ABSTRACT

Title of Thesis: DESIGNING NEIGHBORHOODS FOR ACTIVE LIVING
THROUGH TRAIL AND TRANSIT ORIENTED DEVELOPMENT

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Master of Landscape Architecture, 2018

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Trail and Transit Oriented Development is a new neighborhood planning and design concept. Trail and transit-oriented developments are high-density, mixed-use communities around public transit stations connected by trails (off-road shared use paths) and a dense network of pedestrian-friendly streets. This concept addresses the lack of pedestrian and bike-friendly design often characterized by suburban sprawl and the resultant lack of physical activity characterized by Americans. Car dependent suburban development promotes sedentary lifestyles. On the other hand, walkable and bike-friendly communities provide opportunities for active living. Neighborhoods

designed with the concept of Trail and Transit Oriented Development have a network of trails connecting public amenities, major destinations, new development, and existing neighborhoods. This research project focuses on applying trail and transit-oriented design and planning principles to the Long Branch Sector Plan. There are two proposed Purple Line light rail stops within the boundary of Long Branch Sector. The proposed design provides an increase in trail length and connectivity. It creates a built environment for active living by creating opportunities for walking and bicycling in everyday life.

DESIGNING NEIGHBORHOODS FOR ACTIVE LIVING

THROUGH TRAIL AND TRANSIT ORIENTED DEVELOPMENT

By

Avantika Dalal

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Dedication

To My Husband- Aditya Inamdar

This thesis is dedicated to my husband who has been a strong source of support. Moving to the United States and travelling with him has made see the world differently and helped me becoming a better urban designer. He encouraged me to pursue the Master's Degree at UMD and believed in me. This accomplishment would not have been possible without him. I am very grateful for his endless love and support.

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List of Abbreviations

TOD = Transit Oriented Development

TrOD = Trail Oriented Development

Tr-TOD = Trail and Transit Oriented Development

M-NCPPC - Maryland-National Capital Park and Planning Commission

Chapter 1: Introduction

This thesis explores the idea of combining concepts of Trail Oriented Development (TrOD) and Transit Oriented Development (TOD) to create a new neighborhood planning and design concept: Trail and Transit Oriented Development (Tr-TOD). The application of the Tr-TOD planning and design concept can provide health benefits for active living and opportunities for increased walking, bicycling, and playing. Being active every day, through activities in the built environment, is important for a healthy life and reduces the risk of obesity and other related diseases. Existing suburban communities, designed for driving and less for walking, do not focus on opportunities for an active lifestyle. People living in these car-dependent communities walk and bike less. This thesis proposes to apply the Tr-TOD concept to plan and design walkable, bike friendly, and green neighborhoods where all the residents will be provided a greater opportunity to engage in a more healthy and active life.

The study combines the design principles of TrOD and TOD and creates a new concept, Tr-TOD, which is then demonstrated through planning and design on the site: the Long Branch Sector, Montgomery County. The proposed Purple Line light rail has two stations in the site, which brings opportunity for redevelopment. The local planning agency, M-NCPPC has a vision plan and guidelines for the redevelopment of Long Branch Sector. This project considers the Long Branch Sector Plan's vision, recommendations, and then builds on those visions and recommendations. The project is a demonstration of the new concept Tr-TOD proposed in this study.

This report is divided into four chapters. Chapter One: Introduction includes the main argument and the overall outline of the report. The Chapter Two: Literature Review explores the health issues in the built environment, the concepts of TOD, TrOD, and their design principles. Chapter Three: The Neighborhood Planning and Design Project includes framing the research question, inventory, analysis, and the application of the concept to the planning area and the site area. Chapter Four: Performance Metrics and Conclusion documents performance metrics comparing the proposed design to existing conditions and the Long Branch Sector Plan and provides and overall summary of the thesis.

Chapter 2: Literature Review

The literature review is divided into six sections: 2.1) issues in the built environment; 2.2) active living, 2.3) trail oriented development (TrOD); and 2.4) transit oriented development (TOD). This chapter forms the literature foundation of the concept of Tr-TOD.

2.1 Issues in the Built Environment and Effect on Public Health

The built environment has a strong influence on public health. It can either impede or facilitate active living, which is crucial for public health (Jackson & Kochtitsky, 2017). Designers and planners are responsible to help create this environment and examine its negative as well as positive impacts on community's health. Our communities are mostly planned and built to enable constant car use promoting more inactive lifestyles. Almost fifty (50) percent of all Americans get less than the recommended amount of physical activity, and more than thirty six (36) percent, do not get in any leisure-time physical activity at all (Center for Disease Control and Prevention, 2018). Inactivity in our lifestyle leads to severe health disorders such as obesity, chronic diseases, and depression. Growing evidence suggests physical and the built environment influences physical and mental health problems (Srinivasan, O'Fallon, & Dearry, 2003). The built environment includes design and location of housing, schools, workplaces, parks, roads and highways. Car centric communities create a "deep-rooted structural issue" impossible to remedy with medicines alone (Green, 2011). Planners and designers should carefully examine the problems while

designing communities and change our neighborhoods so that they can help in improving public health.

The percentage of children walking or bicycling to school has dropped from 49% to 13%, whereas use of family vehicles has increased. (Safe Routes to School National Partnership, 2018). For example, when safe routes schools were properly designed, 800 schools in DC, FL, OR, and TX found an increase of around 31% in walking and bicycling.

2.1.1 **Physical Health**

Our built environment has strong implications for physical health. One of the most prominent health issues America is witnessing is obesity. Car-centric neighborhoods promote more sedentary lifestyles. Children and adults spend more time inside the house and in the cars. More than one-third (36.5%) of U.S. adults are obese and obesity related conditions include: heart disease, strokes, and diabetes (Carroll, Fryar, Flegal, & Ogden, 2015).

In the U.S., the estimated annual medical cost of obesity was $147 billion in 2008 (Center for Disease Control and Prevention, 2017). People suffering from obesity, paid $1,429 higher than those within normal weight range (Tsai, Williamson, & Glick, 2011). The cost of healthcare in the U.S. has reached seventeen (17) percent of gross domestic product (GDP) and the country now ranks as one of the most obese nations on the earth (American Society of Landscape Architects, 2017).

Designing for active living focuses on assimilating physical activities in everyday life. The literature on active living argues that people walk and bike more in active

neighborhoods, which helps in improving peoples overall health. In addition to this, there are many other benefits and different ways to incorporate active design techniques into existing and proposed communities.

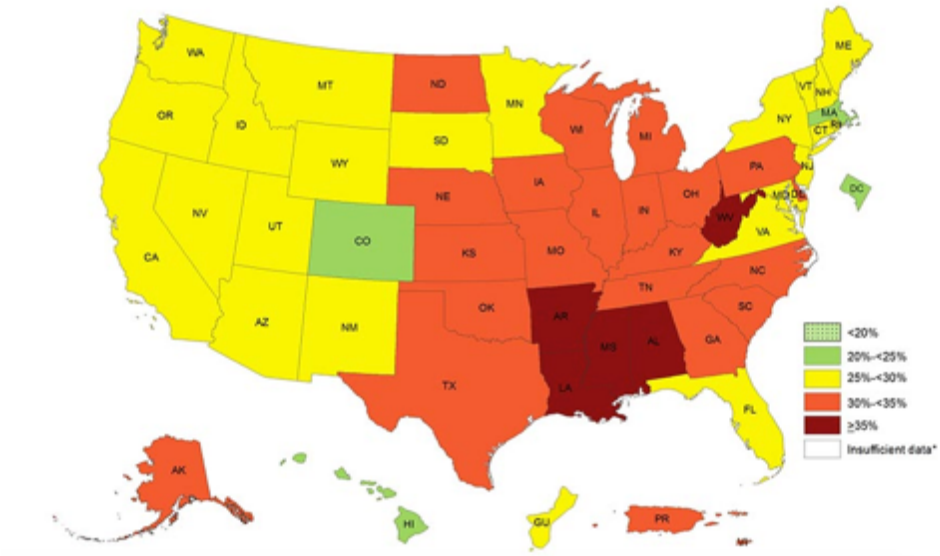


Figure 1: Prevalence of Self-Reported Obesity Among U.S. Adults by State and Territory

(Center for Disease Control and Prevention, 2018)

Studies have shown that people of color have higher rates of obesity. For instance, non-Hispanic blacks have the highest rates of obesity (48.1%) followed by Hispanics (42.5%). Also, obesity is higher among middle age adults age 40-59 years (40.2%) and older adults age 60 and over (37.0%). Obesity affects some groups more, while less than others (Center for Disease Control and Prevention, 2018). Five states have obesity rates equal of greater than 35% (Figure 1).

Obesity is also related to socio-economic status of the community. Communities with lower incomes are more likely to be obese than those with high income. Women with higher income are less likely to have obesity than women with low-income.

(Center for Disease Control and Prevention, 2018). Access to opportunities for active living in communities with lower incomes should be a priority.

Amenities like trails, bike lanes, parks, and recreational centers would be helpful in providing more opportunities to be active.

2.1.2 **Mental Wellbeing**

Health is defined as complete state of physical and mental well-being and not merely the absence of disease (World Health Organization, 1946). Neighborhood design and city planning impact individuals' mental health and wellness. It is important to understand how urban built form influences mental health. In order to be mentally healthy, one needs to be both physically active and feel connected to one's community and natural environment. Canada's 'Designing Healthy Living' report demonstrates the ways in which the built environment acts as a basis for physical health and mental wellbeing (Public Health Agency of Canada, 2017). The built environment is defined as the entire seen and unseen infrastructure that we experience, in our routines – our homes, streets, workplaces, parks, public spaces and transport systems (Public Health Agency of Canada, 2017).

Post-World War II urban development created a standard model for American cities: single-use suburban sprawl designed for cars as the primary mode of transportation. In such neighborhoods, children and the elderly are dependent on others for access to services since services and activities were not designed and planned with walking in mind. Many young teens live isolated in suburbs. They do not have access to public transportation, community centers, or shops. They are dependent on others to move around safely within are their communities (Jackson & Sinclair, 2012). These

children and other adults who cannot drive become isolated from social life and that puts them at an increased risk of boredom and depression (Jackson & Sinclair, 2012). Mental illness affects approximately 13 million American adults each year (Colman, 2015). In U.S., antidepressants have become second most prescribed medication and children's' use of antidepressants has doubled (Jackson & Sinclair, 2012). These issues are connected with inactivity, which could be addressed by making our neighborhoods more walkable and bike friendly. Most people cannot have mental wellness without human or nature contact and a supportive environment (Jackson & Sinclair, 2012). Residents living in walkable and sociable communities will have reduced stress, less anxiety and a reduced risk for depression.

2.2 Active Living

Active living is a way of life that integrates physical activity into everyday routines (Active Living by Design, 2009). The goal of active living is to add up at least thirty (30) minutes of activity each day. People can achieve this goal by simply walking or bicycling for transportation, exercise or pleasure; playing in the park; working in the yard; taking the stairs; or using recreation facilities (Active Living by Design, 2009). Being active reduces the risk of being obese and reduces the risk of other chronic diseases as well. The concept of active living helps the design and planning community in their goal to promote physical activity, through interventions in the built environment. Active living provides three major benefits: increased physical fitness, improved mental wellbeing, and a focus on preventive disease control.

2.2.1 **Relationship of built environment and being active**

The way communities are designed has a great influence on how active we are. When communities are designed for safe and comfortable walking, biking and have connections to landscapes, children and families are more likely to be active outdoors (Sallis, Floyd, Rodríguez, & Saelens, 2012).

There are many urban design theories in designing walkable, bike friendly communities. Some of these include Trail Oriented Development, Transit Oriented Development, Livable Communities, Healthy Communities, Sustainable Developments, etc. This thesis focuses on Trail Oriented Development (TrOD) to increase pedestrian and bicyclist connectivity and Transit Oriented Development

(TOD) to provide transportation alternatives and building high density mixed use neighborhoods around transit stations so that individuals are less dependent on cars.

2.3 Trail Oriented Development

There is a growing demand for bike-friendly and walkable places to live and work. Real estate developers are building "trail-oriented" communities to meet this demand (Shaver, 2016). In such communities, developers cater to a wish for "active transportation" and also offer amenities such as bicycle storage, extra-wide hallways and elevators, bike cleaning stations, bike "valets," bike-share systems and shower or locker facilities (Shaver, 2016).

Building trails is a high quality long-term investment for the residents of any community. Developers are taking advantage of these investments by building Trail Oriented Developments (TrOD). By doing this, the trail network is integrated into the urban developments. TrOD changes the neighborhood from a car-centric community to a walking and biking-centric community. Such developments are not only useful for people who cannot afford a car but also for individuals who choose a lifestyle to exclude driving for health or environmental reasons (Urban Land Institute, 2016).

Since the year 2000, bike commuting rates have increased by 62% nationally (United States Census Bureau, 2014). The rate increased even more dramatically where the communities are designed for bicycling. In large bike friendly communities, bike commuting rates increased by 105%. On the other hand, the rate increased by only 31% in non-bicycle friendly communities. (The League of American Bicyclists, 2013).

TrOD reflects this trend and responds to people's desire to live in places where there are safe, convenient, and affordable options for active transportation. These developments aim to provide a network of local business and housing choices within

a web of safe and enticing trails (Rails to Trails Conservancy, 2007). A well-planned trail network provides convenient access to active transportation choices. Such bike-friendly systems make the healthy option of walking or biking, the easy choice, which helps improve peoples' physical fitness and overall well-being. People living in TrOD walk or bike to nearby destinations connected by trails. The trails provide an alternative to a typical five-minute car trip.

By combining the active transportation benefits of trails with the revitalization potential associated with well-designed urban parks, TrOD helps creating more livable communities (Moskerintz, 2016). Active transportation plays an important tool for improving health of communities. Much of this is dependent on trails in the region. Therefore, it is important to understand their background and role in different contexts and scales.

Trails at different scales connect people to destinations. Neighborhood trails connect housing, schools, shopping and entertainment at a neighborhood scale. Regional trails connect various neighborhoods within a city or urban region. When new developments are built along trails, a greater percentage of the population can actively commute by walking or biking. Such developments also have a positive impact by reducing traffic congestion and thus improving overall air quality (Tennessee Department of Health, 2016).

The concept of TrOD was discussed by Rails to Trails Conservancy in 2007. It became well known in 2016 when Urban Land Institute studied TrOD as a recent popular trend in Active Transportation. There are many developments in Maryland as

well where TrODs are occurring, e.g. The Flats at Bethesda near Capital Crescent Trail, Riverdale Park is an example of TrOD.

2.3.1 **Design Features**

Trail Oriented Developments have some design features in common. For example most of the properties have direct trail access, bicycle storage, bike parking facilities, and on-site bicycle shop. The trails increase connectivity among neighborhoods and connect people to natural features. TrODs typically include the preservation of natural features like creeks and forests. Width of the trails typically ranges from 10’ to 15’ wide (Urban Land Institute, 2016).

2.3.2 **Benefits**

Some of the important benefits of TrOD are that they provide opportunities for exercising, and allow users to integrate exercise into daily their routines. TrODs have increased focus on pedestrian-bike safety. Trails serve as not only as recreational amenities but as a component of an integrated seamless urban or regional multi-modal transportation system providing benefits of improved health and wellness. The trails, offering an option for active transportation, decrease use of cars, which helps in improving air quality. TrODs have unique character, which create community identity and pride. These developments encourage economic development, attract tourism, and increase property values (Urban Land Institute, 2016).

2.4 Transit Oriented Development

Transit Oriented Development (TOD) is a high density, mixed-use community within 1/2 mile walking distance of a transit station. TOD encourages people to live near transit services and to decrease their dependence on driving (Calthorpe, 1993).

2.4.1 **Design Features**

Typically TODs have high density mixed use buildings. The buildings are close to sidewalks (Bartholomew & Ewing, 2013). In TOD, parks, plazas are the focal points of the neighborhood. It is recommended that for every 1000 people, there should be 3.5 acres of open space including parks, gardens, and plazas. Also, transit oriented communities have easy access to transit, less car parking, and more bike parking (Calthorpe, 1993).

2.4.2 **Benefits**

TODs have many benefits including social, economic, and environmental benefits. TOD depend less on cars and have increased independence for the elderly and the children. These communities use transit to commute to work. They improve the commuter experience and reduce commute time. TODs provide affordable housing. TODs, being compact developments, consume less land, energy, and resources. These communities also reduce greenhouse gas emissions by reducing traffic (Calthorpe, 1993).

Chapter 3: The Neighborhood Planning and Design Project

The previous chapter of literature reviews highlights the design principles of TrOD and TOD. This review helps in understanding the foundation of the new concept of combining design principles of TrOD and TOD. This chapter builds onto the knowledge from literature review and explains the origin of the concept Tr-TOD. Next, this study frames the research question, followed by site inventory and analysis, design development, and final design including the master plan, sections, perspectives and user narratives.

3.1 The New Concept "Tr-TOD" = TrOD + TOD

This thesis combines the two concepts: TrOD and TOD to create a concept of Trail and Transit Oriented Development (Tr-TOD) which will provide opportunities for health benefits of active living. The application of Tr-TOD design and planning principles to the site aims to create walkable built environments, improve pedestrian and bicycle safety, and encourage people to be outdoors. Moreover, it provides health benefits for the communities, which include improving physical health and mental well-being, and preventive disease control.

3.2 Design Principles of TrOD and TOD

	Design Principles of TrOD (Urban Land Institute, 2016)	Design Principles of TOD (Calthorpe, 1993)
	Integrating trails/bike-friendly infrastructure into development projects.	Design mixed-use, high-density development within 1/2 mile radius walk-shed around stations.
	Creating a network of neighborhood trails connecting to the regional trail network.	Create a walkable street network around stations.
	Connecting public amenities with trails/ low-traffic-stress on-street bicycle network.	Design active public spaces around stations.
	Design the trail network such that a maximum number of properties have direct access to trails.	Reduce parking within the 1/2-mile radius walk shed.
	Design new development along trails.	Incorporate bicycle infrastructure to increase bicycle access to stations within 2-mile bike-shed around stations

Table 1: Design Principles of TrOD and TOD

3.3 Research Question

How can the design and planning concept of Trail and Transit Oriented development (Tr-TOD) be applied to provide health benefits of active living? Figure 2 graphically represents the concept Tr-TOD for Active Living. It shows that the selected design principles of TrOD and TOD are combined together creating a new concept of Tr-TOD to provide health benefits of active living. The icon on the left represents TrOD showing people walking and biking on trails. On the right, the icon shows transit oriented development.

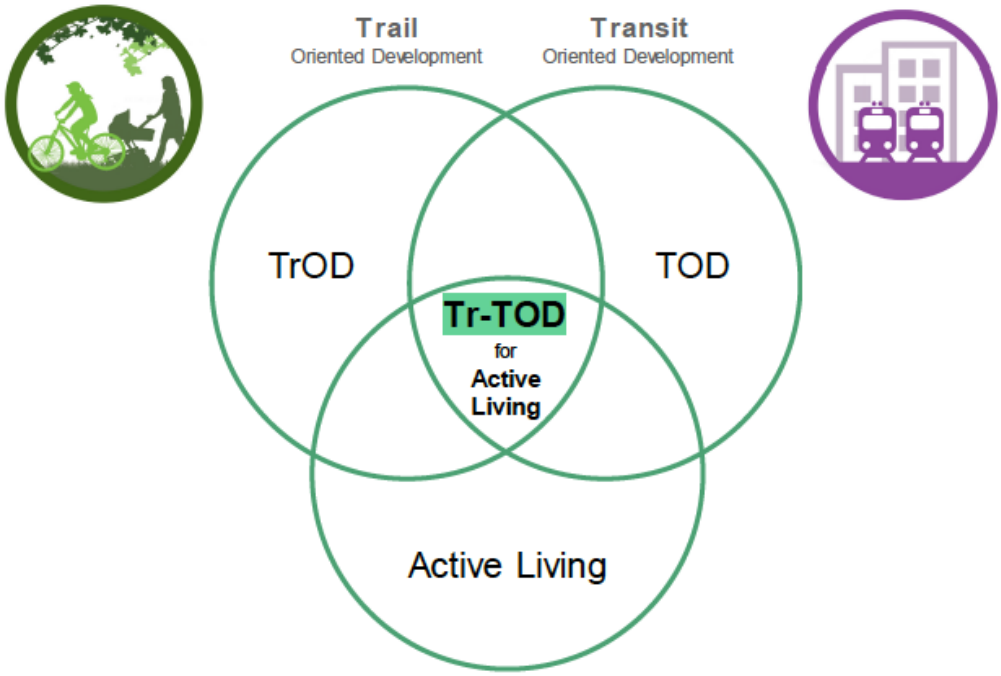


Figure 2: Concept diagram of Tr-TOD for active living

3.7 Goals, Objectives, and Method

The following section outlines the goals, objectives, and methods used to develop the planning and design project.

The goals are as follows:

A. Design a model neighborhood based on principles of Tr-TOD with trails and transit as armatures to promote active living that encourages physical activity in everyday life.
B. Increase pedestrian and bicycle connectivity by providing trails connecting public amenities, major destinations, new development, and existing neighborhoods.
C. Create a high-density, mixed-use, walkable neighborhood around Purple Line transit stations.
D. Connect the community to nature by providing more green open spaces like new parks, gardens, trails, and plazas. Increase access to existing open spaces such as forests, parks, and trails.

The objectives are as follows:

A. Trail Oriented Development:

The objectives for TrOD include increasing the number of miles of trails in the neighborhood and creating a new neighborhood trail system that provides direct access to trails from each property in the proposed re-development area. Also, extending the Long Branch Trail towards North.

B. Transit Oriented Development:

The objectives for TOD include designing a high-density, mixed-use, infill redevelopment around Purple Line light rail transit stations and adding new streets to

break existing large superblocks. Moreover, increase intersection density within the neighborhood and create a Complete Streets network defined by pattern of small block sizes.

C. Access to Open Space

The objectives related to access t open space include providing new green open space in form of parks, gardens, and trails. Additionally, directly connect and enhance access to existing green open space like forests, parks, trails, etc.

3.5 Inventory and Analysis

This section includes the site selection criteria, planning area and design area inventory and analysis, and the opportunities and constraints for the area and site.

3.5.1 **Site Selection Criteria**

The site was selected based on its proximity to regional trails as well as to the new transit stations with potential for redevelopment within the Washington DC area. The Long Branch area satisfies both of these criteria and was also had a recently developed sector plan.

Trails

The regional trails in parts of Montgomery County, Prince George's County and Washington DC are principally situated in well-forested areas (Figure 3). They provide an opportunity for active transportation as well as regional connectivity. The Long Branch Sector area is near Piney Brach Trail and includes the Long Branch Stream Valley Trail.

Purple Line Light Rail

The proposed Purple Line is a light rail, mostly at grade, located in southern Montgomery County and middle Prince Georges County. The Purple Line is16-miles long with 21 stations (Figure 4). Ten stations are located in Montgomery County, with two stations within the selected Long Branch Sector site. The proposed Purple Line brings opportunity to redevelop the site as Transit Oriented Development.

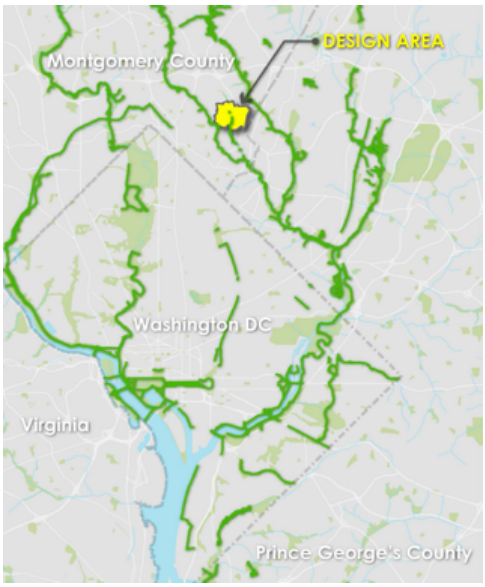


Figure 3: Regional Trail Network

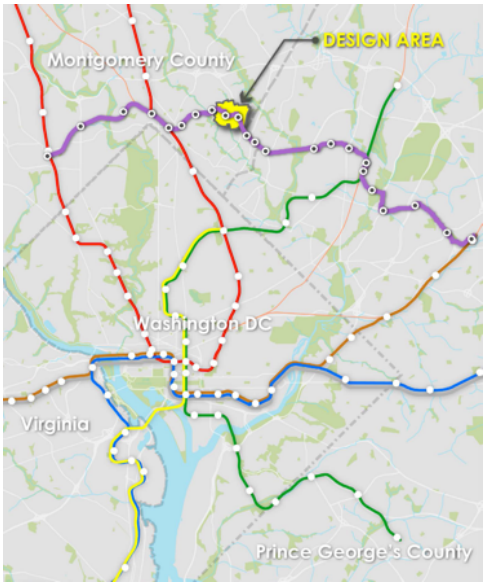


Figure 4: Regional Transit Network

3.5.2 **Planning Area and Design Area**

The Planning Area is the area studied to understand the surrounding setting and communities' context. The Design Area is the site for design intervention (Figure 5). The inventory and analysis of existing conditions is conducted at these two scales. This section documents existing conditions. The Planning Area is 1870 acres and the Design Area is 247 acres.

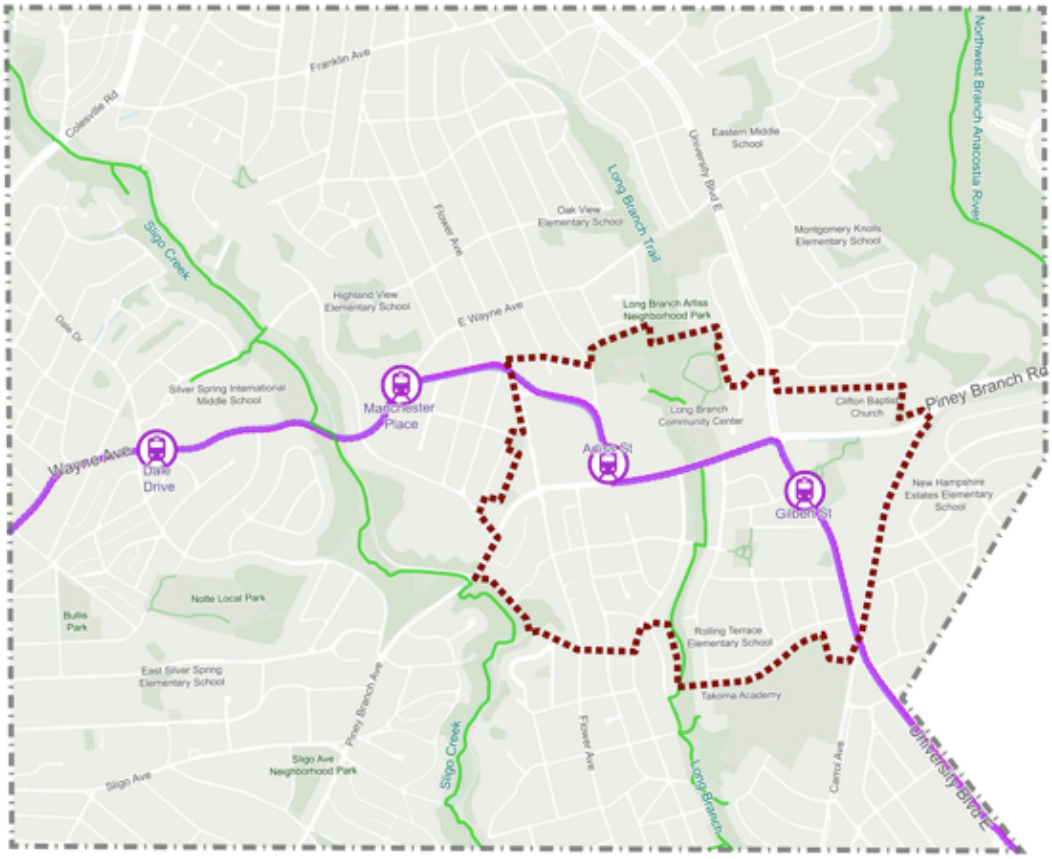


Figure 5: Planning Area and Design Area

Planning Area

Design Area

3.5.3 Site Inventory and Analysis: Planning Scale

Purple Line

The proposed Purple Line light rail provides an East-West connection connecting Bethesda, Silver Spring, College Park, and New Carrollton, MD. There are a total of 21 stations, out of which 10 stations are located in in Montgomery, including two

within the Design Area. Figure 6 shows quarter mile and half mile walking radiuses around stations for future TODs.

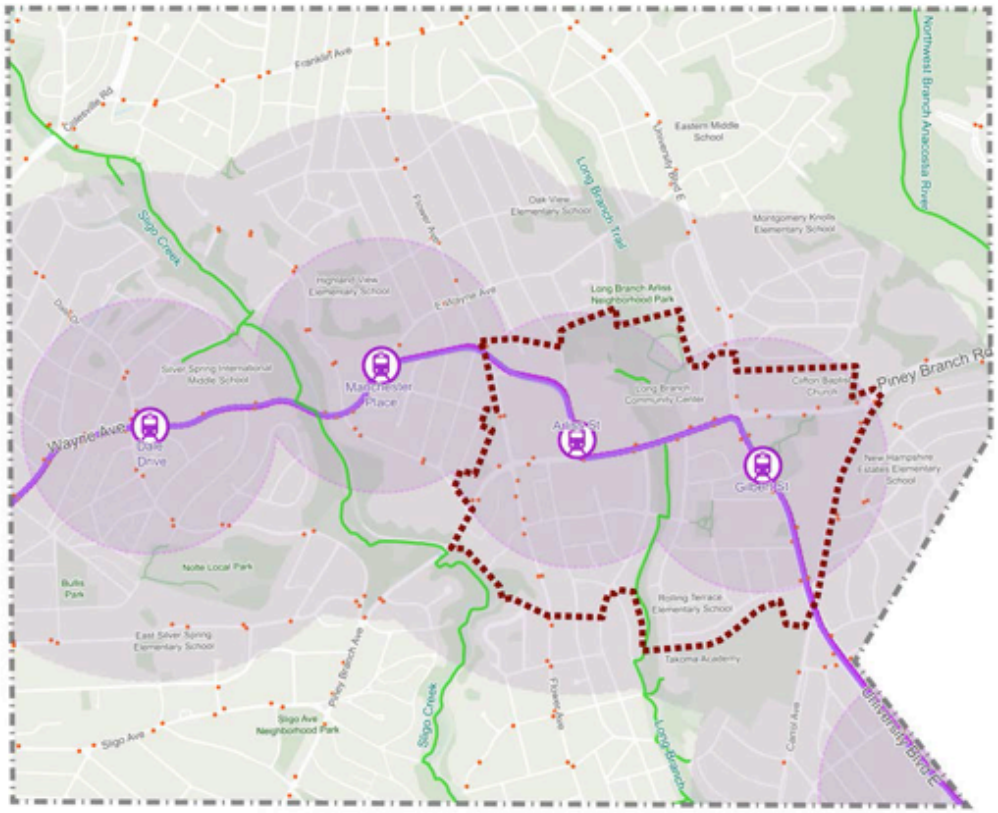


Figure 6: Purple Line in Planning Area

Trails

There are three important regional trails in the Planning Area: the Long Branch Trail, Sligo Creek Trail, and Northwest Branch Anacostia River Trail (Figure 7). These stream valley trails are generally well-forested and are located parallel to each other due to the underlying geomorphology. There is an opportunity to create horizontal connections to increase connectivity between these trails.

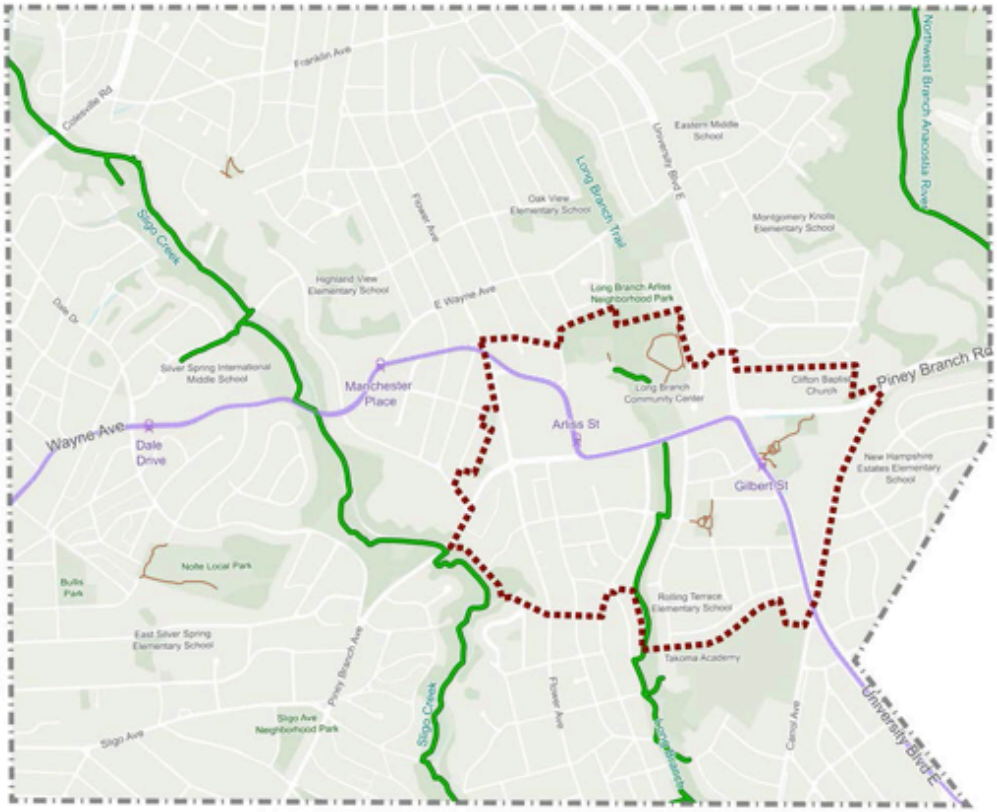


Figure 7: Trails in Planning Area

Regional Trails **Park Trails**

Access to Trails

Sligo Creek Trail provides pedestrian and bicyclists trailhead access at every quarter mile interval, which connects residents with natural settings (Figure 8). On the other hand, The Long Branch Trail abruptly disconnects at Piney Branch Road (Figure 8).

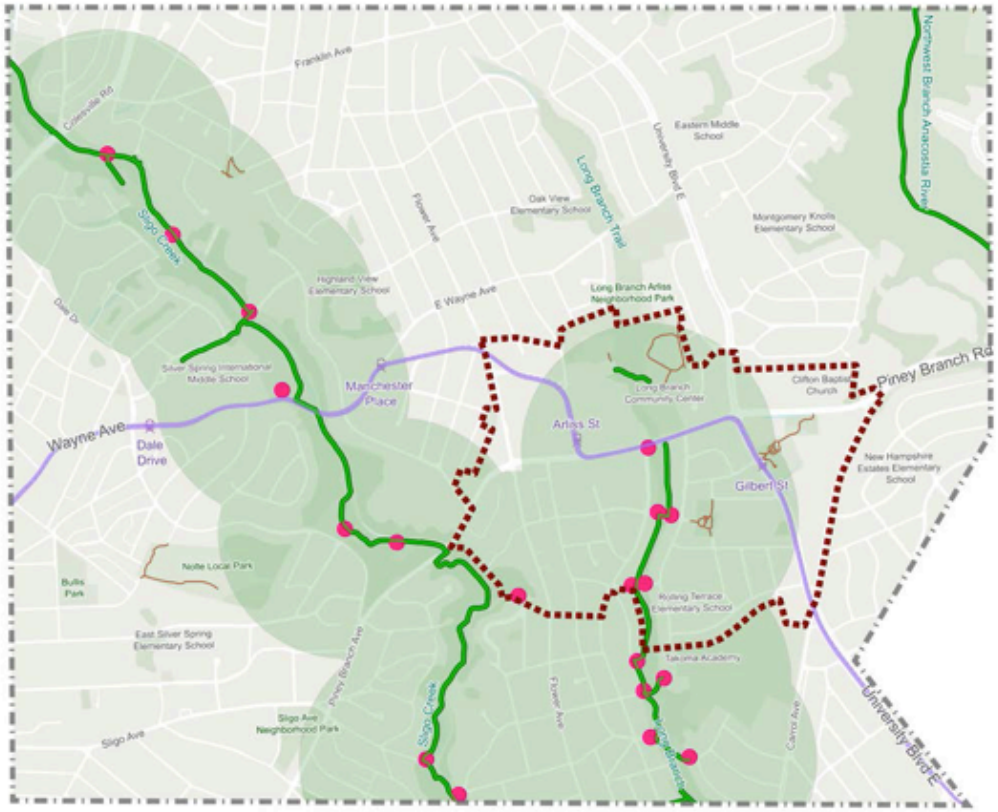


Figure 8: Purple Line in Planning Area

Trail-heads
Park Trails
Stream Valley Trails
Forest
Parks
0.25 mi buffer

Forest and Parks

In the Planning Area, 15% of land use is parks. Most of these parks are located in the stream valley (Figure 9). Almost 13% of the Planning Area is covered with forested tree canopy. A horizontal trail connection among these forested parks will increase pedestrian and bicyclist connectivity. These trail connections could be on-road or off-road shared use paths, depending upon availability of space.



Figure 9: Forests and Parks in Planning Area

Forest
Parks

3.5.4 **Opportunities and Constraints: Planning Area**

Opportunities:

In the Planning Area, there is an opportunity to create horizontal trail connections among regional trails with low traffic stress bicycle network and continuous sidewalks shaded with trees. Tr-TOD could be continued along other proposed purple line stations and trails. The Planning Area also provides an opportunity to connect parks, new station areas, schools, and community buildings by improved pedestrian-bicyclist connection. Figure 10 displays a synthesis of existing conditions and potential opportunities.

Constraints:

One of the main constraints is that streets with high vehicular speed limits, e.g., University Boulevard and Piney Branch Road, are dangerous to cross and create hostile environment for walking and biking.

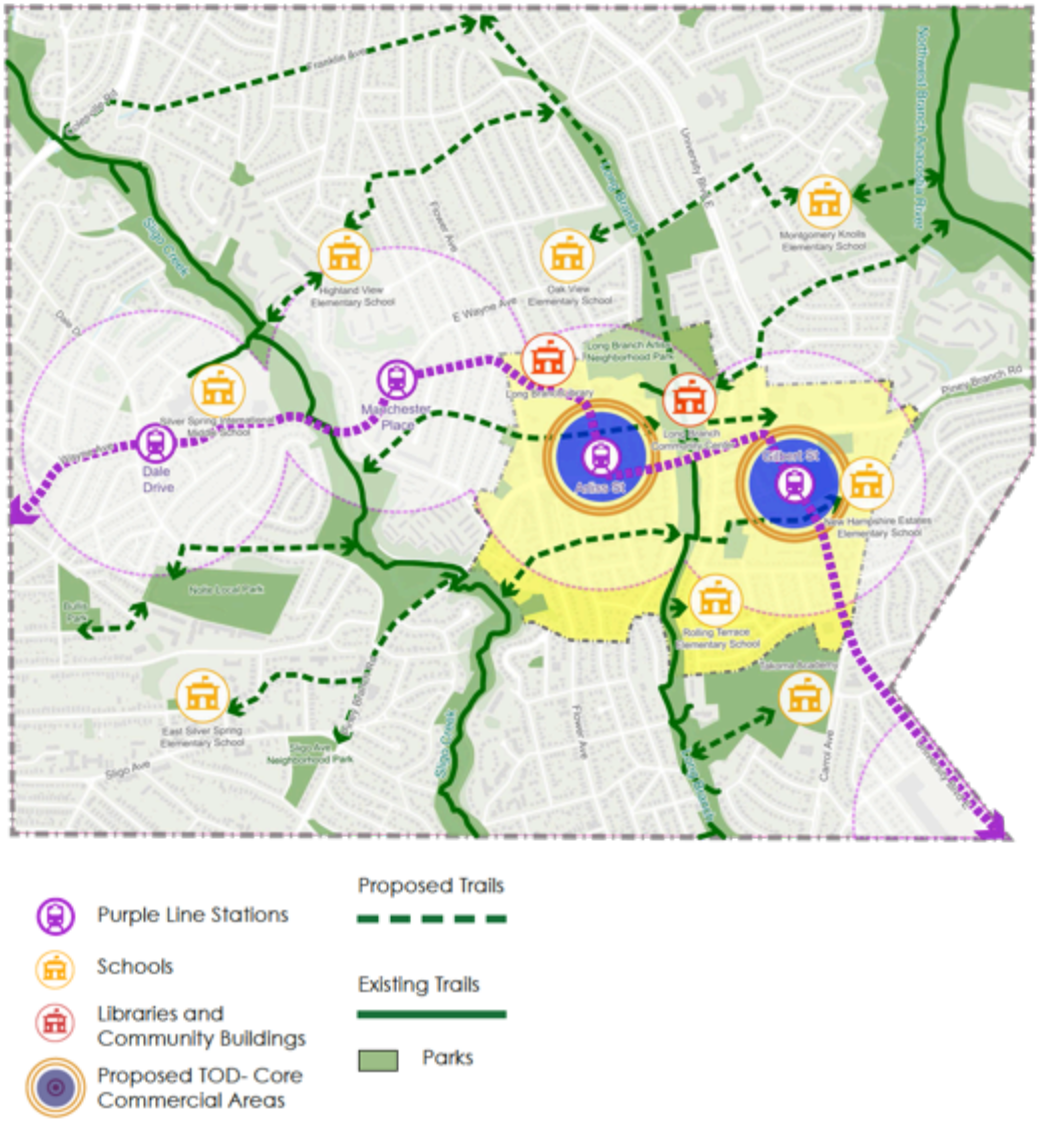


Figure 10: Opportunities and Constraints in Planning Area

3.5.5 Site Inventory and Analysis: Design Area

Land Use

Almost 60% of land use within the Design Area is residential (Figure 11). The commercial area is suburban in character with single story buildings with large parking lots fronting the street. This site provides an opportunity for building high-density mix use development.

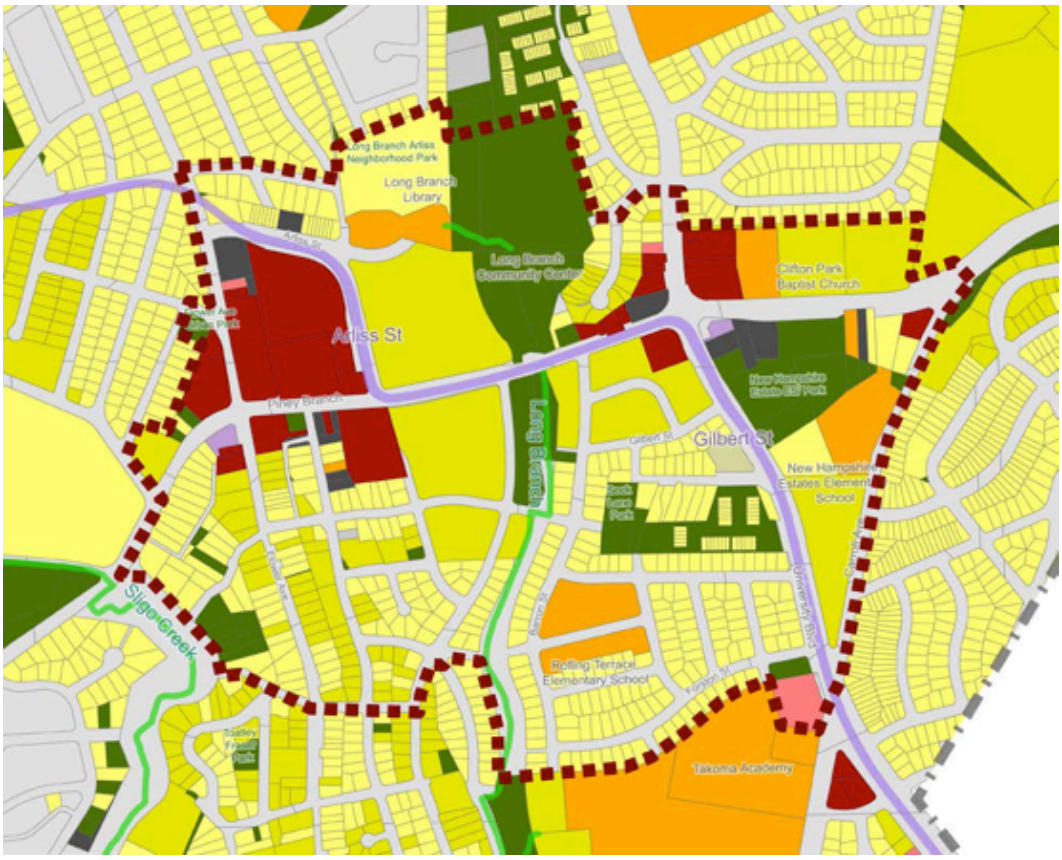


Figure 11: Existing Land Use (GIS data from Montgomery County Planning Department)

Figure Ground with Institutional and Public Buildings

Large blocks of freestanding commercial buildings as well as post-war garden style apartments front Piney Branch Road, Arliss Street, and University Boulevard are going under redevelopment. The Long Branch Sector Plan has identified the properties along these street fronts for potential redevelopment. This area has schools, a library, and a com½ity building within the walkable 1/2-mile radius (Figure12). This offers an opportunity to create safe routes to schools from proposed redevelopments.



Figure 12: Figure Ground with Institutional and Public Buildings

- Buildings
- Institutional/ Cultural
- Libraries
- Community Center
- Historic Building

Access to Trail

The Long Branch Trail is an important regional trail in the Design Area. It connects to Sligo Creek trail on its southern end, which provides a connection to a larger regional trail network (Figure 13). Very few residential properties currently have direct access to trails within the Design Area.

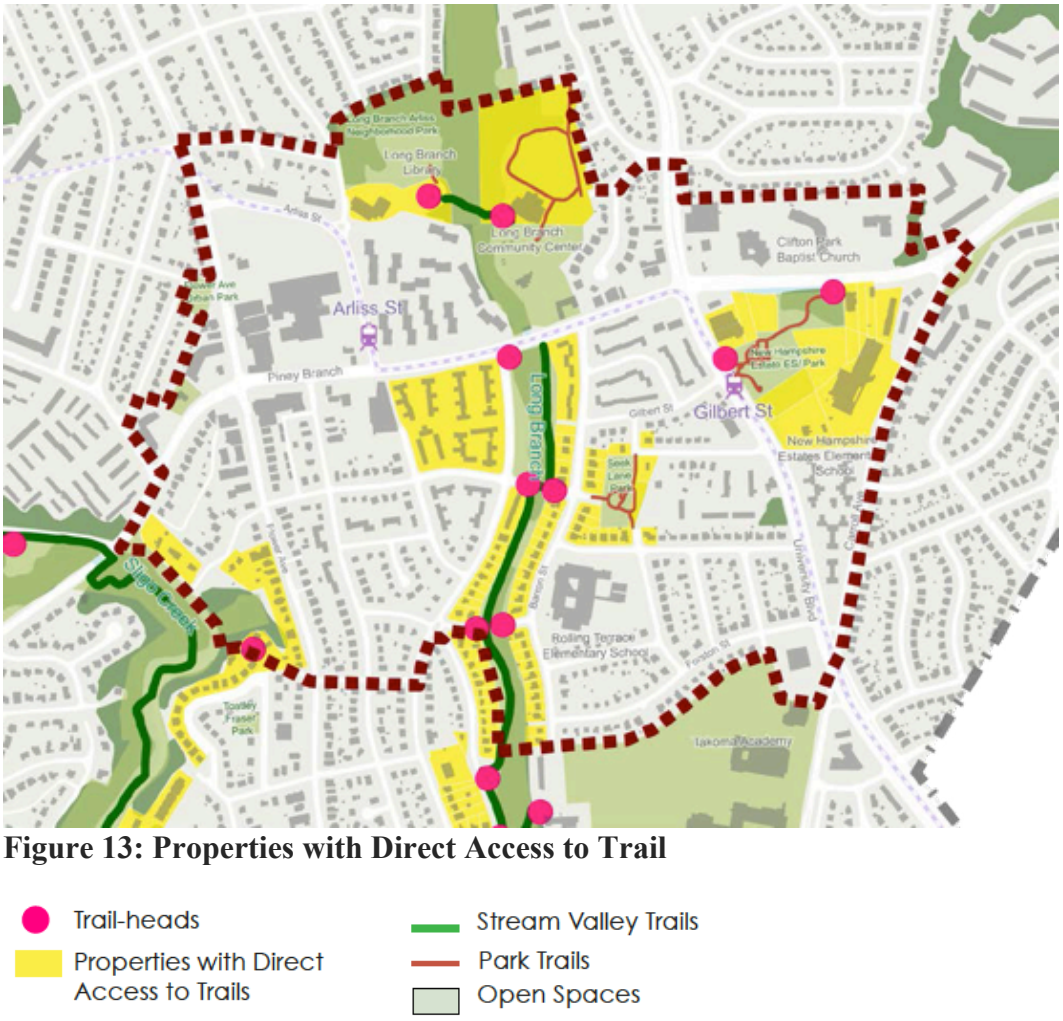


Figure 13: Properties with Direct Access to Trail

Figure 14 shows the Long Branch Trail towards south of Piney Branch Road. It provides an opportunities for hiking, exercising, and connecting to nature.



Figure 14: Existing Long Branch Trail

Level of Traffic Stress for Bicyclists

The level of traffic stress for bicyclists varies due to the interaction of vehicular traffic and bicyclists (Figure 15). The blue color streets are quiet residential streets with a low speed limit and traffic volumes, which qualifies as a low-stress environment. In contrast, the red colored streets are major roadways with a high speed limits and traffic volumes making them high-stress environment for the bicyclist. Such streets need to be redesigned with high quality separated bicycle facilities or with near-by parallel trails.



Figure 15: Bicycle Stress Map (data source from Montgomery County Planning Department)

Level of Traffic Stress Experienced by Bicyclist:

Piney Branch Road is a major arterial running through the Design Area. It is very wide with high vehicular speeds and traffic volumes. It is an example of a high traffic stress street for bicyclists. It does not have any bicycle facilities and is also not a pedestrian friendly street with very narrow sidewalks, frequently spaced wide driveways, and is fronted by large parking lots.



Figure 16: Piney Branch Road with Wide Travel Lanes



Figure 17: Piney Branch Road with High Speed Limit

Neighborhood Character

The Design Area is characterized by single-family detached housing development (Figure 18). Major roadways are fronted by suburban commercial development characterized by large parking lots and strip commercial development (Figure 19 and Figure 20). There are also many garden style apartments within the Design Area (Figure 21). Montgomery County's (M-NCPPC) Long Branch Sector Plan (Montgomery County Planning Department, 2013) recommends redevelopment of these suburban strip commercial and garden style apartment buildings into mixed-use high density walkable development. Also, there are well-established neighborhoods behind these commercial areas with many single family detached houses. Currently, these are not planned to be redeveloped in the Long Branch Sector Plan.

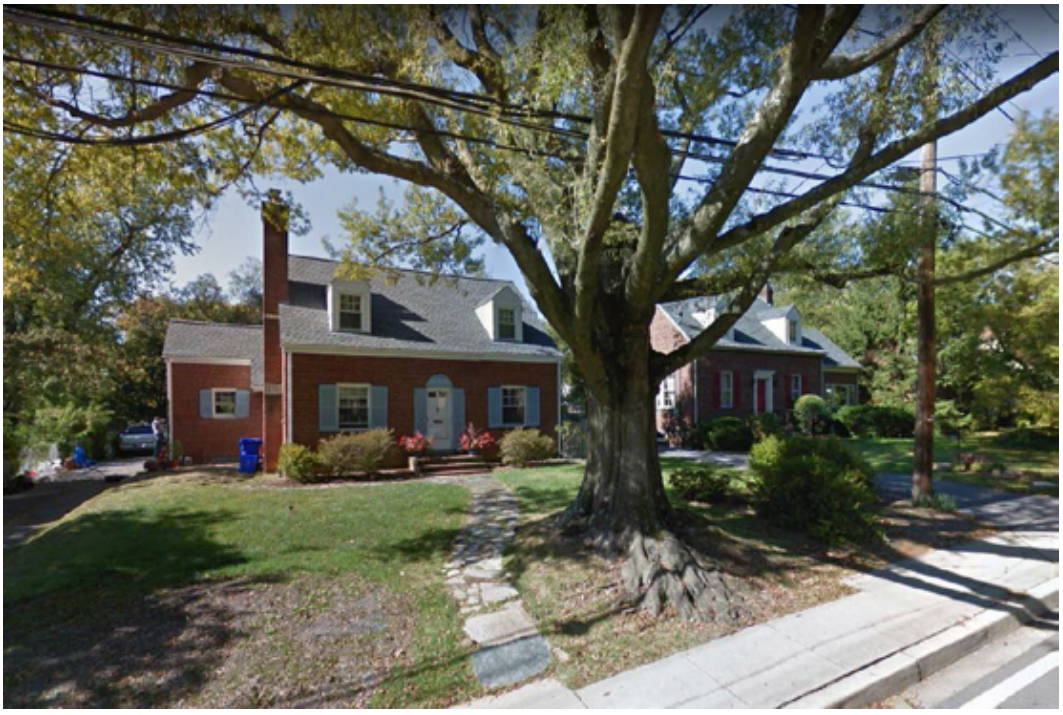


Figure 18: Existing Single Family Detached Houses



Figure 19: Strip Mall with Big Parking Lot Create Hostile Environment for Pedestrians



Figure 20 Single Story Commercial Building



Figure 21: Typical Garden Style Apartments to be redeveloped



Figure 22: Intersections of Piney Branch Road and Arliss Street Unfriendly for Bicyclist and Pedestrians

Piney Branch Road has narrow sidewalks, which impact walkability in a negative way (Figure 22). The Long Brach trail is well connected with the neighborhood on south of Piney Branch and it abruptly disconnects towards the north as seen in Figure 23.



Figure 23: Long Branch Trail Gets Disconnected by Piney Branch Road

3.5.6 **Demographics: Long Branch Sector Plan Area**

The info-graphics below shows the overall demographic makeup of the Long Branch Sector. 14% population is school going children and 12% is over the age of 65. 35% people use transit as their mode of commute and Purple Line will increase this number even more. Also, 5.5% people walk or bike to work.

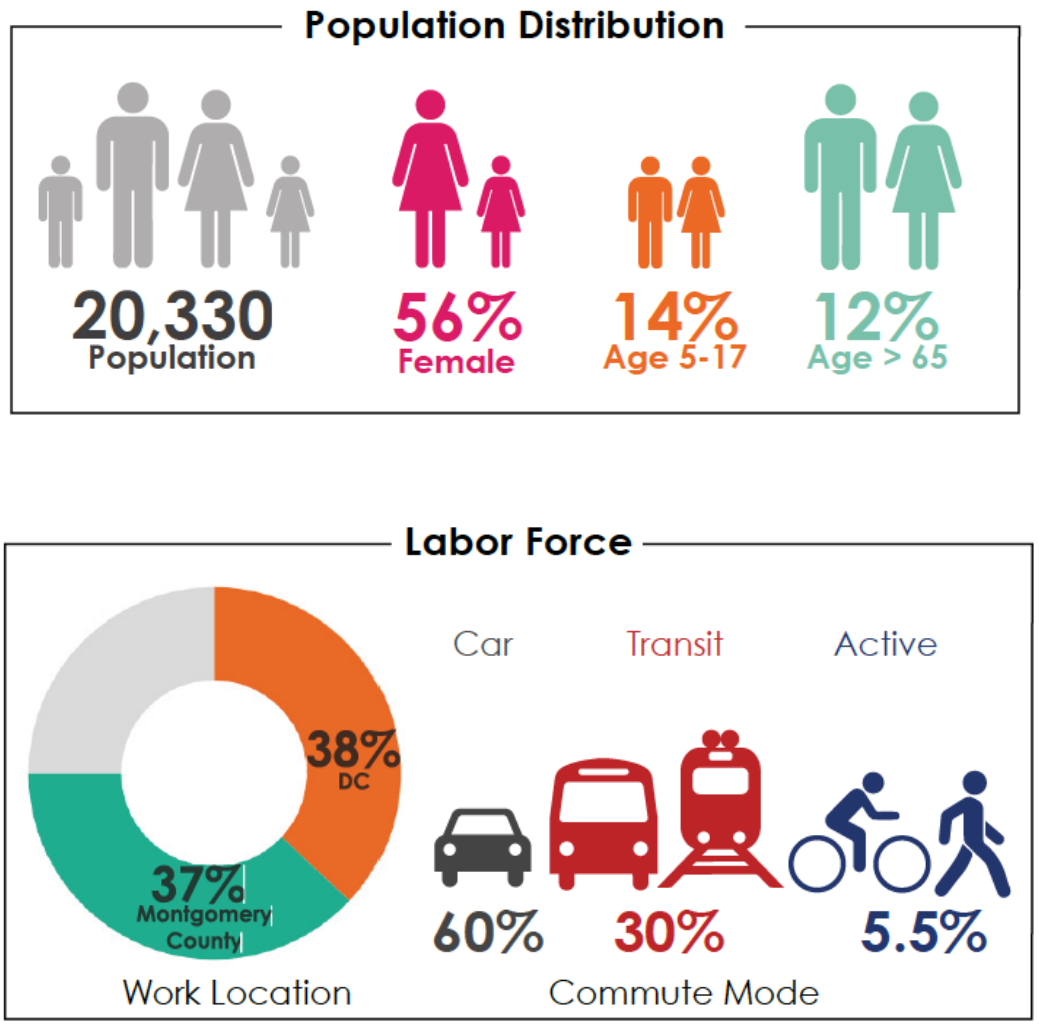


Figure 24: Long Branch Sector- Population Distribution and Commute Mode Info Graphics (The U.S. Census Bureau, 2008)

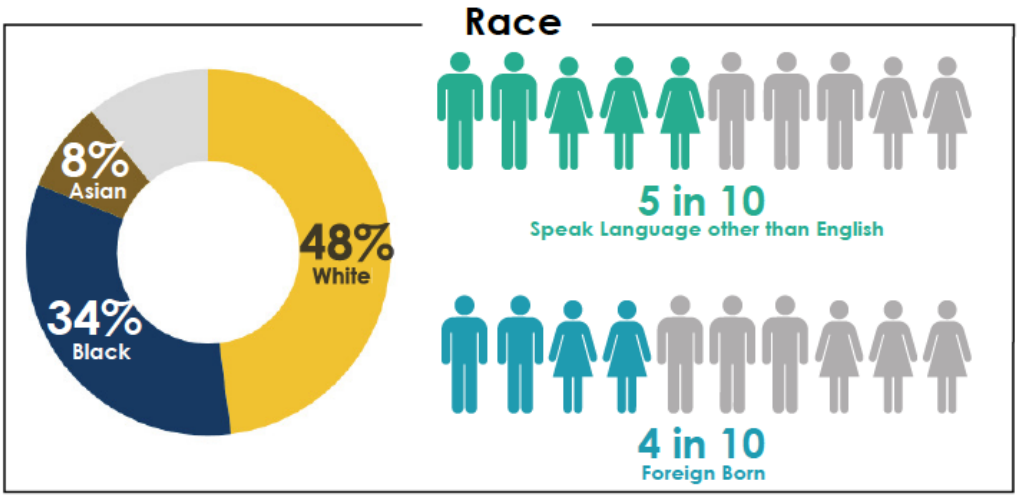


Figure 25: Long Branch Sector- Race, Language Spoken, and Foreign Born Residents Info Graphics

(The U.S. Census Bureau, 2008)

3.5.7 **Montgomery County's (MNCPPC) Long Branch Sector Plan**

Montgomery County's Planning Department, part of the M-NCPPC, developed the Long Branch Sector Plan in 2013. The plan has identified the commercial parcels for mixed-use redevelopment. Piney Branch Road is proposed as an urban boulevard. This plan proposes some street improvements for pedestrians and bicyclist (Figure 26). This thesis project builds upon the recommendations identified in the Long Branch Sector Plan.



Figure 26 Long Branch Sector: Vision Plan

(Montgomery County Planning Department, 2013)

The Sector Plan also has urban design guidelines, which show proposed building heights ranging from 50' to 120' tall buildings (Figure 27) and how to transition the new development into existing established single-family residential neighborhoods (Figure 28). The Piney Branch Road will be transformed into an urban boulevard (Figure 29). Typical urban block will have retail fronting the streets and parking garages in the back (Figure 30). Figure 31 show requirement of affordable and subsidized housing.

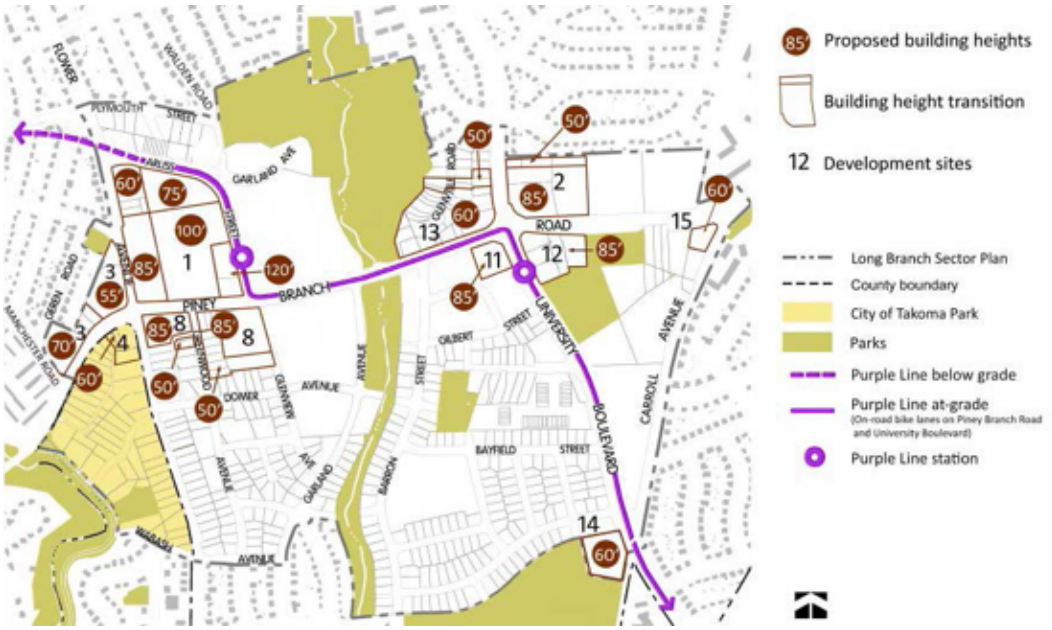


Figure 27: Long Branch Sector: Building Height Guidelines

(Montgomery County Planning Department, 2013)



Figure 28: Long Branch Sector Plan: Building Height Transition

(Montgomery County Planning Department, 2013)

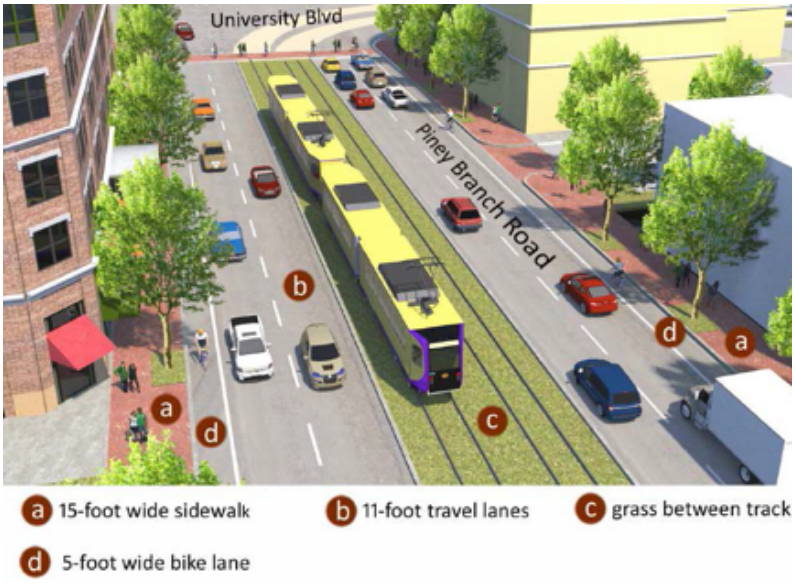


Figure 29: Proposed Piney Branch Urban Boulevard

(Montgomery County Planning Department, 2013)

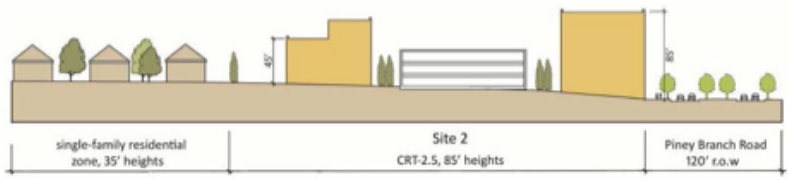
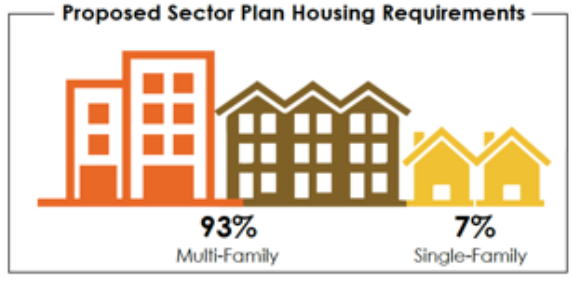


Figure 30: Long Branch Sector Plan: Street Oriented Buildings with Garage in the Back

(Montgomery County Planning Department, 2013)



Multi-Family = 4963 (93%) **Single-Family** = 369 (7%)
-Affordable = 882 (18%)
- Subsidized = 1056 (21%)
- Market Rate = 3025 (61%)

Figure 31: Long Branch Sector Plan: Housing Requirement

(Montgomery County Planning Department, 2013)

3.5.8 **Opportunities and Constraints: Design Area**

After analyzing the inventory and looking at the Long Branch Sector Plan vision, these are the opportunities and constraints for the design area:

Opportunities:

The proposed Purple Line offers a great opportunity to build high density mixed use along the transit stations. The design is based on TOD principles providing an opportunity of access to off-road shared use trails from each property in the proposed redevelopment. Other opportunities include creating a 1.5 mile long loop trail, and connecting schools, libraries, and community buildings to parks using trails. The Paseo would be activating the retail blocks by connecting Flower Avenue Urban Park to Long Branch Trail through the commercial area. Connecting cul-de-sacs to streets would provide an opportunity to create short blocks and increase connectivity.

Constraints

Long Branch Trail currently ends abruptly, which makes the crossing dangerous for pedestrians. Streets with high vehicular speeds are also dangerous to cross. Some culs-de-sac could not be joined to streets because of single-family residential land use. Existing sidewalks in Long Branch Sector Area are narrow.

Figure 32 visually represents the opportunities and aims to apply the concept of Tr-TOD to the design area. It shows the proposed redevelopment opportunities and a way to integrate new trails and parks into the neighborhood. Existing trail is extended, neighborhood trail are established and a loop trail is proposed to integrate neighborhood trials and connect to the existing and extended valley trail.



Figure 32: Design Area: Opportunities and Constraints Diagram

3.7 Design Development

This project pursued the goal of providing trail access to every property in the proposed redevelopment. The plan and design aims to make connections from existing and proposed trails to major destinations like parks, schools, libraries, and other public amenities creating improved connections using on bike facilities and improved pedestrian access (Figure 33).



Figure 33: Concept Sketch: Improving Connections to Parks, Schools and Public Amenities

The next idea was about creating a linear park parallel to Piney Branch Road called The Paseo. Paseo means a leisurely walk or stroll, especially one taken in the evening. This term is used with reference to the tradition of taking such a walk in Spain or Spanish-speaking communities. (Merriam-Webster, n.d.)

The Paseo connects the existing Flower Avenue Urban Park to the Long Branch Stream Valley Trail and continues further to connect NW Branch Anacostia River Trail (Figure 34). The Paseo will activate retail in the new commercial area near the Arliss Street Purple Line Station.



Figure 34: Concept Sketch: Creating a Linear Park to Activate Retail

The urban design framework (Figure 35) is the basis for the final design. This concept integrates the proposed open space network of trails and parks with the built environment. The addition of some new streets creates short, walkable blocks (Figure 35). The new blocks are also well integrated with existing built fabric. Piney Branch Road, Arliss Street, and University Boulevard are designed as main streets activated by retail.



Figure 35: Conceptual Urban Design Frameworks

3.7 Final Design

This section includes the master plan, proposed site sections, and perspectives with associated user narratives highlighting how different people might experience the proposed trail network.

3.7.1 Master Plan

The proposed Master Plan (Figure 36) is designed based on the new concept of Tr-TOD. Piney Branch Road, Flower Avenue, Arliss Street, and University Boulevard are treated as main streets by proposing high density mixed use buildings along these streets. Each property has direct access to a neighborhood trail, which then connects to the loop trail. The loop trail then joins the Long Branch Trail. The proposed trail and park network within the building structure provides opportunities for active living.



Figure 36: The Master Plan

3.7.2 Urban Design Framework

Large superblocks and some cul-de-sac streets define the existing street network (Figure 37). Superblocks are subdivided into small blocks and short new segments of streets are added to connect cul-de-sacs increasing connectivity and walkability (Figure 38). Existing freestanding strip commercial malls and old garden-style apartment buildings form a suburban urban form (Figure 39). The proposed design develops new street oriented buildings to develop perimeter blocks, which will help create a more walkable environment (Figure 40).



Figure 37: Existing Street Network



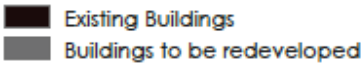
Figure 38: Proposed Street Network

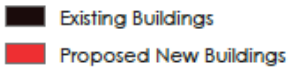


Figure 39: Existing Figure Ground



Figure 40: Proposed Figure Ground





The Purple Line will run on Arliss Street, Piney Branch Road, and University Boulevard (Figure 41). Proposed mixed-use, high-density buildings are located along the transit corridor and main streets. The density and height of the buildings gradually decreases towards existing single-family residential neighborhoods (Figure 42).

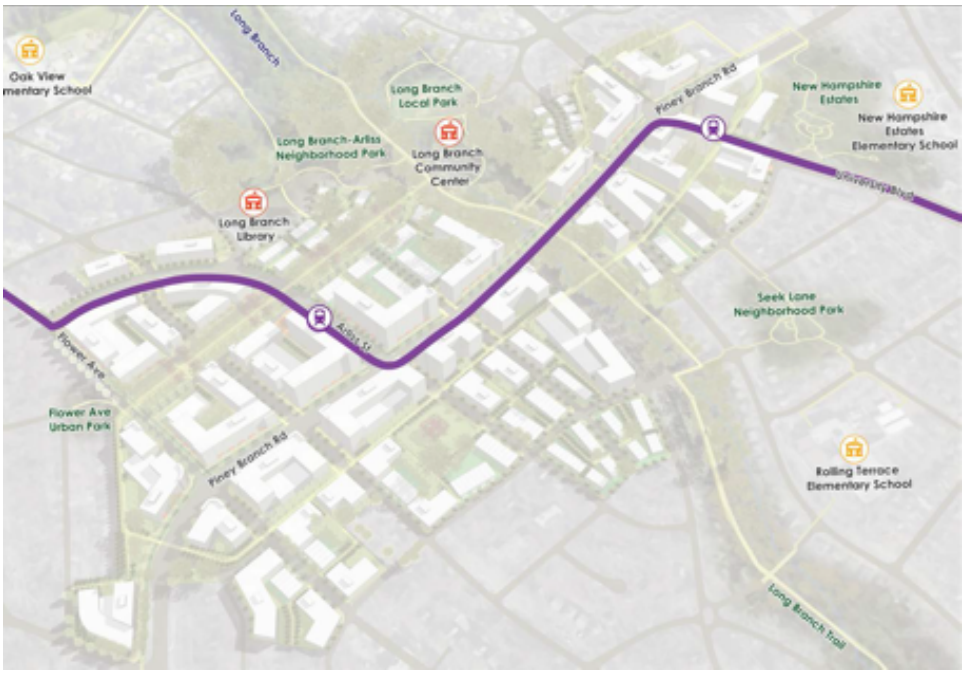


Figure 41: Purple Line in Proposed Master Plan



Figure 42: Building Uses in Proposed Master Plan

Building heights are higher on major streets like Piney Branch Road and they gradually decrease towards existing single-family neighborhoods (Figure 43). Figure 44 shows the bird's eye view of the proposed master plan.



Figure 43 Building Massing



Figure 44: Bird's Eye View of Future Long Branch Sector

The design of an integrated hierarchical network of trails is one of the central elements in this design. There are four types of trails (Figure 45):

1. Regional Forest Trail: This is an extension of existing stream valley trail, which is off-road, 15 feet wide, typically paved asphalt, and a shared use path. People use this trail mostly for hiking, bicycling, long distance commuting or for a leisurely walk in the well-forested valley trails.

2. Community Loop Trail: the Loop Trail connects the individual neighborhoods to the broader community. The Loop Trail acts as a connector between the neighborhood trails and the existing and proposed additions of the regional trail. It is an off road trail, minimum 12 feet wide, typically paved, shared use path. In the proposed design, the Loop Trail is a 1.5 miles long. The Paseo is the portion of the loop trail in the commercial area of the redevelopment

3. Neighborhood Trail- This trail type provides access to the trail network from every property. It is an off road trail, minimum 10 feet wide, typically paved, and a shared use path.

4. Sidewalk Trail- This trail acts as a link between neighborhood trails when vehicular streets separate the neighborhoods. It helps the users in crossing the streets safely. The width should be minimum 8 feet in residential areas and minimum of 10 feet in commercial areas.

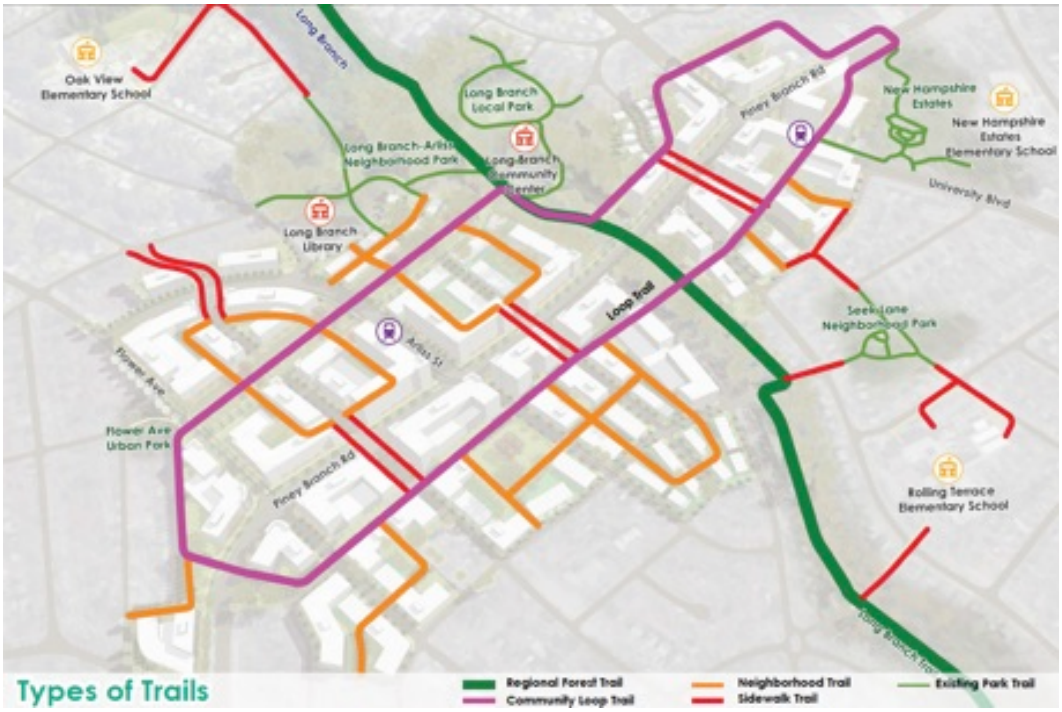


Figure 45: Types of Trails

In case of mixed-use buildings, trails will be accessible from the back sides of the buildings (Figure 46). The ground floor uses in these buildings will have decks and patios facing the trail as well as having direct access to the trail. The single family and multifamily buildings will also have access to trails from their back yards. Children will be able to go to school using these safe routes. The design of backyards with decks, patios and direct access from residential properties will help generate 'eyes on the trail' to promote safety with passive informal surveillance by neighbors.

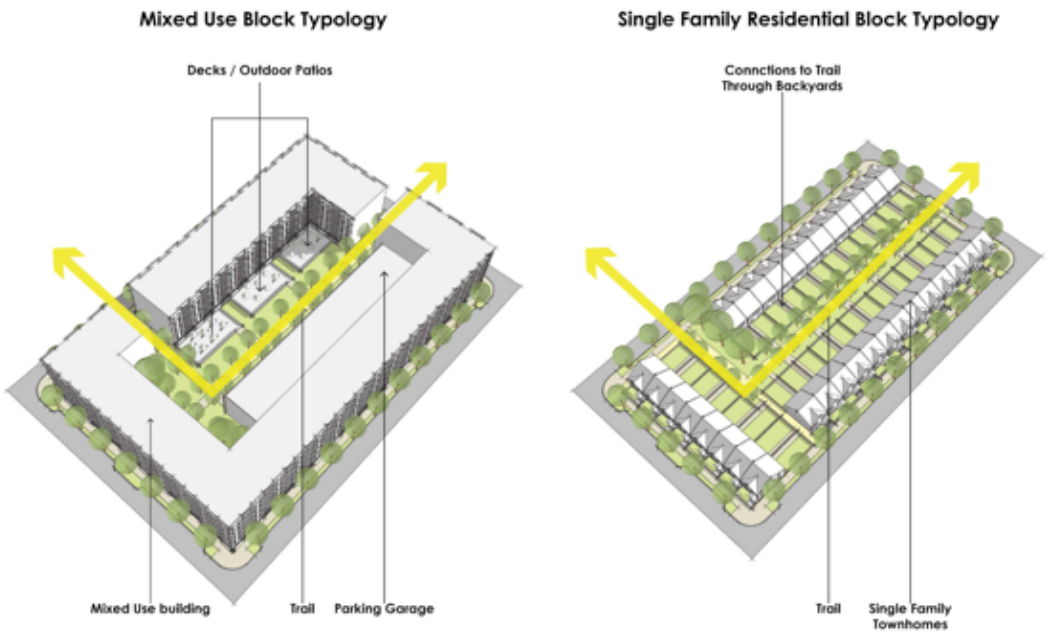


Figure 46: Trail and Block Typology Diagram

The individuals in communities designed with the concept of Tr-TOD will have opportunity to be more active. The residents will use the trail network for active transportation and recreation. Increased access to open space will encourage physical activity and improve mental well-being of the community.

In this neighborhood design, there are different types of open spaces. This includes the Paseo, transit plazas, community garden, courtyard gardens, existing parks, and the trails. The future Long Branch Sector is going to have approximately 5000 new homes. Population is projected to increase by 2.5 times. This area should have greener, active, social spaces. This neighborhood design offers 36 acres of open space consisting of parks and trails.

One of the main design features is the Paseo. It is a one-quarter mile long linear park, which will help activate the retail in the surrounding buildings and encourage the residents to be engaged with retail activities. In the community garden, people can

rent a lot for growing healthy food, gardening, or creating art. The courtyard gardens will be semipublic so that trails will be accessible for everyone. The proposed landscape will increase the open spaces and improve quality of life for Long Branch residents.

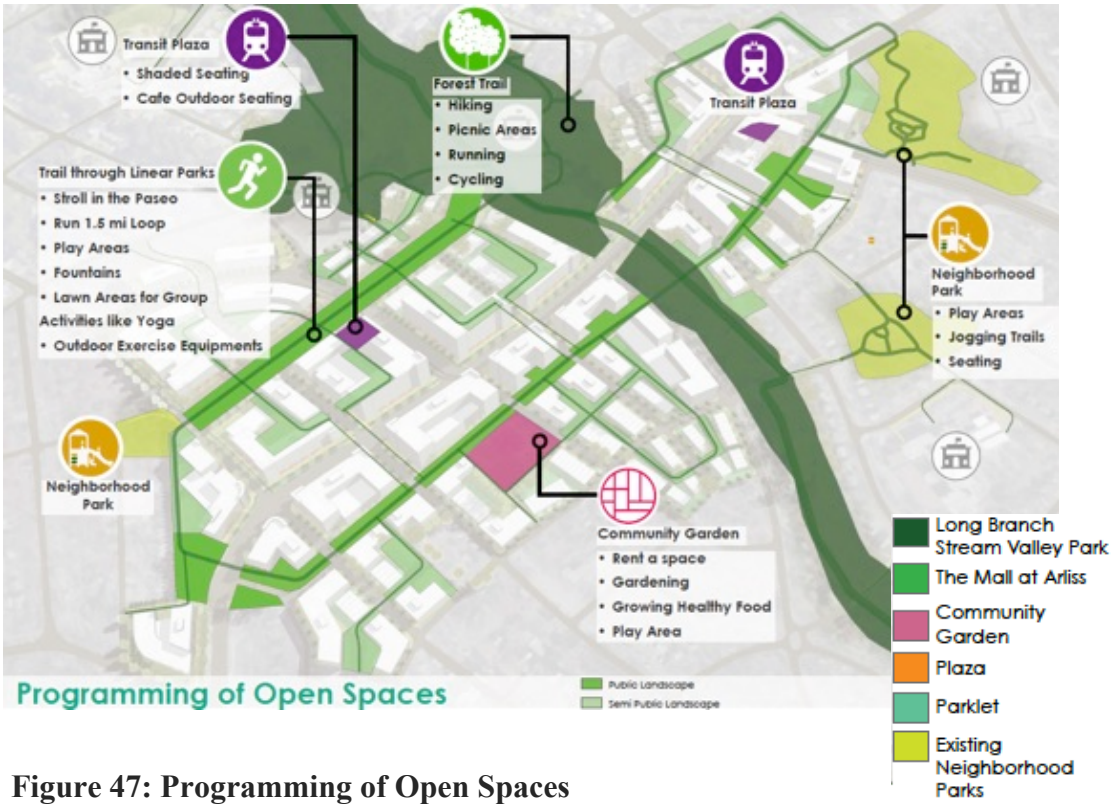


Figure 47: Programming of Open Spaces

3.7.3 Proposed Site Sections

Section Elevation AA' shows the relationship between proposed Purple Line on Arliss Street and the 120 feet tall buildings (Figure 48). This street has Purple Line tracks and a 2-way bicycle track along with vehicular lanes. Mixed-use buildings on both sides of Arliss Street have twelve stories. The ground floor will be retail, second will be offices, and upper floors will be residential. The neighborhood trail passes through the courtyard garden. Backsides of the buildings have decks and balconies facing towards the trail.

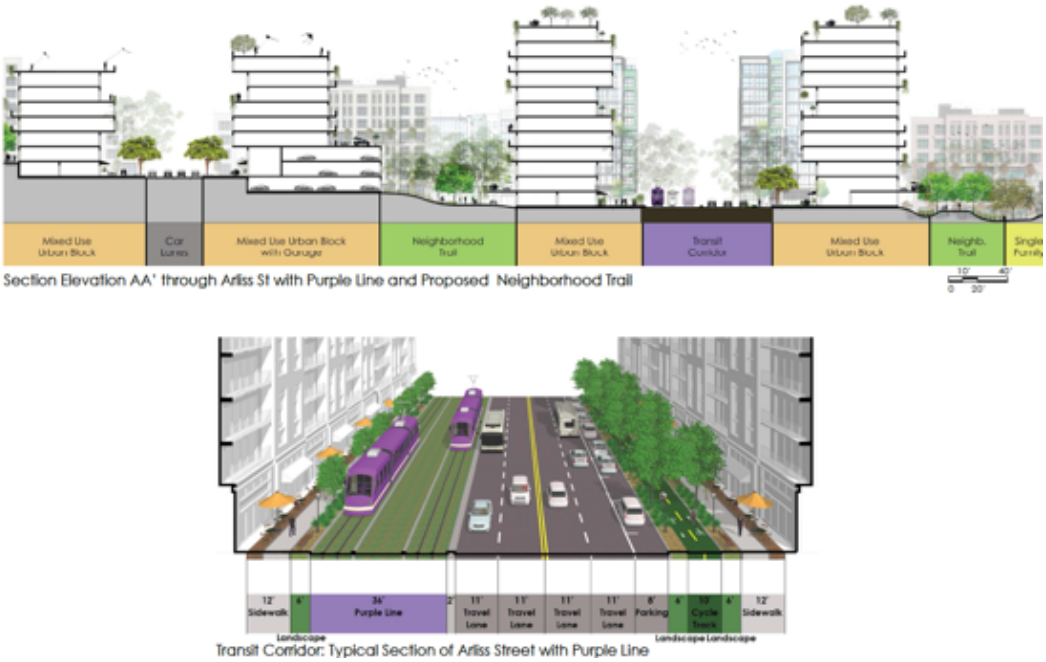


Figure 48 Section Elevation AA' (on top) and Typical Section of Arliss Street with Proposed Purple Line (on bottom)

Section Elevation BB' shows the neighborhood trail connecting to the Paseo (Figure 49). It also shows that the buildings are mid-rise surrounding the Paseo with retail on street level. The Paseo is 100' wide with 16' loop trail and multi programmed spaces on both sides. This loop trail connects to the regional trail.

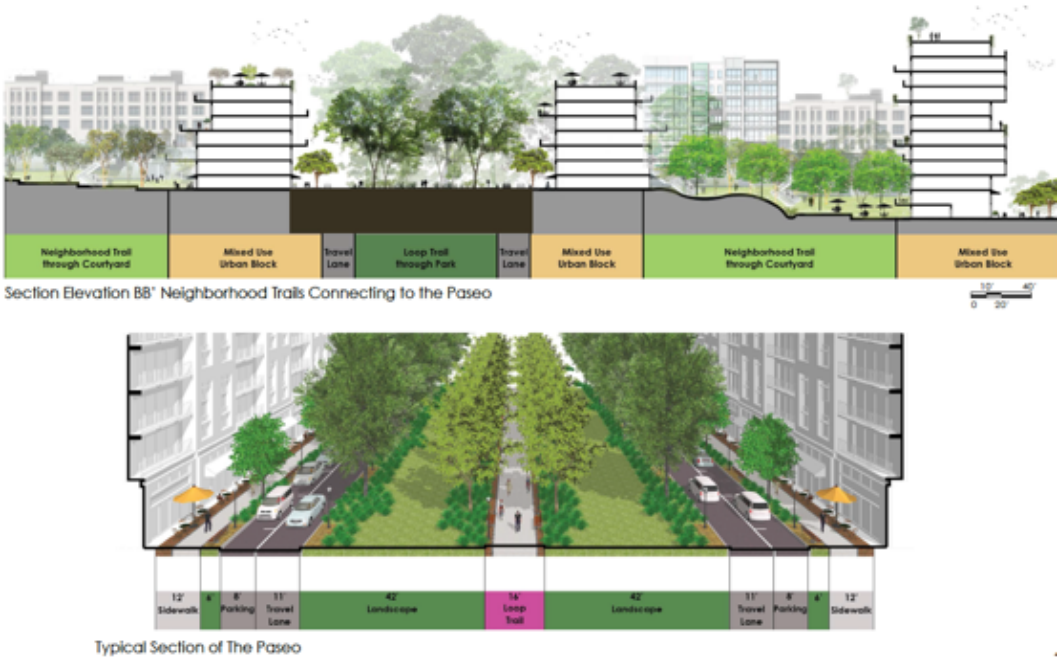


Figure 49: Section Elevation BB' (on top) and The Paseo with Mid Rise Mixed Use Buildings (on bottom)

Figure 50 shows proposed Purple Line on Piney Branch Road and a typical residential street with the proposed design. Piney Branch Road has no purple line stops. There is on-street parking on both sides and two-way cycle track on the north side buffered with landscape. The proposed redesigned street offers a low traffic stress environment for the bicyclists.

Other typical residential streets will include traffic calming measures such as curb extensions, raised crossings for trails and will be treated as bicycle boulevards with sharrow markings, to indicate that bicyclists will share streets with other vehicles.

These will be relatively quiet streets with vehicular speeds less than 25 miles per hour. These streets will have on-street parking and sidewalks lined with trees.

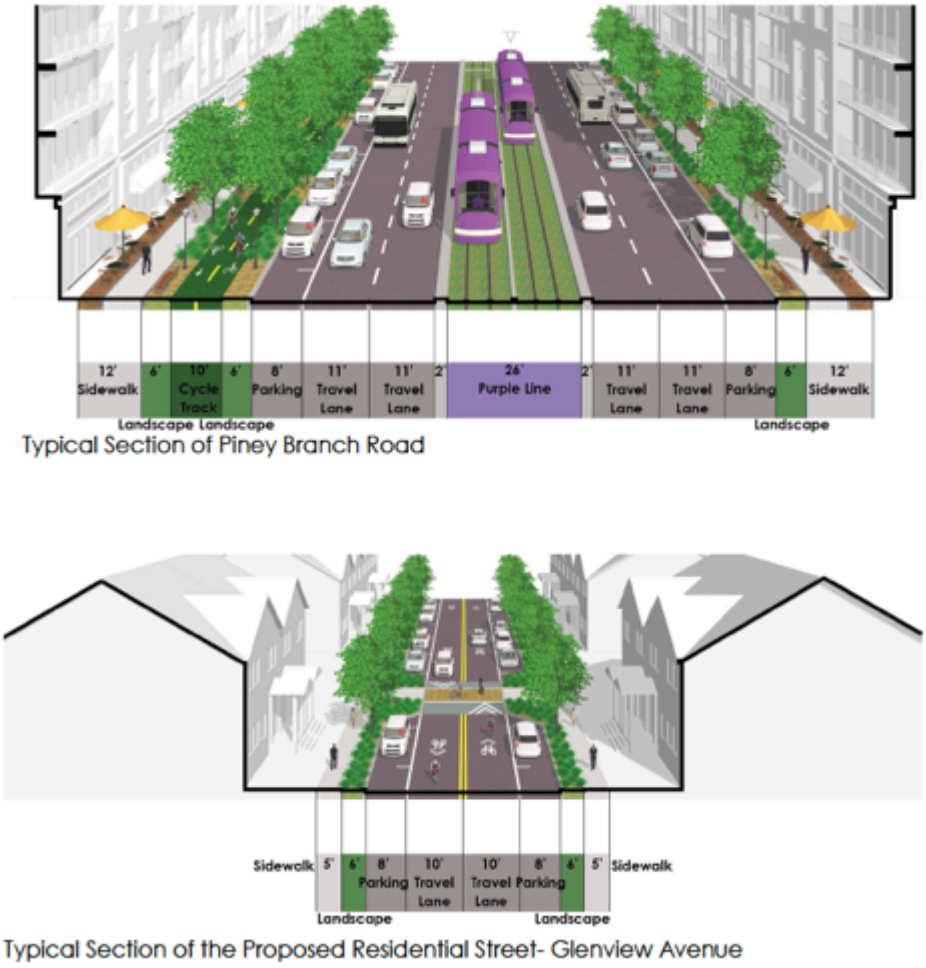


Figure 50: Typical Section of Piney Branch Road (on top) and Residential Street with Sharrows (on bottom)

The Community Loop trail transitions through the Paseo to the Long Branch Trail (Figure 51). Residents will have the opportunity to feel calm and relaxed while experiencing the forest. People will be able to listen to the sound of the water and birds chirping while walking along the stream. This opportunity to connect with natural features will improve community well-being.

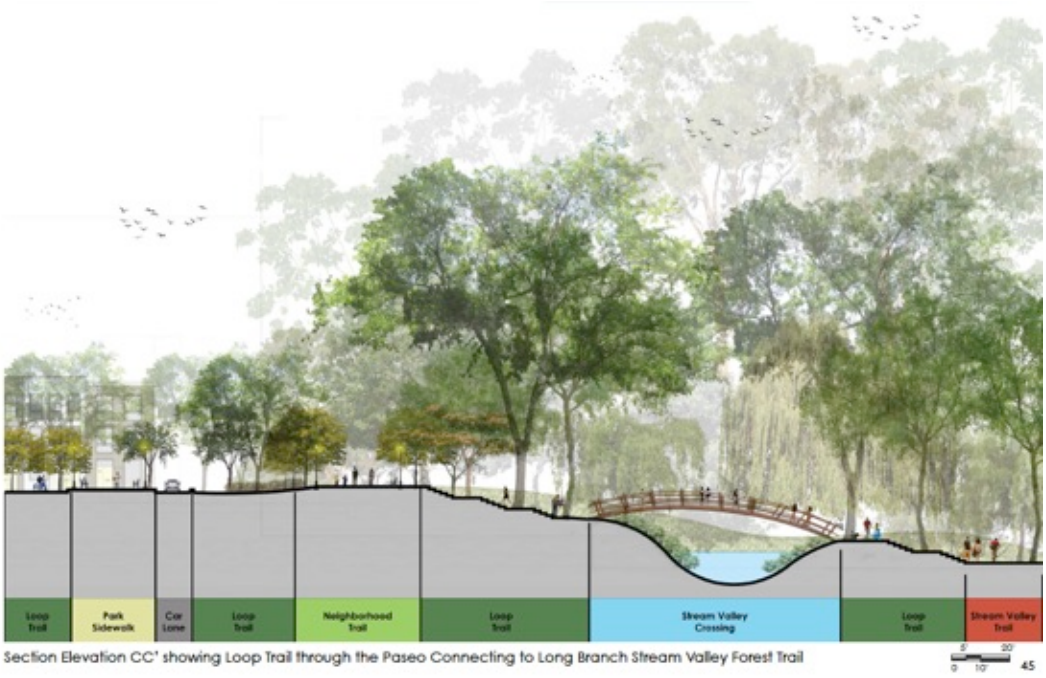


Figure 51: Section showing transition from urban Paseo to Stream Valley Park

3.7.4 User Stories

This section shows four narratives. The idea behind telling the user stories is to look at the design from the lens of a user's eyes. These following stories and the perspectives will walk us through the site and show how the experiences are designed using a gradient of the green landscape. The green gradient starts with the least naturalistic setting or most urban in the first story to the most naturalistic setting in the last.

Figure 52 shows four users and location of the perspective, which relates to that story. For example, S1 stands for story one and on the map, the pointer shows where the perspective is located.

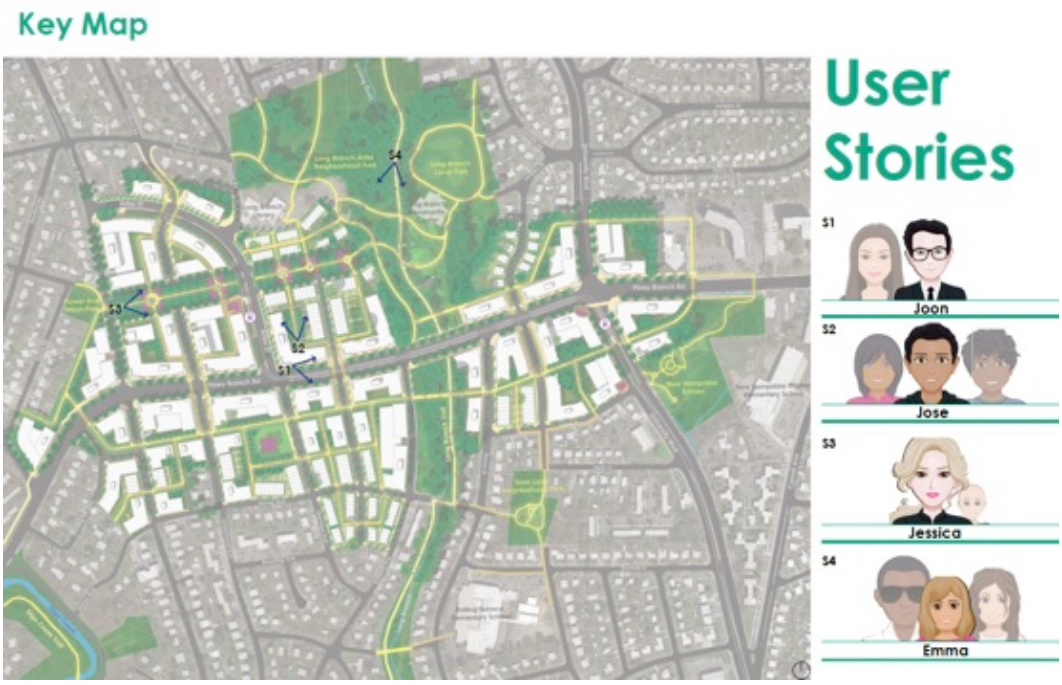


Figure 52: Key Map for User Stories

Joon's story shows how he uses the proposed Long Branch Neighborhood in his routine (Figure 53). Joon is a young professional living in Downtown Silver Spring and working in Long Branch. Joon uses Purple Line and gets off at Arliss St Station for work. Joon's office is located on Piney Branch Road. He loves walking through the Paseo in the morning when he goes from Arliss Station to his office. Joon often gets lunch with his colleagues at a restaurant on Piney Branch Road. In the perspective, the proposed Piney Branch road shows a dense, walkable, mixed use neighborhood (Figure 54). It has retail on street level, wide sidewalks with trees and street furniture.

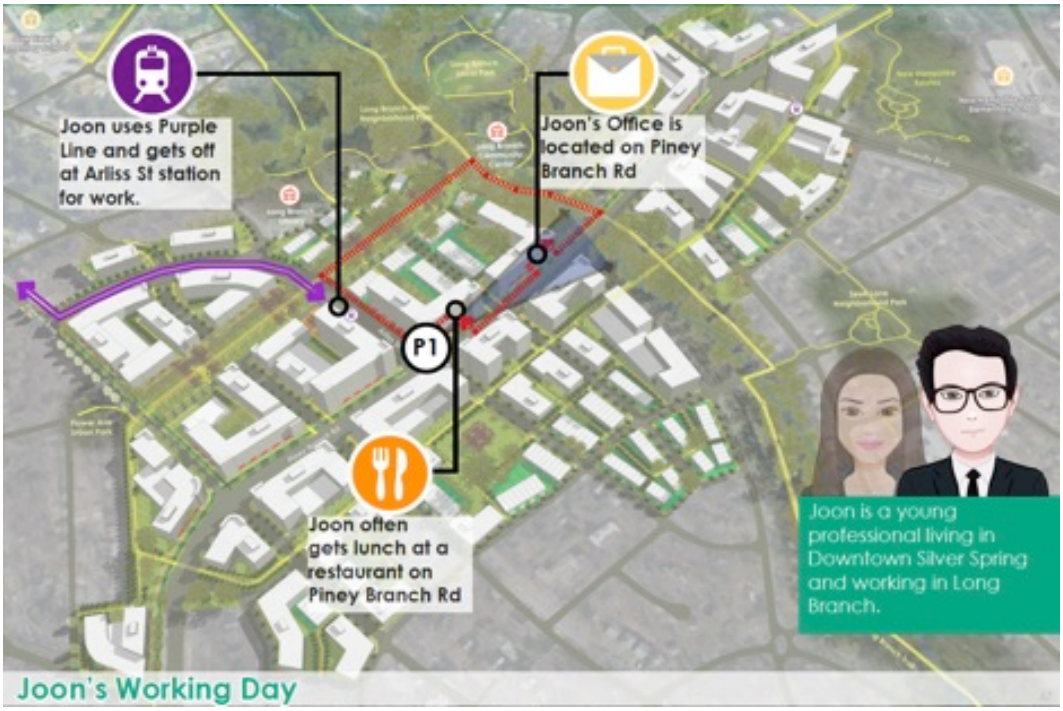


Figure 53 Joon's Walk



Figure 54 Joon Walking on Proposed Piney Branch Road

This story shows Jose's bicycle ride to the Long Branch Library and Seek Lane Park (Figure 55). Jose is ten years old. He loves reading and playing in the neighborhood park with his friends. On Sunday afternoons, Jose goes to the Long Branch Library (Figure 56). After spending an afternoon with books, he plays with friends in Seek Lane Neighborhood Park. He returns home after his visit to the park. Jose's parents feel safe to send him outdoors on his own because the proposed trail network is safe for children to walk or bike. These trails have 'eyes on the trail' making those safe for everyone. Children like Jose will use the neighborhood trail to go to schools, meet friends, or go to parks.

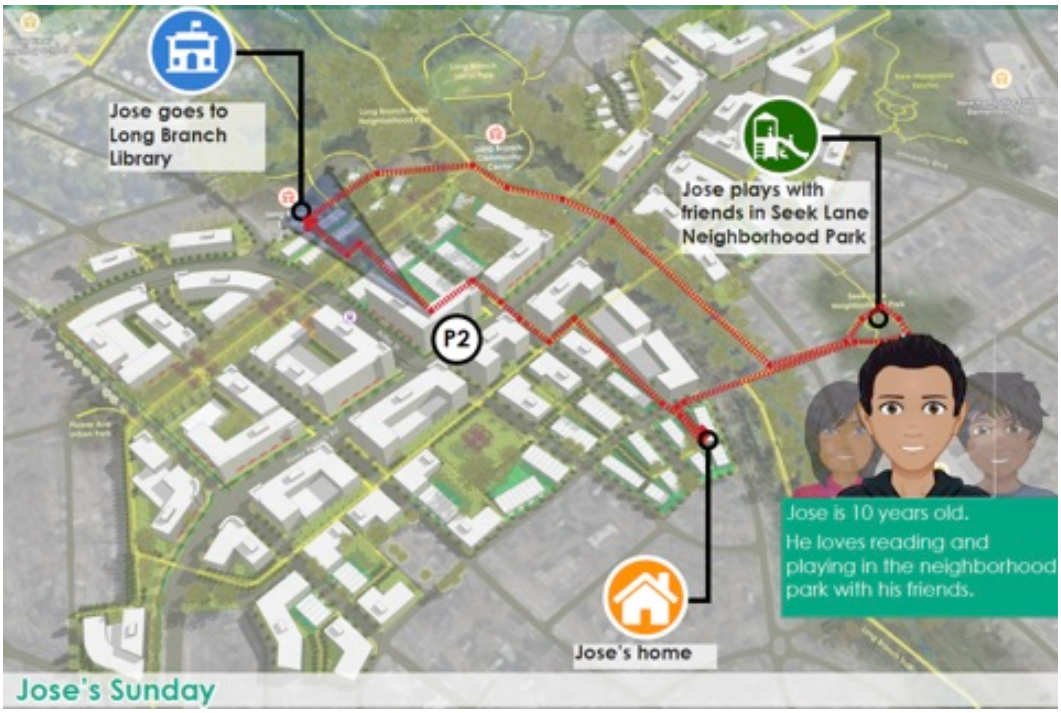


Figure 55: Jose's Bike Ride



Figure 56: Jose Going to the Library Using a Safe Neighborhood Trail

Jessica's story shows the way she uses the Community Loop Trail (Figure 57). Jessica is a single mom. She likes to go for a run to be fit. She along with her baby in a stroller starts running from the Paseo. Jessica runs 1.5 mi on the Community Loop Trail every day. The Loop Trail joins communities in Long Branch Sector to each other. The Paseo is programmed for different uses like group yoga, outdoor exercise, and play areas for children, splash parks, and fountains. It encourages residents to participate in social activities connecting with neighbors.



Figure 57: Jessica's Running Loop



Figure 58: The Paseo Providing Spaces to be Active

Emma's story shows that the forest trail is the greenest trail. Little Emma loves going on nature walks with her sister and dad (Figure 59). Butterflies and birds fascinate her. Emma in her stroller goes to the Long Branch Valley Trail to see butterflies (Figure 60). This forest trail connects the community with nature. People hiking on this trail will have opportunities to feel calm and relaxed. This experience will be very different than other trails as this is the most naturalistic setting. One will hear sounds of water and birds chirping while walking or biking under the forest canopy. Children will have opportunities to develop curiosity and bonding towards nature by using forest trail. Hikers can go on long walks for exercise or for pleasure.

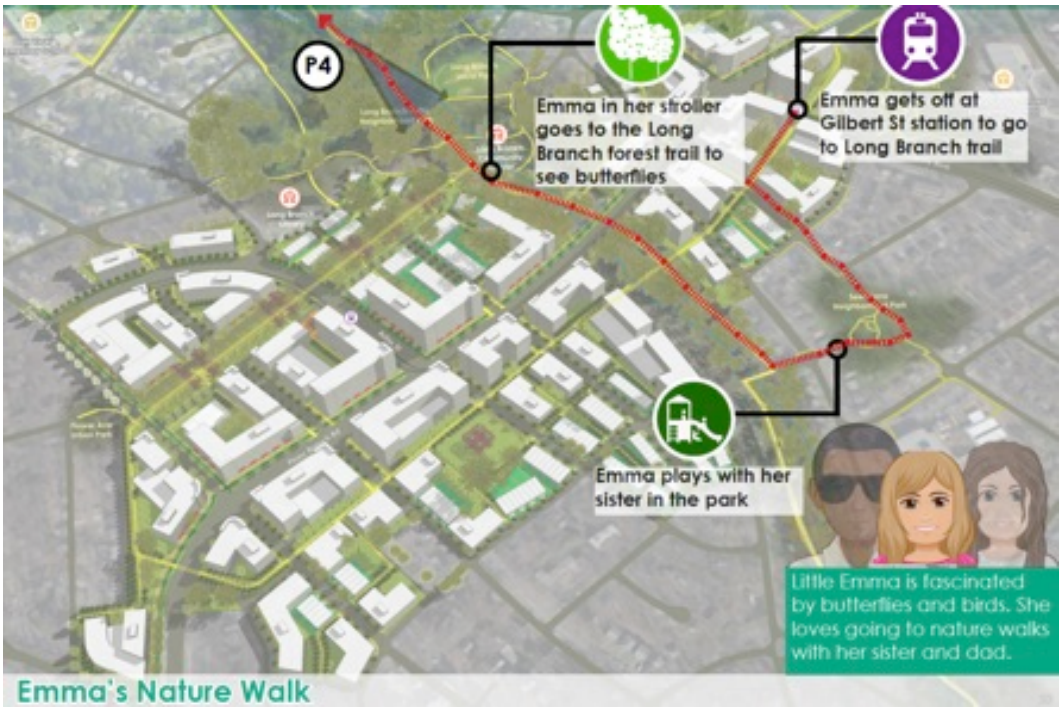


Figure 59: Emma's Nature Walk



Figure 60: Long Branch Forest Trail

3.7 Planning Area Recommendations

Figure 61 shows how the proposed Long Branch Sector fits into the larger Planning Area context. The proposed site is designed using the concept of Tr-TOD. Such developments could be continued along other transit stations where regional trails are available. If Tr-TODs are continued along the Purple Line corridor, it will increase pedestrian bicyclist connectivity and multiply opportunities for health benefits.

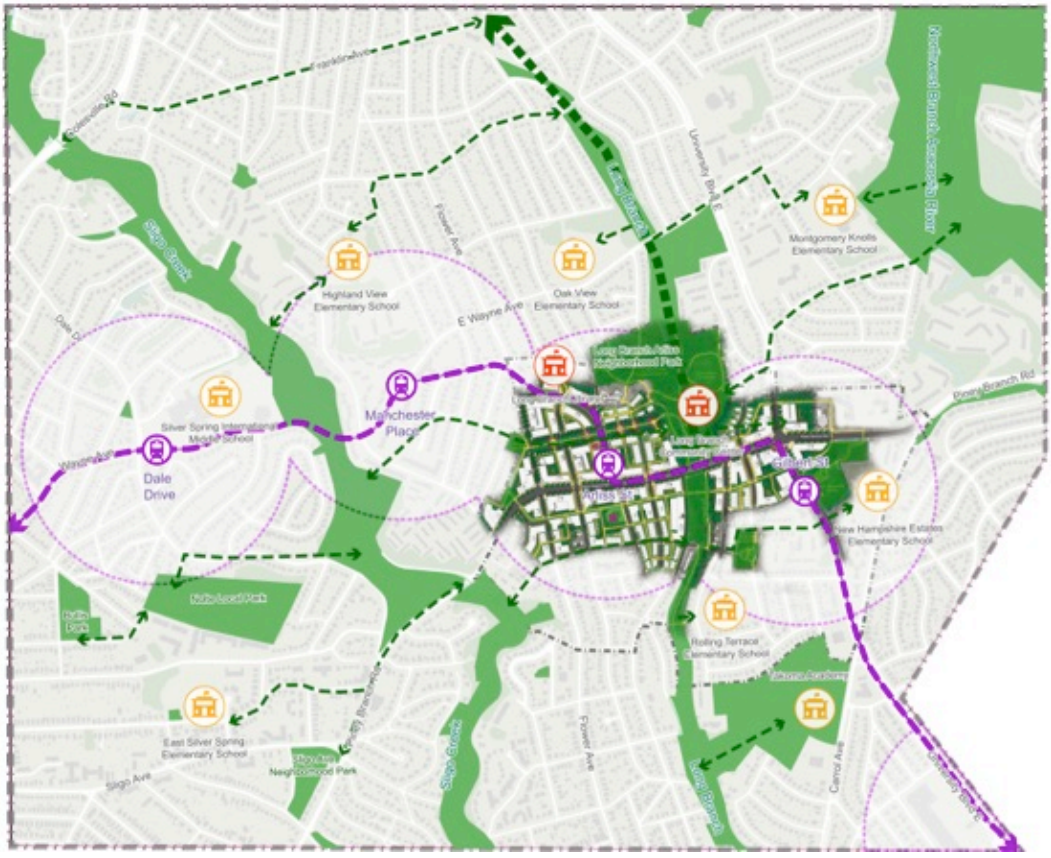


Figure 61: Planning Area Connections to Schools and Public Amenities

Chapter 4: Performance Metrics and Conclusion

4.1 Performance Metrics

The performance metrics documents how the proposed design compares with the Long Branch Sector Plan and existing conditions on all major goals and objectives. The proposed design adds approximately three miles of new trails and provides access to trails from all the proposed buildings. It connects schools, parks, library, and community center in the Long Branch Sector. Trail density increases from 1.05 trails per square mile to 9.07 trails per square mile.

Population will increase by 2.5 times more than existing population. The proposed master plan accommodates 5,361 dwelling units and 1,133,434 square feet of commercial area. The design adds 1.2 miles of new streets and increases intersection density from 97-intersectionsper square miles to 145 intersections per square mile. The proposed Tr-TOD adds 36 acres of new open spaces consisting of trails, parks, gardens, semipublic courtyards, and streetscapes. After adding that to existing 36.5 acres of parks and forests, the total open space equals 72.5 acres. Therefore, open space per person equivalents 215 square feet per person.

Figure 62 summarizes the performance of proposed designed and compares it with existing conditions and Long Branch Sector Plan.

	Existing	Sector Plan	My Design
A. Trail Oriented Development			
1. Miles of Road Trails	0.4 mi	0.7 mi	**3.45 mi**
2. Number of Properties with Direct Access to Trail	90	N/A	**5451**
3. Number of Destinations Directly Connected by Trails	4	4	**8**
4. Trail Density (Trail Length Mi/ Sq. Mi.)	1.05	1.84	**9.07**
B. Transit Oriented Development			
1. Population	5,222	12,796	**12,866**
2. Proposed No. of Dwelling Units	2,176 DU	5,332 DU	**5,361 DU**
(Multifamily DU)	(1,804 DU)	(4,963 DU)	(5,144 DU)
(Single Family DU)	(372 DU)	(372 DU)	(217 DU)
3. Proposed Commercial Area (sq.ft.)	336,823 sq.ft.	909,403 sq.ft.	**1,133,434 sq.ft.**
(Retail)		(N/A)	(566,717 sq. ft.)
(Offices)		(N/A)	(566,717 sq. ft.)
4. Miles of New Streets		0.43 mi	**1.21 mi**
5. Intersection Density (Int./Sq. Mi.)	97 int./ sq. mi	123 int./sq.mi.	**145 int./ sq. mi.**
C. Open Spaces			
1. Proposed New Landscape (acres)	36.5 ac	38.0 ac	**72.5 ac**
(Trails, Forest, Parks, Gardens, Semi Public Courtyards, Streetscape)			
2. Addition of New Landscape (acres)		1.50 ac	36.0 ac
3. Open Space sq.ft./ per Person	304 sq. ft.	130 sq.ft.	**215 sq.ft.**

Table 2: Performance Metrics

4.2 Conclusion

Car dependent suburban neighborhoods can be transformed to be active communities through Tr-TOD. The application of the Tr-TOD planning and design concept provides health benefits of active living and opportunities for an increase in walking, bicycling, and playing. People living active lifestyles have reduced risk of obesity and other related diseases. Trail and Transit Oriented communities connect the residents with nature, which helps in improving mental well-being. A greater opportunity for active living improves physical health of the community.

Long Branch would be a model neighborhood, designed with the concept of Tr-TOD. The trails and transit will promote active living and encourage physical activity in everyday life. Trails will increase pedestrian and bicycle connectivity by connecting public amenities, major destinations, new development, and existing neighborhoods. The new development around Purple Line transit stations will accommodate high-density, mix land uses, and create a walkable neighborhood. The community will be connected to nature with more green open spaces like new parks, gardens, trails, and plazas. Increased access to existing open spaces such as forests, parks, and trails will also bring community close to nature. The proposed plan and design has added trails, increased connectivity and created a green neighborhood with an open space system providing opportunities to be active. Trail and Transit Oriented Development is an effective way to integrate active living while retrofitting existing communities.

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