

Enhancing Rural Community Assets through Active
Transportation Planning:
A Case Study of Norway, Maine

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Abstract

Over the last several decades the reduction in transportation options and spread of sprawling land use patterns in rural areas have left rural Americans structurally dependent on their cars with few other safe or practical alternatives. Furthermore, declines in traditional economic sectors has put additional financial burden on rural residents to travel further and spend more of their limited budgets on vehicle ownership and operation to reach outlying employment opportunities. The purpose of this study is to provide small rural towns guidance on connecting valuable community assets with bicycle and pedestrian networks as a means to revitalize their communities. This project also aims to bring a rural perspective to the field of active transportation planning. The Town of Norway, Maine serves as a case study to demonstrate the potential for enhancing existing linkages between community assets in rural towns with connected active transportation facilities. The results of this study reveal that Norway can create connected bicycle and pedestrian networks by prioritizing the repair of existing sidewalk facilities, striping on-street bicycle facilities, and improving safety at intersections where two distinct street types cross. Bicycle and pedestrian networks are proposed by connecting street segments that are in need of new or upgraded infrastructure with the location of valuable community assets. The methodology explored in this thesis can serve as a model to other rural towns interested in applying a data driven approach to active transportation and community development planning.

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Chapter 1: Introduction

Many rural towns have the advantage of developing prior to the introduction of the automobile. In these older communities, dense commercial districts and neighborhoods developed at the nexus of natural resource extraction points and transportation (including rail stations, river ports, and major crossroads) resulting in walkable access to basic services (The Partnership for Sustainable, 2011). In subsequent decades, the proliferation of the automobile has had a substantial impact on the transportation environment and land use patterns in small rural towns. Owning a car in most rural communities has become essential for accessing jobs, health care, education, recreation, and retail opportunities. Despite receiving 32 percent less in yearly income than urban households, rural households spend a larger percentage of that income on transportation related expenses (Hawk, 2013). Rural residents are additionally burdened by the costs associated with vehicle ownership because unlike their urban counterparts, access to other transportation choices is extremely limited. Safety is a major concern for making biking and walking realistic transportation options in rural towns, particularly because crashes involving bicyclists and pedestrians are much more likely to result in fatalities or serious injuries due to higher vehicle speeds and truck traffic on rural roads (Hall et al., 2004).

Providing safe and accessible transportation options in rural towns not only improves individual safety and mobility, but can also be a strategy for community development. The loss of traditional natural resource-based jobs in many rural areas has forced communities to make choices to deal with economic stagnation and shrinking tax bases. Many rural towns have embraced sprawling

land use patterns characterized by commercial strip development with large retail stores along arterial roadways in hopes of spurring growth (Daniels, 1999). However, some communities are realizing that automobile-oriented transportation and land use planning over the past several decades has not brought the prosperity they had hoped for (Environmental Protection, 2013). High vehicle speeds and lack of bicycle and pedestrian facilities along roadways in small rural towns serve as physical barriers for residents to access local destinations without a vehicle. Even those communities that have preserved their traditional Main Streets often struggle to maintain economic vitality due to the decentralization of employment and retail destinations (Read, 2010).

This thesis proposes a strategy for small rural towns to develop active transportation infrastructure that will help support local community development and connect its most valuable assets, which are defined as local capacities and institutions within a community (Kretzmann and McNight, 1993). This research examines a small town in Maine named Norway as a case study to demonstrate the potential for enhancing existing linkages between community assets. This project builds upon the Rural Active Living Assessment (RALA) tools developed by Dr. David Hartley (2009) by creating a framework that allows for the practical use of data for active transportation and asset-based planning purposes.

The purpose of this study is to provide small rural towns guidance on connecting valuable community assets with bicycle and pedestrian networks as a means to revitalize their communities. The overarching goal of this study is to add a rural perspective to the active transportation planning field. There are two

primary outputs of this project. The first is a typology of rural roads based on land use and built environment data that will characterize the existing land use and transportation context and highlight deficiencies along the current roadway network in Norway. The street typology has a narrative format describing the different street types and the existing conditions for biking and walking along streets with similar characteristics. The second output is a web-based Google map and accompanying descriptions that display identified community assets (including schools, parks, recreational/athletic areas or complexes, trails, farms, libraries, etc), existing land use and streets conditions, and proposed biking and walking networks. Problematic intersections located at the transition between different street types are also mapped and an array design solutions including active transportation facilities and traffic calming treatments are suggested to improve the safety of biking and walking in Norway. Although this study focuses on the town of Norway as a representative case study, the methodology can help other rural towns utilize data for active transportation and community development planning purposes.

Chapter 2: Literature Review

The following literature review defines what it means to be a rural community and current challenges facing those towns, identifies strategies for active transportation planning, discusses potential economic benefits associated with active transportation, and explores strategies for rural community development. Finally the literature review includes a description of the Rural Active Living Assessment (RALA) tool, which serves as the major data source for this project, and provides examples of how it has been used in practice.

Defining Rural Communities

When people think about rural areas in the United States, visions of bucolic rolling hills, mountains, and farmlands often come to mind. However, a more nuanced description is warranted for transportation planning purposes, as the definition of “rural” varies greatly across the literature with no single set of criteria emerging. The federal Office of Management and Budget defines rural as non-metro counties that are not included in a Metropolitan Statistical Area of at least 100,000 people, or 75,000 specifically in New England (Health Resources, 2012). The U.S. Census Bureau defines rural as encompassing all population, housing, and territory not included within an Urbanized Area (UA) that has a population of 50,000 or more (U.S. Census Bureau, 2010). The Census Bureau also defines Urban Clusters (UCs) as any population of at least 2,500 and less than 50,000, classifying all census blocks by population density and providing a more detailed picture of densely settled rural populations (U.S. Census Bureau, 2010).

The aforementioned definitions offer quantitative measures of rural areas but the literature also presents qualitative descriptions as well. For example, rural communities can be categorized by their economic, geographic, transportation and land use contexts. The International City/County Management Association (ICMA) characterizes rural towns into five separate types: *gateway communities* located near high-intensity recreational or tourist attractions, *resource-dependent communities* whose economies rely on single industries, *edge communities* abutting metropolitan areas, *traditional Main Street communities* that have

retained their compact street design, historic architecture, and commercial districts, *and second home and retirement communities* undergoing development pressures from new residents with higher incomes (Read, 2010). Twaddel and Emerine (2007) categorize rural towns into *exurban communities* located near urban areas that serve as job centers, *destination communities* that have shifted to tourism-based economies with access to natural amenities, *and production communities* often isolated and dependent on single industries.

Comparisons between rural and urban areas can be valuable in formulating planning techniques that are tailored to different economic and transportation contexts in rural towns. Economic differences between rural and urban areas are significant. As urban centers become more heavily rooted in the service-based economy, many rural towns (although declining in some industries) rely on farming, logging, mining, and other natural resource extraction activities (Twaddel and Emerine, 2007). Poverty rates are similar across rural and urban communities, while rural median household income is found to generally be \$10,000 lower and educational and employment opportunities are more difficult to obtain in rural communities as well (Twaddel and Emerine, 2007).

Identifying Challenges in Rural Communities

Just as urban centers were thought not to be worth saving just a few decades ago, rural towns are currently being similarly discounted amid economic uncertainty (Snow, 2001). Rural towns today are facing several challenges, including declining or stagnant economies, funding and capacity limitations,

sprawling land use/development patterns, and transportation-related issues including accessibility, industrial traffic and safety, and auto-dependency. While specific challenges will vary from community to community, this list encompasses some of the common trends being observed in rural towns across the country.

One of the most often discussed problems facing rural America today is the decline of traditional industries and related skilled job opportunities. Maine serves as a fitting example to demonstrate this change, with manufacturing accounting for 24 percent of employment and gross state product (GSP) in 1980, declining to as little as 10 percent of employment and 12 percent of GSP in 2004 (Colgan, 2006). Resource-based economies are particularly vulnerable to changes in commodity prices, mechanization, land ownership and value, and other market forces (The Partnership for Sustainable, 2011). Rural communities that are reliant on single sectors of the economy for a majority of their job opportunities are uniquely vulnerable to declines in these industries and are often left with few alternative prospects (Snow, 2001). Some authors hypothesize that economic hardship and immobility reinforce each other in a vicious cycle; dispersed development patterns in rural towns require significant dependence on automobiles that people with low incomes struggle to afford, forcing them to work nearby low-paying jobs, not participate in the labor force, or leave the area in search of better opportunities and more transportation options (Nutley, 2000).

Another major barrier to addressing many of the issues facing rural America today is the lack of funding and professional capacity available to small

towns. Rural communities struggle financially to maintain and preserve their existing infrastructure, limiting the prospects for expansion or upgrades to transportation facilities (Twaddel and Emerine, 2007). The lack of local government staff can significantly reduce the capacity of small towns to engage in comprehensive planning, regional collaboration, or the implementation of innovative planning solutions (Loh et al., 2011; Read, 2010). The aforementioned lack of capacity can often lead to haphazard development and reduced transportation network connectivity (Loh et al., 2011).

A third challenge facing rural towns is related to poor land use decisions, as communities facing economic difficulties have welcomed sprawling development patterns for the last few decades under the guise that any growth is an indicator of a healthy economy (Read, 2010). However, the literature points to a shift in attitude among some rural communities, with the understanding that sprawling land use development patterns prevent them from meeting their fiscal, social, public health, and environmental goals (The Partnership for Sustainable, 2011; Read, 2010). Outcomes from urban areas that have invested in multi-modal transportation without adding or widening roads are providing strategies that can be employed in rural settings as a way to contain unwanted development and support local economic growth (Twaddel and Emerine, 2007).

Access to transportation options represents another challenge to rural communities. Transportation is an issue on both the regional and local levels, as rural communities attempt to balance the need to accommodate freight vehicles that support resource industries and short trips made within the community

(Twaddel and Emerine, 2007). Twaddel and Emerine (2007) conducted a comprehensive survey of transportation issues facing rural communities by disseminating 3,000 paper surveys to 1,384 counties and 1,666 municipalities, as well as an online survey distributed to state DOTs, professional and civic organizations, tribal planners, and interested individuals. Respondents reported the most significant challenge facing their communities was to provide access to local destinations such as jobs, shops, services, education, and healthcare (Twaddel and Emerine, 2007). Written comments from the survey suggest that poor access for pedestrians and cyclists is due to a lack of sidewalks, bike lanes, and wheelchair-accessible facilities in many rural communities (Twaddel and Emerine, 2007). Additional literature suggests that transportation accessibility is of particular concern for low-income residents, children, and senior citizens who have barriers to automobile operation (Partnership for Sustainable, 2011).

Safety is another significant transportation challenge in rural towns due to the widespread presence of heavy truck and freight traffic on rural roads and Main Streets. According to data from the National Highway Traffic Safety Administration (2013), 19 percent of the U.S. population lives in rural areas but rural fatalities accounted for 55 percent of all traffic fatalities in 2011. Additionally, more than 70 percent of all fatal crashes in 2005 happened on rural roadways with speed limits of 55 mph or higher, with accidents involving both light and large trucks occurring more frequently in rural compared to urban areas (National Highway, 2005). The fact that many rural Main Streets are also designated as state highways leaves many rural communities with limited control

over any changes that would improve the safety for pedestrians and bicyclists (Smart Growth, 2014).

Gray et al. (2011) note that the conditions created by the land use patterns and lack of transportation options in rural towns leave rural Americans “structurally dependent” on their cars (p. 122). Nutley (1996) points out that most of the literature from the United States and the United Kingdom related to carless populations focuses heavily on urban areas, despite the fact that rural residents face significantly greater spatial barriers to mobility. In auto-dependent rural communities, the financial burden of vehicle ownership and maintenance falls disproportionately on the rural poor who tend to have lower incomes, poorer quality roads, and longer travel distances (McDonagh, 2006). Specifically, Litman (2002) suggests that transportation costs consume more than 25% of income for those earning less than \$20,000 annually. The lack of public transportation in rural towns leaves low-income and elderly residents with very limited options for accessing essential services besides car ownership.

Active Transportation Planning in Rural Towns

Despite the challenges facing rural towns noted above, many are looking to expand transportation options within their communities. Fortunately, some rural towns have the underlying conditions for active transportation to flourish, including compact commercial districts and adjacent residential areas that make it feasible for rural residents to use active transportation for regular trips between one and three miles (Loh et al, 2011). Additionally, rural Americans have

expressed interest in improving biking and walking infrastructure. A recent survey by the U.S. Department of Transportation revealed that 95 percent of rural respondents ranked sidewalks as the most important of eight identified transportation-related facilities, compared to 91 percent for major roads and only 87 percent for parking (Loh et al, 2011). Maybe even more surprisingly, 75 percent of rural respondents said that bike lanes were important transportation facilities (Loh et al, 2011). Concurrently, the body of academic and grey literature surrounding this topic has also been growing in recent years. Strategies to increase active transportation in rural towns as found in the literature include enhanced street connectivity, complete streets policy and design approach, and traffic calming.

Street connectivity is a road design strategy that aims to minimize travel distances and increase transportation mode options (Twaddel and Emerine, 2007). A report written by the U.S. Departments of Urban Development, Transportation, Environmental Protection, and Agriculture suggest that increasing street connectivity using short block lengths and frequent intersections will enhance the environmental and financial sustainability of rural communities (The Partnership for Sustainable, 2011). Mota et al. (2007) found that street connectivity was a predictor of active transportation, and emphasized that increased street connectivity through on-road infrastructure upgrades improves perceptions of safety and the availability of walking and bicycling as a means of transportation in rural towns (Mota et al., 2007).

Complete Streets are an approach to policy and design that strives to plan streets that are comfortable, accessible, and safe for pedestrians, bicyclists, transit riders, and motorists (National Complete Streets, 2011). Although Complete Streets efforts in urban areas have received the most attention within the planning profession, towns outside of urban centers represented nearly one in five of all communities adopting Complete Streets policies in 2011 (National Complete Streets, 2011). The literature stresses the importance of avoiding a one-size-fits all approach to Complete Streets planning in rural towns, as sidewalks would not be appropriate in an agriculture land use context but would be recommended in a central commercial district for example (Smart Growth, 2014). Rural towns could benefit from Complete Streets planning in a myriad of ways, including reinvestment and economic development, additional mobility for all users (elderly, disabled, low-income), and increased access to community destinations (Twaddel and Emerine, 2007; The Partnership for Sustainable, 2011; Smart Growth, 2014). Establishing a Complete Streets policy at the local level was noted as a powerful way for rural towns to communicate with state agencies regarding their community's vision for street design and transportation goals (Smart Growth, 2014)

Traffic calming is a strategy that utilizes mainly physical measures to reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users (Lockwood, 1997). Many rural towns do not control their own Main Street because they have been designated as part of the state road network. The state highway classification is problematic for

small communities because it typically results in higher traffic volumes and vehicle speeds, as well as safety concerns for children, the elderly, and pedestrians and bicyclists (Twaddel and Emerine, 2007; Smart Growth, 2014; Hallmark et al., 2007). European countries have more extensive experience with traffic calming in rural areas, while this strategy has been employed generally on residential urban roadways in the United States (Hallmark et al., 2007). Hallmark et al. (2007) directly evaluated traffic-calming treatments on major roads through several rural towns in Iowa by collecting speed data before and after implementation. They found that the most effective treatments included speed tables, driver speed feedback signs, and colored on-street speed pavement markings (Hallmark et al., 2007). Additional traffic calming recommendations from the literature include treatments such as gateways, rumble strips, lane narrowing, and chicanes, as well as “reverse measures” that remove existing engineering features on rural roads in favor of natural landscape elements and road surfaces (Sustrans, 2004).

Economic Benefits of Active Transportation Infrastructure

The economic benefits of active transportation as described in the literature include increased property values, local business benefits, tourist and creative class potential and transportation expenditure savings. Rural communities could take advantage of the relatively low costs to build active transportation infrastructure, compared to more expensive projects like building new roads, widening lanes, or adding new parking facilities, and potentially reap economic benefits to revitalize their stagnant economies.

Research suggests that property values can benefit from nearby biking and walking infrastructure. Along the Little Miami Scenic Trail in Ohio, the trail was estimated to increase nearby home prices by \$39.3 million (or \$3.98 per square foot) (Parent and vom Hofe, 2013). Similarly, researchers found that homes within a half-mile of the Monon Trail in Indiana sold for 11 percent more than the average price in the area (Lindsey et al., 2014). On-street bicycle facilities have been shown to provide benefits in urban areas, with San Francisco architect and developer David Baker noting that wide streets with fast-moving vehicle traffic tend to depress property values, while buildings on streets with bicycle and pedestrian improvements have appreciated in value (Anderson and Hall, 2013). However, contradictory findings from suburban areas found that both off-street and on-street bicycle facilities negatively impacted home values, likely due to perceptions of trespassing, former railroad rights of way, and commuting to work by bicycle (Krizek, 2006). Therefore, it is important to understand the local context of the community to determine the potential impact of active transportation infrastructure on housing prices.

There is a significant amount of literature that describes the benefits to local businesses of active transportation improvements, including increased retail visibility, sales volumes, and concentrated investment in local economies (Anderson and Hall, 2014; Blue, 2013; Clifton et al., 2012; Litman, 2002). Studies have found that bicyclists and pedestrians are considered to be “competitive consumers,” meaning drivers spent the most money on average per trip, but those using non-motorized transportation made more frequent trips,

resulting in higher per month spending at the same establishments (Clifton et al., 2012, p. 40). Local businesses in cities and rural towns alike have reported increased economic activity following the installation of active transportation infrastructure. Sales increases from 49 percent in New York City (Anderson and Hall, 2014) to 179 percent in Fort Worth, Texas (Blue, 2013) were reported by businesses along streets where new on-street bicycle facilities were installed. A small town (population 750) in rural Minnesota that was struggling economically now reaps a \$1.5 million yearly dividend from spending by rail-trail users, while many new businesses have opened on their now thriving Main Street (Loh et al., 2011). A long distance multi-use path between Homestead, PA and Cumberland, MD has attracted 700,000 yearly users who spent \$40 million in the local economy, and 54 businesses catering to trail users have opened or expanded, generating 83 new jobs (Loh et al., 2011). There were similar findings state-wide in Vermont with bicycle-pedestrian-oriented businesses reporting an estimated \$30.7 million in output and 561 employees with a total payroll of \$9.9 million in 2009 (Economic Impact, 2009).

While population growth in most rural towns is on the decline, tourist and recreation destination communities are experiencing growth from an influx of young families, retirees, former urbanites and outdoor enthusiasts who are increasingly interested in biking and walking (Loh et al., 2011). The State of Vermont, which boasts significant biking and walking recreational amenities, calculated that bike and pedestrian activities (including bicycle-pedestrian event tourism and bicycle-pedestrian oriented businesses) amounted to a net positive of

\$1.6 million tax and fee revenues for the state budget in 2009 (Economic Impact, 2009). Tourism has the additional benefit of translating into potential future residents and business owners (Loh et al., 2011). According to a study by the U.S. Department of Agriculture's Economic Research Service, rural counties that are able to attract "creative class" businesses enjoy job-growth rates higher than even metropolitan areas, and that those workers are looking for qualities including active street scenes and outdoor recreational opportunities (Loh et al., 2011). In Billings, Montana, trails are no longer viewed just as a recreational resource or community amenity, but rather as essential infrastructure for business recruitment (Loh et al., 2011).

Active transportation infrastructure can also have an economic impact on rural residents in the form of savings on household transportation expenditures. Because transportation is the biggest expense for American households after housing, additional transportation options can improve individual mobility, increase consumer choice, and reduce monthly costs (Litman, 2002; Loh et al., 2011). Several estimates from the literature suggest that individuals could save an average of \$4,500 to \$9,000 a year by reducing their dependency on automobile travel (Williams, 2010; Litman, 2002). The literature also presents the argument that money spent on operating a vehicle (purchasing gas for example) provides less direct economic benefits to local economies than other consumer expenditures like housing, services, and entertainment (Litman, 2002; Blue, 2013). Investments in active transportation can have an even greater impact in

rural areas where people have less disposable income by providing significantly cheaper transportation options, thus stretching household budgets further.

Strategies for Rural Community Development

When transportation planning and community development efforts are incongruent, small towns often develop in a manner that bypasses traditional economic centers, renders Main Streets unsafe for pedestrians and bicyclists, and limits mobility to local destinations (Twaddell and Emerine, 2007). To address these issues, traditional community development approaches have focused on the needs, deficiencies and problems of struggling towns (Kretzmann and McKnight, 1996). Alternative approaches to community development found in the literature include compact growth and asset-based planning efforts. Both of the aforementioned strategies have a common thread in that they focus on building upon existing strengths rather than the weaknesses of individual communities to spur rural economic development. An integrated approach of active transportation planning and community development strategies can attract and concentrate investment around traditional neighborhoods and community focal points.

Land Use and Compact Growth

Rural towns face several land use challenges as previously discussed, as variable land use standards have resulted in commercial sprawl and loss of agricultural lands, which is changing the character of many rural towns (Twaddell and Emerine, 2007). The literature suggests that rural land use planning should focus on compact growth to provide residents with opportunities to live closer to

services, attract new businesses and tourists, and provide safe community gathering places (Twaddell and Emerine, 2007). One resource suggests evaluating rural land use planning efforts by the percentage of new homes built in mixed-use neighborhoods, average residential density, and percentage of households within walking distance to stores, services, parks, and schools (The Partnership for Sustainable, 2011). As an example, the town of Unity, Maine amended its land use ordinance to require all new retail and most new commercial development be located in the town center and required all commercial developments over 10,000 square feet to build in a way that encouraged modes of transportation other than the automobile (Twaddell and Emerine, 2007). Before this change in land use policy, eight of ten storefronts on Main Street were vacant, now they all have thriving new businesses (Twaddell and Emerine, 2007).

Compact growth is a land use planning approach that encourages communities to build upon the strengths of their existing built environment to grow and thrive economically (Dalbey, 2008). According to the literature, the overall best practices to achieve compact growth include mixing land uses, limiting setbacks, varying housing choices, designing walkable and attractive streetscapes, preserving open space and farm land, providing a variety of transportation options, and encouraging community involvement in the planning process (Dalbey, 2008). Other literature focuses specifically on compact growth in rural towns, offering a framework that focuses on supporting rural working lands and protecting open space, preserving historic Main Streets and maintaining existing infrastructure, and creating desirable spaces that young people do not

want to leave (Read, 2010). The authors of this framework suggest that it be used for rural towns that are experiencing rapid growth to shape proposed developments, and for those stagnant economies to articulate a vision for enhancing existing resources and attracting investment around community goals (Read, 2010). The literature also stressed that compact growth is not only about new development, but it is also about building on existing assets, including Main Streets, street grid networks, or historic buildings to leverage future economic value out of these prior investments (Read, 2010).

Asset-Based Community Development

Kretzmann and McKnight (1993) outlined the concept of asset-based community development (also known as ABCD), which suggests an alternative path to the traditional “deficiency model” under which development in low income communities is viewed through the lens of a long list of needs or problems that can only be met by outsiders. The authors argue a different approach is needed because the prospect of outside help in the form of a single large-scale employer or significant new investment from the federal government is unlikely for many small rural towns (Kretzmann and McKnight, 1993). Their alternative approach is based on the premise that each community boasts a unique set of assets upon which a future can be built that incorporates individuals, associations, and institutions (Kretzmann and McKnight, 1993). Local leaders and residents can begin to build new relationships between identified assets in a manner that multiplies their power and effectiveness in community development efforts (Kretzmann and McKnight, 1993).

The asset-based community development method is typically a three-pronged approach that includes institutions, individuals, and associations (Kretzmann and McKinght, 1993). The authors define institutions as physical establishments located in the community, such as schools, libraries, parks, police and fire stations, non-profits, hospitals, and social service agencies (Kretzmann and McKinght, 1993). Local businesses and historic buildings are also considered to be institutional assets essential for future economic revitalization in small towns (Snow, 2001). An asset based strategy for community development tasks local leaders and residents with identifying and mapping local assets in an effort to create literal and figurative connections between important community associations, individuals, and institutions. Identifying and mapping existing community assets can help to lay the groundwork in small communities for future planning efforts and funding requests (Snow, 2001).

Examples of successful asset-based community development projects include Maine's Strategies for a Stronger Sanford, which brought together citizens, nonprofits, businesses, and government officials to map community assets and design economic investment plans to combat juvenile crime (Walker, 2006). Another example from Maine comes from the Western Mountain Alliance, where they worked with six competing regional banks to form a joint low-interest loan bank to support small farms (Walker, 2006). Additionally, a rural town in Arkansas rehabilitated a historic building in order to consolidate public services and transform it from a liability to a community asset, which helped to channel future development onto their struggling Main Street corridor (Snow, 2001). A

strength-based approach to community development has been successfully employed in rural and urban contexts alike, with communities leveraging their existing assets to improve the quality of life and economic opportunities for their residents.

Rural Active Living Assessment (RALA) Tool

The Rural Active Living Assessment (RALA) is a tool that helps rural towns identify physical community assets (many of which are essential local destinations) and evaluate the conditions for active transportation within different land use contexts in their communities (Yosefian et al., 2010). Researchers at the Maine Rural Health Research Center at the University of Southern Maine, Tufts University, and the Universities of Alabama and Mississippi developed the tool for the purpose of aiding active living planning efforts (Yosefian et al., 2010). The RALA tools are comprised of three separate components: Town Wide Assessment, Program and Policy Assessment, and the Street Segment Assessment, and were designed to be user-friendly for practitioners and reliable for researchers (Active Living, 2009). Both the Town Wide Assessment and Program and Policy Assessment require the user to objectively identify existing community assets and programs and policies as they relate to active living. The Street Segment Assessment is a street audit tool designed to evaluate walkability mainly by categorizing the presence (or lack thereof) of infrastructure, as well as its condition based on a four-point Likert scale (Yosefian et al., 2010). The Rural Active Living Assessment was developed in collaboration with rural residents, town planners, recreation directors, and health advocates in an effort to create an

appropriate, feasible, and user-friendly planning tool for rural communities across the country (Yosefian et al., 2010).

The Rural Active Living Assessment has been implemented in several rural Canadian towns, where users found that it helped to inform the development of recommendations for infrastructure and programming improvements (S. Liem, personal communication, October 28, 2014; Perrotta and Chin, 2014). Many towns in Maine including Norway are carrying out RALA assessments as part of grant funding they received from the Center for Disease Control. Additionally, the Bicycle Coalition of Maine has added a fourth section to the RALA tools called Bikeability Measures to evaluate the same streets that were assessed using the Street Segment Assessment tool (Bicycle Coalition, 2013). Therefore, the data from this tool is readily available to serve as a baseline for active transportation planning in the context of this project.

Chapter 3: Methods

The town of Norway will serve as a case study to demonstrate how active transportation infrastructure can support rural community development by connecting and enhancing existing community assets. Norway is an ideal case for this project because the town has retained its historic built environment, which stands as an example of the underutilized but valuable Main Streets that exist in small rural towns across the country. The dense built environment and walkable nature of Norway can function as a paradigm for how active transportation planning can be applied in a rural setting to provide residents and visitors with safe, comfortable, and convenient ways to access essential local destinations and

valuable community assets. Additionally, several local elected officials, organizations, and advocates have offered their support for this project, including the Norway Town Manager, the Center for an Ecology Based Economy (CEBE), Healthy Oxford Hills (HOH), and the Western Foothills Land Trust.

Data Collection

Literature related to transportation and land use issues, as well as approaches to community development in rural areas was reviewed as a foundation for this research. Data was collected using the Rural Active Living Assessment (RALA) tools to identify community assets and evaluate the built environment for biking and walking (Yousefian et al., 2010). Staff from Healthy Oxford Hills (HOH) collected the data using three tools from Rural Active Living Assessment. I collected the bikeability data using an separate fourth tool created by the Bicycle Coalition of Maine's called Bikeability Measures, and ground-truthed each segment by taking photos to document the condition of existing active transportation facilities along the roadways. All data collected using the RALA tools were digitized for analysis purposes. The participation of local residents in the data collection using the three original RALA tools will improve the validity and utility of the results for future local planning efforts.

Establish Case Study Context

The Town-Wide Assessment is used to characterize Norway's population, topography, as well as important destinations and town assets. The limited population data from the Town-Wide Assessment is supplemented with U.S. Census data in order to paint a broader picture of the residents living in Norway

and provide a point of comparison to understand how the analysis and proposed recommendations might apply to similarly situated municipalities. Additionally, the Town-Wide data provides a list of community assets including schools, parks, gyms, athletic facilities, and bike/pedestrian trails. Supplemental data collection efforts provide a more comprehensive list of community assets that include libraries, police and fire stations, non-profits, hospitals, and social service agencies, along with other places of community significance.

Rural Street Typology

Next, I analyze the data collected using the Rural Active Living Assessment and Bikeability Measures to create the first output of my thesis in the form of a typology of streets in Norway based on several variables from the assessment. The “Segment Zone” type category serves as a basis for the creation of the street typology, from which variables are descriptively compared and contrasted including land use, presence and condition of pedestrian infrastructure (sidewalks, crosswalks, and signage), pedestrian safety features (public lighting, stop signs, and school flashing lights), and roadways (pavement conditions, speed limit, and traffic volume) Additionally, the Segment tool asked the auditor to make a subjective judgment as to whether the street segment is walkable or aesthetically pleasing.

The Bikeability Measures provide a score for each road segment based on its “bikeability” as determined by several variables, including lane and shoulder width, storm drain position, speed limit, and parking orientation. The Bikeability Measures tool has a possible score ranging from seven to 23 for each street

segment with the option of additional points for on or off-road bike facilities and deductions for the presence of detrimental features such as debris in shoulders or industrial traffic. I developed a Bike Friendliness Range by categorizing the scores from the Bikeability Measures based on the presence and condition of infrastructure that support bicycling (Table 1). The range was developed in order to provide additional context and meaning to the numerical scores created by the original Bikeability Measures tool.

	Bike Friendliness Range		
Features	<i>Not Bike Friendly</i> (<i><10 – 16</i>)	<i>Moderately Bike Friendly</i> (<i>17 – 19</i>)	<i>Very Bike Friendly</i> (<i>≥20</i>)
<i>Lane Width</i>	≥14'	11'-13.5'	≤11'
<i>Shoulder Conditions</i>	None	<3'	≥3'
<i>Storm Drains</i>	Majority below or above grade, unsafe	Mix of below and at grade, unsafe and safe	All at grade, safe
<i>Posted Speed Limit</i>	≥40 mpg	≥30mph	≤25mph
<i>Pavement Condition</i>	Poor (broken)	Fair (cracked)	Good (smooth)
<i>On-street Parking</i>	Parallel or drive in angled	Back in angled	None
<i>Bike Facilities</i>	None	Share the road signage, racks, connects to shared use path	On-street bike lanes, shared lane markings, bike share system
<i>Other Considerations</i>	Industrial traffic, debris in shoulder		

Table 1: Bike Friendliness Range

By aggregating the segment and bikeability data I am able to classify the street segments into categories based on the surrounding built environment and conditions for both walking and biking. An in-depth narrative follows, describing the characteristics that make certain street types unique, along with a discussion

and photos of deficiencies in existing active transportation infrastructure. The street typology highlights the varying built environments and land uses that exist in rural areas that can either support or serve as barriers to active transportation.

Community Assets and Active Transportation Network Mapping

The second output of the thesis project includes a data visualization element. A Google Map with layers illustrating the location of community assets and streets evaluated using the Rural Active Living Assessment's Segment tool is created to present the results of this project in both a visual and interactive form. Google Maps was chosen to create the visual component in an effort to provide interested local leaders and residents with an easily accessible and replicable version of the results. This output is intended to build on the Rural Active Living Assessment in part to make the collection and interpretation process of the RALA data more useful to small rural towns in the future.

It is important to note that the Rural Active Living Assessment was deficient in its attempt to collect data specifically related to the "connectivity" between the biking and walking facilities and town assets. Additionally, the Segment tool was the only one out of the four tools that did not incorporate a scoring mechanism. Due to the fact that the wording of the connectivity question is not particularly clear and the lack of a method to score data collected using the Segment tool, a framework was developed to demonstrate how the intersection of community assets and evaluated street segments can be utilized in a practical way to propose bicycle and pedestrian routes to form an active transportation network.

For this reason, the web-based map also includes layers that propose connected bicycle and pedestrian routes. The bicycle network is broken into primary and secondary routes; primary routes are suggested mainly along Town Center and Thoroughfare streets where large numbers of community assets are located, while secondary routes provide bicyclists connections from residential areas to the primary bicycle network. The Bike Friendliness Range provided a metric to gain an understanding of existing conditions for bicyclists along street segments in Norway. The proposed pedestrian network was developed by analyzing data from the RALA Segment tool, ground-truthing, and the 2002 Sidewalk Inventory & Improvement Plan completed by Pine Tree Engineering. The suggested network is split into two categories, proposed sidewalks and sidewalks in need of repair. Within each category, a priority is assigned to each sidewalk segment based on the existing conditions and the increased level of connectivity it would provide to community assets within the existing sidewalk network.

Another layer on the map highlights problematic intersections based on past crashes between automobiles and bicycles/pedestrians and improvements are also suggested to increase safety at these locations. Pedestrian and bicycle facilities that would be appropriate in the land use context of a small rural town are described and recommended to improve safety at these intersections, including but not limited to sidewalks, crosswalks, yield lines, pedestrian refuge islands, crossing signals and signage, curb ramps and extensions, bike lanes, and speed tables and raised intersections.

Chapter 4: Results

Case Study Context

The discussion of the geographic, demographic, economic, and transportation context that follows will help to lay the foundation and reinforce the need for an integrated approach to active transportation and asset-based planning that supports rural community development. According to the most recent Comprehensive Plan completed in 2011, the town's vision for future land use planning focuses on retaining the rural and historic character of Norway (Town of Norway, 2011). The language in the plan suggests that the town wants to contain sprawl by investing 75 percent of its dollars for municipal growth-related expenditures within designated locations including the downtown, gateways, residential, and commercial areas (Town of Norway, 2011). Additionally, the plan also stresses that all areas not already served by sewer are considered rural and growth should be concentrated in areas where services like sewers are presently available (Town of Norway, 2011). This vision of preserving a dense commercial Downtown Village Area and providing basic provisioning opportunities in Rural Village Areas is the type of land use planning that makes short trips by active transportation practical and combats sprawling commercial development patterns.

Geographic and Demographic Context

The town of Norway is positioned in Oxford County in the region known as Western Maine. The town is intersected by three state routes (Routes 26, 117, and 118) and is located forty-four miles northwest of the city of Portland

(see Figure 1 below). A traditional mixed-use commercial district surrounded by dense residential neighborhoods characterizes the heart of downtown Norway and serves as the town center. Outside of the traditional Main Street corridor and neighborhoods, the development pattern along state Route 26 is best described as commercial sprawl, with large lot sizes, numerous driveways, poor bicycle and pedestrian access and chain retail stores. Route 26 is situated so that all through traffic traveling from points north or south bypass the Main Street corridor altogether. The town's topography includes foothills and small water bodies, including Pennessewassee Lake, which serves as a significant tourist destination and recreational opportunity for the town during the summer months.

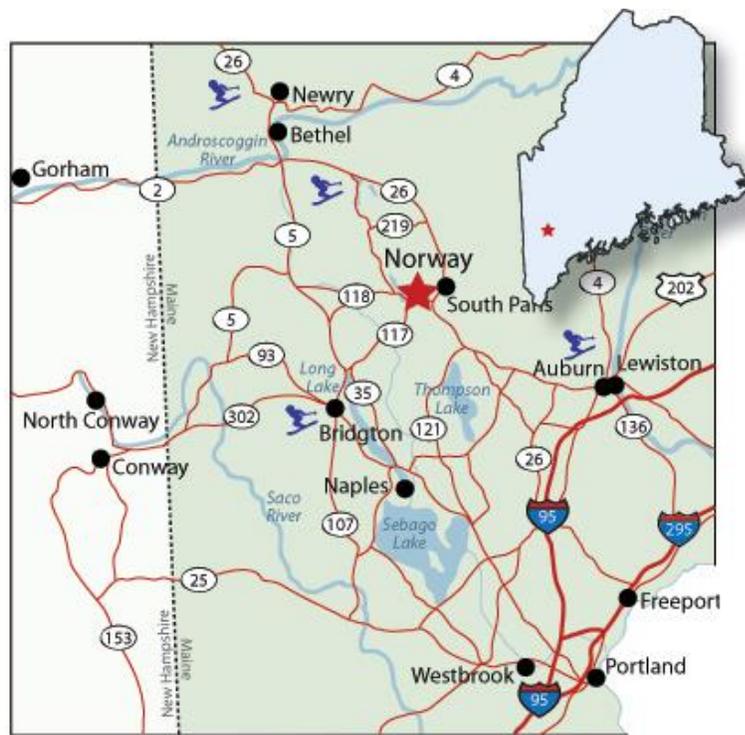


Figure 1: Norway's Geographic Location

At the time of the 2010 Census, Norway had a total population of 5,014 people. The town's population has been fluctuating over the past several decades with a population increase of 32 percent from 1970 to 1990, followed by a decrease of 3 percent from 1990 to 2000, and subsequently an increase of almost 9 percent from the 2000 to the 2010 Census (Town of Norway, 2011). Norway has a significantly higher population density (111.3 persons per square mile) compared to 43 persons per square mile in the state as a whole, highlighting the dense nature of the town's residential and commercial areas (U.S. Census Bureau, 2010). Both Norway and the state have a rather homogenous populace with more than 90 percent of the population registering as white on the 2010 Census (U.S. Census Bureau, 2010). Interestingly, while Norway boasts a higher high school graduation rate in comparison to the state, attainment of a bachelor's degree or higher is significantly lower at 13 percent compared to almost 28 percent in Maine overall (U.S. Census Bureau, 2010).

Economic Context

Norway has also been losing ground in terms of income since 1979, when the median household income was 86 percent of that for the state but fell to only \$37, 551 or 76 percent of the state's median household income (\$40, 055) in 2009 (Town of Norway, 2011). Interrelated is also the issue of rural poverty in Western Maine. While Norway has a comparable percentage of families below the poverty line with the state at approximately 12 percent, the percentage of families with children under eighteen (17.5%) and with a female only head of household

(36.4%) below the poverty line is alarmingly higher than the state at 12 and 28 percent, respectively (Town of Norway, 2011).

The income and poverty issues are certainly not unique to Norway. Many rural communities in Maine have been struggling over the past several decades with economic decline, particularly in the manufacturing sector. With an abundance of natural resources including water and timber for power and inputs, Norway was a leading producer of snowshoes and other wood products, once known as the “Snowshoe Capital of the World” (Norway Historical, 2015). However, in the last decade, employment in the manufacturing sector has declined from almost 20 percent in 2000 to approximately 13 percent in 2013 (United States Census, 2000; United States Census, 2009-2013). Accompanying the loss of manufacturing jobs, there has been a corresponding increase in service sector jobs in health care, education, and retail over the same time period (United States Census, 2000; United States Census, 2009-2013). Jobs in the educational services, health care, and social assistance sectors increased by 10 percent, while retail employment has also increased substantially by 7.5 percent between 2000 and 2013 (United States Census, 2000; United States Census, 2009-2013).

Transportation Context

Historically, Norway residents could access passenger rail service to Vermont, New Hampshire, and other points in Maine via a rail branch to neighboring South Paris. The Norway-Paris Street Railway operated between the two towns from 1895 to 1918 (Norway Historical, 2015). In addition to

connecting residents to regional destinations in New England, the street railway also linked the commercial districts of Norway and South Paris supporting retail, social, and entertainment opportunities in the area (Norway Historical, 2015). Additionally, a steam-powered ferry operated on Lake Pennesseewassee beginning in 1890 (Norway Historical, 2015). Currently, Norway is not served by any fixed-route bus or rail service. However, Western Maine Transportation operates a demand response shuttle service that provides the poor and elderly with transportation to medical appointments. Private access to neighboring cities and towns is constrained to personal vehicles or carpooling, underscored by the 78 percent drive alone commute rate in Norway according to the U.S. Census Bureau (United States Census, 2009-2013).

Main Street in Norway can be described as a pedestrian-friendly environment with wide sidewalks, crosswalks, and in some locations rapid flash beacons that warn drivers of pedestrians crossing the roadway. Additionally, the density and historic architecture along Main Street provides pedestrians a practical and interesting walking environment. The presence of sidewalks connecting the neighboring residential areas to Main Street provide access to important local destinations for commercial, entertainment, and civic activities. Despite the existing favorable walking conditions, Norway's walking rate for commuting purposes is several percentage points lower at 1.5 percent compared to 4 percent state-wide (United States Census, 2009-2013). According to a survey administered as part of the town's 2011 Comprehensive Planning efforts, a majority of respondents were satisfied with the sidewalks. However, that

percentage decreased from the 1992 survey results, suggesting the quality of sidewalks may be declining (Town of Norway, 2011).

According to the American Community Survey, zero percent of residents use a bicycle to get to work in Norway, only slightly less than 0.5 percent for the rest of the state (United States Census, 2009-2013). The lack of participation in bicycling in Norway may be related to the fact that the town has little in the way of existing bicycle infrastructure. However, Norway does have an on-street bike lane, new bike racks, and a budding community bike share program positioning it quite well for future growth in bicycling compared to most small rural towns. Additionally, there is increasing interest in the town or the local land trust in obtaining the abandoned Norway Branch Railroad right of way that would connect downtown Norway with the regional high school, athletic fields, and commercial opportunities in neighboring South Paris. The 2011 Comprehensive Plan does not discuss bicycle transportation or related infrastructure in detail, but instead focuses on improving bicycle facilities as part of the town's recreational amenities. However, the Plan does refer to bicycle and pedestrian trails as having the ability to enhance the attractiveness of the town for young workers, increase mobility for residents, and provide connections to downtown and other commercial areas (Town of Norway, 2011).

State highways serve as major barriers to active transportation in many rural towns including Norway, particularly in terms of the safety risk created by high traffic speeds and volumes, and the lack of safe biking and walking facilities along these roadways. The three aforementioned state highway routes within

Norway's geographic boundary, including Route 26 running north to south, Route 118 running east to west, and Route 117 branching off the former route to the southwest. From 2009 to 2013 there were a total of eleven bicycle and pedestrian crashes in the Town of Norway (Maine DOT, 2013). These state highways also serve as Main Street, providing access to the regional high school, and connecting residents to commercial, employment, and recreational opportunities in and around Norway; for this reason, the safety situation on these roadways is of major concern.

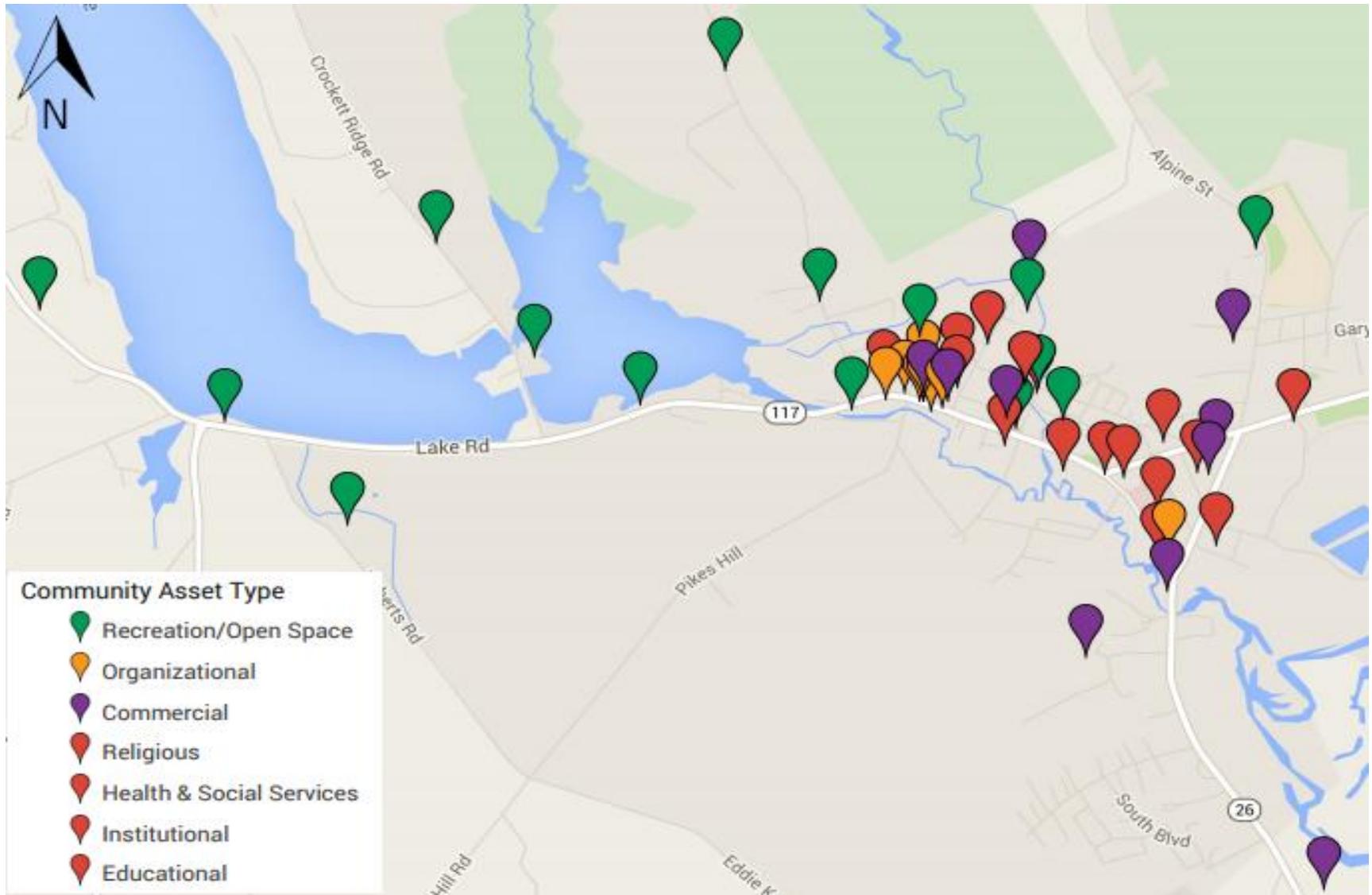
Identifying and Mapping Community Assets

The purpose of mapping community assets is to identify valuable local resources that can be enhanced through future planning efforts to connect community assets via an active transportation network. Norway has a plethora of community assets that make up the physical environment, including educational, institutional, health and social services, organizational, religious, recreation/open space, and commercial assets. In total, 55 assets were identified based on data from the Rural Active Living Assessment's Town-wide tool, Norway's 2011 Comprehensive Plan, and the Oxford Hills Chamber of Commerce website. The locations of these assets are mapped by category in Figure 2 below.

Norway's location in Western Maine affords it numerous recreation and open space assets indicated by the green pins in Figure 2, the largest of which is the 987-acre Pennessewassee Lake that boasts a park, boat launch, beach, playground, and athletic fields. Several other recreation and open space assets are

located adjacent to the Lake including the Shepard's Farm Preserve, Roberts Farm Preserve, Witt Swamp Preserve, and Ordway Grove that offer mountain biking, hiking/walking, and cross country ski trails. The former Norway Branch Railroad serves as an informal biking and walking trail that connects downtown to commercial opportunities in South Paris. There are also more athletic oriented assets in town including the Goiun Athletic Complex with a track, football/soccer fields as well as a baseball diamond, Cottage Street Recreation Area with a tennis and basketball court, New Balance Fitness Path outdoor exercise stations, as well as private exercise businesses including a yoga studio and Curves fitness center.

Figure 2: Community Asset Overview*

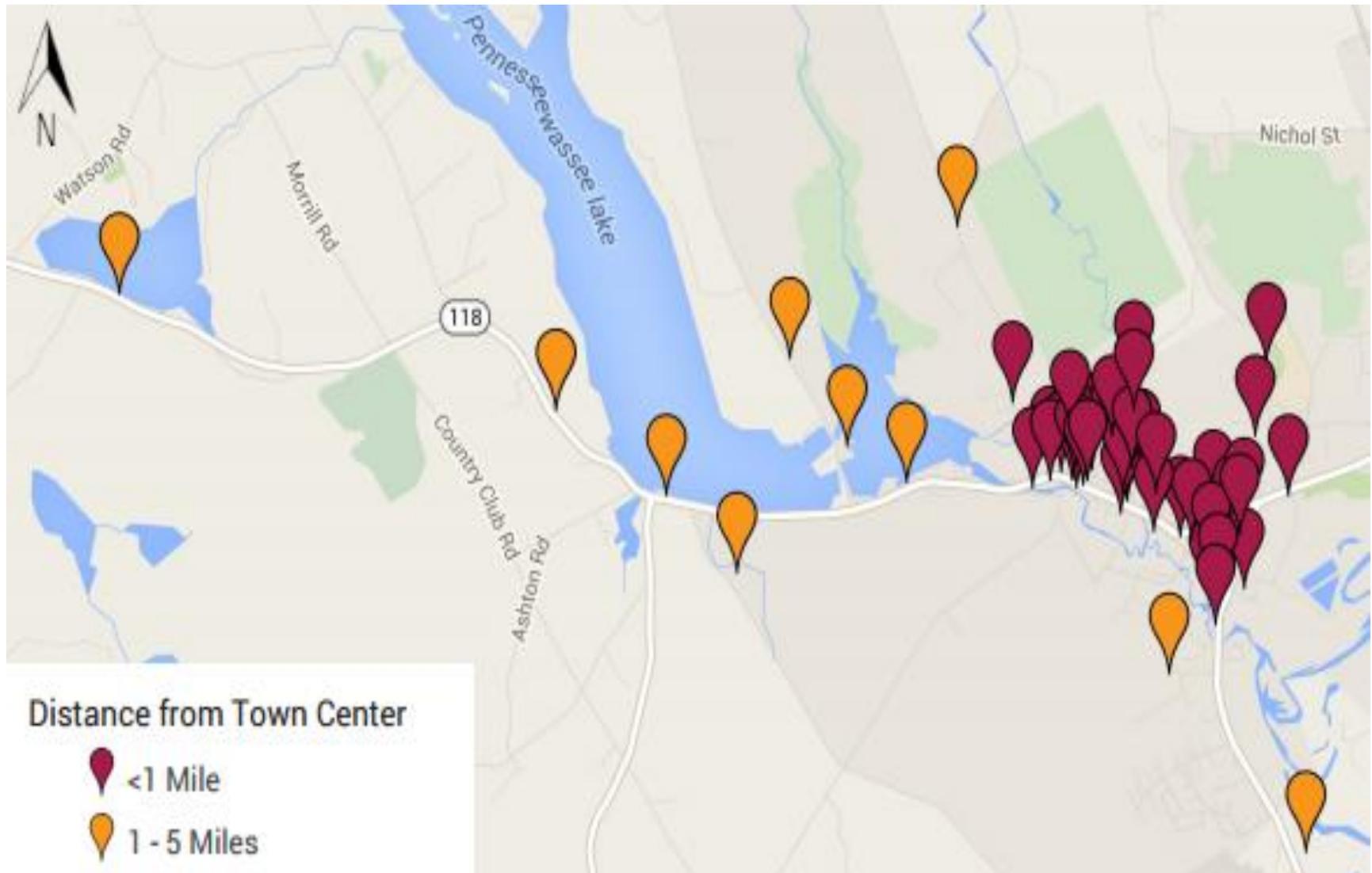


*An interactive version of this map and all subsequent maps can be accessed here:
<https://www.google.com/maps/d/edit?mid=zAmtCUE7fRI8.kCHoaM3ytGQk>

Norway is home to an elementary school and an alternative school named the Streaked Mountain School, with the regional high school located just over the town line and across Route 26 in South Paris. The town's institutional assets include the Norway Memorial Library and the Town Office; the latter also houses the Police and Fire Departments, all of which are located in the town center. Norway also has several health and social services assets including Stephen's Memorial Hospital, Child Development Services, a Head Start facility, the Progress Center Inc. for persons with disabilities, and the Norway Family Shelter. Additionally, Norway has numerous non-profit organizations including the Center for an Ecology Based Economy, Western Foothills Land Trust, Norway Downtown, and Healthy Oxford Hills, all of which are dedicated to preserving the rural and historic character of the town and improving residents' access to healthy food and recreational opportunities. Norway also boasts five other non-profit organizations that maintain their buildings as historic landmarks, including the Opera House, Historical Society, Weary Club, Matolcsy Art Center, and Grange Hall, along with six churches.

As shown in Figure 3 below a total of 44 educational, institutional, health and social services, organizational, and religious assets are more concentrated around the town center (< 1 mile) as represented by the densely clustered maroon pins. Alternatively, 11 of the 55 community assets are located between one and five miles from Norway's town center. These assets are represented by orange pins and include nine Recreation/Open Space assets and two Commercial assets. The town's largest employers consist of Stephen's Memorial Hospital, the New Balance Shoe Manufacturing facility, Grover Gundrilling Inc., and Norway Rehab and Living Center.

Figure 3: Community Asset Spatial Distribution



With the exception of Norway Rehab, all of these large employers are located less than one mile from the town center and many are clustered along Main Street. However, the only full service grocery store is located in the neighboring town of Oxford, which is represented by the southern-most point on the map in Figure 3. The dense spatial distribution of Norway's community assets suggests that an active transportation network could feasibly improve access to these locations.

Not surprisingly, assets located outside the town center do not have the same level of sidewalk access, which is defined as at least a sidewalk on one side of the street that is accessible from the asset's property Figure 4 below illustrates the fact that 20 of the 55 assets do not have sidewalk access, including 13 recreation/open space assets, four commercial assets, and three religious and organizational assets. The only existing bicycle infrastructure in Norway is an on-street bike lane along Beal Street. Due to the limited bicycling infrastructure available in Norway, only four asset locations were identified as having bicycle access including three institutional assets (Town Office, Police and Fire Departments) and one health and social services asset (Head Start center) shown with the green pins in Appendix 1.

Overall, this analysis demonstrates that Norway has numerous valuable community assets. The largest number of assets in Norway are recreation/open space, which is consistent with the rural character of the region. The map in Figure 2 further highlights that Norway has preserved a traditional development pattern and mixed land uses as reflected by the clusters of varying types of community assets around the town center.

Figure 4: Community Asset Sidewalk Access



However, certain types of assets are currently better served by sidewalks (particularly educational, organizational, religious, institutional, and health and social services assets), while others including recreation/open space and commercial assets are further removed from the existing sidewalk network. Additionally, the bicycle infrastructure is presently lacking with only a handful of the 55 assets abutting this type of facility. The following analysis of data from the Rural Active Living Assessment Segment tool and Bikeability Measures will provide a more detailed investigation and presentation of the existing environment for biking and walking in Norway and opportunities for future improvements.

Rural Street Typology

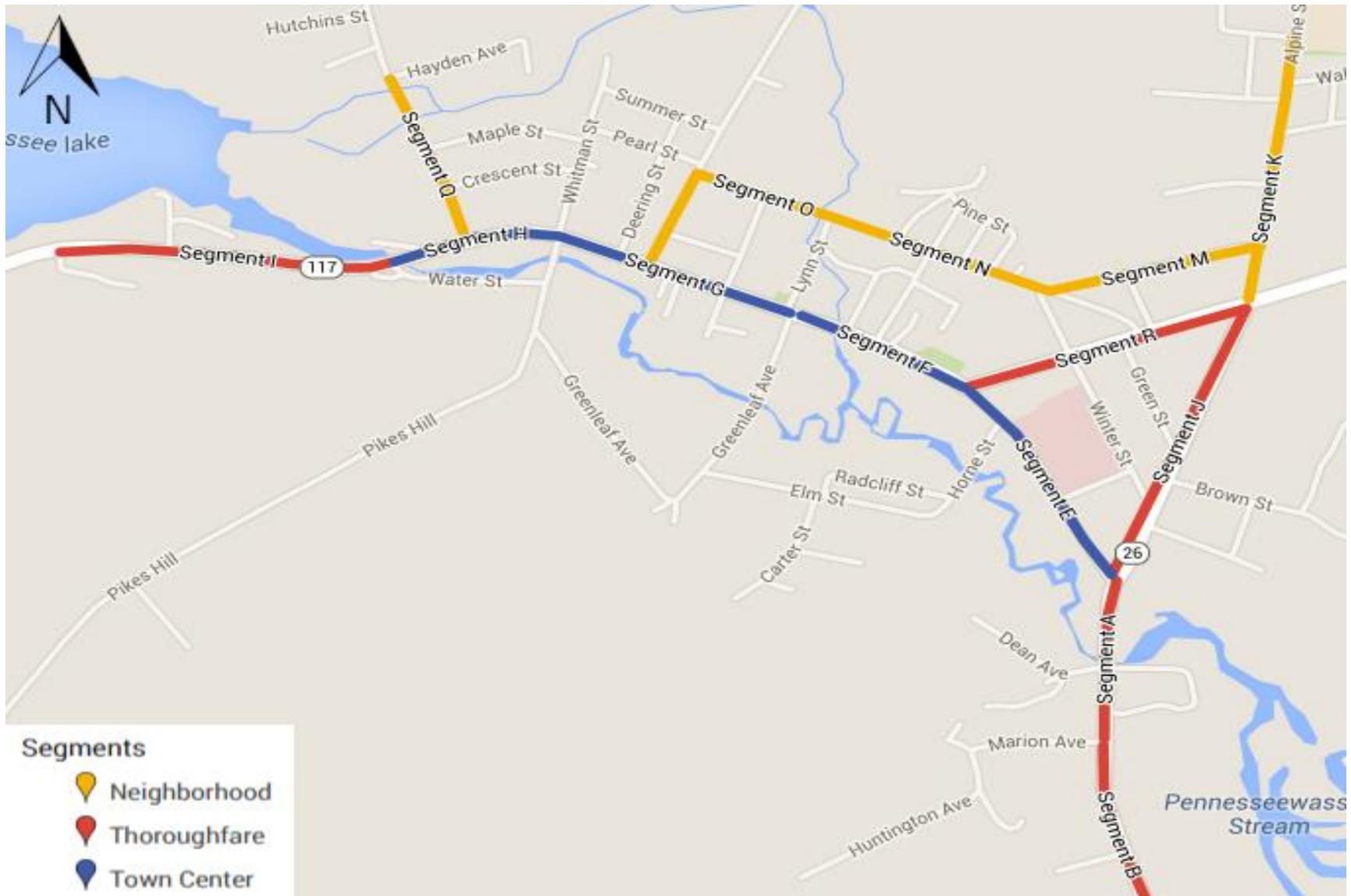
The Rural Active Living Assessment's Segment tool and Bikeability Measures provided a mechanism through which a local auditor collected detailed data about the land use and transportation environments along a sample of streets within four different zones, including a Town Center Zone, Thoroughfare Zone, Neighborhood Zone, and Isolated School Zones. The Town Center Zone is defined as any street segment that falls within a one-mile radius of a selected town center point, which in Norway was the library on Main Street (Hartley, 2009). The Thoroughfare Zone is defined more broadly as any street segment that connects the town center to a school or residential cluster, or a major highway or roadway passing through or near the town center (Hartley, 2009). The Neighborhood Zone or Isolated School Zone is defined as any street segment located within a 0.3 square-mile radius of the center of a primarily residential area with minimal through-traffic or a school that does not fall into any other zone (Hartley, 2009).

In Norway, 19 segments were chosen for auditing using the Segment tool within all of the previously defined zones, excluding the Isolated School Zone because all of the schools located in or abutting Norway are situated in Town Center or Thoroughfare Zones. The distribution of segments includes eight Neighborhood streets, seven Thoroughfare streets, and four Town Center streets and is presented visually in Figure 5 below. Variables related to land use and transportation were descriptively compared and contrasted in an effort to classify the three aforementioned street types according to their common characteristics.

Overall, the Rural Street Typology process helped provide an understanding that many streets have similar characteristics, deficiencies, and opportunities for improving the built environment to support biking and walking in Norway. Town Center streets serve predominantly commercial and public/civic uses but also have a mix of other land uses. They are also typically paved single lane roads with low speed limits, medium traffic volumes that include frequent industrial traffic, and parallel and drive-in angled on-street parking. Thoroughfare streets generally have commercial and open space land uses and are paved multi-lane roads with wider lane widths and higher traffic speeds and volumes than other street types. Thoroughfare streets also do not have parking along them and sidewalks and crosswalks are present but they are generally in poor to fair condition. Thoroughfare streets are considered to be somewhat bike friendly and not aesthetically pleasing.

Neighborhood streets have moderate residential density and are paved single lane roads often without a centerline that intersect Thoroughfare streets with abrupt adverse changes in the bicycle and pedestrian environment.

Figure 5: Norway, Maine Street Typology



Traffic speeds through residential areas are generally below 30 miles per hour with low overall traffic volumes. Sidewalks on Neighborhood streets are typically only on one side of the street but are also in good condition contributing to the walkability, moderate bike friendliness and aesthetically pleasing nature of these roadways. In general, the Rural Street Typology exercise highlights the fact that safety and viability of active transportation mode choices differ between distinct street types in small rural towns. An overview of the results of the street typology is provided in an easy to reference format in Appendices 2, 3 and 4 with representative photos, descriptions, and a list of similar characteristics.

Town Center Streets

The four street segments that were selected for auditing as Town Center streets run through the heart of downtown and comprise the entirety of Main Street in Norway, bounded by Water Street to the north and Route 26 to the south (see Table 2 below). The primary land use along all four segments is commercial, including numerous small retail businesses, a food market, gas station, restaurants and cafes, private offices, banks, art galleries, and other commercial ventures. However, Main Street does have a mix of land uses including public/civic uses like a hospital, library, post office, churches and two public schools. Although there is low residential density on these four segments, it is important to note that there are very dense residential areas that border them that have convenient access to the services provided on Main Street.

Segment ID	Primary Streets	Boundaries	Street Type	Primary Lane Use	Bike Friendliness	Walkability Subjective	Aesthetic Subjective
E	Main St	Route 26 to Paris St	Town Center	Commercial	Not	Disagree	Agree
F	Main St	Paris St to Greenleaf Ave	Town Center	Commercial	Moderately	Agree	Agree
G	Main St	Greenleaf Ave to Pikes Hill	Town Center	Commercial	Moderately	Strongly agree	Strongly Agree
H	Main St	Pikes Hill Rd and Water St	Town Center	Commercial	Very	Agree	Strongly Agree

Table 2: Overview of Town Center Street Segments

Town Center streets in Norway are all paved single lane roads (carry either one or two-way traffic) between 11 feet and 13.5 feet. Two streets (Segments F & G) located in the heart of downtown have good pavement condition while the outer streets (Segments E & H) are in fair and poor condition, respectively. All four segments were similar in that they have speed limits less than or equal to 25 miles per hour and medium traffic volume. Based on field observations of the vehicles traveling along Main Street, much of the traffic is the result of its function as a major commercial district and its designation as a state highway used for commuter and industrial trucking. There are no major physical barriers to bicycling and walking along all four Town Center segments, but it is important to note that the sidewalk ends on the northbound side of Main Street as it approaches Pennesseewassee Lake. Aside from the last block of Segment H that only has a sidewalk on one side, all other Town Center segments have sidewalks on both sides of the street. Similar to the pavement conditions on all four street segments, Segments F and G have good sidewalk conditions while the outer streets (Segments E & H) are in fair and poor condition, respectively. The sidewalks along the Lower Main Street corridor (Segment E) are barely functioning as pedestrian facilities, with poor pavement conditions and

frequent driveways compared with the other Town Center segments (see Figure 6 below for an example).



Figure 6: Sidewalk conditions along Lower Main Street (southbound)

The Lower Main Street corridor (Segment E) also has a buffer or green esplanade in very poor condition that intrudes into what is left of the existing sidewalk infrastructure and in some places it is difficult to distinguish between the buffer and the shoulder (see Figure 7 below). Although the Rural Active Living Assessment defines buffers only as sidewalks and shoulders, two Town Center streets (Segments G & F) have parallel and drive-in angled parking that can also serve as a buffer, adding to the perception of safety from moving vehicles for pedestrians. All four Town Center segments have crosswalks in fair condition and public lighting, while Segment F also has pedestrian crossing signals, signs, and stop signs. Pedestrian-scale and decorative public lighting could be an option for further improving the streetscape along Town Center streets in Norway. Three of the Town Center street segments were identified as walkable, while the Lower Main Street corridor (Segment E) was not considered walkable by the

auditor because the shoulder of the road is filled with potholes and the sidewalk is broken and uneven.



Figure 7: Sidewalk and buffer conditions along Lower Main Street (northbound)

There was more variation found in the evaluation of the bikeability of Town Center segments; Segment H at the northern section of Main Street scored as very bike friendly due in part to narrow lane widths, wide shoulders, and no parking, while Segments G and F in the heart of Main Street only scored as moderately bike friendly, and Segment E was not bike friendly due in part to higher vehicle volumes and industrial traffic. All segments were identified as aesthetically pleasing; Segments G and F were likely rated as the most aesthetically pleasing of all the segments based on the overall pedestrian experience, which includes the orientation and density of the buildings, width and condition of sidewalks, frequent crosswalks, and interesting storefronts.

Thoroughfare Streets

Seven segments were evaluated as Thoroughfare streets and are also state highways, which serve as connectors between commercial services and regional destinations proximate to Norway (see Table 3 below). The segments include Route 26 originating at the Oxford town line, continuing north to the intersection of Paris Street and Fair Street (Segments A, B, D, and J) and then heading west along Paris Street to the intersection with Main Street (Segment R). North of the town center the segments also include Main Street from Water Street to Walker Avenue (Segment I) and Lake Road between the rest stop and Harrison Road (Segment S). The primary land use on all seven segments is commercial, which includes small retail and some big box businesses, a supermarket, pharmacy, private offices, bank, auto sales and repairs, and other commercial enterprises. Thoroughfare segments also have other land uses including residential and open space. There is low residential density on three streets (Segments B, D, and S), but the density becomes moderate on three streets (Segments A, J, and R) and high on Segment I. This reflects the fact that Thoroughfare streets that transition into Town Center streets have higher residential densities than those that function as isolated segments. It is also important to note that Oxford Comprehensive High School is located along a Thoroughfare street. This arrangement provides easy vehicle access, particularly for regional traffic, but it also detracts from safety and deters those for whom bicycling and walking to school could be a viable transportation option.

Segment ID	Primary Streets	Boundaries	Street Type	Primary Lane Use	Bike Friendliness	Walkability Subjective	Aesthetic Subjective
A	Rt.26	Main St to Marion Ave	Thoroughfare	Commercial	Somewhat	Agree	Disagree
B	Rt.26	Marion Ave to Town & Country Rd	Thoroughfare	Commercial	Somewhat	Agree	Disagree
D	RT. 26	Town & Country Rd to traffic light @ Pizza Hut	Thoroughfare	Commercial	Moderately	Agree	Disagree
I	Main St	Water St to Walker Ave	Thoroughfare	Residential	Moderately	Agree	Agree
J	Fair St (Rt. 26)	Main St and Paris St	Thoroughfare	Commercial	Not	Agree	Disagree
R	Paris St	Main St and Fair St (Rt 26)	Thoroughfare	Commercial	Moderately	Agree	Agree
S	Lake Rd	Rest Area to Harrison Rd	Thoroughfare	Open Space	Moderately	Disagree	Disagree

Table 3: Overview of Thoroughfare Street Segments

The majority of Thoroughfare streets in Norway are multi-lane roads (three or more lanes) with good pavement condition, while three segments are single lane roads with fair pavement conditions (Hartley, 2009). All segments have a lane width greater than 11 feet aside from Segment I as it leaves the northern section of Main Street. Speed limits on a majority of Thoroughfare segments were over 30 miles per hour and all segments either had high or medium traffic volume coming from regional and through traffic. The presence of sidewalks along Thoroughfare segments is mixed, with four streets (Segments A, B, D, and R) having sidewalks on both sides, two streets (Segments I & J) with only sidewalks on one side of the street, and one street without any sidewalks along Lake Road (Segment S). Of the six segments that have sidewalks, only one street (Segment D) has sidewalks in good condition, four streets (Segments A, B, I, and R) are considered to be fair, and one street (Segment J) has sidewalks in poor condition

particularly along the southbound travel lane. It is important to note that these ratings do not take into effect the number of driveways and curb cuts that interrupt the sidewalk for the length of the segment, which can detract from the safety of the pedestrian environment.

A majority of Thoroughfare streets have a defined shoulder that acts as a buffer between the travel lane and pedestrian walkway; however, several are in poor to fair condition due to cracked pavement, debris, or narrow widths. Crosswalks are present on five out of the seven Thoroughfare segments, but four of the crosswalks (Segments A, D, I and J) are in poor or fair conditions. Route 26 (Segment D) also has crossing signals and pedestrian signs at two locations. Generally, there are also more traffic control devices along Thoroughfare streets compared with Town Center streets, including traffic lights, stop signs, school flashing lights, and public lighting. Six of the seven Thoroughfare street segments were identified as walkable, although multiple comments by the auditor indicate feelings of being unsafe due to high-speed traffic and narrowing of certain sidewalk sections.

There was variation found in perceived bikeability of the Thoroughfare segments; no segment scored as very bike friendly, while six out of seven segments ranked as moderately bike friendly (Segment A, B, D, I, R, & S). Fair Street (Segment I) was rated as not bike friendly. All segments were identified as not being aesthetically pleasing, besides Paris Street and Main Street (Segments R and I, respectively). This is due to higher vehicle volumes and speeds, lack of density among commercial land uses, and absence of an interesting streetscape that engages pedestrians with varying types of architecture and available activities.

Neighborhood Streets

Eight segments, the largest number in the analysis, were evaluated using the Rural Active Living Assessment in Norway (see Table 4 below). The primary purpose of a Neighborhood street is to provide residents with convenient access between residential areas and local destinations, as well as contribute to a high quality of living in Norway. Seven of the segments are located north of Main Street, while the last Neighborhood street is in an isolated area off of Route 26 to the south (Segment C). The primary land use on all eight segments is residential, with moderate to high residential density on five segments. A majority of the Neighborhood segments have both single family detached homes and multi-family/apartments, with mobile homes present on Segment C. Neighborhood streets have a few other land uses, including public/civic (police, fire stations, and town offices), open space (hiking/walking trails, community garden, and athletic fields/courts), and industrial (New Balance manufacturing facility). It is also important to note that the athletic field/courts that serve the Oxford Comprehensive High School are located along a Neighborhood street, requiring children to cross Route 26 to access the facilities.

All eight Neighborhood streets in Norway are single lane roads with only three segments in good pavement condition, while the other five streets have fair pavement condition (Hartley, 2009). Half of the segments have a narrow lane width of less than 11 feet or between 11 and 13.5 feet, helping to encourage slower vehicle speeds and a safer environment for biking, walking, and children playing.

Segment ID	Primary Streets	Boundaries	Street Type	Primary Lane Use	Bike Friendliness	Walkability Subjective	Aesthetic Subjective
C	Town & Country Rd	Route 26 to Fir Dr	Neighborhood	Residential	Moderately	Agree	Agree
K	Alpine St	Fair St (Rt 26) and Aldrich Ave	Neighborhood	Residential	Moderately	Disagree	Agree
L	Alpine St	Aldrich to Woodland Dr	Neighborhood	Residential	Not	Agree	Agree
M	Tucker St	Alpine St and Beal St	Neighborhood	Residential	Moderately	Agree	Agree
N	Beal St	Tucker St and Lynn St	Neighborhood	Residential	Very	Agree	Agree
O	Beal St	Lynn St and Cottage St	Neighborhood	Residential	Very	Agree	Agree
P	Cottage St	Beal St and Main St	Neighborhood	Residential	Moderately	Agree	Agree
Q	Pleasant St	Main St and Hayden Ave	Neighborhood	Residential	Moderately	Agree	Agree

Table 4: Overview of Neighborhood Street Segments

Alternatively, Alpine Street (Segments K & L) and Cottage Street (Segment P) are wider, with travel lanes that are 14 feet wide. Both streets are lacking defined shoulders, parking stalls, or centerlines, which contribute to the wider lane widths. Speed limits on all Neighborhood streets were less than or equal to 30 miles per hour and all segments had low traffic volumes. The presence of sidewalks along Neighborhood segments is variable; one segment has sidewalks on both sides of the street, four only have sidewalks on a single side, and three do not have any sidewalks including Alpine Street (Segment K & L) and Town & Country Road (Segment C). Those Neighborhood streets that do have existing sidewalks are all in good to excellent condition, with only one in fair condition. This is mainly due to the fact that the sidewalk ends a block before the end of the segment on Pleasant Street (Segment Q).

Six out of the eight Neighborhood streets have crosswalks (excluding Segments C & L) in good condition with the exception of the intersection of Alpine Street and Route

26 that is in fair condition (Segment K). Seven of eight Neighborhood street segments were identified as walkable, with only Alpine Street (Segment K) as the outlier due to the lack of sidewalks and perceived danger to pedestrians. The two segments that make up Beal Street scored the highest of all the Neighborhood streets as very bike friendly due to the narrow lane widths, on-street bike lanes, safe grates, and good pavement conditions. A majority of Neighborhood streets (Segments C, K, M, P, & Q) are all rated as moderately bike friendly. The remaining Thoroughfare street (Alpine Street, Segment L) is not considered bike friendly. All eight Neighborhood streets were rated as aesthetically pleasing according to the auditor's comments because of recreational and open spaces that are accessible along these types of streets in Norway.

Chapter 5: Recommendations and Discussion

The Rural Active Living Assessment's Town-wide tool provided basic town demographic data and an initial set of community assets, which was supplemented with additional data from the U.S. Census and the local Chamber of Commerce. The RALA tools and Bikeability Measures were also used to collect data on the walkability, bikeability, and surrounding land uses of representative street segments in Norway. An analysis of the data resulted in the creation a typology that classified distinctive street types into categories based on the presence and condition of biking and walking facilities along those segments. The following section provides recommendations to enhance the connections to existing community assets with active transportation networks in Norway. Potential bicycle and pedestrian facility types are described in Figures 8 and 11 and a connected network of primary and secondary bicycle routes (Figure 10) are proposed along with priorities for sidewalk repair and construction (Figure 12).

Recommended Bicycle Network

The Bicycle Coalition of Maine's Bikeability Measures were used to collect data related to the bicycling experience on the same street segments that were audited as part of the Rural Active Living Assessment to propose a bicycle network in Norway. The Bike Friendliness Range was used to categorize street segments based on similar characteristics pertaining to presence and condition of existing infrastructure that supports or detracts from bicycling. Connecting street segments that are in need of new bike facilities with the location of valuable community assets served as the basis for proposing the following bicycle route network. It is important to first feature bicycle facilities that can help form Norway's bicycle network. Figure 8 below provides descriptions and representative photos of bicycle facilities that can be utilized to develop a connected bicycle network in Norway from lowest to highest facility quality. The street segments that were rated as very or moderately bike friendly need only a limited amount if any additional bike infrastructure to incorporate them into a bicycle network. While segments rated as not bike friendly need higher quality facilities to make them safe and inviting to potential bicyclists. Figure 9 provides a breakdown of the proposed bicycle network by facility type.

The proposed network is also categorized into primary and secondary routes that reflect the priority they should be given for implementation purposes. The primary routes are focused mainly along Town Center and Thoroughfare streets where large numbers of community assets are located and secondary routes provide bicyclists connections from residential areas to the primary bicycle network. Dedicated bicycle facilities are proposed for primary routes where space allows because there are typically higher vehicle speeds

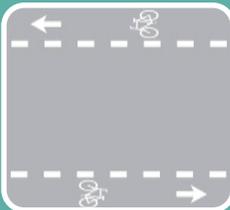
and volumes along these roadways compared with secondary routes where predominantly shared facilities are proposed.



Shared Lane Markings (SLMs) are pavement markings that assist with the lateral position of bicyclists in lanes that are too narrow for dedicated bike lanes and help alert motorists for the need to share the roadway with bicycle traffic (MUTCD 9C-07, 2009)



Bike Lanes are pavement markings that designate a minimum 5 foot portion of a roadway for preferential use by bicyclists with a solid white line, bicycle symbols, and directional arrows (MUTCD 9C-04, 2009)



Advisory Bike Lanes are dashed pavement markings used to designate where bicycles are expected to operate in cases where there is not enough width for conventional bike lanes. These facilities should be used on roadways with low traffic volumes and speeds with a minimum 16' width between the dashed lanes (FHWA,, 2015)



Buffered Bike Lanes are pavement markings that designate a minimum 5' section of roadway for preferential use by bicyclists, similar to a conventional bicycle lane with an added striped buffer that provides extra space between the bike lane and moving vehicles and/or parked cars (MUTCD 3D-01, 2009)



Shared-use Paths are a type of off-road bicycle and pedestrian facility that supports transportation as well as recreational trips and is designed to accommodate bidirectional travel (Axelson et al., 2001)

Figure 8: Bicycle Facility Toolkit

Figure 9: Proposed Bicycle Network by Facility Type



Proposed Primary Bicycle Routes & Asset Connections

Figure 10 below shows the proposed primary and secondary bicycle routes that can be used to create a robust bicycle network in Norway. The proposed primary bicycle network focuses the implementation of bicycle facilities along Town Center and Thoroughfare streets in order to provide safer access to community assets along these roadways (see Table 5 below for a list of proposed primary routes). Beal Street serves as the foundation of the proposed bicycle network because it is the only existing dedicated bike facility in Norway and was rated as very bike friendly based on the segment analysis. The purposed network would continue east onto Tucker Street with Shared Lane Markings (SLMs) as the chosen facility type because there is not enough space to accommodate bike lanes and the segment has characteristics that ranked it as moderately bike friendly due in part to the low traffic speeds along the roadway. The network would continue onto Alpine Street where an advisory bike lane is the preferred facility. With the potential addition of a new sidewalk on one side of Alpine Street there would not be adequate space for bike lanes in both directions, however, the street's rating as only somewhat bike friendly and the anticipated bicycle traffic between the High School and athletic fields warrants a higher quality facility on this stretch of roadway.

Segment ID	Location	Route Type	Status	Facility Type
M	Tucker Street	Primary	Proposed on-street	Bike lane
L & K	Alpine Street	Primary	Proposed on-street	Advisory bike lane
R	Paris Street	Primary	Proposed on-street	Bike lane
E	Lower Main Street	Primary	Proposed on-street	Bike lane
F, G, H	Main Street	Primary	Proposed on-street	Shared Lane Marking (SLMs)
P	Cottage Street (Main St to Beal St)	Primary	Proposed on-street	Shared Lane Marking (SLMs)
I & S	Lake Road	Primary	Proposed on-street	Bike lane (marked shoulder)
J	Fair Street	Primary	Proposed off-road	Shared-use path
N & O	Beal Street	Primary	Existing on-street	Bike lane
Q	Pleasant Street	Secondary	Proposed on-street	Advisory bike lane
N/A	Maple Street & Pearl Street	Secondary	Proposed on-street	Shared Lane Markings (SLMs)
N/A	Cottage Street (Beal St to New Balance Factory)	Secondary	Proposed on-street	Advisory bike lane
N/A	Cottage Street (New Balance Factory to Alpine St)	Secondary	Proposed on-street	Advisory bike lane
N/A	Alpine Street (Woodland Ave to Cottage St)	Secondary	Proposed on-street	Advisory bike lane
N/A	Norway Branch Railroad	Secondary	Proposed off-road	Shared-use path
N/A	Beal Street (Tucker St to Paris St)	Secondary	Proposed on-street	Bike lane
N/A	Lynn Street	Secondary	Proposed on-street	Bike lane

Table 5: Proposed Primary & Secondary Bicycle Routes

The bicycle network would then continue south onto Thoroughfare streets at the intersection with Route 26, where bicyclists have the option of taking a right to travel down Paris Street on a proposed conventional bike lane or a buffered bike lane, which is the preferred facility type due to the higher traffic volumes and significant industrial truck traffic. The other route option from the Alpine Street and Route 26 intersection would be to continue south down Fair Street (Route 26). Due to the fact that this segment was rated as not bike friendly, it would not be prudent to build an on-street bicycle facility. Although it will be more expensive to construct a shared-use path along the roadway, it is the preferred option for safe bicycle travel along this stretch of roadway and could connect to similar existing paths at Oxford Comprehensive High School.

The proposed shared-use path would terminate at the intersection of Fair Street (Route 26) and Lower Main Street where the network would continue onto Town Center streets in the form of a conventional bike lane or buffered bike lane. An upcoming MaineDOT project for the reconstruction of Lower Main Street would be the ideal opportunity to obtain the comparably small amount of funding for this proposed bicycle facility. As Main Street crosses Paris Street the roadway becomes more narrowed due to the existing parallel and drive-in angled parking, so there is currently not adequate right of way for a dedicated bicycle lane. Instead shared lane markings are the proposed facility type on Main Street; however a Priority Shared Lane should be considered, which consists of a green-backed shared lane markings and dashed lines to simulate a bike lane in the middle of the travel lane as a higher-quality treatment along Main Street (Furth, 2009).

Additional study of parking needs on Main Street may yield an opportunity to convert the drive-in angled to parallel parking, as this change combined with a reduction in lane width to 11 feet would provide sufficient space for a bike lane on both sides of the street. Completing the network are shared lanes markings on one block of Cottage Street between Main Street and Beal Street; this segment would also benefit from centerline and parking stall striping to help visually narrow the roadway. A segment of Lake Road is included in order to connect Main Street to Pennesseeewassee Lake Park with a bike lane created by marking the existing shoulder with bicycle symbols. Adding removable bollards to the new bike lane would substantially increase the safety along this facility for potential users with little additional cost. Both of the aforementioned treatments are recommended to be interim facilities as a shared-use path would ideally connect the town to its most valuable recreation asset.

It is important to note that despite the fact that the proposed bicycle route network would serve numerous community assets (see Appendix 5), the segment of Route 26 which stretches from the intersection with Main Street to the Hannaford's just over the Oxford town line is not included; this is due to existing lane configuration and high traffic volumes that would preclude the implementation of a safe on-street bicycle facility. A longer-term project to connect Norway with the grocery store would include the continuation of the proposed shared-use path originating at Oxford Comprehensive High School.

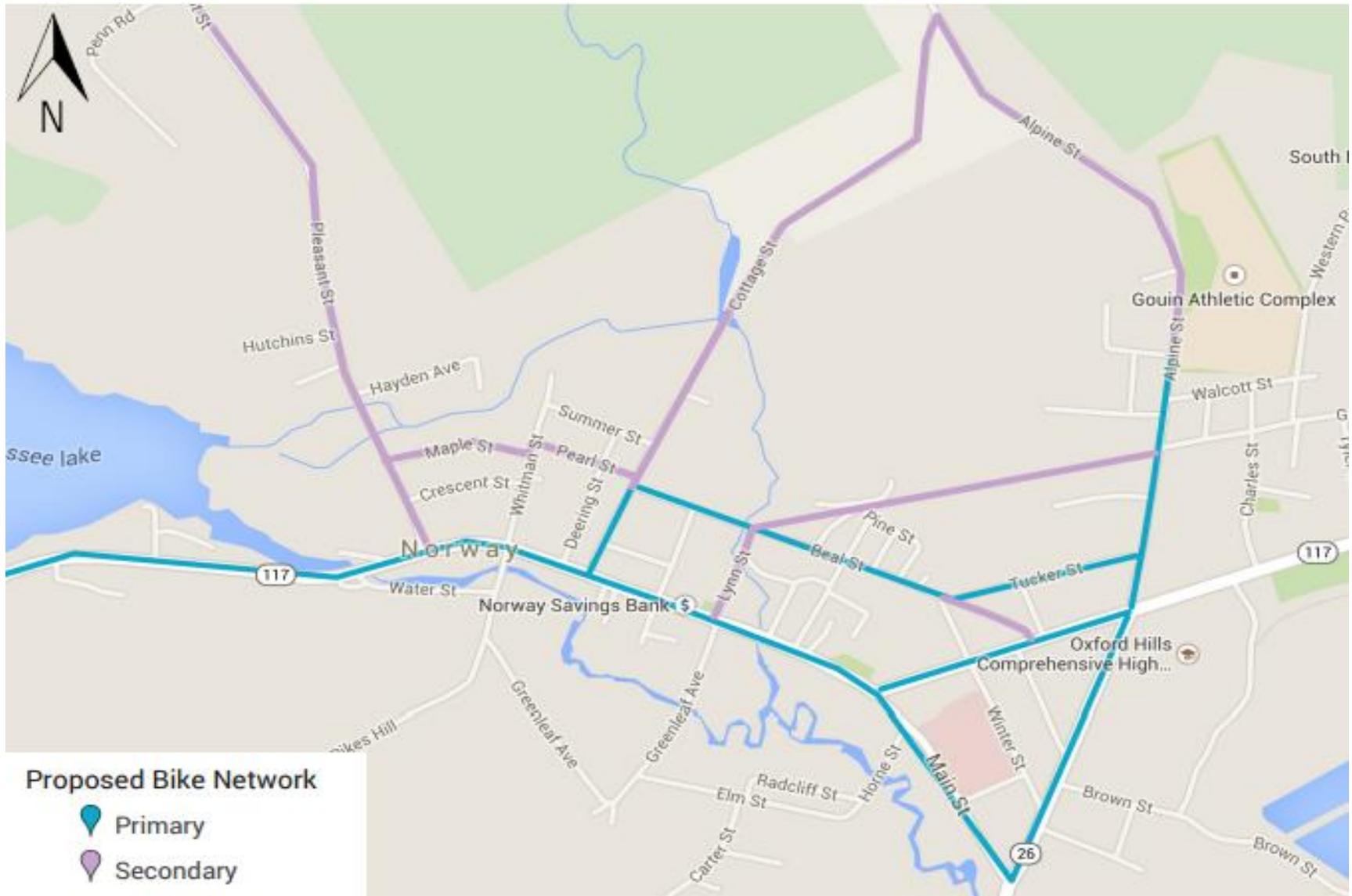
Proposed Secondary Bicycle Routes & Asset Connections

The proposed secondary bicycle routes are located along Neighborhood street types to provide connections from residential areas to the primary bike network and to

additional recreation/open space community assets (see Appendix 6 for a list of proposed secondary routes). Shared facilities are proposed along secondary bike routes because they are located on roadways with lower vehicle speeds and expected bicycle volumes than the proposed primary routes. Starting at the western side of town, an advisory bike lane along Pleasant Street would provide a bicycle route to those wishing to access the trails at Ordway Grove and the Witt Swamp Preserve. Shared lane markings could be provided on adjoining Maple and Pearl Streets that would serve the Alan Day Community Garden and connect to the existing primary bicycle network at the intersection of Cottage and Beal Streets. North of the aforementioned intersection, an advisory bike lane would continue up Cottage Street, past the Progress Center, Inc. and the Cottage Street Recreation Area and provide access for employees to the New Balance Manufacturing Facility. In an effort to provide continuity for the secondary bicycle route, advisory bike lanes are proposed to continue north onto Alpine Street, which would be something Norway would need to work with the town of Paris to complete as it extends beyond the town line.

As the advisory bike lane continues along Alpine Street and passes the Gouin Athletic Complex and Grover Gundrilling it intersects the Norway Branch Railroad, which is proposed to be a shared-use path that will provide bicyclists a connection back to Beal Street. Two additional secondary routes are proposed that would extend the existing bike lane on Beal Street to the intersection with Paris Street and create a connection on Lynn Street between the primary routes on Beal and Main Streets. The secondary bicycle routes serve significantly less community assets (see Table 7 in the Appendix) but still act as important connections from Neighborhood streets to the additional assets and the primary bicycle network.

Figure 10: Proposed Bicycle Network by Route Type



Recommended Pedestrian Network

A pedestrian network consists of sidewalks and crossings; intersections can be particularly dangerous for pedestrians especially across state highways. The Rural Active Living Assessment's Segment tool was used to collect detailed data about the existing conditions of sidewalks on a representative sample of streets in Norway. Based on the evaluation of 19 segments, one had sidewalks in excellent condition, six in good condition, six were fair, two were in poor condition, and four streets did not have sidewalks (Segments C, K, L, & S). Because Norway has an existing sidewalk network, the purpose of the following section was to use the RALA data to identify gaps, poor infrastructure conditions, and prioritize construction and repair of new and existing sidewalks. In an effort to build upon previous work and paint a more comprehensive picture of sidewalk needs in Norway, findings from a 2002 Sidewalk Study & Improvement Plan prepared for the town of Norway were also included in the analysis (Pine Tree, 2002).

First, pedestrian facilities and infrastructure that would be appropriate to improve Norway's existing pedestrian network are discussed. Descriptions and representative photos of infrastructure that can be utilized to enhance the pedestrian environment in Norway are provided in Figure 1 below. While the existing sidewalks do create a fairly well connected network of pedestrian facilities in Norway, one of the most significant problems is the poor condition of the sidewalk material. There are also several key sidewalk connections between Neighborhood streets and both Town Center and Thoroughfare streets that are

lacking. Therefore, suggested improvements to the pedestrian network in Norway are separated into two different categories: proposed sidewalk repair and proposed new sidewalks (Figure 12).

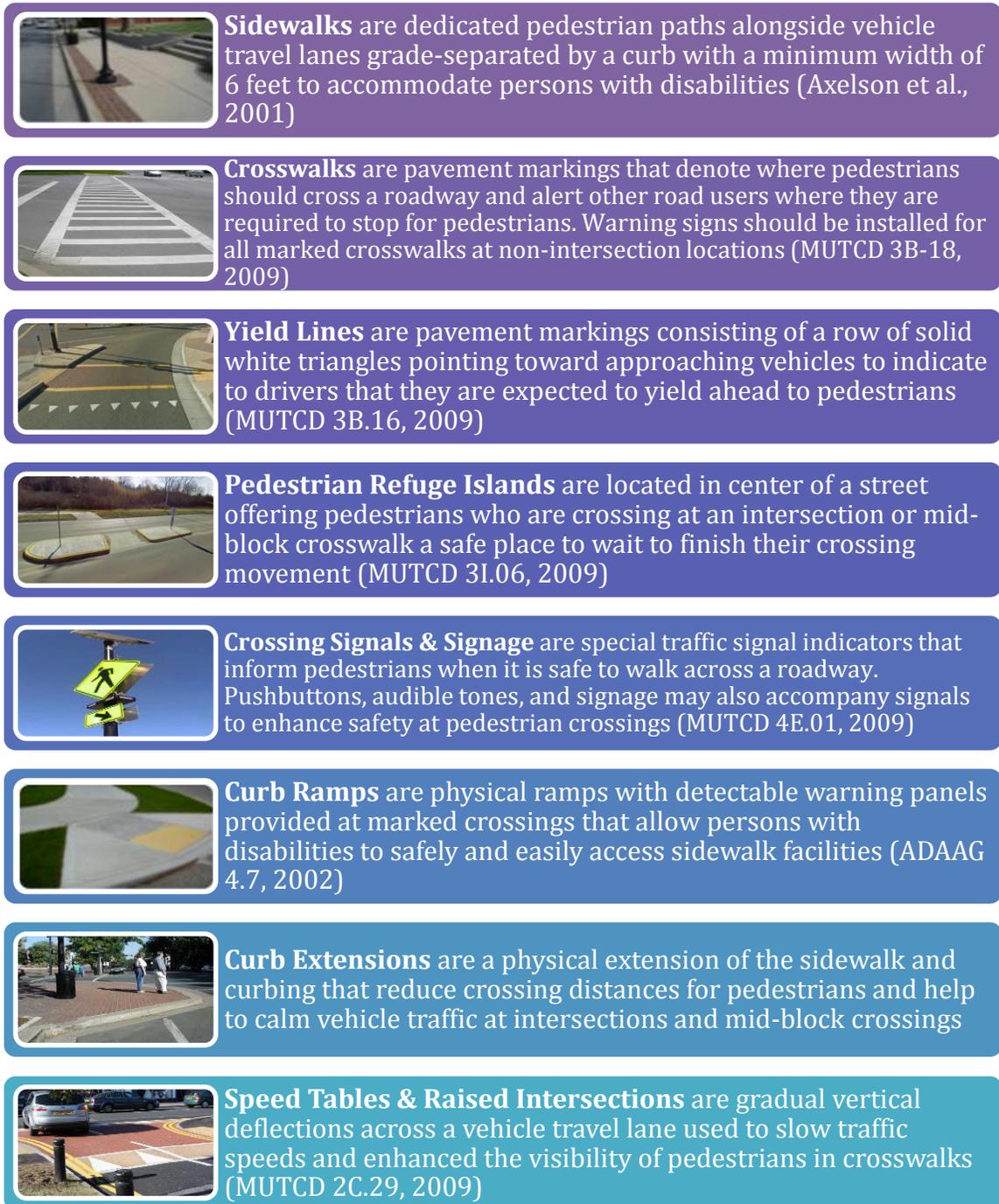
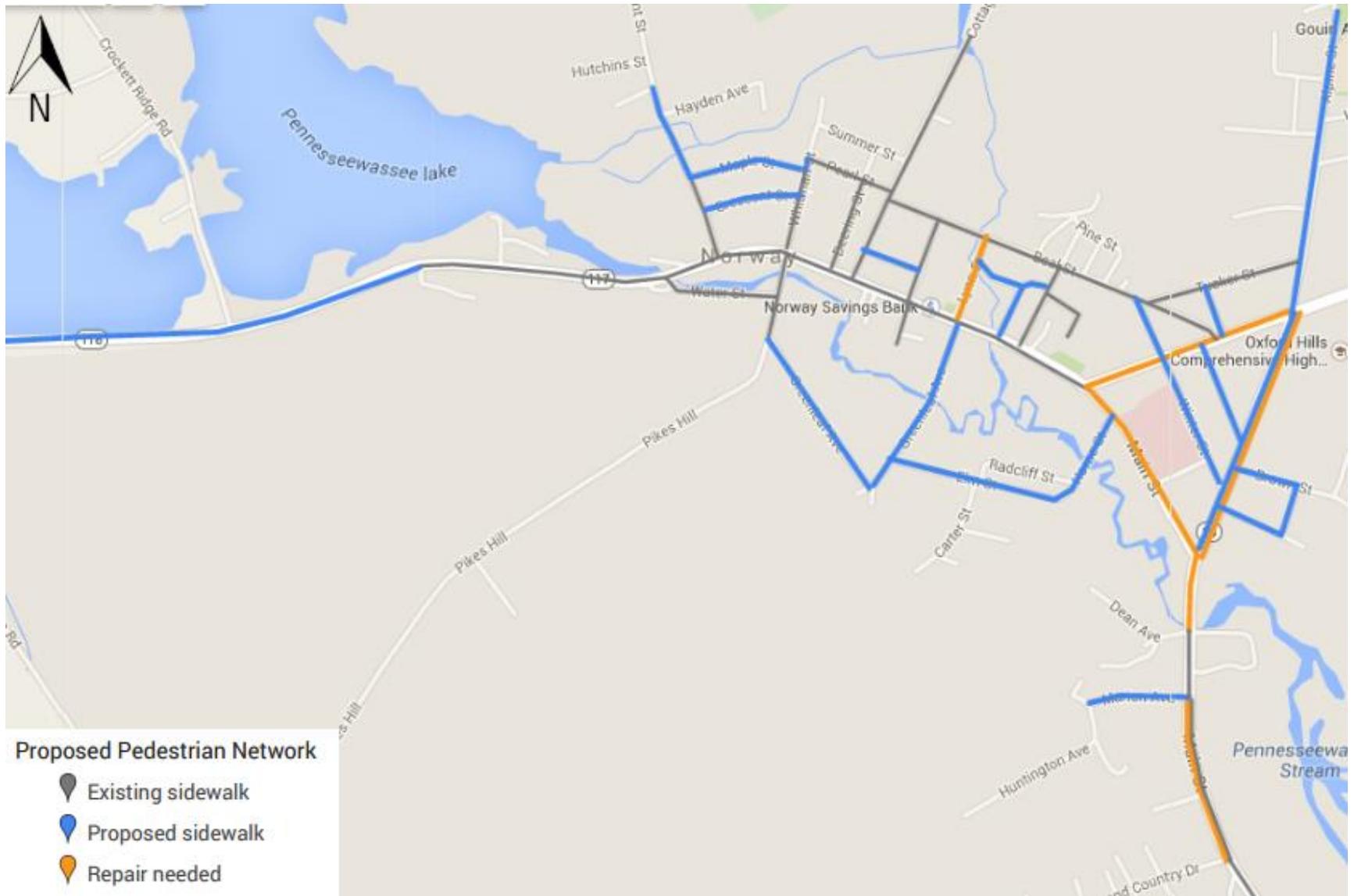


Figure 11: Pedestrian Facility Toolkit

Figure 12: Proposed Pedestrian Network



Proposed Sidewalk Repair

Based on the data collected through the RALA Segment tool and the 2002 Sidewalk Inventory & Improvement Plan, sidewalk segments were identified in need of repair because they are in poor or fair condition. Table 6 below shows the priority rankings for sidewalks in need of repair based on the existing conditions and information obtained from public meetings as part of the 2002 Sidewalk Inventory & Improvement Plan. A majority of the six sidewalk facilities that are in need of repair are only located on one side of the respective street segment, while the sidewalks along Lower Main Street and Paris Street are in need of repair on both sides of the street.

Segment ID	Location	Existing Conditions	Status	Facility Type	Priority
E	Lower Main Street	Poor	Repair	Both sides of street	Priority I
R	Paris Street	Fair	Repair	Both sides of street	Priority I
N/A	Lynn Street	Poor	Repair	One side of street	Priority I
J	Fair Street (northbound, Lower Main St to Paris St)	Poor	Repair	One side of street	Priority I
A	Route 26 (Lower Main St to Sanborn Cir)	Fair	Repair	One side of street	Priority II
B	Route 26 (southbound, Marion Ave to Town & Country Dr)	Fair	Repair	One side of street	Priority II

Table 6: Sidewalk repairs needed in Norway, Maine

Figure 13 below provides an example of the poor conditions on Paris Street as the sidewalk is indistinguishable from the shoulder and travel lane, potentially allowing for vehicle encroachment on the dedicated pedestrian way.



Figure 13: Sidewalk in need of repair on Paris Street

Additionally, it is important to note that the two Route 26 segments in Table 8 above were not evaluated as part of the 2002 Sidewalk Inventory & Improvement Plan. However, sidewalks on both segments are intermittent with frequent curb cuts at driveways and parking lots and changes in widths along the segment, which pose safety issues for pedestrians and particularly those with disabilities.

Proposed New Sidewalks

In addition to needed repairs, a list of new sidewalks was created after analyzing the RALA Segment data and supplementing it with the 2002 Sidewalk Inventory & Improvement Plan to fill existing gaps in the pedestrian network and better connect residential areas to community assets in Norway. The proposed sidewalk segments are categorized in Table 7 below by priority from I to III. There are five new sidewalk segments ranked as the top priority for future construction, including Lake Road (from Walker Avenue to Pennesseewassee Park), Fair Street (southbound, Paris St to Lower Main St), Greenleaf Avenue, Tannery Street, and Winter Street. A new sidewalk on Lake Road would connect Main Street in Norway with the town’s most significant recreation/open space asset in Pennesseewassee Lake, a park by the same name, New Balance Fitness Trail, White’s Marina, Curves, and Roberts Farm Reserve. The shared-use path proposed for Lake Road as part of the bicycle network could accommodate both bicyclists and pedestrians along this street segment.

Segment ID	Location	Status	Facility Type	Priority
S	Lake Road	Proposed	One side of street	Priority I
J	Fair Street (southbound, Paris St to Lower Main St)	Proposed	One side of street	Priority I
N/A	Greenleaf Ave	Proposed	One side of street	Priority I
N/A	Tannery Street	Proposed	One side of street	Priority I

N/A	Winter Street	Proposed	One side of street	Priority I
N/A	Temple Street	Proposed	One side of street	Priority II
N/A	Pleasant Street (Maple St to Edgewood St)	Proposed	One side of street	Priority II
N/A	Maple St & Whitman St	Proposed	One side of street	Priority II
N/A	Orchard Street	Proposed	One side of street	Priority II
N/A	Mill Street	Proposed	One side of street	Priority II
N/A	Elm Street & Horne Street	Proposed	One side of street	Priority III
N/A	Green Street	Proposed	One side of street	Priority III
N/A	Solon Street	Proposed	One side of street	Priority III
N/A	Grove Street	Proposed	One side of street	Priority III
N/A	Alcott Street	Proposed	One side of street	Priority III
N/A	Brown Street	Proposed	One side of street	Priority III
N/A	Crescent Street	Proposed	One side of street	Priority III
N/A	Marion Ave	Proposed	One side of street	Priority III

Table 7: Proposed sidewalk segments in Norway, Maine

Another important new sidewalk connection would be located along the southbound lane of Fair Street (Route 26) between Paris Street and Lower Main Street, which runs along a Thoroughfare street across the street from Oxford Hills Comprehensive High School. In addition to the high school, this new stretch of sidewalk would meet existing demand for access to Walgreens, Oxford Federal Credit Union, along with several other commercial establishments. Appendix 7 shows a “desire line” or footpath along the southbound lane of Fair Street created by pedestrians because of the lack of adequate sidewalk facilities. Alternatively, a shared use path could address the need for a new sidewalk on the southbound side and the proposed repair to the sidewalk on northbound side of Fair Street, while building out the proposed bicycle network at the same time. Proposed sidewalks on Greenleaf Avenue and Tannery Street would increase connectivity between dense neighborhood areas and Main Street in Norway, while a new sidewalk along Winter Street would increase access for residents to the aforementioned community assets along both Paris and Fair Streets

Unsafe Transition Zones Between Street Types

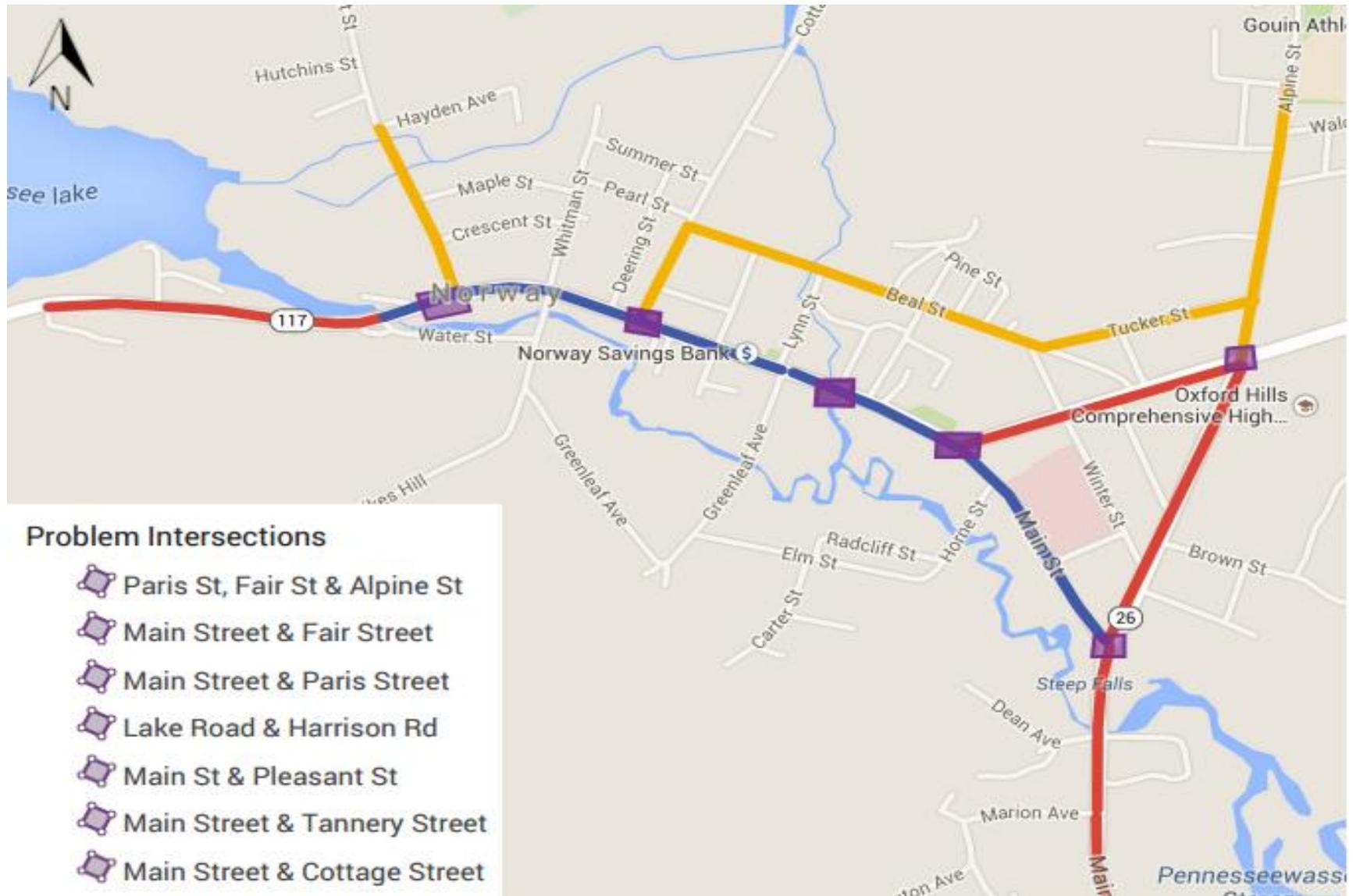
There are numerous challenging intersections in Norway that pose safety hazards to both pedestrians and bicyclists. In Table 8 below is a list of locations of 11 bicycle and pedestrian crashes that have occurred in Norway between 2009 and 2013 (see Appendix 8 for a graphical representation). Of the total 11 crashes, eight of them occurred at the intersection of roads that are also state highways (highlighted in Table 8 below). Although no crashes occurred in the intersection of Main Street and Paris Street over the last several years, it is included here because it is also considered to be a challenging intersection for pedestrians and cyclists based on field observations.

Location	Road User	# of Crashes
Paris St, Fair St, & Alpine St	Pedestrian & Bicycle	5
Main Street & Fair Street	Pedestrian	2
Lake Rd & Harrison Rd	Pedestrian	1
Main Street & Pleasant Street	Bicycle	1
Main Street & Tannery Street	Bicycle	1
Main Street & Cottage Street	Pedestrian	1

Table 8: Bicycle & Pedestrian crashes 2009-2013 in Norway, Maine

A closer look at the problematic intersections in question in Figure 14 below reveals the fact that they are all found where two different street types cross rather than along a street segment. The only exception is the Lake Road and Harrison Road intersection, because both street segments would be considered Thoroughfare streets. This finding is likely due to the fact that when different street types intersect, there are significant changes in traffic speeds and volumes and active transportation facilities. This finding underscores the importance of thinking of intersections not just as street crossings, but also as transitions from different land use areas and street types to another that can act as barriers or otherwise pose safety issues to pedestrians and bicyclists. For example, a transition from a Neighborhood street to a Thoroughfare street exposes bicyclists and pedestrians to a significantly higher level of traffic risk than if they were traversing two Neighborhood streets.

Figure 14: Unsafe Transition Zones between Street Types



The interactive version of Figure 14 above provides pictures and a list of existing issues in all of the problematic intersections. The history of safety issues in these intersections suggests that measures should be taken to both provide continuous bicycle and pedestrian routes and utilize infrastructure to slow vehicle speeds at transition zones.

Intersection 1: Paris Street, Fair Street and Alpine Street

Suggested Improvements:

- Paris Street leg: new crosswalk & yield lines, pedestrian crossing signals & signage, curb extensions & ramps, remove eastbound left turn lane, remove dedicated left turn lane for Walgreens Pharmacy
- Fair Street leg: repaint crosswalk, add yield lines, reconstruct pedestrian refuge island, pedestrian signage, curb extensions & ramps
- Alpine Street leg: repaint crosswalks, reconstruct pedestrian refuge island, pedestrian signage, curb extensions & ramps, remove southbound left turn lane

It is important to underscore the fact that one bicycle and four pedestrian crashes occurred at the Paris Street, Fair Street, and Alpine Street intersection where a high school and several other important assets are located. Any MaineDOT project that involves this stretch of roadway should address the safety concerns for children that currently or could bicycle or walk to school in the future if the intersection's infrastructure and safety features were significantly improved.

Intersection 2: Main Street & Fair Street

Suggested Improvements:

- Main Street leg: reconstruct pedestrian refuge island, curb extensions & ramps
- Fair Street leg: new crosswalk, pedestrian crossing signals & signage

While significant pedestrian infrastructure is unlikely across Fair Street (Route 26), Norway may be able to work with the MaineDOT to provide more enhanced pedestrian facilities across the entrance to Main Street. This intersection acts as a “gateway” onto Main Street in Norway; however, its current composition does not entice visitors to diverge off their course to patronize local businesses. A coordinated signage scheme may help to enhance this intersection as a gateway into town and additional way finding signs along Main Street could help direct people to valuable community assets.

Intersection 3: Main Street & Paris Street

Suggested Improvements:

- Main Street northern leg: new crosswalk and yield lines, pedestrian signage, curb extensions and ramps, new stop sign
- Main Street southern leg: repaint crosswalk and add yield lines, pedestrian signage, curb extensions and ramps
- Paris Street leg: repaint crosswalk and yield lines, pedestrian signage, curb extensions and ramps, new stop sign

A raised intersection is the suggested treatment in order to significantly reduce vehicle speeds, which is of particular importance due to the elementary school in this

intersection. Additional school zone signage would be a helpful addition as well to better alert drivers of the need to reduce their speed.

Intersection 4: Lake Road & Harrison Road

Suggested Improvements:

- Lake Road leg: new crosswalk to marina, pedestrian signage
- Harrison Road leg: new crosswalk, reconstructed pedestrian refuge island, curb extensions and ramps

A stated goal in the town's comprehensive plan was to include this intersection in a “Special Commercial Zone” in order to allow for expansion of the business area already located there and promote growth of roadside and neighborhood service establishments (Town of Norway, 2011). The application of a coordinated signage scheme may also provide visual clues to travelers that this area is an important zone within the town of Norway. The infrastructure improvements suggested for this intersection would both increase safety for pedestrians and bicyclists and further the goal of attracting new businesses to this location.

Intersection 5: Main Street & Pleasant Street

Suggested Improvements:

- Pleasant Street leg: curb extensions and ramps
- Main Street leg: add yield lines, enhanced pedestrian signage, curb extensions and ramps

While there are crosswalks provided in this intersection, the streetscape transitions from the dense town center to more dispersed land use patterns, providing visual cues to drivers that they can increase speed. The minimal amount of suggested infrastructure and signage might also help to provide better access to the existing community assets abutting the intersection including Bob Butters Park and the Gingerbread House.

Intersection 6: Main Street & Tannery Street

Suggested Improvements:

- Tannery Street leg: curb ramps
- Main Street leg: new crosswalk, add yield line, pedestrian signage

This intersection is not in need of a significant amount of new infrastructure but pedestrians would benefit from an additional crosswalk across Main Street and infill development that would restore the buildings along the street frontage, thus increasing the appearance of density and the need to reduce speeds along this segment.

Intersection 7: Main Street & Cottage Street

Suggested Improvements:

- Cottage Street leg: repaint crosswalk
- Main Street leg: repaint crosswalk, add yield lines, curb extensions, speed table

Improved pedestrian infrastructure is needed at this intersection because it serves as an important connection between the dense residential areas along Cottage Street and Main Street. This intersection could benefit from a specific type of pedestrian facility called a pinchpoint curb extension that shortens crossing distances and slows traffic speeds at

mid-block crosswalks. A speed table is also suggested as the slight change in vertical grade can serve as a traffic calming measure along Main Street.

Discussion

While the majority of the planning profession's focuses on urban issues, it is critical to recognize the challenges that currently exist in rural areas and potential benefits these communities can gain by taking thoughtful approach to future transportation and development efforts. Many rural communities in Maine have embraced auto-focused development patterns in the face of economic stagnation and shrinking tax bases, which has resulted in the reduction of available transportation options. Providing opportunities for safe and practical alternatives outside of private vehicle ownership is just as important for those living below the poverty level in rural areas, as they are in poor communities in urban settings. However, many small rural towns that have retained their traditional commercial district and neighborhood designs have an opportunity to build upon that foundation by connecting valuable assets with active transportation networks to better serve residents' daily needs and attract tourists and new businesses.

In this thesis, Norway was used as a case study to demonstrate how active transportation planning facilities can be applied in a rural land use context to support community development. The results of this study reveal that the town should prioritize the repair of existing sidewalk facilities, stripe on-street bicycle facilities, and improve safety at problematic intersections using pedestrian facilities and consolidating travel lanes to establish a more connected network of active transportation infrastructure. Increasing the safety for pedestrians and bicyclists at intersections will significantly

strengthen connections between the town center, residential areas, and local community assets. The recommendations put forward by this thesis are attainable for financially restricted municipalities because active transportation improvements are relatively inexpensive investments in comparison to costly projects such as building new roads, widening lanes, and adding parking facilities. The proposed approach to active transportation and community development can help rural towns reach their goals related to improving quality of life, increasing transportation options, supporting local businesses, attracting new employers, all while helping to retain existing residents, particularly young people.

The Rural Active Living Assessment provides an opportunity for small rural towns that may lack staff or sufficient resources to collect and analyze data to inform future transportation and land use priorities in their communities. However, it is important to acknowledge that there are several limitations to the RALA tools and the results of this study. The guidelines for data collection instruct the auditor to select a sample of streets within a one-mile radius of the town center, potentially omitting relevant segments from the evaluation. Staff from a local non-profit organization collected a majority of the data using the RALA tools, which may increase the reliability and validity of the data, but some confusion over terminology may have introduced some abnormalities into the data. For example, the Segment tool instructs staff to evaluate the type and condition of existing buffers between the sidewalk and travel lane, but after reviewing the data, it appeared that the auditor may have interpreted a sidewalk buffer as just the presence of a sidewalk rather than a landscape/esplanade area to buffer pedestrians from moving vehicles. Finally, there may be some limitations to applying the

proposed approach to towns that do not benefit from a centralized downtown area and moderately settled residential areas.

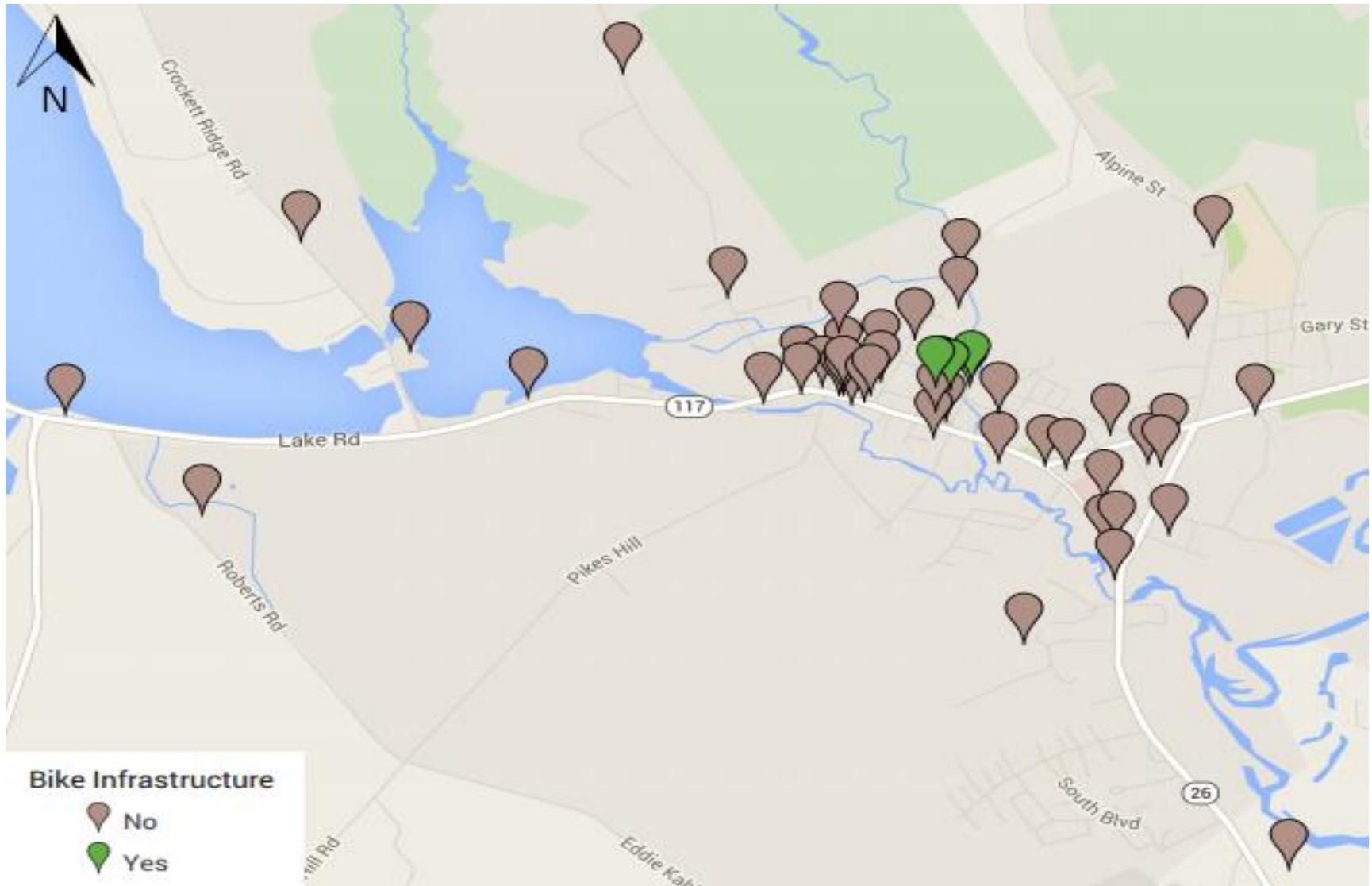
Additionally, there is room for improvement in the Rural Active Living Assessment itself. There seemed to be some gray area between defining “active living” as biking and walking for recreational purposes and using sidewalks as transportation connections between certain parts of a town and recreational amenities. So in an effort to propose active transportation networks to serve community assets, I had to identify assets in addition to the recreational variety that may not entirely represent all of the assets believed to be valuable by local residents. The Segment tool also did not allow for the collection of substantive data on the quality of connections between street segments and existing active transportation infrastructure. Therefore, the further development of the Segment tool to evaluate connections would greatly increase the utility of this data collection tool in the future.

Moreover, it is unclear why the Rural Active Living Assessment mentioned bicycling several times in its guidance document but then did not specifically provide the option to collect data on the existing conditions for bicycling in rural towns. The Bicycle Coalition of Maine developed a separate tool called Bikeability Measures to collect supplementary data on existing bicycling conditions. It is important to acknowledge that the Bikeability Measures was developed by an organization and not tested and peer reviewed as were the tools to be included in the established Rural Active Living Assessment. This means that the tool was designed with certain assumptions that may have affected the results and may not be consistent for all bicyclists. For example, streets with no parking and wide shoulders scored as the best condition for bicycling, even

though that scoring methodology may cause a Thoroughfare street to have a similar level of bikeability as a Town Center street. I suggest that the Rural Active Living Assessment build upon the Bikeability Measures to incorporate bicycling more effectively into the data collection and evaluation process.

A suggestion for future research is to develop the Rural Active Living Assessment into a “Rural Active Living & Transportation Assessment” that evaluates bicycling and walking both for recreation and transportation purposes. Expanding the definition would allow for the collection of additional data points, including curb radii, crossing distances, lane width, and additional segment evaluations. However, the collection of these additional data points would be more time consuming and may be difficult to accomplish given staff and resource constraints in small rural towns. Future planning efforts might also include an in-depth look at parking utilization and industrial traffic, particularly along Main Streets in rural towns. A parking study can help towns identify where parking is needed or currently underutilized, which may open opportunities for additional right of way to expand sidewalks or add on-street bicycle facilities. A study of industrial traffic and subsequent ordinance to establish alternate truck routes or restrict industrial trucking to certain hours of the day along Main Streets may help to reduce the presence of these large vehicles that currently pose safety risks to pedestrians and bicyclists in Norway.

Appendix



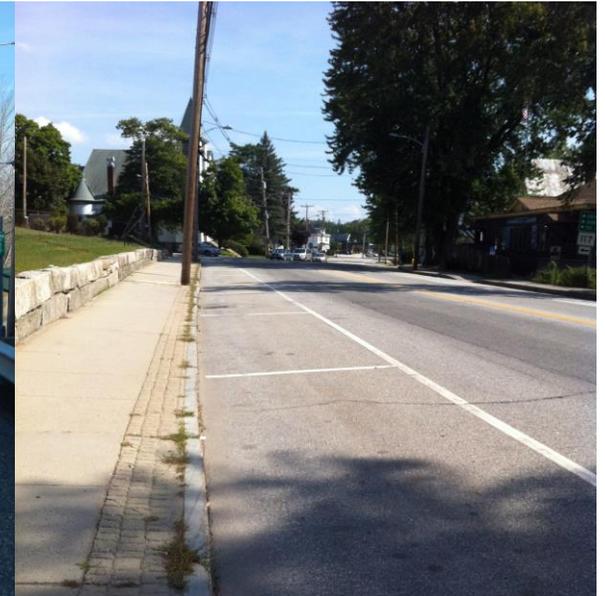
Appendix 1: Community Asset Bike Infrastructure Access



Main Street: Greenleaf Ave to Pikes Hill Rd



Main Street: Pikes Hill Rd to Water Street



Main Street: Paris Street to Greenleaf Ave

Norway's Main Street exemplifies a Town Center street because it serves as the central commercial corridor and heart of the town's historic downtown district. Town Center streets have unique streetscapes that consist of historic architecture, wide sidewalks, street trees, and a density of mixed uses. These streets provide an interesting and inviting environment for pedestrians to access important community assets and destinations. Town Center streets in Norway are also part of the state highway system serving local, commuter, and freight traffic often causing congestion along the roadways.

Similar Characteristics

- Land Use: commercial, public/civic
- Road Type: paved single lane
- Lane Width: 11'-13.5'
- Speed Limit: ≤25mph
- Traffic Volume: medium
- Storm Drains: at grade, safe grates
- Parking: parallel, drive-in angled
- Sidewalks: both sides of street
- Pedestrian Facilities: crosswalks, public lighting
- Walkable
- Moderately Bike Friendly
- Aesthetically Pleasing

Rural Street Typology: Thoroughfare

Norway, Maine



Paris Street: Main St to Fair St (Rt 26)



Route 26: Marion Ave to Town & Country Rd



Main Street: Water St to Walker Ave

Thoroughfare streets are characterized by their primary commercial land use and auto-oriented design to facilitate the movement of vehicles and goods through the town and region. Development is typically located on large lots that are set back from the street creating longer travel distances to access services. There is no parking allowed along these roadways and parking is provided through private surface lots. These streets often pose barriers for pedestrians and bicyclists due to a lack or poor condition of dedicated infrastructure and higher vehicle speeds. Frequent driveways and curb cuts are especially problematic to persons with disabilities.

Similar Characteristics

- Land Use: commercial, open space
- Road Type: paved multi-lane
- Lane Width: 11'-13.5' to $\geq 14'$
- Speed Limit: ≥ 30 mph to ≥ 40 mph
- Traffic Volume: medium to high
- Storm Drains: at grade, safe grates
- Parking: none
- Sidewalks: Both side of street/one side of street
- Sidewalk Condition: poor to fair
- Crosswalk Condition: poor to fair
- Somewhat Bike Friendly
- Not Aesthetically Pleasing

Rural Street Typology: Neighborhood

Norway, Maine



➤ Pleasant Street: Main St to Hayden Ave

Tucker Street: Beal St to Alpine St

Alpine Street: Route 26 to Aldrich Ave

Neighborhood streets provide residents with convenient access between housing and local destinations, as well as contribute to a high quality of living in Norway. These streets are characterized by a moderate level of density, lower traffic speeds and volumes, and more comfortable walking and bicycling environments. Neighborhood streets generally lack centerline markings but pedestrian infrastructure including sidewalks and crosswalks are in good condition. The transitions from Neighborhood streets to Thoroughfare streets pose significant barriers to active transportation with drastic differences in vehicle volumes and speeds, crossing distances, and dedicated infrastructure.

Similar Characteristics

- Land Use: residential
- Residential density: moderate
- Road Type: paved single lane
- Lane Width: $\leq 11'$ to $\geq 14'$
- Speed Limit: ≤ 30 mph
- Traffic Volume: low
- Sidewalks: One side of street or none
- Sidewalk Condition: good
- Crosswalk Condition: good
- Moderately Bike Friendly
- Walkable
- Aesthetically Pleasing

Segment ID	Location	Route Type	Community Assets
M	Tucker Street	Primary	None
L & K	Alpine Street	Primary	Grover Gundrilling, Gouin Athletic Complex
R	Paris Street	Primary	St. Catherine's of Sie,nna
E	Lower Main Street	Primary	Stephen's Memorial Hospital, Streaked Mountain School, Healthy Oxford Hills, Second Congregation Church
F, G, H	Main Street	Primary	Guy E. Rowe School, Child Development Services, Norway Memorial Library, Witherall Park, Norway Savings Bank, Key Bank, Organizational: Weary Club, Norway Downtown, Western Foothills Land Trust, Center for an Ecology Based Economy, Historical Society, Matolcsy Art Center, Opera House, Fair Share Co-op, Norway Unitarian Universalist Church
P	Cottage Street (Main St to Beal St)	Primary	Norway Baptist Church
I	Lake Road	Primary	Bob Butters Park & Gingerbread House, White's Marina, Curves, Pennessewassee Park, New Balance Fitness Trail
J	Fair Street	Primary	Walgreens Pharmacy, Oxford Federal Credit Union
N & O	Beal Street	Primary	Norway Branch Railroad Trail, Town Offices, Fire and Police Stations

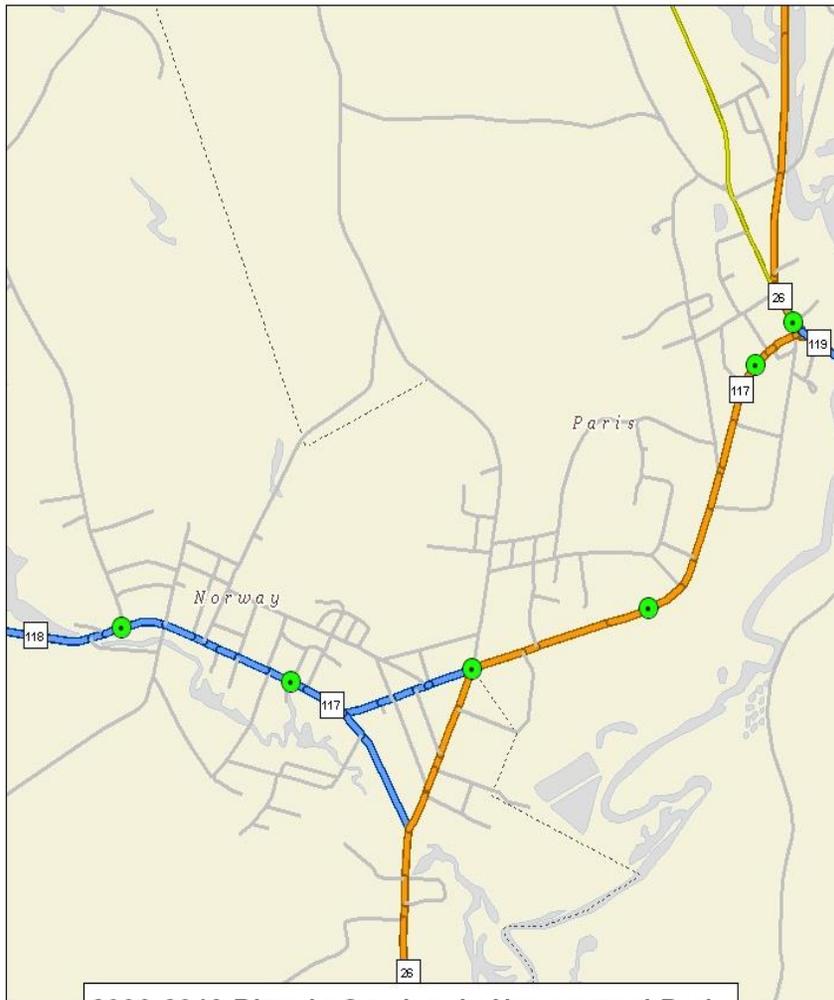
Appendix 5: Primary Bike Network Asset Connections

Segment ID	Location	Route Type	Community Asset
Q	Pleasant Street	Secondary	Witt Swamp Preserve, Ordway Grove
N/A	Maple Street & Pearl Street	Secondary	Alan Day Community Garden
N/A	Cottage Street (Beal St to New Balance Factory)	Secondary	Progress Center, Inc., Cottage Street Recreation Area, New Balance Shoe Manufacturing
N/A	Cottage Street (New Balance Factory to Alpine St)	Secondary	None
N/A	Alpine Street (Cottage St to Woodland Ave)	Secondary	Gouin Athletic Complex
N/A	Norway Branch Railroad	Secondary	Norway Branch Railroad Trail
N/A	Beal Street (Tucker St to Paris St)	Secondary	None
N/A	Lynn Street	Secondary	Head Start

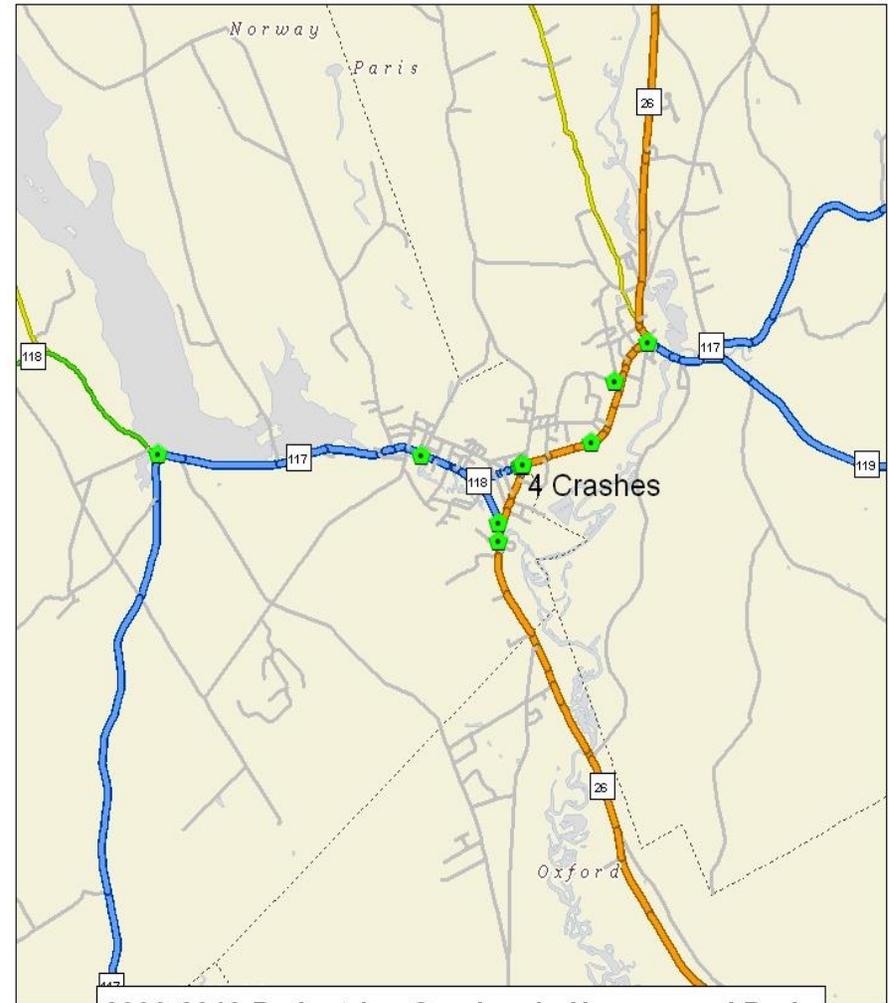
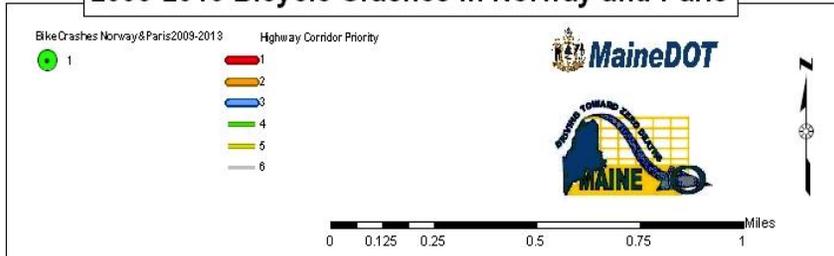
Appendix 6: Secondary Bike Network Asset Connections



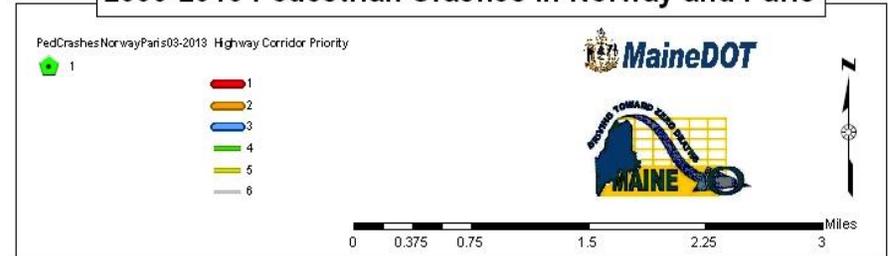
Appendix 7: Desire line along Fair Street southbound lane



2009-2013 Bicycle Crashes in Norway and Paris



2009-2013 Pedestrian Crashes in Norway and Paris



Appendix 8: Maps of Bicycle & Pedestrian Crashes in Norway 2009- 2013

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