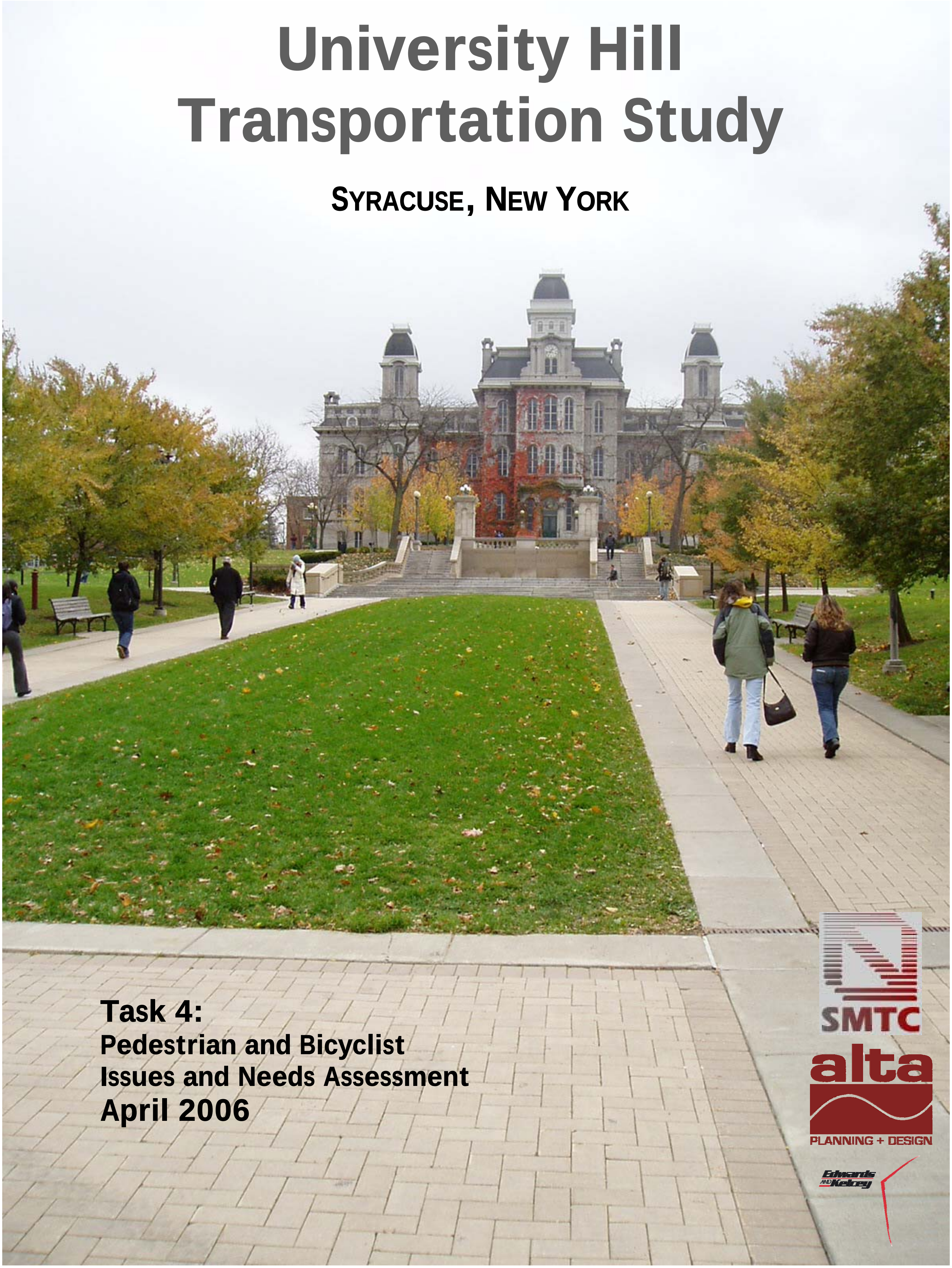
University Hill Transportation Study

SYRACUSE, NEW YORK



Task 4:

Pedestrian and Bicyclist Issues and Needs Assessment

April 2006

SMTC

alta PLANNING + DESIGN

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CONTENTS

1. Overview

University Hill is located southeast of the Syracuse Central Business District. The Hill is home to over 16,000 residents, two major education institutions (i.e., Syracuse University, State University of New York (SUNY) College of Environmental Science and Forestry and SUNY Upstate Medical University Hospital,) four major hospitals and healthcare facilities (i.e., Crouse, Upstate Medical University/SUNY Health Science Center, Veteran's Administration and Hutchings Psychiatric Center). In addition, the Syracuse University Carrier Dome, a 50,000 seat stadium/arena, is located on the University campus.

This mix of institutions, businesses, homes and events results in traffic being a major issue on University Hill. It affects everyone who works or lives on University Hill on a daily basis. Thus, the Syracuse Metropolitan Transportation Council and its partner agencies are continuing their cooperative efforts to address this problem.

This initiative will focus on three primary issues:

- Interstate Access
- Institutional Parking, and
- Transit, Walking and Biking.

The plan will identify proposed improvements to meet the needs of University Hill for these three issues as it develops over the next 20 years. A major aim of the initiative is to ensure the economic viability of the institutions located in the study area while minimizing impacts to surrounding neighborhoods.

As part of the project, two alternative visions for transportation on the Hill will be analyzed. One vision will summarize the likely future if transportation relies primarily on automobiles. The alternative will examine the impacts of a greater emphasis on transit, walking and biking than currently exists. Each will be compared to the current planned vision for development on University Hill to assess impacts, benefits and costs.

The purpose of this report is to document existing conditions that will be used to identify *planning level needs* for pedestrian and bicyclist transportation in the University Hill Study area. For the first part of this task, digital photos, field notes, and maps were used to identify 'typical' field conditions for sidewalks, crossings, on-road bike facilities, bike parking, transit access, and compliance with the Americans with Disabilities Act of 1990 (ADA). For the second part of this task, models were developed with existing Census and other data to quantify pedestrian / bicyclist demand and potential benefits including pollution reduction, increased physical activity and related health benefits. The Syracuse Metropolitan Transportation Council's (SMTC) 2005 Bicycle and Pedestrian Plan provided background materials for this report.

The pedestrian/bicyclist study area was defined for the models to incorporate the boundaries of Census Tracts 43, 44, 55 and 56.01 in the City of Syracuse. These boundaries were modified slightly for field work to focus on the central core of University Hill. For the purposes of the field analysis, the study areas for pedestrians and bicyclists were defined as follows:

1. Pedestrian Study Area: generally within .5 mile to 1 mile of Waverly Avenue, an area roughly bounded by Madison Street, Ostrom Ave, Stratford Street and Almond Street.

2. Bicycling Study Area: approximately 2 miles from Waverly Avenue, bordered by Madison Street, Lancaster Street, E. Colvin Street / South Campus and Almond Street.

Aerial view of the University Hill vicinity, looking east with I-81 in the foreground.

2. Pedestrian and Bicyclist Friendly Communities

The built environment must be well designed for pedestrians and bicyclists in order for these modes of travel to achieve their potential as an integral element of a community's transportation system. The primary elements that are essential for pedestrians are sidewalks and safe crossings. For bicyclists, the necessary street improvements are similar to those required for driving a car: safe, user-friendly streets, signals and parking facilities. For both pedestrians and bicyclists, compatible vehicular traffic speeds, volumes, and behavior of motorists on the streets are also important. In addition, the streetscape infrastructure must be well maintained year-round in order to create a safe environment for walking and bicycling. These features are summarized in the Table below:

Table 1: Key Elements of Pedestrian and Bicycle Friendly Infrastructure

The pedestrian/bicyclist environment should be safe.
The pedestrian network should be accessible for all ages and abilities.
Sidewalks should be continuous, concrete, 5' minimum width in residential areas, with 10' or greater sidewalks in urban areas.
Provide a network of shared-use paths and trails.
Provide on-street bikeways including bike lanes, signed routes and shared lanes.
Provide user-friendly access to transit, including ADA compliant shelters and bike racks on buses.
Provide bicycle parking as a typical streetscape element and at all appropriate destinations.
Provide safe pedestrian crossings, with Manual of Uniform Traffic Control Devices (MUTCD) compliant pavement markings, signage and signals.
Ensure that urban streetscapes include pedestrian-scaled facades, lighting, signage and amenities.
Pedestrian right-of-way laws must be enforced.
Speed limits should be appropriate for pedestrian and bicyclist safety.
Pedestrian and bicyclist facilities should be maintained for safe year-round use.

The following illustrations show the basic elements of bicycle and pedestrian friendly streetscape design. The upper graphic shows key street design elements; the lower graphic shows the elements of the sidewalk and pedestrian streetscape.

Figure 1: Street Design Elements

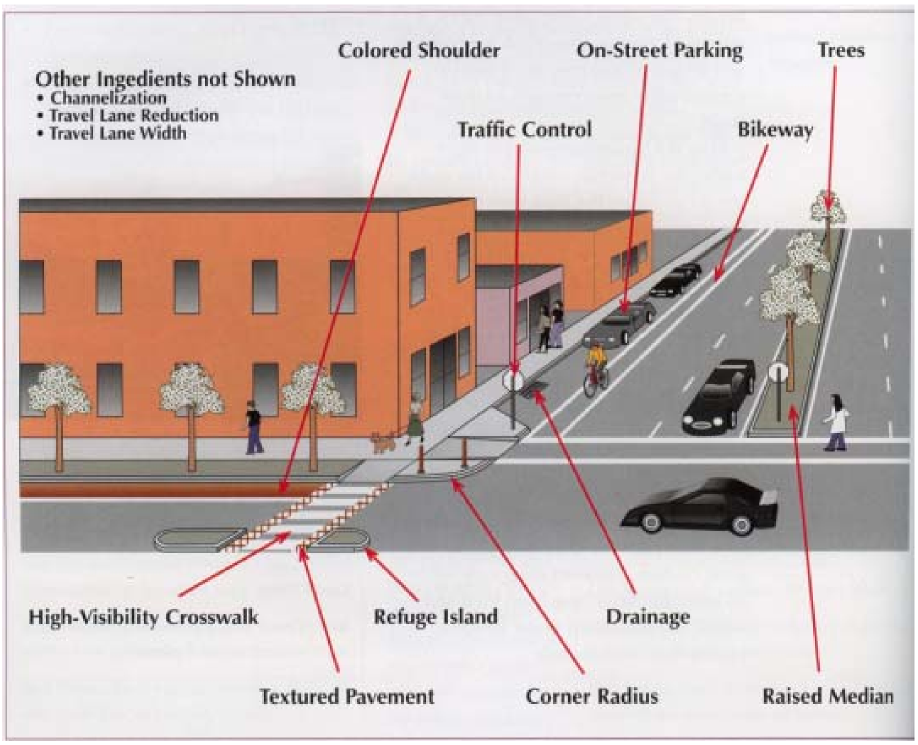
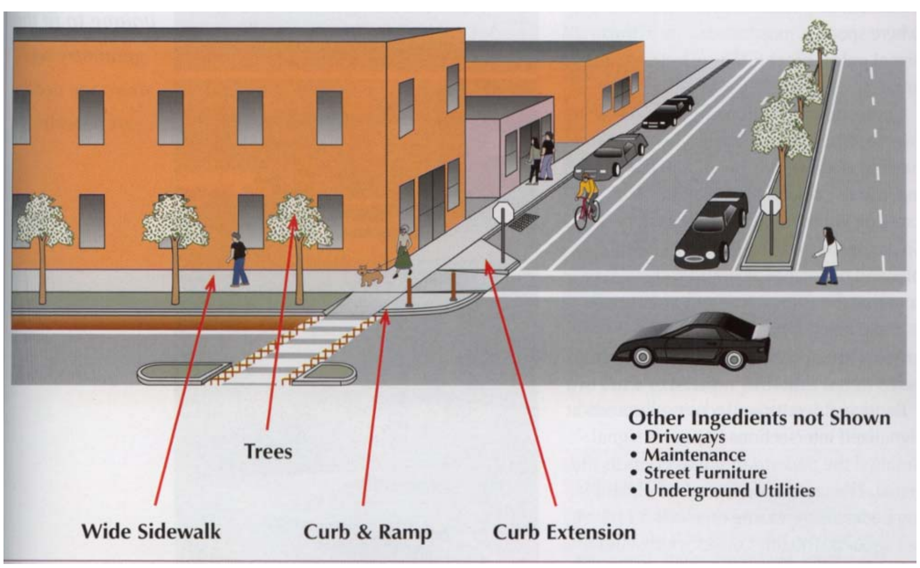


Figure 2: Pedestrian Design Elements



Source: Oregon DOT, "*Main Street…when a highway runs through it*," 1999

3. Field Review of Existing Conditions

3.1 Summary

Field observations were taken on a cold, November day. The weather was partly cloudy, 25° F, light wind, and observations were taken between 10 am and 3 pm. Significant pedestrian activity areas were observed along Irving Avenue near the medical centers, in the University Place area, (which is a limited access car free zone) and in the business district on Waverly Avenue. There were larger numbers of cyclists than might be expected (approximately 30 cyclists per hour were counted at the intersection of Comstock Avenue and Euclid Avenue near the campus entrance at 12:00 noon). The new bike lanes on Comstock Avenue and E. Colvin Street are a positive step towards improving conditions for cyclists on University Hill. However, in general, there are only a few sections within the project area that present a pedestrian and bicyclist friendly image. These include University Place, Comstock Park (the boulevard section along Walnut Park between Waverly and E. Adams St.), the new streetscape on Waverly Place, and the traditional neighborhoods around Thornden Park and along Euclid Avenue.

3.2 Key Focus Issues

During the field observations, a series of key issues were identified within the study area. These issues are: 1. Large Block Buildings and Parking Lots, 2. Topography, 3. Streetscape Conditions, 4. the Interstate 81 Barrier and 5. the Lack of Shared-Use Paths . Each of these issues is described in the sections below.

Large Block Buildings and Parking Lots

Large-block buildings and surface parking lots create long sections of streetscape that are not in scale with pedestrian activity. These places require people to walk long distances between destinations, and are often lacking in the amenities identified in section 2 above. Extensive sections of the study area feature large block buildings fronting the streetscape, including the Veterans Administration and Upstate Medical Center hospital complexes along Irving Avenue. The east side of the Carrier Dome is dominated by multiple large surface parking lots. These areas are not pedestrian friendly, and could present safety/security issues during evening hours due to faster vehicle speeds, fewer 'eyes on the street' and unmarked pedestrian crossings at multiple locations.

The 'moat' of surface parking west of the Carrier Dome creates an environment that is better designed for motor vehicles than pedestrians. This area separates the buildings on the Hill from the OnTrack station and destinations west of I-81. Even within large parking areas, clear aisles should be provided for people walking from their car to their destination, and the surrounding streets should include good sidewalks and crossings.

Topography

The topography of the core hilltop area slopes up from the perimeter of University Hill, with steeper grades to the west and long, gradual grades from north and south. This aspect of the Hill is less of a barrier to pedestrian/bicyclist mobility than might be expected. There are large, relatively flat areas of the Hill, although the steep slopes of University, Waverly, Marshall, Adams west of Ostrom Avenue (and sections of Comstock, Walnut and University below Adams) present challenges for people walking and bicycling.

The access from this parking deck across from the Carrier Dome illustrates the challenges of ADA compliance on University Hill's steep grades.

Streetscape Conditions for Pedestrians and Bicyclists

There are many streetscape obstacles to non-motorized transportation on University Hill. These include wide driveways, missing curb ramps, and the lack of consistent design of pedestrian crossing treatments throughout the project area. Street trees and lighting are intermittent, and there are many streets with missing or broken sidewalks. Appropriate design and traffic calming features can ensure compliance with speed controls and traffic laws. This is important to ensure that motorists, bicyclists and pedestrians will safely share the road – and several instances were observed of motorists and pedestrians not obeying the law. Maintenance is also an important issue, especially during the winter months when ice and snow are present.

This crossing on Waverly Avenue near Thornden Park is missing curb ramps, an SUV is parked across the sidewalk, a car is parked in the intersection, street trees are not continuous, and street lighting is not adequate. These conditions are consistent with many locations in the project area.

The Interstate 81 Barrier

The I-81 interstate corridor presents a significant barrier to pedestrian and bicyclist mobility at the western edge of the study area. The elevated highway and the collector/distributor streets associated with Almond Street under the highway contribute to this issue. The length of time required to cross Almond Street is a concern due to the width of the roadway and signal timing. There are limited pedestrian crossing locations under I-81 at E. Genesee Street, Harrison Street, E. Adams Street, W. Castle Street and E. Colvin Street; these generally include multiple vehicular turning movements, and poor visibility underneath the elevated highway. There are also some sections of the neighborhoods west of I-81 with vacant houses and potential concerns about safety and security, notably at E. Genesee Street and Almond Street (see the photo below).

Pedestrian crossings under I-81 are a challenge due to limited visibility, vehicle turning movements, and the conditions of existing sidewalks and crossings. Location: E.Genesee Street and Almond Street on the west side of I-81.

On the west side of I-81, the highway is a barrier to pedestrians approaching University Hill. Location: W. Castle Street looking east towards I-81 near the Martin Luther King Magnet school.

Lack of Shared Use Paths

It is important to note that there are no dedicated bicycle/pedestrian shared-use path facilities within the study area. This is due to the development pattern of University Hill, which did not include a network of rights-of-way other than the street grid. There are a few potential opportunities for shared-use trail facilities that may exist along the Meadowbrook corridor and parallel to the OnTrack rail line (which connects to the developing Onondaga Creekwalk and the Syracuse lakefront). It is important to note that the 325-mile Erie Canalway trail across New York State is proposed to pass through the City of Syracuse, and significant existing sections of the trail are located to the east and west of the City. Connections to this system would provide a significant quality-of-life benefit for University Hill.

The OnTrack station west of the Carrier Dome is down a steep hill from the University Campus and is located adjacent to I-81. The station is currently used for special events and limited rail service. The corridor may have the potential as a Rail-with-Trail connector to the Onondaga Creekwalk shared-use path.

The Meadowbrook Drive corridor, which is east of the core study area, includes a single-track trail around the Barry Park pond, and the roadway has the potential to be a landscaped parkway with pedestrian and bicyclist facilities for the east side of University Hill. This corridor could serve as part of a connecting trail between University Hill, LeMoyne College and the Erie Canalway Trail in East Syracuse.

3.3 Observations

The following sections of this report present a more detailed pedestrian/bicyclist perspective of University Hill, with additional detail on both positive and negative examples of local conditions. This information provides an overview of the current conditions for walking and bicycling on University Hill. These conditions can be used to help identify potential facility improvement needs that would be required to expand the quantity and quality of non-motorized mobility in the project area. These potential improvements could be developed as part of the overall transportation plan for the project area.

Field Review: Positive Examples

University Hill features several locations where innovative and high-quality facilities have been provided for pedestrians and bicyclists. While these improvements are not systematically applied throughout the project area, they indicate the potential for future enhancements. The following photos highlight these positive examples.

A 'yield to pedestrians' safety cone at a mid-block crossing location near Crouse. This simple device encourages compliance with New York State's vehicle and traffic law.

New bike lanes on East Colvin Street. Both E. Colvin Street and Comstock Avenue have recently been re-striped to provide bike lanes.

The area around University Place has an attractive streetscape design and restrictions on motor vehicle access to create a pedestrian priority zone.

Marshall Street features a consistent streetscape design with seating areas, lighting and decorative pavers.

This new transit shelter along Crouse Avenue includes both an accessible pedestrian waiting area and bicycle parking.

Marshall Street provides an example of a graphic identity for University Hill.

The residential neighborhoods along Walnut Place are a good example of a traditional, pedestrian friendly streetscape, with good sidewalks, landscaped buffers between the curb and sidewalk, on-street parking and mature street trees. Similar neighborhoods exist around Thornden Park and along Euclid Avenue.

Field Review: Typical Conditions

In general, the majority of the roadways on University Hill are lacking in pedestrian and bicyclist infrastructure. While the project area has some sections with a traditional land use pattern that includes sidewalks and a grid street network, there are a variety of factors which need to be addressed in order to create a built environment that is safe, accessible and user friendly for people walking, bicycling, driving and riding public transit throughout University Hill. These conditions are identified below.

Unmarked Crossings

Wide streets with unmarked crossings are a common condition in the project area. Due to the large blocks associated with institutional uses on University Hill, there are multiple locations where signalized crossings are far apart, and undesignated mid-block crossings are frequently used by pedestrians.

E. Adams Street near the SUNY Upstate Medical University. The pedestrian bridge does not replace the need for people to cross the street at grade.

Irving Avenue near the Crouse Hospital and VA Medical Center is a four-lane street with long distances between pedestrian crossings.

Mid-block crossings are common in locations between building entrances on the University campus, such as this example on Waverly Avenue.

Suburban Streetscape Designs

There are locations where the streetscape of University Hill appears more suburban than urban in nature. The lack of street trees, wide streets, large corner radii, overhead utilities and lack of pedestrian amenities indicate an environment that is oriented more towards driving a car than walking or bicycling.

Henry Street, west of the Carrier Dome, a few blocks south of the VA Medical Center. This street has few amenities for people walking between the parking areas, OnTrack and other destinations.

East Colvin Street near Manley Field House is an example of a wide, suburban-styled street. The center turn lanes facilitate automobile driving, but make the street difficult for pedestrians to cross.

On-Street Bicycling Facilities and Bicycle Parking

Other than the new bike lanes on Comstock Avenue and E. Colvin Street, there are no other dedicated bike lanes on University Hill. Bicyclists use shared lanes along with motorists on all streets in the project area. There are outdoor bike racks in some locations on the University Campus, but there are few locations where these racks are protected from rain and snow.

The intersection of Comstock and Euclid Avenues (l) has a high usage of bicyclists. Many bikes are locked to signposts, railings and other locations due to the lack of safe, convenient bicycle parking in the project area.

Old "schoolyard" style bike racks on University Avenue (l) make it difficult to lock modern bicycles securely. The person on the right is traveling with a musical instrument on his back – evidence that the bicycle is a useful vehicle on University Hill.

Safety and Accessibility

In general, while most of University Hill has sidewalks, the conditions of the pedestrian streetscape are inconsistent, with missing sections of sidewalk, a lack of consistent street trees, lighting, and furnishings. Pedestrian crossings are generally not marked with high-visibility pavement markings, and ADA accessibility is lacking in many locations. A good pedestrian environment requires these details to be provided and well maintained.

Sidewalk conditions include numerous locations where car parking crosses the sidewalk, and where missing sections of concrete sidewalk have been patched with asphalt.

Bus stops in the project area generally do not include shelters or ADA accessibility enhancements.

Broken and missing sections of sidewalk can limit the mobility of pedestrians of all ages and abilities.

Intersections: Signs, Signals and Pavement Markings

Many of the intersections in the project area do not have up-to-date signage, pedestrian signals and pavement markings. There are multiple speed limits ranging from 15 mph to 30 mph, traffic signals do not have countdown timers or other innovative treatments, and crosswalk markings are difficult to see by both motorists and pedestrians. These factors limit the ability for people to walk safely throughout University Hill.

These pedestrian signal controls on Comstock Ave are not in a state of good repair. If the signal information and controls are not working, pedestrians will cross the street without the assistance of the signal system.

This intersection on Irving Avenue does not have marked crosswalks, ADA compliant curb ramps or appropriate pedestrian signals.

Pavement markings require constant maintenance to maintain their visibility, and this is a challenge in the Syracuse region's climate.

Streetscape Details

A high quality streetscape includes lighting, street trees, benches, way-finding signage, and other amenities that support walking and bicycling. The field review indicates that many of these features are not present in the University Hill project area.

This streetscape on Marshall St. is missing important elements, including a clearly delineated a pedestrian walkway, street trees, and lighting. The building façade creates a blank wall along the street, and the low curbing along the street allows cars to park across the pedestrian right-of-way.

The view looking downtown from E. Adams street at Ostrom Avenue shows the city's steep topography, and an area where the sidewalk is a narrow 4' asphalt strip.

This section of Waverly Ave has had the planting strip filled with asphalt, creating an unattractive streetscape and a potential safety issue because cars can drive across the pedestrian right-of-way.

4. Demand Analysis

4.1 Existing Pedestrian Demand

Demand models are often used to quantify usage of existing pedestrian and bicycle facilities and to estimate the potential usage of new facilities. The model used for this study was developed by Alta Planning + Design, and incorporates information from existing publications as well as data from the U.S. Census. This model has been utilized on numerous pedestrian plans for cities throughout the United States.

The study area used for the demand model followed the boundaries of four existing census tracts encompassing the study area. The northern boundary generally follows Cedar Street between Irving and Lancaster Avenues. The eastern boundary follows portions of Lancaster Avenue, Nottingham Road and Roe Avenue. Portions of Colvin Street and Interstate 481 serve as the southern boundary, and Interstate 81 serves as the western boundary.

The model consisted of several variables including commuting patterns of working adults, and predicted travel behaviors of area college students and school children. The information was ultimately aggregated to generate a total existing demand for pedestrian facilities in the study area. Table 1 identifies the variables used in the model. Data regarding the existing labor force (including number of workers and percentage of commuters) was obtained from the 2000 Census.

This model included an additional variable to address transit access. Specifically, this variable includes an estimate of pedestrian trips to and from public transit stops. Transit currently accounts for about 5 percent of commuting trips in the study area, and the analysis assumed that, based on a conservative estimate, approximately 75 percent of transit users would walk to and from transit stops. Estimating the pedestrian mode share of college students incorporated data from other universities, as well as the pedestrian commute mode share in the census tract located in the area around the University campus.

Table 1 summarizes estimated existing daily walking trips within the study area. The table indicates that over 89,000 pedestrian trips are made on a daily basis. Most of these trips on foot are made by college students, while school children make the fewest number of pedestrian trips. The model also shows that non-commuting trips comprise the vast majority of existing pedestrian demand. Nearly 3 out of 4 daily walking trips are made for purposes other than walking to school or work.

Table 2: Aggregate Estimate of Existing Pedestrian Activity in the Syracuse-University Hill Study Area

Variable	Figure	Calculations
Employed Adults, 16 Years and Older		
a. Study Area Population (1)	16,204	
b. Employed Persons (2)	6,182	
c. Pedestrian Commute Percentage (2)	36.8%	
d. Pedestrian Commuters	2,275	(b*c)
e. Work-at-Home Percentage (2)	3.3%	
f. Work-at-Home Pedestrian Commuters (3)	102	[(b*e)/2]
g. Transit Commute Percentage (2)	4.6%	
h. Transit Pedestrian Commuters (4)	213	[(b*g)*0.75}
School Children		
i. Population, ages 6-14 (5)	762	
j. Estimated School Pedestrian Commute Share (5)	11%	
k. School Pedestrian Commuters	84	(i*j)
College Students		
l. Full-Time College Students (7)	15,494	
m. Pedestrian Commute Percentage (8)	60%	
n. College Pedestrian Commuters	9,296	(l*m)
Work and School Commute Trips Sub-Total		
o. Commuters Sub-Total	11,970	(d+f+h+k+n)
p. Commute Trips Sub-Total	23,941	(o*2)
Other Utilitarian and Discretionary Trips		
q. Ratio of "Other" Trips in Relation to Commute Trips (9)	2.73	Ratio
r. Estimated Non-Commute Trips	65,359	(p*q)
Total Estimated Daily Pedestrian Trips in Study Area	**89,300**	(p+r)

Notes: Census data collected from 2000 U.S. Census for tracts 43, 44, 55 and 56.01 in Onondaga County.

(1) 2000 U.S. Census, STF3, P1.
(2) 2000 U.S. Census, STF3, P30.
(3) Assumes 50% of population working at home makes at least 1 daily walking trip.
(4) Assumes 75% of transit riders access transit by foot.
(5) 2000 U.S. Census, STF3, P8.
(6) Estimated share of school children who commute on foot, as of 2000 (source: National Safe Routes to School Surveys, 2003).
(7) 2004–2005 full-time enrollment (source: Syracuse University).
(8) Based on walking mode share from other universities. Also reflects high walking mode share in the census tract encompassing the core project area.
(9) 27% of all trips are commute trips (source: National Household Transportation Survey, 2001).

4.2 Existing Bicyclist Demand

Existing demand for bicyclist facilities was estimated using a model similar to the pedestrian demand model. The study area boundaries were identical to the pedestrian model, as they were based on the four census tracts encompassing University Hill. While bicyclists can generally travel farther than pedestrians (national data indicate walking trips to usually be less than 1 mile, and bicycling trips to be 2-5 miles in length), the approximately 2 mile diameter study area is small enough to use the same model boundaries for both modes. The variables and methodology for estimating pedestrian demand also generally reflect those used in the bicycle demand model.

In addition to people commuting to the workplace, the bicycle model also incorporated a portion of the labor force working from home. Specifically, it was assumed that about half of those working from home would make at least one bicycling or walking trip during the workday. These trips were included in the bicycling model, and in order to avoid 'double counting', were not also included in the pedestrian model. College students constituted a significant variable in the model due to the presence of Syracuse University. Data from the Federal Highway Administration regarding bicycle mode share in university communities was used to estimate the number of students bicycling to and from campus. The 2000 Census was also used to estimate the number of children within the study area. This figure was combined with data from national Safe Routes to School surveys to estimate the proportion of children riding bicycles to and from school. Finally, data regarding non-commute trips was obtained from the 2001 National Household Transportation Survey to estimate bicycling trips not associated with traveling to and from school or work.

Table 2 summarizes estimated existing daily bicycle trips within the study area. The table indicates that nearly 13,000 trips are made on a annual average daily basis. Most bicycle commuting trips are made by college students while school children make the fewest trips. The model also shows that non-commuting trips comprise the vast majority of existing bicycle demand. Nearly 3 out of 4 daily bicycle trips are made for purposes other than commuting to school or work. These trips are likely to be weather dependent, with potentially more trips made by bicyclists during warmer weather, and less during winter conditions. It is also worth noting that current bicycle usage is primarily due to the historic land use pattern of University Hill. While a few recent improvements have been made to encourage increased bicycling, a more comprehensive network of bicycle facilities would be necessary to create increased use.

Campus communities including Cornell, UC Berkeley and Wisconsin-Madison have made significant investments in non-motorized transportation. This photo shows one of the network of "Bicycle Boulevards" created to link UC Berkeley to surrounding city neighborhoods and destinations. Bicycle Boulevards are a hybrid on-street bike facility composed of sections with bike lanes, shared lanes, traffic calming treatments, and signage.

Table 3: Estimate of Existing Bicycling Activity in Syracuse-University Hill Study Area

Variable	Figure	Calculations
Employed Adults, 16 Years and Older		
a. Study Area Population (1)	16,204	
b. Employed Persons (2)	6,182	
c. Bicycle Commute Percentage (2)	0.9%	
d. Bicycle Commuters	56	(b*c)
e. Work-at-Home Percentage (2)	3.3%	
f. Work-at-Home Bicycle Commuters (3)	102	[(b*e)/2]
School Children		
g. Population, ages 6-14 (4)	762	
h. Estimated School Bicycle Commute Share (5)	2%	
i. School Bicycle Commuters	15	(g*h)
College Students		
j. Full-Time College Students	15,494	
k. Bicycle Commute Percentage	10%	
l. College Bicycle Commuters	1,549	(j*k)
Work and School Commute Trips Sub-Total		
m. Daily Commuters Sub-Total	1,722	(d+f+i+l)
n. Daily Commute Trips Sub-Total	3,445	(m*2)
Other Utilitarian and Discretionary Trips		
o. Ratio of "Other" Trips in Relation to Commute Trips (8)	2.73	ratio
p. Estimated Non-Commute Trips	9,404	(n*o)
Total Estimated Daily Bicycle Trips in Study Area	**12,848**	(n+p)

Notes:

Census data collected from 2000 U.S. Census for tracts 43, 44, 55 and 56.01 in Onondaga County.

(1) 2000 U.S. Census, STF3, P1.
(2) 2000 U.S. Census, STF3, P30.
(3) Assumes 50% of population working at home makes at least 1 daily bicycle trip.
(4) 2000 U.S. Census, STF3, P8.
(5) Estimated share of school children who commute by bicycle, as of 2000 (source: National Safe Routes to School Surveys, 2003).
(6) 2004–2005 full-time enrollment (source: Syracuse University).
(7) Review of bicycle commute share in 7 university communities (source: National Bicycling & Walking Study, FHWA, Case Study #1, 1995).
(8) 27% of all trips are commute trips (source: National Household Transportation Survey, 2001).

5. Benefits Analysis

5.1 Air Quality Benefits

In addition to models quantifying existing and future demand for non-motorized facilities, a variety of models can also quantify the benefits of such facilities. Models were used in this study to estimate the positive air quality impacts associated with existing and future bicycle/pedestrian travel within the study area. Non-motorized travel directly and indirectly translates into fewer vehicle trips and an associated reduction in vehicle miles traveled and auto emissions.

The variables used as model inputs generally resembled the variables used in the demand models discussed earlier. Data including study area population, employed persons and commute mode share were used for this analysis. In terms of daily bicycling and walking trips, assumptions regarding the proportion of transit commuters and those working at home reflect those used in the demand models. Other inputs included data regarding college student and school children commuting patterns.

Additional assumptions were used to estimate the number of reduced vehicle trips and vehicle miles traveled, as well as vehicle emissions reductions. In terms of reducing vehicle trips, it was assumed that 73 percent of bicycling and walking trips directly replace vehicle trips for adults and college students. For school children, the reduction was assumed to be 53 percent. To estimate the reduction of existing and future vehicle miles traveled, a bicycle round trip distance of eight miles was used for adults and college students; and one mile for school children. For pedestrian trips, a roundtrip distance of 1.2 miles was used for adults and college students, and a 0.5 mile distance was used for children. These distance assumptions are used in a variety of non-motorized benefits models. The vehicle emissions reduction estimates also incorporated calculations commonly used in other models, and are identified in the footnotes of Table 3.

Table 3 summarizes current air quality benefits associated with bicycling and walking in the Syracuse-University Hill study area. Combined, bicycling and walking currently remove nearly 10,000 weekday vehicle trips from the study area, eliminating over 20,000 vehicle miles traveled. Bicycling and walking also prevent nearly 400 tons of particulates from entering the ambient air each weekday. It should be noted that this model only addresses commute-related trips. Unlike the demand model, this model does not account for air quality improvements associated with recreational non-motorized travel. Quantifying the benefits of recreational travel could further improve the air quality benefits of bicycling and walking.

Bikeway and pedestrian network enhancements can be expected to generate more bicycling and walking trips in the future. This growth should be expected to improve air quality by further reducing the number of vehicle trips, vehicle miles traveled and associated vehicle emissions.

Table 4: Current Air Quality Benefits

	Bicycle	Pedestrian
Vehicle Travel Reductions		
Reduced Vehicle Trips per Weekday (1)	1,254	8,722
Reduced Vehicle Trips per Year (2)	327,351	2,276,330
Reduced VMT per Weekday (3)	9,977	10,435
Reduced VMT per Year (2)	2,604,048	2,723,515
	Bicycle	**Pedestrian**
Vehicle Emissions Reductions		
Reduced PM_{10} (tons per weekday) (4)	184	192
Reduced NO_X (tons per weekday) (5)	4,977	5,205
Reduced ROG (tons per weekday) (6)	724	758
Reduced PM_{10} (tons per year) (7)	47,914	50,113
Reduced NO_X (tons per year) (7)	1,298,899	1,358,489
Reduced ROG (tons per year) (7)	189,054	197,727

Notes: VMT means Vehicle Miles Traveled
PM_{10} means Particulate Matter
NO_X means Nitrogen Oxide
ROG means Reactive Organic Gases

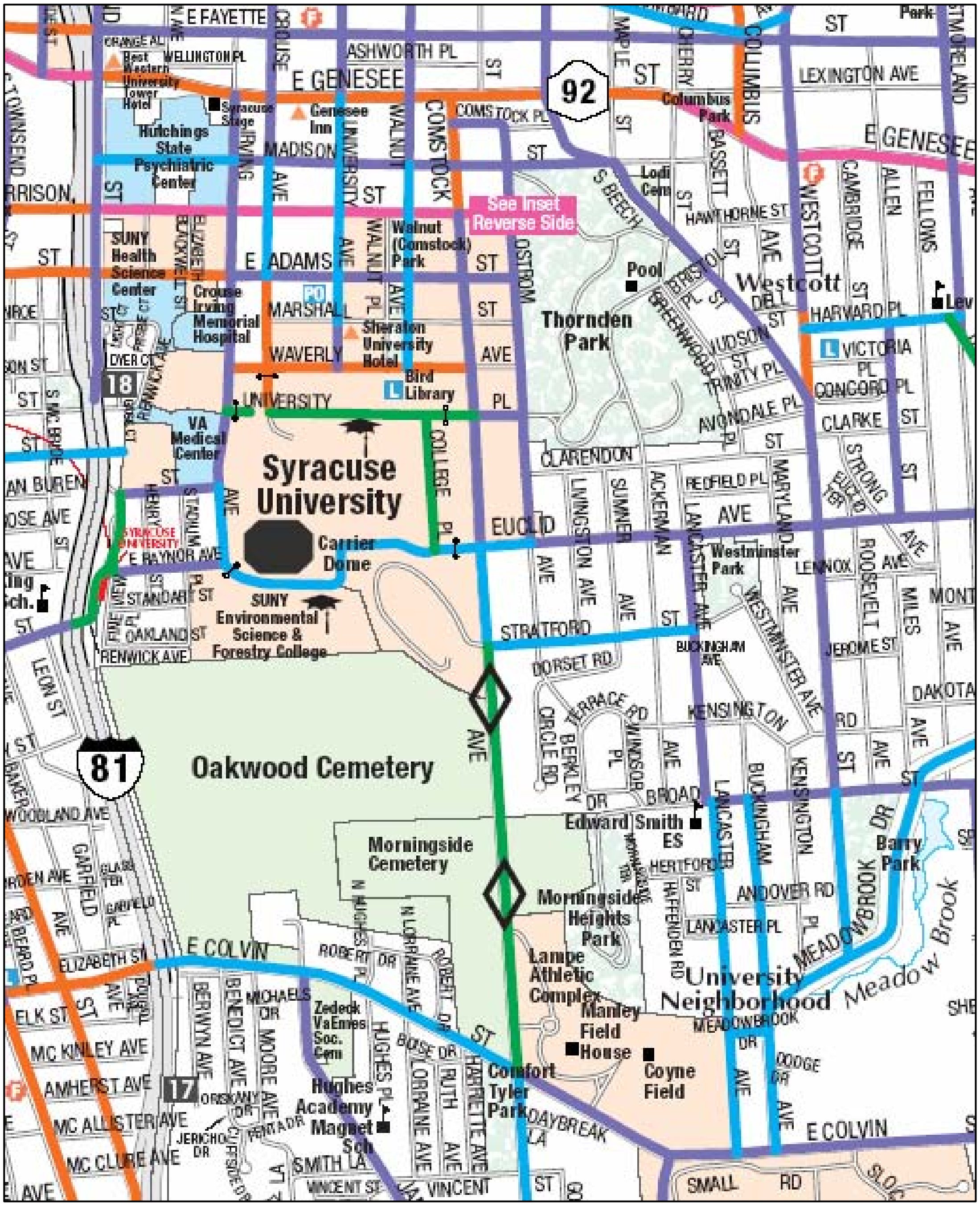
(1) Assumes 73% of bicycle trips replace vehicle trips for adults/college students; 53% reduction for school children.
(2) Weekday trip reduction multiplied by 261 weekdays per year.
(3) Bicycle trips: assumes average round trip of 8 miles for adults/college students; 1 mile for school children. Pedestrian trips: assumes average round trip of 1.2 miles for adults/college students; 0.5 mile for school children.
(4) PM_{10} reduction of 0.0184 tons per mile.
(5) NO_X reduction of 0.4988 tons per mile.
(6) ROG reduction of 0.0726 tons per mile.
(7) Weekday emission reduction multiplied by 261 weekdays per year.

6. Appendix: Supplemental Information from the 2003 SMTC Bicycle and Pedestrian Plan

- SMTC Bicycle Suitability Map, including existing conditions for bicyclists in the University Hill project area

- SMTC Bicycle Crash Data Summary; data was developed for the City of Syracuse, and is provided to show a general overview of bicycle safety in the City.

- SMTC Pedestrian Crash Data Summary; data was developed for the City of Syracuse, and is provided to show a general overview of pedestrian safety in the City.



The 2003 SMTC Bicycle Suitability Map rated roads from fair/poor (pink and orange) to good/excellent (blue and green), with purple scored as 'average.' An on-street network could be developed with a series of treatments that could create an interconnected network of green/excellent bikeways throughout University Hill.

Summary of bicyclist/motor vehicle crash data, 1987–2000 (Source: SMTC)

Summary of pedestrian/motor vehicle crash data, 1987-2000 (Source: SMTC)