West River, Fair Haven, Hill North, Newhallville, and West Rock. Health surveys, adapted from surveys administered by the national Centers for Disease Control Behavior and Risk Factor Surveillance Survey,[22] were administered by trained community members to over 1,200 randomly selected neighborhood residents. Information collected in the survey and reported in the context of this analysis includes data about general health perceptions, prevalence of common chronic health conditions, and physical activity.

Additional data collected in the CARE survey but not in the national BRFSS include data related to stress and feeling down, depressed or hopeless. All survey data was self-reported, including data assessing prevalence of health conditions. For instance, to assess prevalence of diabetes, the respondent was asked "Have you ever been told by a doctor or health professional that you have diabetes?" The Hill North neighborhood was the only neighborhood included in the survey that is directly adjacent to the Route 34 East corridor. Hill North neighborhood data is reported and compared to composite data from all six surveyed neighborhoods.

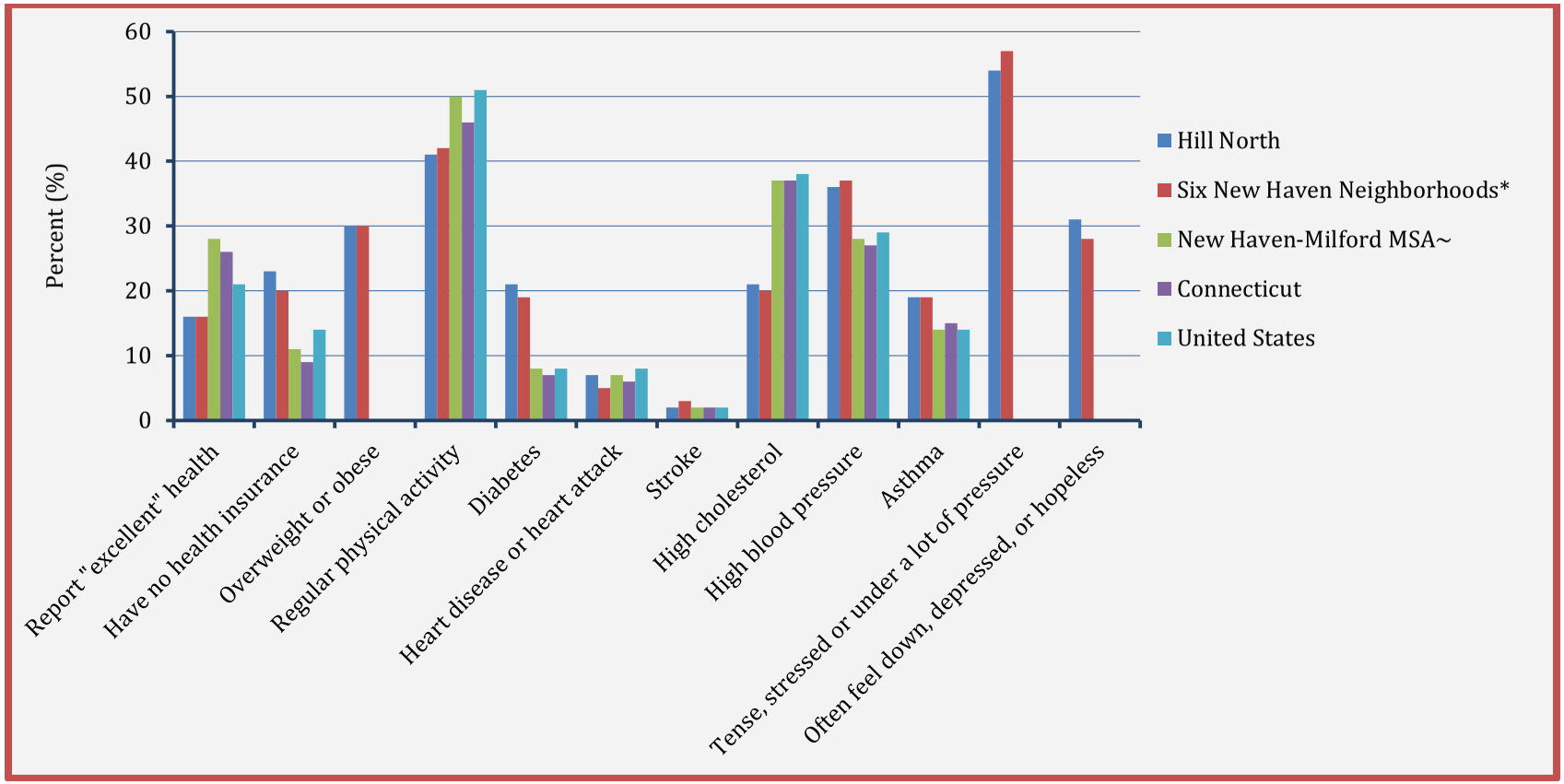
To our knowledge, there was not data available to assess neighborhood-specific health conditions in the Downtown neighborhood. Similarly, there was not a comprehensive and accessible health assessment of the employed population in the medical district so those individuals were not included in this baseline health analysis.

To assess the baseline physical activity and health conditions of residents of the broader region, we used data from the Centers for Disease Control Behavior Risk Factor Surveillance Survey (BRFSS) from the same year that the CARE survey was conducted (2009). Comparable data related to general health perceptions and prevalence of common chronic health conditions were available at the New Haven Metropolitan Statistical Area[7] (including New Haven, Milford and surrounding communities), state of Connecticut, and national (50 states and the District of Columbia) levels. Comparable data for just the City of New Haven, including all neighborhoods, was not available. Data for obesity and overweight were not compared to CARE data, because BRFSS assesses respondent's weight status by calculating BMI from self-reported height and weight data (instead of by self-reported obesity or overweight status as assessed by the CARE survey in which the respondent was asked "Have you ever been told by a doctor or health professional that you are overweight or clinically obese?"). Similarly, data related to stress and mental health were collected differently in the CARE survey than the national BRFSS so were not included for the broader region populations.

Results

Compared to residents of the broader region, state and country, residents of the Hill North neighborhood and the other five surveyed neighborhoods less frequently reported "excellent" health and more frequently reported having no health insurance. They less frequently reported participating in regular physical activity, and disproportionately suffer from common health conditions associated with inactivity including diabetes and high blood pressure and other common conditions including asthma. Hill North and other surveyed neighborhood residents reported having heart disease and stroke at rates similar to residents of the broader region, state, and country. Interestingly, surveyed residents reported having high cholesterol less frequently than residents of the region, state, or country. This could be related to the fact that more residents report not having health insurance; since high cholesterol is diagnosed with a blood test, diagnosis requires access to a health care provider. About a third of Hill North and other surveyed neighborhood residents report being overweight and obese, and a similar proportion report that they "often feel down, depressed or hopeless". Over half report feeling "tense, stressed or under a lot of pressure". Figure 11 depicts baseline health conditions in the Hill North neighborhood, a composite of six disadvantaged New Haven neighborhoods included in the CARE survey, the New Haven-Milford Metropolitan Statistical Area, state of Connecticut, and the United States.

Figure 11: Self-reported general health, physical activity, and related health outcome data from residents in the Hill North neighborhood, a composite of six New Haven neighborhoods (*Dixwell, Dwight/West River, Fair Haven, Hill North, Newhallville and West Rock), the New Haven-Milford ~Metropolitan Statistical Area, Connecticut, and the United States. Data from the Community Alliance for Research and Engagement[7] (2009) and the Centers for Disease Control BRFSS[22] (2009).



Summary of Baseline Demographic and Health Conditions

A large population of residents and workers who live or work around Route 34 East could be affected by the proposed Downtown Crossing project. Like residents and workers across the state and country, New Haven residents and workers face health conditions including obesity, high blood pressure, diabetes, and heart disease. These and other health conditions can improve with exercise. Many area households do not own cars, so people commonly use public transit, walking and bicycling for transportation and commuting. These findings suggest that providing an environment that is attractive and safe for walking and bicycling is of paramount importance.

ASSESSMENT AND RECOMMENDATIONS

Projecting Impacts and Providing Recommendations

We conducted a review of relevant public health, urban planning, and transportation planning research to 1) determine the association between proposed elements of the Phase I plan and pedestrian and cyclist physical activity and risk of unintentional injury and 2) identify evidence-based strategies to increase levels of physical activity and reduce unintentional injury in the corridor. We hypothesized potential impacts based on a synthesis of analyses of existing conditions, review of the proposed Phase I plan, and a review of literature subjectively assessed to be relevant. The literature review consisted of targeted searches of the PubMed, Scopus, and WebofKnowledge electronic databases. We solicited additional data sources from members of our advisory committee. When available and relevant, we included evidence stratified by road user type, age, place, and gender. Detailed consideration of the quality of execution of included studies was not possible given the scope and resources available to conduct this review. Broadly speaking, the evidence base in these areas of inquiry is limited and many studies are cross-sectional which allows for identification of associations between outcomes of interest and explanatory variables but limits determinations of causality. Subsequently, based on evidence from the literature review, we developed recommendations for design strategies that may increase pedestrian and cyclist physical activity and reduce unintentional injury.

Balancing HIA Recommendations with Other Project Goals

Health impact assessment is used to evaluate the potential health impacts of a proposed project. By definition, it assesses policies and projects through the lens of public health in order to provide practical recommendations to optimize health outcomes. However, health is one of many potential outcomes associated with a project. The recommendations of a health impact assessment must be considered in the context of multiple competing considerations and limitations that affect a project's design.

Promoting Physical Activity

Existing Conditions Analysis

Pedestrian and Bicyclist Environment

Overview

In order to assess the potential impact of Phase I of the Downtown Crossing project on walking and biking, it is critical to understand how the quality of the current environment accommodates non-motorized users along the corridor. To accomplish this assessment, we conducted a comprehensive inventory of the existing bicycle and pedestrian environment using two environmental audit tools developed by the San Francisco Department of Public Health. We also reviewed data from a recent community survey to assess perceptions of safety and accessibility of walking and bicycling facilities among local residents.

Pedestrian Environmental Quality Index and Bicycle Environmental Quality Index

The Pedestrian Environmental Quality Index (PEQI)[23] and Bicycle Environmental Quality Index (BEQI)[24] are environmental audit tools used to assess the suitability of an environment for pedestrian and cyclists. The PEQI and BEQI incorporate weighted scoring of selected features of the built environment (Tables 1 and 2) that are thought to affect pedestrian and cyclist activity and safety. Both tools generate a composite score for intersections and each side of a street segment. Based on the scores, intersections and street segments are classified as having unsuitable, poor, basic, reasonable, or ideal

conditions for pedestrians or cyclists. The PEQI and BEQI were used to audit the roadways along Route 34 East and those in the immediate surrounding area that may be affected by the project.

In September of 2011, auditors from the RWJF Clinical Scholars Program (CF and GF), the Southern Connecticut State University Department of Public Health (SB and SB), and the Yale School of Public Health (SD) independently assessed both sides of each street segment and all intersections within one block of the project area. We collected data for both the BEQI and PEQI according to the manuals available from the San Francisco Department of Public Health (SFDPH). We entered complete records into a customized Microsoft Access database initially designed by the SFDPH and modified for the current audit by the research team. Two auditors (CF and GF) returned to each street segment to reach a consensus agreement on the appropriate scoring of audit items for which there were discordant responses during the initial data collection period. We used data to create maps in ArcGIS 10 (Esri, Redlands, CA) in order to provide a visual representation of the PEQI and BEQI ratings for both sides of each audited street segment and intersection.

Table 1: Items included in the Pedestrian Environmental Quality Index (PEQI)

Intersection Safety	Traffic	Street Design	Perceived Safety	Land Use
Crosswalks	Number of vehicle lanes	Width of sidewalk	Illegal graffiti	Public art/historic sites
Ladder crosswalk	Two-way traffic	Sidewalk impediments	Litter	Restaurant and retail use
Countdown signal	Vehicle speed	Large sidewalk obstructions	Lighting	
Signal at intersection	Traffic volume	Presence of curb	Construction sites	
Crossing speed	Traffic calming features	Driveway cuts	Abandoned buildings	
Crosswalk scramble		Trees		
No turn on red		Planters/gardens		
Traffic calming features		Public seating		
Additional signs for pedestrians		Presence of a buffer		

Table 2: Items included in the Bicycle Environmental Quality Index (BEQI)

Intersection Safety	Traffic	Street Design	Safety/Other	Land Use
Left turn bicycle lane	Number of vehicle lanes	Connectivity of bike lanes	Bicycle/Pedestrian scale lighting	Line of sight
Dashed intersection bicycle lane	Vehicle speed	Trees	Presence of bicycle lane signs	Bicycle Parking
No turn on red signs	Traffic calming features	Width of bike lane		Retail use
	Parallel parking adjacent to bike lane/route	Presence of a marked area for bicycle traffic		
	Traffic volume	Pavement type/condition		
	Percentage of heavy vehicles	Driveway cuts		
		Street slope		

We evaluated 31 street segments and 28 intersections (Table 3). In general, we found existing conditions inadequate for pedestrians and cyclists. Most street segments had poor or basic pedestrian conditions (Figure 12), although a small number had reasonable conditions. There were no street segments with ideal pedestrian conditions. The worst pedestrian conditions were concentrated along the North and South Frontage roads. Except for one intersection rated as reasonable, all intersections were rated as unsuitable, poor, or basic for pedestrians. All segments were rated as poor or basic for cyclists (Figure 13). Two intersections were rated as poor for cyclists, but all others were found to be unsuitable.

Table 3: Number and percent of intersections and street segments rated as unsuitable, poor, basic, reasonable, or ideal in the PEQI and BEQI.

	All		Unsuitable		Poor		Basic		Reasonable		Ideal	
	#	%	#	%	#	%	#	%	#	%	#	%
PEQI												
Intersections	28	100%	12	43%	3	11%	12	43%	1	4%	0	0%
Streets	62	100%	0	0%	21	34%	33	53%	8	13%	0	0%
BEQI												
Intersections	28	100%	26	93%	2	7%	0	0%	0	0%	0	0%
Streets	62	100%	0	0%	45	73%	17	27%	0	0%	0	0%

Figure 12: Results of the Pedestrian Environmental Quality Index (PEQI)

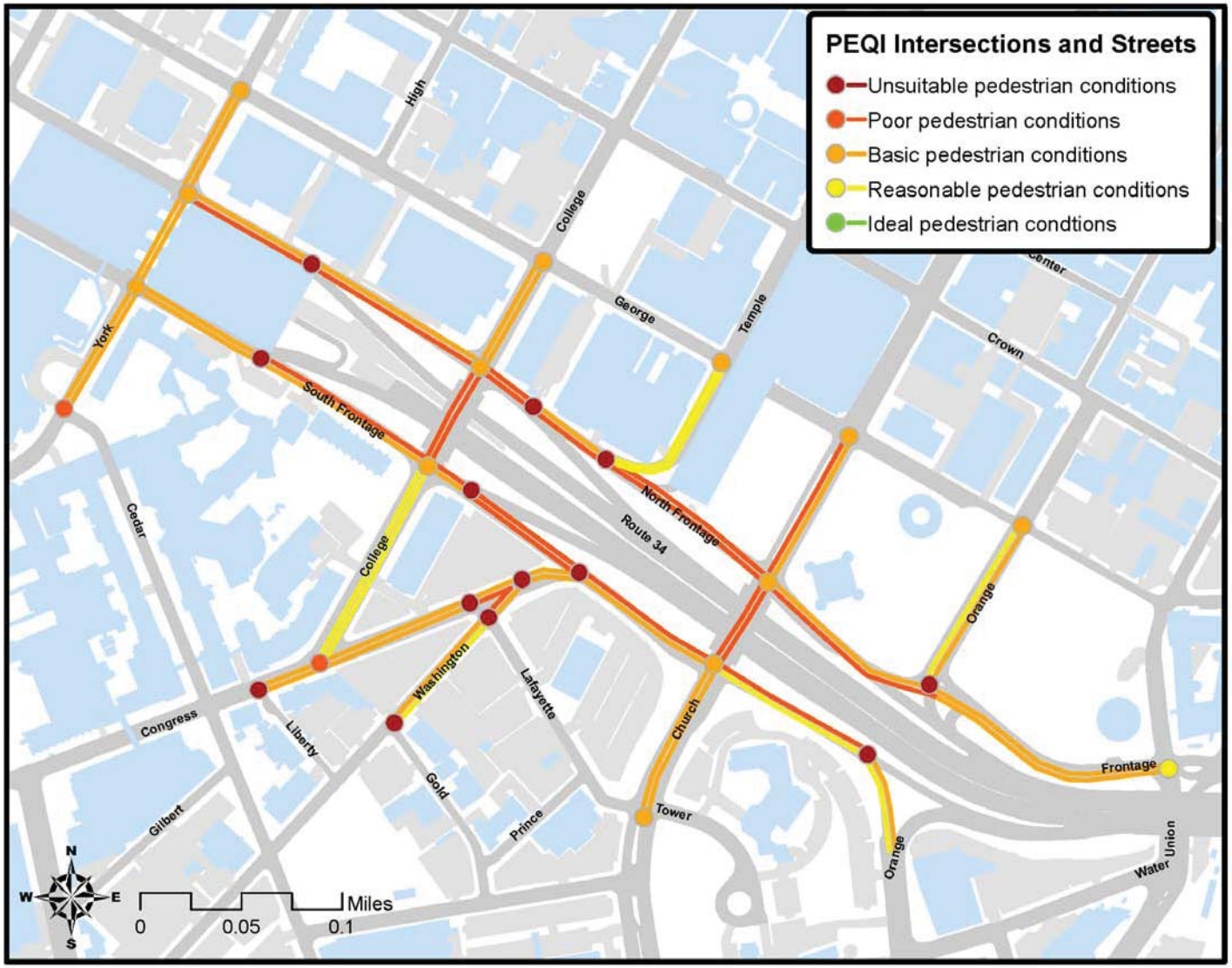
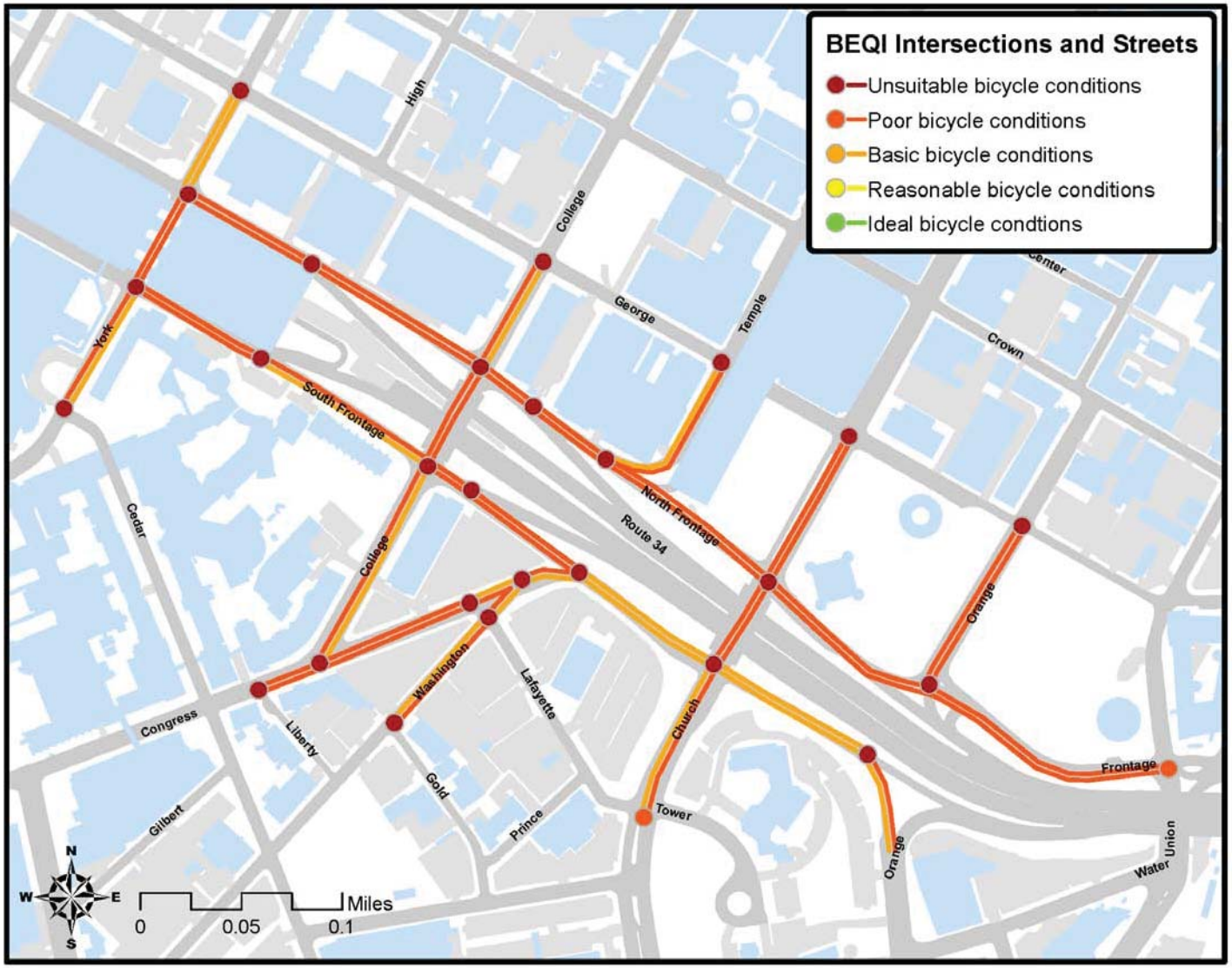


Figure 13: Results of the Bicycle Environmental Quality Index.



Community Alliance for Research and Engagement (CARE) Neighborhood Health Surveys and Asset Mapping

Additional data collected in the Community Alliance for Research and Engagement health assessment[7] survey assessed perceived safety and availability of neighborhood pedestrian and bicycling facilities. Thirty-one percent of Hill North neighborhood residents disagreed with the statement "There are safe sidewalks and crosswalks on most of the streets in my neighborhood" and 66% disagreed with the statement "There are facilities to bicycle in or near my neighborhood that are safe from traffic, either on the streets or on special lanes, paths or trails". This suggests that there is a significant perceived lack of safe facilities for walking and bicycling.

Mode of Transportation

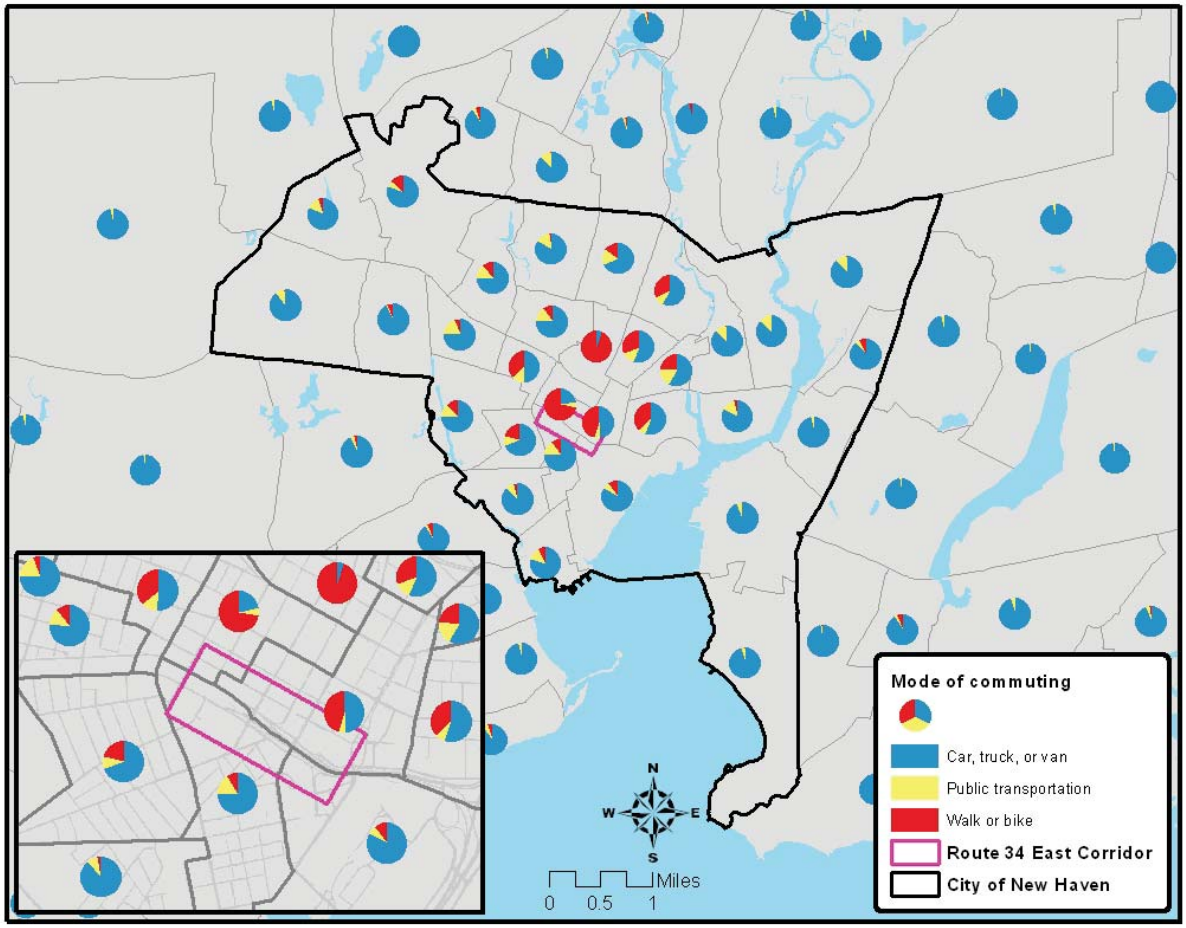
Overview

Many individuals live or work in or around the Route 34 Corridor. The design of the Downtown Crossing project could encourage local residents and employees to use public transit, walk, or cycle for transportation, all of which have been associated with health benefits. To assess the potential impact of improved walking and bicycling facilities in and around the Route 34 Corridor, we conducted a review of commuting patterns. We identified four sources, described below, to investigate the commuting behavior of residents and workers into and out of the Corridor and surrounding areas. Sources included US Census Bureau data on commuting mode choices, US Census Bureau data on the relative locations of people's homes and places of employment, a Yale University Commuter Survey, and data from the Yale New Haven Hospital Transportation Demand Management Program.

US Census Bureau Data on Commuting Mode Choice

We obtained self-reported mode of transportation for commuting (motor vehicle, public transit, or walking and cycling) from the US Census Bureau's American Community Survey using 5-year estimates from 2006-2010[13] and analyzed data at the census tract level. Census tracts closest to the Route 34 East corridor demonstrated some of the highest levels of public transit use and walking and cycling for the purpose of commuting, consistent with the socio-demographic characteristics of the surrounding communities and the nature of densely populated urban environments. This is highlighted in Figure 14, which depicts the relative proportion of each of the three major modes of commuting by census tract. Appendix 1 demonstrates the percentage of commuters who commuted by motor vehicle, public transportation, or by walking and cycling, respectively, by census tract.

Figure 14: Percent of population that commutes either 1) by car, truck or van (CTV), 2) by public transportation (Public), or 3) on foot or by bike (WalkBike). Data from the ACS 5 year estimates, 2006-2010.



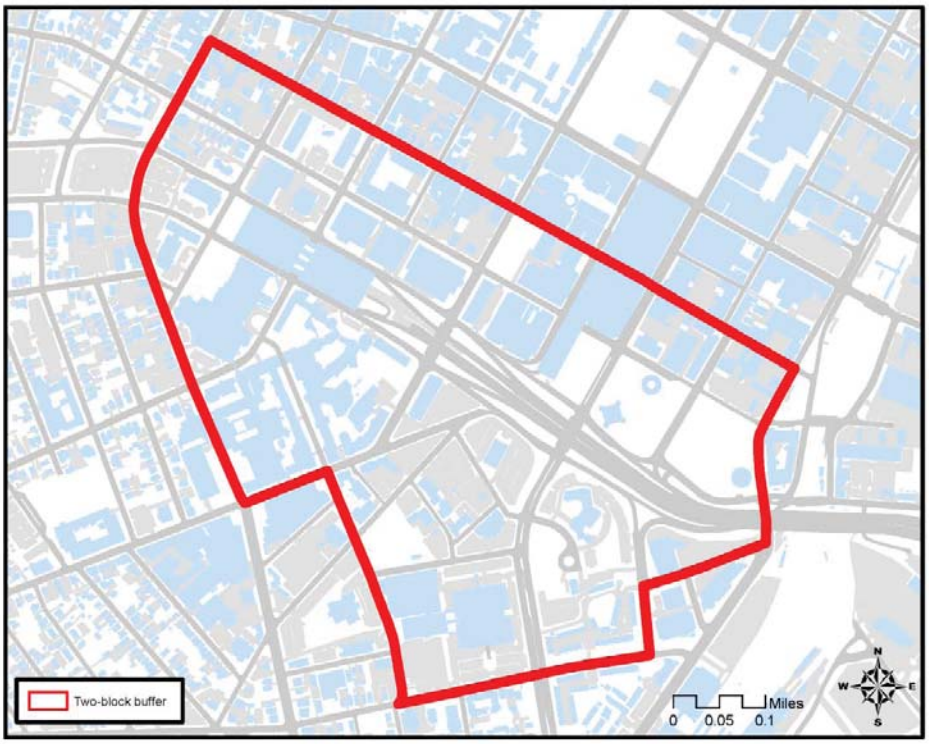
Analysis of Home Locations of Employees Working in Close Proximity to the Route 34 Corridor

Many individuals who live within close proximity to their place of employment could increase their levels of physical activity by walking or biking to work. Providing an environment that is inviting and safe for pedestrians and cyclists is essential to facilitating increased use of these commuting modes.

OnTheMap[25] provides access to the US Census Bureau's Longitudinal Employer-Household Dynamics database which links individuals' places of residence with their places of employment. This information can be used to evaluate the relative distance and direction between people's homes and workplaces. This data was used to determine the percentage of people who work in or adjacent to the Route 34 Corridor who could potentially walk or bike to work.

An approximate two-block buffer around the corridor was defined using ArcGIS (Figure 15).

Figure 15: Approximate two block buffer around Route 34 East corridor used for analysis of local workers.



Using OnTheMap, we identified all employees working within the buffer in 2009. We then determined the proportions of employees who lived in census tracts that were within one mile, two miles, and five miles of the buffer (Table 4). Many of the census tracts with the highest numbers of residents who work in or adjacent to the corridor were within five miles of the corridor (Figure 16). After accounting for the relative sizes of different census tracts, those census tracts with the largest number of corridor employees per square mile were within one mile of the corridor (Figure 17).

Table 4: Number of workers within a two block buffer of Route 34 East who live in a census tract within one, two, or five miles of the buffer. Data from the Labor Employment-Household Dynamics program, 2009.

	All	Live within 1 mile	Live within 2 miles	Live within 5 miles
Number of workers in buffer	11,936	1,066	2,285	4,904
Percent of all workers in buffer	100%	9%	19%	41%

Figure 16: Number of individuals who work within a two-block buffer of Route 34 East by home census tract. Data from the LEHD program, 2009.

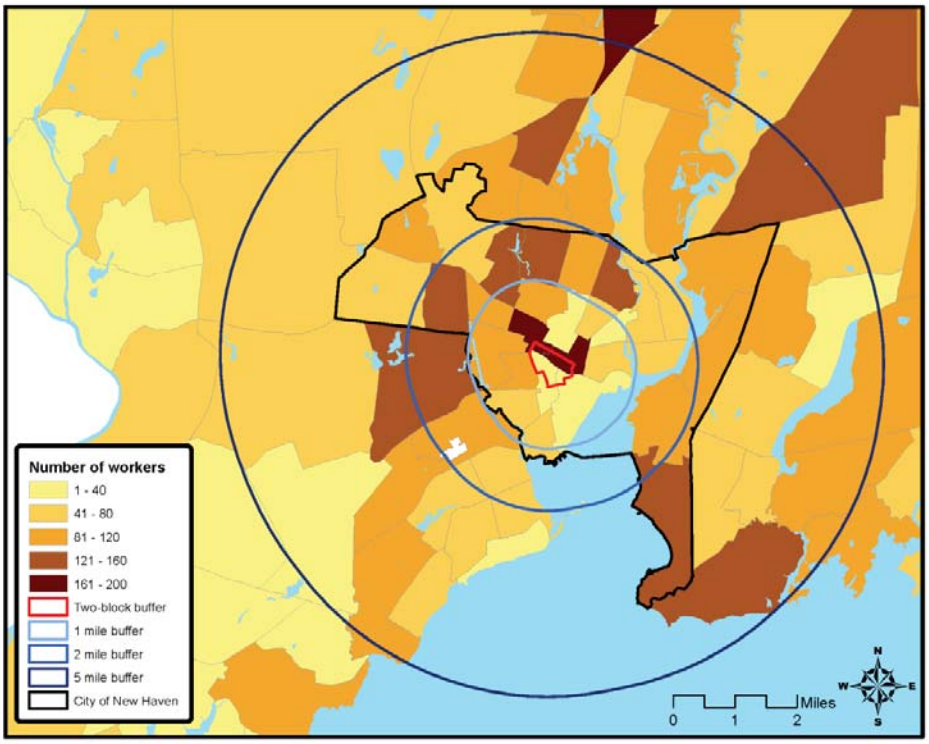
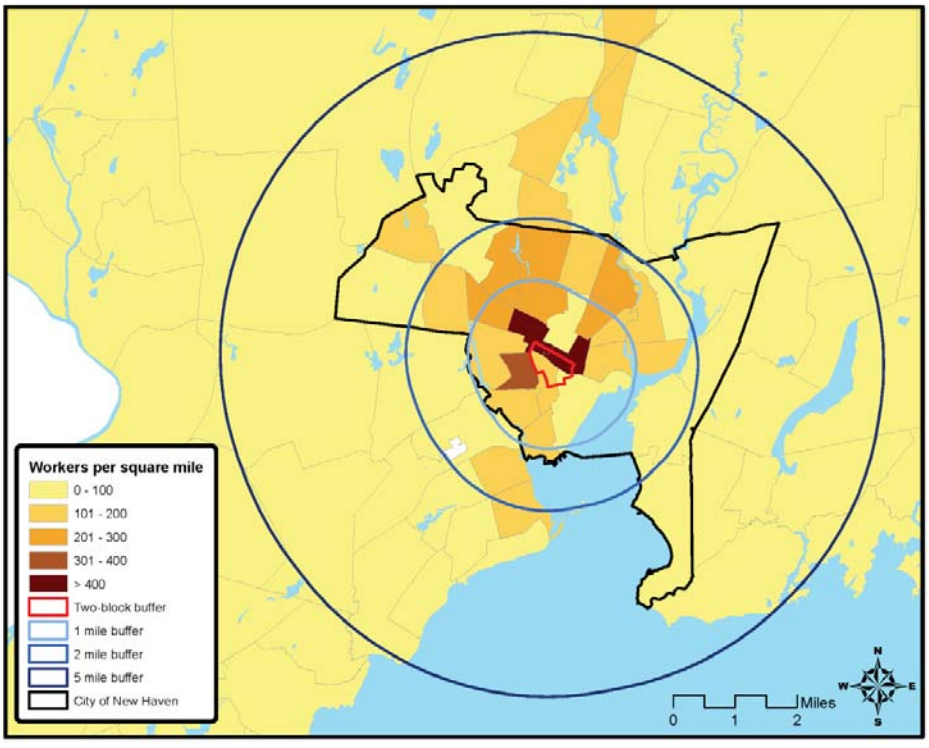


Figure 17: Density of individuals who work within a two-block buffer of Route 34 East by home census tract (workers/square mile of home census tract). Data from the LEHD program, 2009.

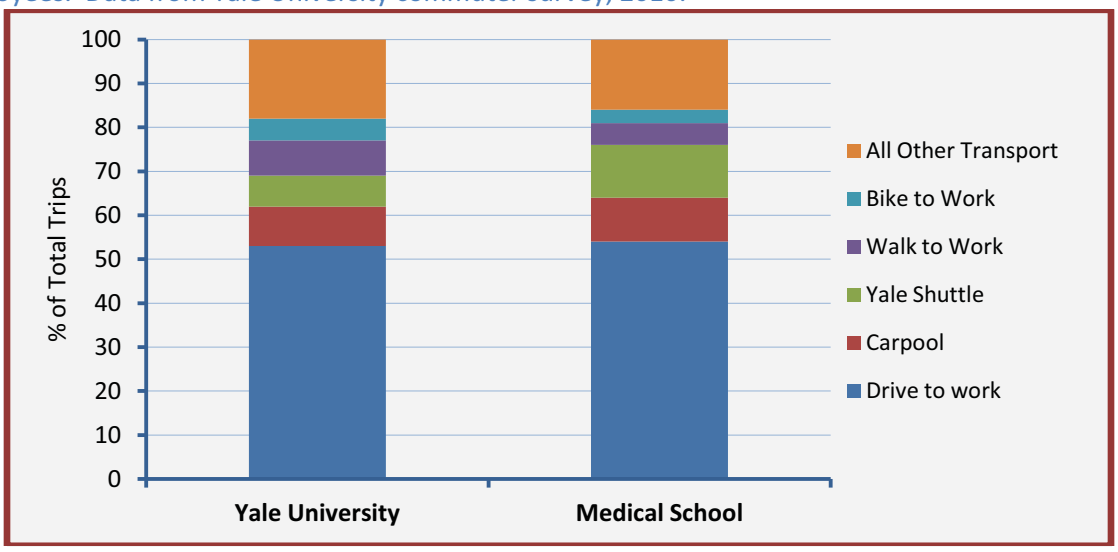


Yale University Commuter Survey

Yale University conducts a commuter survey annually. The survey includes a representative, stratified random sample of the commuting population, including faculty, service and maintenance staff, clerical and technical staff, managerial staff, graduate students and postdoctoral fellows and associates. Respondents are asked to report their commuting patterns in the week prior to survey administration.

In 2010, 997 total respondents completed the commuter survey (out of a total population of approximately 18,000 potential commuters). Figure 18 shows the mode share of commuting populations at the Yale School of Medicine ("Medical School", n=250) and all Yale University commuters (n=997). Approximately one-tenth of commuters at the Yale School of Medicine and at Yale University report walking or biking to work in the past week.

Figure 18: Breakdown of commuting mode share for surveyed Yale University and Yale Medical School Employees. Data from Yale University commuter survey, 2010.



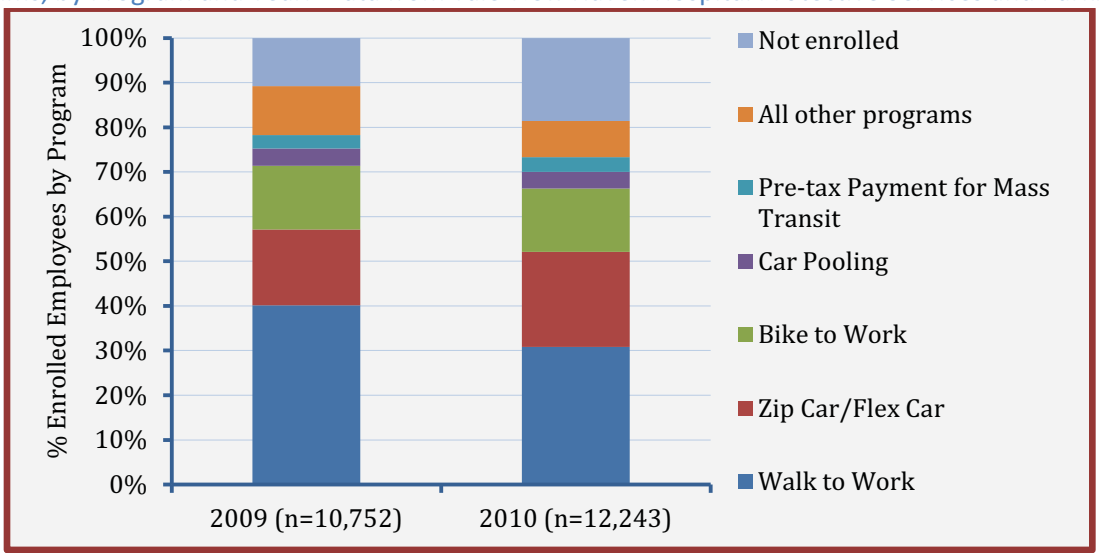
* "All Other Transport" includes employees who commuted by Shoreline East, MetroNorth, Amtrak, Connecticut Transit, or Dattco commuter shuttle, or who were dropped off, drove alone then took a shuttle/bus/train, or teleworked.

Yale New Haven Hospital Transportation Demand Management Program

Yale-New Haven Hospital (YNHH) also annually collects information about employees enrolled in its Transportation Demand Management Program. Employees include Yale-New Haven Hospital employees and long term contractual staff, Yale School of Medicine faculty, students (from medical, public health, and physician assistant training programs), doctoral scientists, and postdoctoral fellows and associates. The number of employees enrolled in each of 11 programs is tracked, as is total number of employees (10,752 in 2009, and 12,243 in 2010).

Figure 19 depicts employee enrollment in YNHH Transportation Demand Management Programs in 2009 and 2010, by program enrollment. A large proportion of Yale-New Haven Hospital Employees are enrolled in a Transportation Demand Management Program, with approximately half of employees enrolled in either a Walk to Work or Bike to Work program each year. Data is specific to enrollment; data capturing use of each Transportation Demand Management program was not available.

Figure 19: All Yale-New Haven Hospital Employees, Enrollment in Transportation Demand Management Programs, by Program and Year. Data from Yale-New Haven Hospital Protective Services and Parking.



* "All other programs" includes Mass Transit Subsidy (mass transit subsidies/discount), Nu-Ride (ride-sharing program with incentives), Van Pools (formal van pool program), Motorcycle Pool, Telecommuting, Park&Ride commuter lots and commuter shuttle.

Summary of Existing Conditions Analysis

The quality of existing conditions for pedestrians and cyclists in the corridor is generally poor and may serve as a barrier to walking and biking for the purpose of transportation or recreation. Our analysis demonstrates that there are many individuals who live or work near the corridor who stand to benefit from efforts to create an environment that is more conducive to walking and cycling. This population includes individuals who lack access to a motor vehicle, feel that their neighborhood is often unsafe or unsuited for walking or bicycling, or live within walking or biking distance of their jobs in the corridor. There appears to be interest in opportunities to walk or bike to workplaces near the corridor. Additionally, more individuals who work in or around the corridor might be willing to take transit to Union Station if walking or cycling from the station through the corridor was more appealing.

Projected Impacts and Recommendations: Physical Activity

Objective 1: Promoting Pedestrian Physical Activity

Impacts of Current Proposal

Given the current poor conditions for pedestrians along the corridor and the enhanced pedestrian amenities proposed in the preliminary design, it is anticipated that the project will increase the amount of walking in the corridor. Certain elements of the current design may be associated with increased pedestrian activity. Proposed improvements in pedestrian signals and traffic calming features could promote walking. Nonetheless, additional design features might further increase pedestrian activity.

Recommendations

Studies from the public health and planning literature suggest some features of the built environment may be associated with increased levels of pedestrian activity. The following recommendations, developed through a literature review conducted in the context of this specific proposal, could enhance the existing design in regards to promoting walking.

- ✓ **Prioritize a connected street pattern**
- ✓ **Utilize traffic calming features**
- ✓ **Increase safety and the perception of safety**
- ✓ **Consider the needs of elderly, minority, and child populations**

A full description of specific actions, priority locations, potential health effects, and representative supporting literature can be found in Appendix 2-A.

Objective 2: Promoting Bicyclist Physical Activity

Impacts of Current Proposal

The current proposal includes increased facilities for cyclists including cycle tracks, bike lanes, and bike boxes. Although existing research does have limitations, there is evidence to suggest that providing cycle tracks (bike lanes protected from traffic by physical barriers; see glossary) and bike lanes is associated with increased cycling. It is anticipated that the current proposal will therefore have positive effects on cyclist activity. Although there is no literature assessing the impact of bike boxes (pavement markings to facilitate bicycle turning maneuvers at intersections; see glossary) on cyclist activity, data does suggest an increased perception of safety associated with bike boxes that may, in turn, promote cycling. However, the impact of bike facilities on levels of cycling is mediated by numerous factors that must be considered in the design process. In particular, careful attention to cyclists perception of safety from injury, cycle track and bike lane locations and routing, and connectivity of bicycle facilities could enhance the potential impact of the project on cyclist activity.

Recommendations

While the current proposal is expected to increase cyclist activity in the corridor, levels of cycling could be further enhanced. The following recommendations, developed through a literature review conducted in the context of this specific proposal, could enhance the existing design in regards to promoting walking.

- ✓ **Increase cycling activity of current non-cyclists by enhancing the perception of safety**
- ✓ **Provide cycle tracks and bike lanes where appropriate for road traffic volume**
- ✓ **Locate bicycle facilities along most desirable routes for cyclists**
- ✓ **Maximize connectivity of cycle tracks and bike lanes**
- ✓ **Increase access to secure bike storage and shower facilities at destinations**
- ✓ **Implement multifaceted cycling promotion interventions simultaneously**

A full description of specific actions, priority locations, potential health effects, and representative supporting literature can be found in Appendix 2-B.

Promoting Safety and Reducing Unintentional Injury

Existing Conditions Analysis

Crash Analysis

The design of the built environment can have important influences on motor vehicle crashes resulting in unintentional injuries to pedestrians and cyclists. We conducted a motor vehicle crash analysis in order to evaluate the risk of unintentional injury given existing conditions and how proposed changes could affect this risk. Unfortunately, little data exists on the number of crashes specifically involving motor vehicles and either pedestrians or cyclists in the corridor. Therefore, we used the total number of motor vehicle crashes (recognizing that most involved only motor vehicles) as a marker of the potential risk of unintentional injury to pedestrians and cyclists.

This analysis captures all crashes involving motor vehicles, including those that involved cyclists and pedestrians, at city street intersections adjacent to Route 34 East or on segments of Route 34 East during the year 2008. Data for city street intersection crashes was derived from New Haven Police Department reports and graphically depicted using ArcGIS 10 (Esri, Redlands, CA) with assistance from the New Haven Department of Transportation, Parking and Traffic. Due to limitations in the recording of police reports, some crashes that occur on city street segments rather than at an intersection may not be reflected in the data. Furthermore, crashes that were not reported and for which no formal police report was filed are not reflected in the database. The data, therefore, underestimates the total number of crashes on city streets. The analysis also depicts crashes along Route 34 East, a state highway. Data for Route 34 East crashes was obtained from the Connecticut Department of Transportation using the Traffic Accident Viewing System.[26]

Route 34 East is a hotspot for motor vehicle crashes in the City of New Haven. Figure 20 demonstrates that intersections in the corridor have the highest numbers of motor vehicle crashes of all intersections in the City, suggesting that the corridor is likely a dangerous environment for pedestrians and cyclists as well. Figure 21 demonstrates that the intersections of the North and South Frontage Roads with York Street are particularly dangerous, as is the intersection of the North Frontage Road and College Street.

Figure 20: Map of all crashes involving motor vehicles along Route 34 East segments and at city street intersections, 2008. Data from New Haven Police Department accident reports.

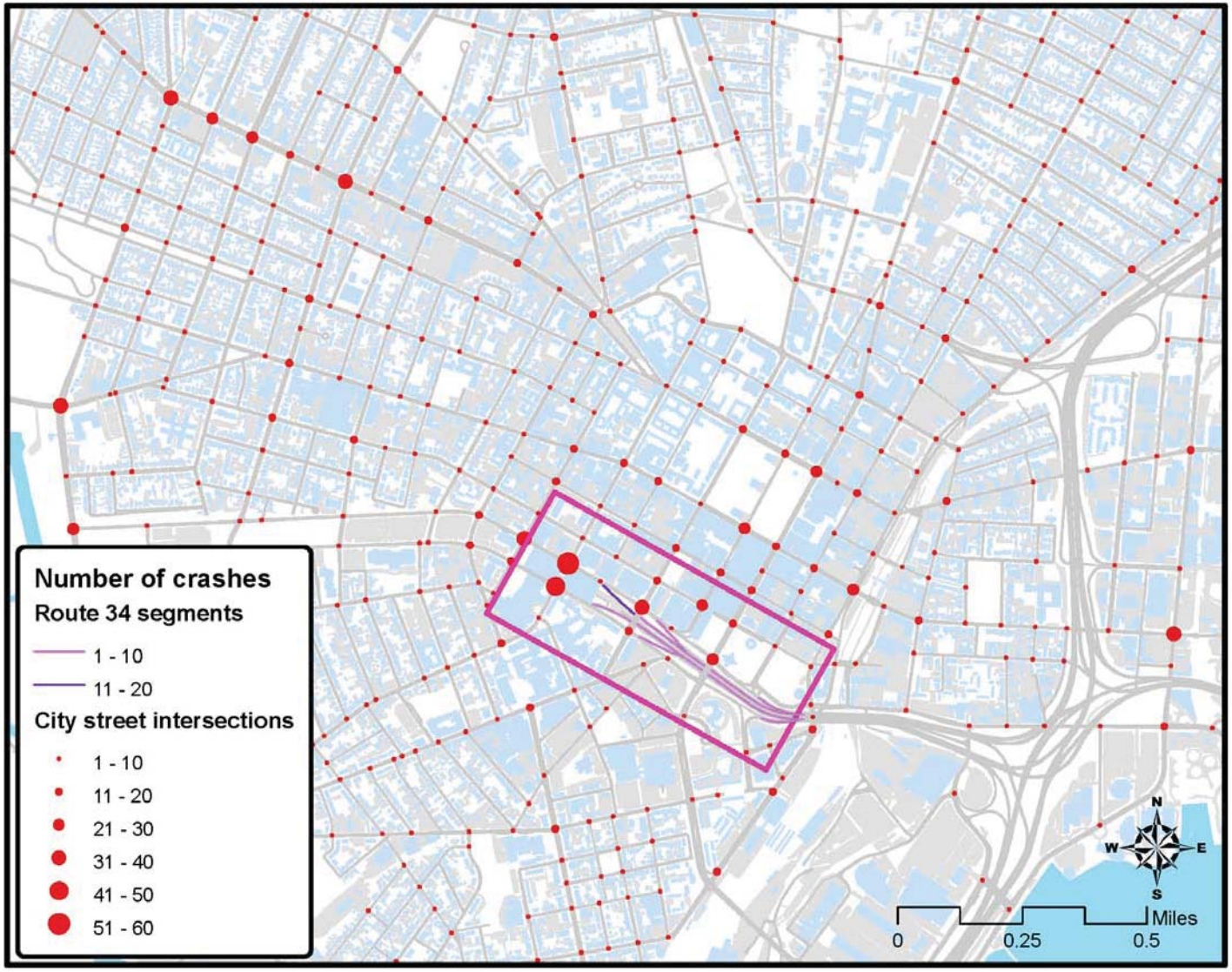
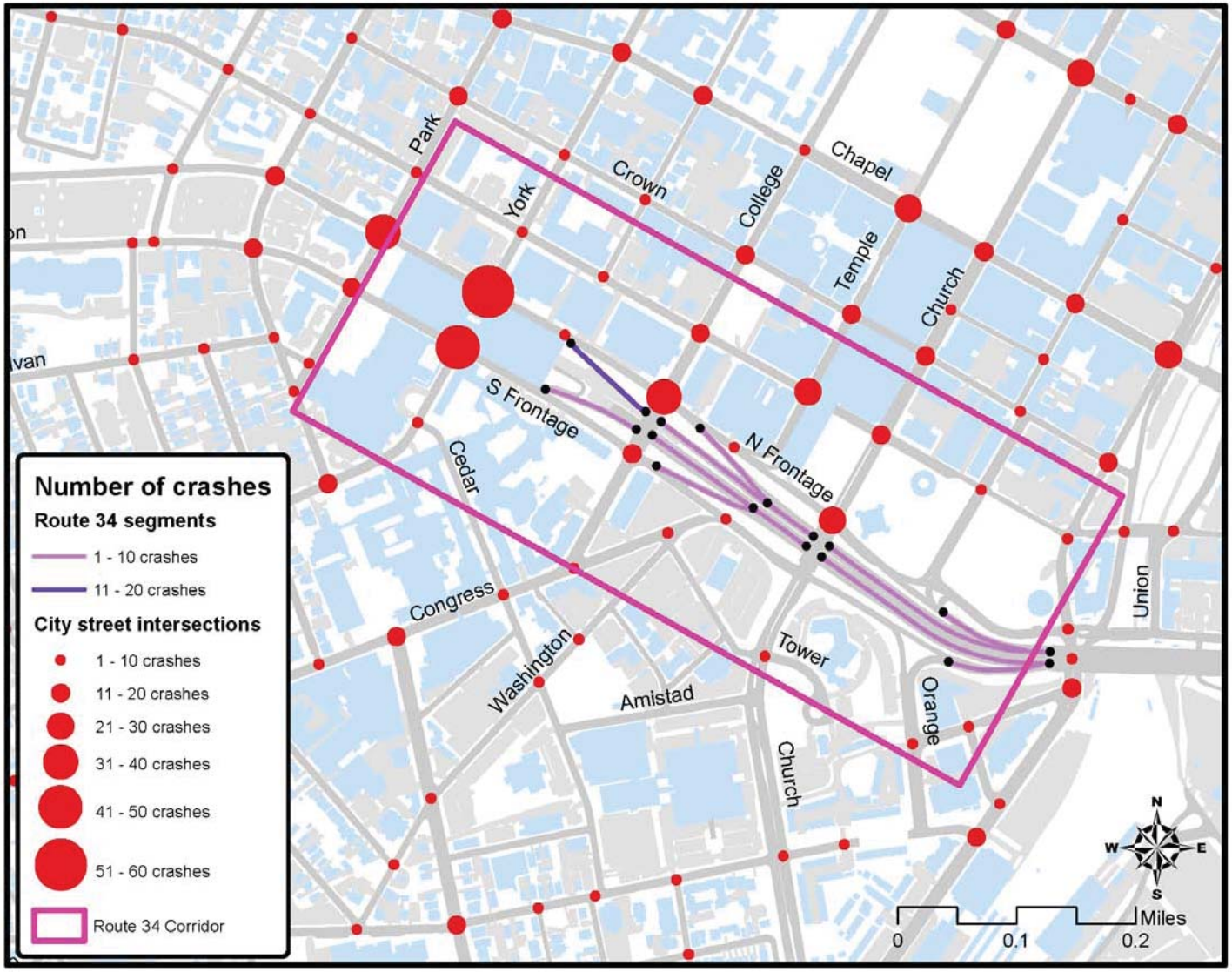


Figure 21: Detail map of all crashes involving motor vehicles along Route 34 East segments and at city street intersections, 2008. Data from New Haven Police Department accident reports.



Fatality Analysis

Similarly, the design of the built environment can have important influences on motor vehicle crashes resulting in pedestrian and cyclist fatalities. We conducted a pedestrian and cyclist fatality analysis to evaluate the prevalence of pedestrian and cyclist fatality given existing conditions and how proposed changes could affect pedestrian and cyclist fatalities.

Using data from the National Highway Transportation Safety Administration's Fatality Analysis Reporting System[27] (FARS), we assembled available information about absolute fatalities and fatality rates for each of five consecutive years (2006-2010). Data were available at the New Haven County, Connecticut State, and national levels; they were not available at the city or neighborhood levels through this data source. There were not data available regarding miles walked or bicycled for these pedestrian and cyclist populations, so it was not possible to account for differences in risk that would be associated with variations in walking or bicycling distances traveled per unit time.

Figure 22 spatially depicts pedestrian and bicyclist fatalities in New Haven between 2006 and 2010. Table 5 depicts annual pedestrian and bicyclist fatalities and fatality rates in the United States, Connecticut and New Haven County from 2006-2010. Pedestrian and bicyclist fatalities occur across the time period; there is not a clear trend in fatality rates across the time period or relative to Connecticut or national fatality rates.

Figure 22: Pedestrian and bicyclist fatalities. Data from FARS, 2006-2010.

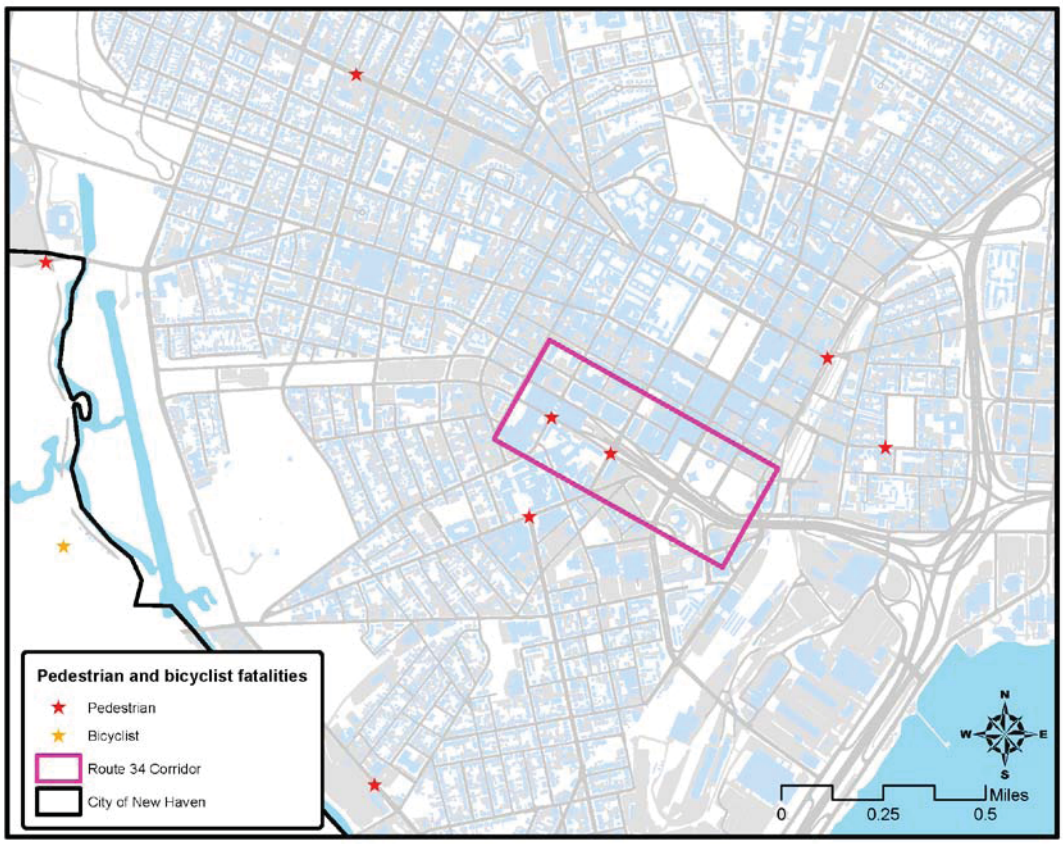


Table 5: Number and rates per 100,000 population of pedestrian and bicyclist fatalities in the United States, Connecticut, and New Haven County. Data from FARS, 2006-2010. *data not available.

	Pedestrians		Bicyclists	
	Number	Rate per 100,000 Population	Number	Rate per 100,000 Population
2006				
US	4795	1.61	772	0.26
CT	38	1.09	5	0.14
NH County	13	1.53	2	0.24
2007				
US	4699	1.56	701	0.23
CT	32	0.92	5	0.14
NH County	8	0.94	1	0.12
2008				
US	4414	1.45	718	0.24
CT	47	1.34	6	0.17
NH County	18	2.1	3	0.35
2009				
US	4092	1.33	630	0.21
CT	26	0.74	1	0.03
NH County	7	0.81	0	0
2010				
US	*	*	*	*
CT	46	*	7	*
NH County	13	1.51	0	0

Summary of Existing Conditions Analysis

The existing conditions analysis demonstrates that the Route 34 East corridor is a hotspot for motor vehicle crashes and pedestrian fatalities in the City of New Haven. This has important implications for the future development of this area. Protecting the safety of vulnerable road users is of paramount importance in this area, particularly given that efforts to increase the number of pedestrians and cyclists will increase the total number of individuals at risk for unintentional injury.

Projected Impacts and Recommendations

Objective 3: Promoting Pedestrian Safety and Reducing Pedestrian Unintentional Injury

Impacts of Current Proposal

The preliminary design incorporates a number of features that may increase the safety of pedestrians including intersection and traffic calming features that may reduce motor vehicle speeds. Should efforts to increase pedestrian activity in the area be successful, there may be more pedestrians and thus the total number of individuals at risk for unintentional injury due to motor vehicle crashes may also increase. However, some evidence suggests that while the *total* number of crashes involving pedestrians goes up with increased pedestrian activity, the *overall risk* to each pedestrian decreases.[28] Appropriate accommodations are necessary to ensure pedestrian safety.

Balancing the needs of all road users is an important objective of Phase I. Given that certain elements of the design may be necessary to accommodate anticipated traffic volumes, it will be critical to ensure that adequate protection is offered to pedestrians to offset the risk of crashes that can occur with proposed features such as increased lane numbers and wider road widths at certain areas.

Recommendations

A number of design features could be considered in order to reduce the risk of motor vehicle crashes with pedestrians, particularly given anticipated increased pedestrian activity and possible increased traffic volumes at intersections.

- ✓ **Minimize motor vehicle speeds**
- ✓ **Minimize traffic volume**
- ✓ **Enhance pedestrian crossings**
- ✓ **Enhance pedestrian link facilities**
- ✓ **Utilize traffic calming features**
- ✓ **Consider needs of vulnerable users**

A full description of specific actions, priority locations, potential health effects, and representative supporting literature can be found in Appendix 2-C.

Objective 4: Promoting Bicyclist Safety and Reducing Bicyclist Unintentional Injury

Impacts of Current Proposal

Given the absence of cycle tracks, bike lanes, or bike boxes currently within the corridor, the proposed design, which incorporates these features, is likely to reduce the risk of injury to cyclists. However, as is true for pedestrians, even if the use of these design strategies reduces the risk of injury for each individual cyclist, if efforts to increase the total number of cyclists are successful, the overall number of cyclist injuries could increase. Therefore, if a goal is to increase the number of cyclists in the corridor, it is critical that features to protect cyclists from injury are adequately integrated into the project.

Recommendations

The current plan proposes numerous bicycle facilities that have been beneficial to the safety of cyclists, including cycle tracks, bike lanes, and bike boxes. Additional features along street segments, approaching intersections, and within intersections could further enhance the safety of cyclists.

- ✓ **Utilize cycle tracks or bike lanes along link sections**
- ✓ **Reduce cyclist-pedestrian conflicts**
- ✓ **Minimize cyclist-motor vehicle conflicts along link sections and at intersection approaches**
- ✓ **Minimize cyclist-motor vehicle conflicts at intersections**
- ✓ **Increase cyclist activity**

A full description of specific actions, priority locations, potential health effects, and representative supporting literature can be found in Appendix 2-D.

Summary of Assessment and Recommendations

A large and diverse population of residents and workers who live or work around Route 34 East could be affected by the proposed Downtown Crossing project. Like residents and workers across the state and country, New Haven residents and workers face health conditions including obesity, high blood pressure, diabetes, and heart disease.

Many area households do not own cars, so people commonly use public transit, walking and bicycling for transportation and commuting. Yet an environmental audit performed for this HIA confirmed that the streets around Route 34 East are not ideal for walking and bicycling. Furthermore, in the past several years, residents have been affected by a relative concentration of motor vehicle crashes in the corridor, including two that resulted in pedestrian deaths.

Despite the condition of the existing infrastructure, our commuting pattern review suggests interest in walking and bicycling for transportation in the area is growing. The Route 34 East corridor is an employment hub in the City, and Census data suggests that a large proportion of people employed in the area also live within walking or bicycling distance of their place of employment (1-2 miles). Residents of the area commonly commute by walking or bicycling or on public transportation and less commonly commute by car, truck or van. A survey of Yale University commuters show a wide range of commuting modes, and Transportation Demand Management enrollment at Yale-New Haven Hospital has grown dramatically in the past several years, particularly enrollment in walking and bicycling to work programs.

These data suggest that there is significant potential for increasing the number of walkers and cyclists in the area, and that given the existing concentration of already active residents, protecting pedestrians and cyclists against injury is important.

Incorporation of the above evidence-based recommendations could serve to increase pedestrian and cyclist physical activity and reduce pedestrian and cyclist unintentional injury in the Route 34 East corridor, addressing two major factors affecting the health of New Haven residents.

LIMITATIONS

This health impact assessment has several limitations. The scope of the HIA was intentionally narrow. Given limited resources to devote to the HIA, we chose to evaluate a few health determinants thoroughly rather than a greater number of determinants superficially. Similarly, we chose to focus on Phase I of the Downtown Crossing project, since the proposed plans for this aspect of the project were more fully developed than those of later phases. Consequently, we did not address many of the potential health effects that could result from the project in its entirety. Furthermore, the health impacts of Phase I may be significantly modified by the manner in which the proposed changes are integrated with later phases.

We relied primarily on existing sources of baseline data to conduct our assessment. As a result, for situations in which we lacked appropriate data, we made inferences from data that was available. For example, given the absence of accurate local pedestrian and cyclist crashes and injuries, we used overall local motor vehicle crashes as a surrogate for potential danger along the corridor. Our projected health impacts and recommendations were also limited by the availability and quality of evidence regarding built environment effects on physical activity and safety. In many cases, existing research has not directly investigated or conclusively proven how specific elements of the proposed plan impact human health. Finally, the conduction of this HIA was guided by members of our Advisory Committee.

PROJECT IMPACTS AND FUTURE DIRECTIONS

The health impact assessment process concludes with a Monitoring phase. Monitoring includes an assessment of how conducting an HIA affected the way health was considered in the context of the Downtown Crossing project. It also includes evaluating the impact of the HIA on health determinants and ultimately health outcomes of the project.

Project Impacts

Process Impacts

This Health Impact Assessment of Phase I of the Downtown Crossing project brought together a professionally diverse group of health advocates and civic leaders who were motivated by a common interest: to improve the health of New Haven residents. Drawing from different backgrounds and broad professional expertise, the group coalesced around mutual priorities to improve health in the city – to promote physical activity and reduce unintentional injury. This type of interdisciplinary effort is valuable to promoting health – as health is increasingly recognized to be intrinsic to where and how we live, work and play.

In addition to introducing HIA as a methodology to our project partners, we were also fortunate to host nearly 40 community health advocates for a two-day training HIA training session in June, 2011. Participants represented a wide range of civic, community, and academic settings in New Haven, and each provided a unique and valuable perspective on improving health in New Haven. Together we learned about the HIA process, considered the application of HIA for two New-Haven specific case studies, and generated ideas for HIA's future application in the city. New Haven community has a strong and vibrant community of advocates, activists, and organizers. This training was organized to inform and build capacity for HIA so participants and other advocates might apply the HIA process to raising awareness of health across all sectors in New Haven.

Downtown Crossing Project Impacts

At the time this report was written, the Final Phase I plans had not yet been released, so it was not yet possible to determine the impact of the HIA recommendations on the finalized plan.

Future Directions

Moving forward, many may be interested in understanding the impact of this HIA on health and health determinants in New Haven. The baseline data that was collected in the context of this HIA lays the foundation for future evaluation. Description of baseline data collection in this report should offer a transparent, reproducible blueprint for future evaluation of conditions of interest. A comparison of future data to baseline data will help lead to a better understanding of the impact of this HIA on health and health determinants.

The City of New Haven plans to conduct ongoing evaluations of the project. Additional monitoring could also be conducted by any project stakeholder, including those that initiated the HIA, HIA collaborators, or interested community members.

A substantial investment is being made to redevelop Route 34 East; monitoring health indicators over time could enhance understanding of how that investment is impacting health in the city. In order to make monitoring activities as focused as possible, there are several determinants and outcomes related

to physical activity and unintentional injury that would be useful to consider in the future. Some key indicators could be collected in the near future, particularly those that were not available for the initial baseline assessment completed for the purposes of this HIA. Others would be useful if collected in later phases and at completion of the Downtown Crossing project. Potential key indicators and monitoring questions are outlined in Table 6.

Table 6: Potential key indicators and monitoring questions related to Phase I of the Downtown Crossing project.

Indicator	Monitoring Questions
Health Behaviors and Conditions	
Physical activity	How have the rates of regular physical activity changed over time?
Health outcomes	How have rates of obesity, overweight, diabetes, heart disease, stroke, high cholesterol, high blood pressure, asthma and mental health concerns changed over time?
Environmental Conditions	
Perceptions of the physical environment	How have residents' perceptions of neighborhood walking facilities changed over time? How have residents' perceptions of neighborhood bicycling facilities changed over time?
Walkability and bikability	How have "walkability" and "bikabililty" of the corridor changed over time, as measured using the PEQI and BEQI?
Commuting Patterns	
Commuting behavior	How has mode choice for commuting changed over time? How has enrollment in transportation demand management programs at Yale and Yale-New Haven Hospital changed over time?
Physical activity	How have the rates of walking and bicycling to work changed over time?
Crash, Injury and Fatality Conditions	
Motor vehicle crashes	How have the rates of motor vehicle crashes changed over time?
Pedestrian and bicyclist Injury	How have rates of pedestrian and/or bicyclist injury changed over time?
Pedestrian and bicyclist Fatality	How have rates of pedestrian and/or bicyclist fatality changed over time?

CONCLUSION

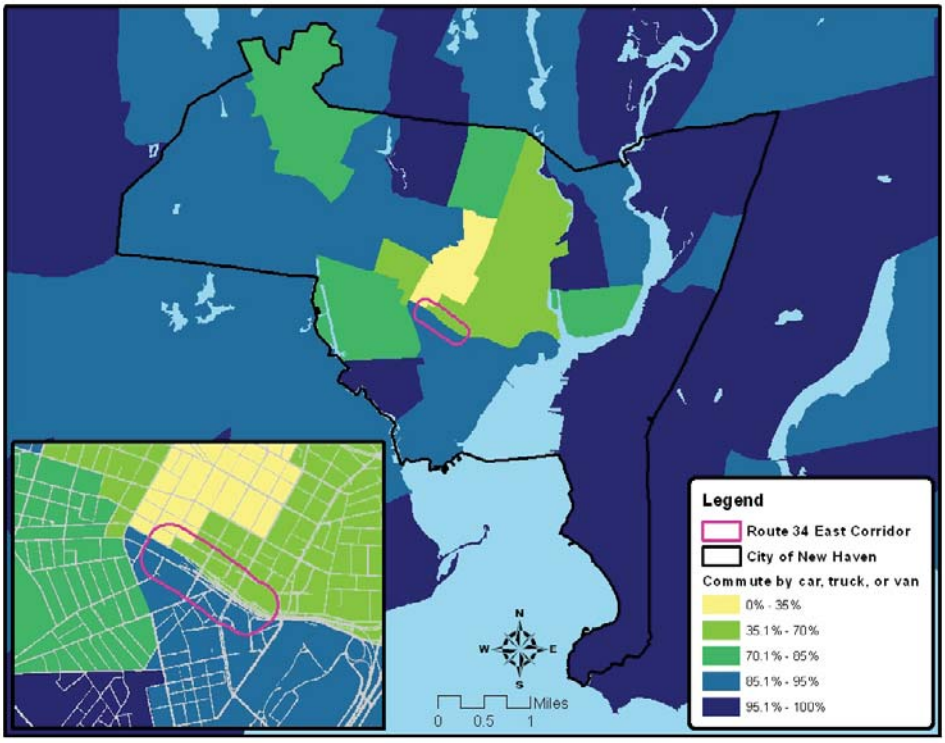
The Downtown Crossing project has garnered a great deal of interest amongst New Haven residents, with many expressed opinions and views about what can and should be accomplished through the redevelopment process. Although there are some differences of opinion, it is clear that health and safety are cherished values across the spectrum of project stakeholders.

While many see the multimillion dollar investment in the Downtown Crossing project as an unprecedented opportunity to transform the city, we also believe it represents an unprecedented opportunity to raise awareness of health in decision-making in the city through the process of HIA. Therefore, the primary goals of this Health Impact Assessment of Phase I of the Downtown Crossing is to improve health in the City of New Haven, specifically with regard to physical activity and unintentional injury, and to raise awareness of health in decision-making. It is our sincere hope that health in New Haven will continue to be a priority, and that this HIA can lay the foundation for use of HIA in other projects and policies in New Haven.

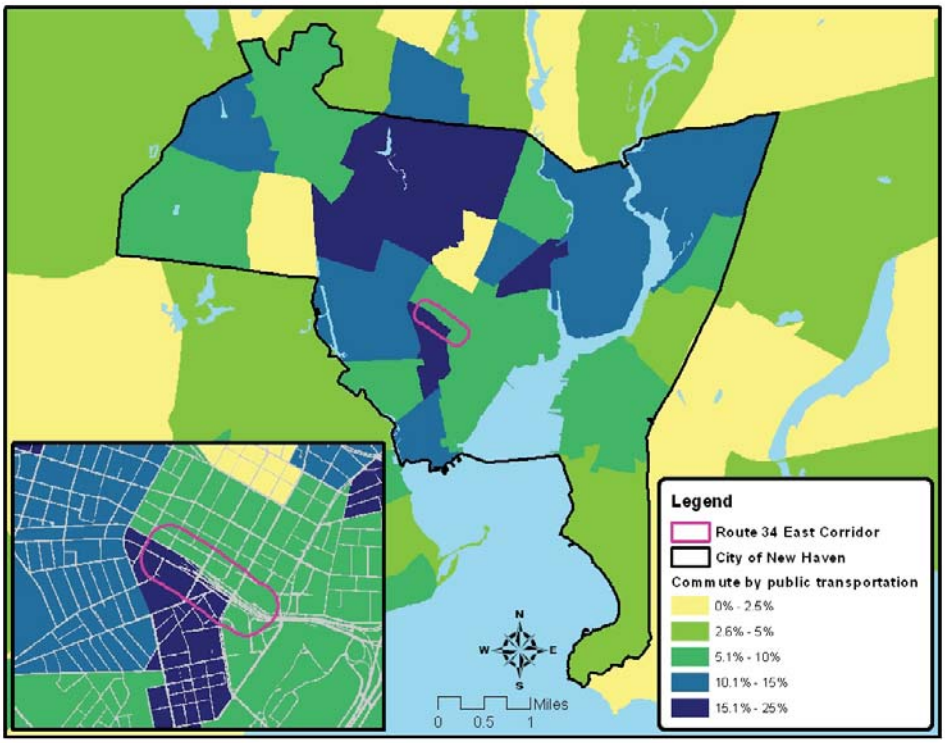
APPENDICES

Appendix 1: Commuting mode share of New Haven residents by census tract

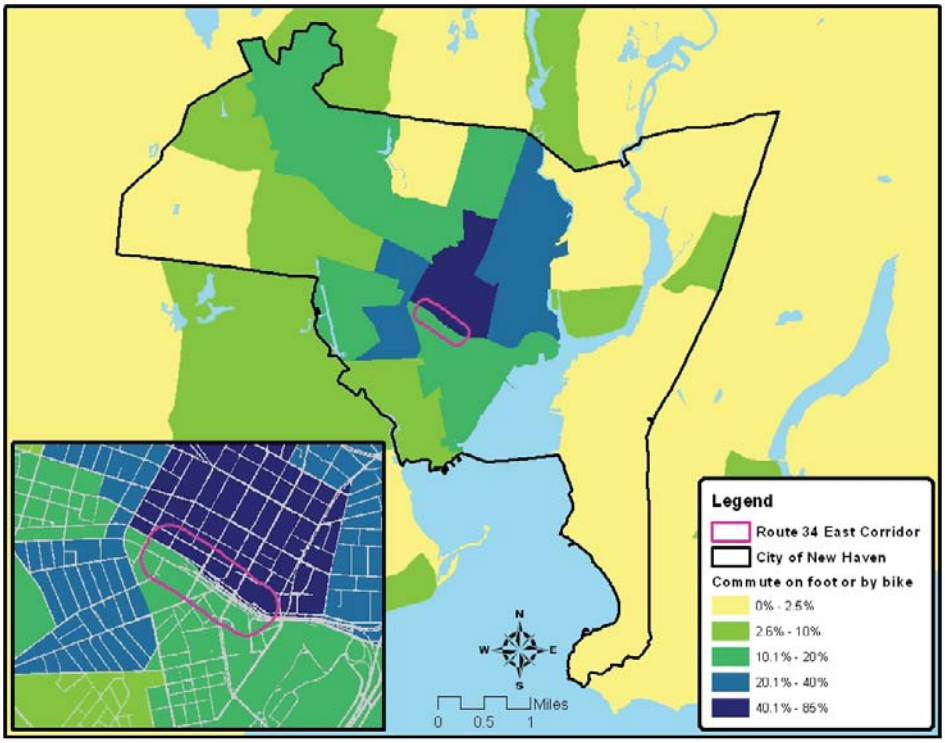
2- A: Percent of population that commutes by car, van, or truck by census tract. Data from the ACS five year estimate, 2006-2010.



2- B: Percent of population that commutes by public transportation by census tract. Data from the ACS five year estimate, 2006-2010.



2- C: Percent of population that commutes on foot or by bike by census tract. Data from the ACS five year estimate, 2006-2010.



Appendix 2: Recommendations

2-A: Recommendations to promote pedestrian physical activity

Recommendation	Potential Actions	Priority Site(s)	Representative Health-Related Effects
Prioritize connected street pattern	• Increase number of pedestrian segments • Connect disjointed street segments	• Temple Street bridge • Orange Street bridge • South Frontage Road between York & College	• Increased connectivity may promote walking[29–34] • More connected, "walkable" neighborhoods may be associated with increased walking[35–38] • Having a variety of nearby destinations/mixed land use may be associated with walking[32,34,39–41]

Utilize traffic calming features	• Where feasible, include:
	  ○ Roadside trees, gardens and planters
	  ○ On-street parking
	  ○ Lane narrowing
	  ○ Adjustments in roadway curvature
	  ○ Pedestrian refuge islands
	  ○ Speed humps and speed tables
	• Maintain sidewalks
		• Entire corridor and cross streets	• Traffic calming features may promote walking[29,42–45]
			• Sidewalk presence[31,34,41,46–48] may be associated with walking

Increase safety and perception of safety	• Utilize pedestrian countdown signaling at signalized intersections • Consider neighborhood characteristics such as pedestrian scale lighting • Enhance pedestrian crossings	• Entire corridor	• Perception of safety (from crime and injury) may be associated with walking[34,49] • Countdown signaling may be associated with pedestrian perception of safety[50] • Neighborhood characteristics/design such as sidewalks, traffic density, street lighting and perceived aesthetics may be associated with walking[34,51–53]
Consider needs of elderly, minority, and child populations	• Maintain high quality sidewalks • Dedicate walking and biking facilities • Enhance pedestrian crossings • Ensure adequate crossing time for slower pedestrians • Promote mixed land-use	• Entire corridor, particularly at Church Street and North and South Frontage Roads	• Walkability, density, connectivity, land use mix, quality of sidewalks, facilities may be associated with physical activity among seniors[54–57] • Perception of safety may be associated with physical activity in those over 65, women and minorities[58–60] • Walkability, traffic speed/volume, density, recreation facilities, mixed land-use, perceived safety may be associated with child physical activity[61–64]

2-B: Recommendations to promote bicyclist physical activity

Recommendation	Potential Actions	Priority Site(s)	Evidence of Health-Related Effects
Increase activity of current non-cyclists by enhancing the perception of safety	• Provide buffered bike lanes or cycle tracks that maximize protection from motor vehicles • Utilize bike boxes, through crossings, and raised or colored bicycle crossings	• Entire corridor	• Particularly for the least confident/skilled riders, perceived lack of safety may be largest barrier to cycling[65] • Bicycle lanes, cycle tracks, and intersection features may increase perception of cycling safety[66,28,67,68]
Provide bike facilities that are appropriate for road traffic volume	• Along arterials, utilize cycle tracks or buffered bicycle lanes. Avoid non-buffered bicycle lanes on arterials if possible • Provide cycle tracks or bicycle lanes along minor and secondary roads • Use increasing level of physical separation from traffic as roadway volume increases • Minimize conflicts with pedestrians on cycle tracks through use of physical barriers	• North Frontage from Church to York • Cycle track along Orange and North Frontage	• People may be more likely to cycle if there are bicycle lanes and cycle tracks[69–71] • People prefer using bicycle facilities[69,72] on low volume roads but may use higher volume arterials provided there is increased physical separation from motor vehicles[69,73–75]
Locate bicycle facilities along most desirable routes for cyclists	• Create networks of bicycle facilities that minimize distances between origins and destinations while avoiding exposure to high traffic volumes through route or facility design • Enhance bicycle facilities on streets crossing the corridor, particularly northbound • Improve connections to Union Station, both from Downtown and the Medical District	• College • Church • York	• Cyclists prefer to use routes that minimize distance and time although this is balanced by a willingness to go out of their way to use bicycle facilities that provide the perception of safety[69,74,75]
Maximize connectivity of bicycle facilities	• Ensure connection between proposed bicycle facilities and existing bike routes • Integrate with proposed short term and long term bicycle network routes	• South Frontage & Church • North Frontage & York • College & South Frontage	• Bicycle facilities that do not connect to a larger network are less likely to be well used[76]
Increase access to secure bike storage and shower facilities at destinations	• Encourage local employers and businesses to provide secure bike storage • Encourage local employers to provide shower facilities	• Entire corridor	• Concerns about secure bike parking and inadequate showering and changing facilities at destinations may be barriers to cycling[73]
Implement diverse types of interventions simultaneously	• Implement infrastructure elements • Develop publicity and educational campaigns to raise awareness of bicycle facilities • Encourage employers to implement cyclist-friendly policies • Encourage integration of bicycle racks on public transportation and increased bike storage at transportation hubs • Consider bikesharing program	• Entire corridor	• Implementing multiple interventions simultaneously may have the greatest impact on bicycle use[73] • Bike sharing programs have been shown to increase bicycle use and mode shift from cars to bicycles

2-C: Recommendations to improve pedestrian safety and reduce unintentional injury

Recommendation	Potential Actions	Priority Site(s)	Representative Health-Related Effects
Minimize motor vehicle speed	• Minimize speed limit • Minimize lane width and total road width to greatest extent feasible • Use other traffic calming features such as pedestrian refuge islands, curb extensions, or speed tables	• Route 34 westbound approaching Church Street • South Frontage between York & College	• Vehicle operating speeds decline as lane and total road widths decrease[77], aggressive driving may also decrease on narrow streets[78] • Wider lanes may be associated with increased total and fatal crashes[79,80] particularly in urban areas[81] • As the proportion of roads >50ft and/or >4 lanes increase, pedestrian crash frequency may also increase[82] • Roads with wide travel lanes and higher operating speeds may be associated with more pedestrian crashes than narrower streets with lower operating speeds[83] • Traffic calming may be associated with reduced vehicle speed,[84] pedestrian crashes,[84] injuries and deaths[85] • As vehicle speeds decrease, severity of pedestrian injuries and risk of fatalities decreases exponentially[86]
Minimize traffic volume	• Encourage alternate forms of transportation, such as walking and bicycling and public transportation	• Entire corridor and cross streets	• Traffic volume is a primary determinant of crash frequency[79,87,88] • Minimizing the frequency of crashes decreases the potential for unintentional injury
Enhance pedestrian crossings	• Minimize pedestrian crossing distance with: ○ Pedestrian medians, refuge islands, curb extensions • Avoid crosswalks at uncontrolled intersections where possible. If necessary, incorporate a raised median. • Continue use of exclusive pedestrian phase signaling • Continue use of pedestrian countdown signals • Alert pedestrians to look for turning vehicles with signs and pavement markings	• North Frontage & Church • North Frontage & College • South Frontage between York and College • South Frontage & Church • South Frontage & College • Church Street bridge	• Exclusive pedestrian phase signals may reduce conflicts between pedestrians and vehicles[89–92] • Pedestrian collisions may be reduced with use of pedestrian crossing islands[83,93,94] • On multilane roads with high traffic volumes, having a marked crosswalk alone (without other substantial improvements) may be associated with higher pedestrian crash rates, mitigated by raised medians[95] • Signs and pavement markings alerting pedestrians to turning vehicles may reduce conflicts[96]
Enhance pedestrian link facilities	• Provide sidewalks along all streets • Provide wider sidewalks	• Entire corridor	• Vehicle-pedestrian collisions may be more likely along street segments without sidewalks than those with sidewalks • Wider sidewalks may decrease crash severity[97]

2-D: Recommendations to improve bicyclist safety and reduce unintentional injury

Recommendation	Potential Actions	Priority Site(s)	Evidence of Health-Related Effects
Utilize bike lanes or cycle tracks along link sections	• Provide dedicated cycle tracks or bicycle lanes	• Entire corridor	• Reduced risk of bicycle crashes with dedicated link section bicycle facilities[98] • Absolute number of crashes may increase with increased riders but risk decreases
Avoid cyclist-pedestrian conflicts	• Raised cycle tracks should be physically, or if not possible, visually separated from sidewalks.	• Cycle track along Orange & North Frontage	• Increased risk of crashes and injuries with riding on sidewalks[99]
Minimize motor vehicle-bicycle conflicts along link sections and at intersection approaches	• Use bike lane through markings to delineate areas where motor-vehicles cross bike lanes or cycle tracks, particularly for complex weaving maneuvers ○ Sharrows or colored treatments • Use signage to instruct drivers and cyclists about proper use of through lanes • Give close attention to design of cycle track approaches to intersections to ensure bicyclist visibility to motor vehicles, particularly those at risk for "right-hook" crashes.	• North Frontage approaching Church • North Frontage at Temple Street Garage • North Frontage & Temple • South Frontage & Church	• Through lane markings may increase motor vehicle yielding to bicyclists in conflict zones[100,101] • Through lane markings may reduce motor vehicle-bicycle conflicts[68,102] • Cycle tracks may lead to increased risk of crashes at intersections if approaches are not carefully designed[68,102]
Minimize motor vehicle-bicycle conflicts at intersections	• Use colored bike boxes to facilitate specific turning movements • Use two stage turn queues to facilitate bicycle left turns across multiple lanes • Use raised or colored intersection crossings where possible • Provide cyclist and driver education regarding appropriate use of bike boxes and crossings • Utilize signage to draw attention to bike boxes and crossing facilities	• North Frontage & Church • North Frontage & College • South Frontage & Church • South Frontage & College	• Bike boxes may increase yielding by motor-vehicles and reduce conflicts[102,103] • Intersection crossing treatments may reduce conflicts with motor-vehicles[66] and increase motor-vehicle yielding[102]
Increase bicycle use	• See recommendations above		• Some evidence suggests that cyclist crash rate is inversely associated with the number of cyclists[28]

*Appendix 3: Glossary**

Active commuting: walking or biking for the purpose of commuting

Bicycle facilities: physical elements of the environment designed specifically for the use of bicyclists, including, bike lanes, cycle tracks, bike boxes, storage lockers, showers, etc.

Bikability: how friendly an area is to biking

Bike box: a designated area for bicyclists at an intersection with a traffic signal that places them ahead of stopped motor vehicles, and therefore allows bicyclists to safely cross or turn prior to the motor vehicles

Bike lane: a type of bike facility that is part of the roadway but is exclusively for bicyclists, as designated by a painted white line

Buffered bike lane: a type of bike facility similar to a bike lane, but in which there is a wide painted area separating motor vehicles from bicyclists rather than just a single white line

Buffer: a geographic area defined by drawing a line around a geographic feature at a specific distance from that feature

Built environment: features of the environment designed, constructed, or installed by people

Census tract: a geographic area defined for the purpose of collecting census data

Centers for Disease Control: the division of the federal government responsible for studying, protecting, and promoting public health

City-level: a unit of analysis that is focused on an entire city, rather than smaller components of the city (i.e. neighborhoods) or individuals that live within it

Conflicts: undesirable interactions between motor vehicles, bicyclists, and pedestrians that result in a collision or avoidance maneuver by at least one party

Connected street pattern: a street network characterized by a greater number of intersections and smaller block sizes as opposed to many dead end streets and long distances between intersections

Countdown timers: pedestrian signals that display the amount of time remaining before the signal changes to "Don't Walk"

Cycle track: a type of bike facility that is parallel to motor vehicle traffic but bicyclists are physically separated from motor vehicles by parked cars, planters, or a curb

Exclusive phase pedestrian signals: a pedestrian signal at intersections that stops motor vehicle traffic in all directions

Dissemination: the process of sharing the findings of a study with stakeholders

Environmental audit: a process of systematic collection of information about the physical environment

Geographic information system (GIS): computer software for mapping and analyzing geographic data

Infrastructure: the physical elements of roads, including sidewalks, bike paths, signs, lights, etc.

Link facilities: sections of roadway between intersections

Literature: a general term that refers to professional scientific journals, published reports, and other scholarly information

Literature review: a process of systematically gathering and analyzing information about a specific topic from scientific journals, published reports, and other scholarly information

Metropolitan statistical area: a geographic entity consisting of one or more counties, including one with an urban area and possibly adjacent counties with a high degree of social and economic integration

Mixed-use: the use of a building, set of buildings, or neighborhood for more than one purpose

Neighborhood-level: a unit of analysis that is focused on an entire neighborhood, rather than smaller components of the neighborhood (i.e. blocks, streets, or intersections) or individuals that live within it

Prevalence: the percentage of a population with a specific health condition

Stakeholder: a person or organization that has any interest in the outcome of a decision

Through lane markings: roadway markings that highlight areas where bicyclists could be crossing intersections or the path of motor vehicle traffic

Traffic calming features: physical elements of the built environment that reduce traffic speeds by modifying driver behavior

Transportation redevelopment: the process of removing and reconstructing the infrastructure necessary for transportation

Unintentional injury: bodily injury that is not caused on purpose (often referred to as accidental injury)

Walkability: how friendly an area is to walking

30% Plan: a preliminary plan of a project that requires approval by regulatory and funding bodies prior to further project development

*All bike facility images reproduced with permission from the National Association of City Transportation Officials Urban Bikeway Design Guide. http://nacto.org/cities-for-cycling/design-guide/

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