



THE US 70 / SWANNANOA RIVER GREENWAY

FEASIBILITY STUDY

For:
Buncombe County Greenways
and Trails Commission

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EXECUTIVE SUMMARY

The Buncombe County Parks, Greenways and Recreation Department contracted Equinox Environmental Consultation and Design, Inc. and McGill Associates to conduct a greenway feasibility study for the Swannanoa River/US 70 corridor. Funding for this multi-jurisdictional project is from the French Broad River Metropolitan Planning Organization (MPO) for the study along the Swannanoa River/US 70 corridor. The study area begins/ends in the Ridgecrest community east of Black Mountain and continues west through Black Mountain, Swannanoa, East Asheville and ends/starts to the east of where the Wilma Dykeman Riverway Plan begins at the John B. Lewis soccer fields on Azalea Road in Asheville (See Appendix A: Context Map). The trail generally runs along the Swannanoa River and US Highway 70 and is organized into the following community sectors or focus areas:

1. Ridgecrest and Black Mountain
2. Swannanoa
3. Warren Wilson College
4. Oteen/East Asheville
5. Azalea Road Connection

The reason why the Swannanoa River/US 70 corridor became the first study area for a greenway feasibility study is because many individual greenway projects are taking place within the study area. The Towns of Black Mountain, Montreat, and Old Fort and the counties of Buncombe and McDowell are jointly participating in a regional trail planning process; Buncombe County and Black Mountain participated in the MPO's Corridor Study to look at future land use and roadway needs along US 70; the Town of Black Mountain and the Swannanoa Coalition requested consideration for sections of this trail in their request to the North Carolina Department of Transportation (NCDOT) under the stimulus package call for projects. In addition, the study area ends on the western end by tying into the Wilma Dykeman RiverWay Plan and Point Lookout Trail on the eastern end.

This feasibility study is the first step in the preliminary planning of the greenway corridor. This step has intentionally been taken before private property owner outreach and public awareness campaigns. The purpose of this study is to gather information about the physical terrain and the ordinances and other restrictions that would create insurmountable obstacles to greenway construction in the corridor. If this study shows that a greenway is physically possible, then the next step will be to investigate the land acquisition possibilities within the proposed trail alignments.

The purpose of the feasibility study is to investigate the possible locations for possible alternative greenway trail alignment locations. The goal of the study is to determine the feasibility for having over 18 miles of greenways and trails for bicyclists and pedestrians to utilize for non motorized transportation and enjoyment within the Swannanoa River/US 70 Corridor.

The goals of the US 70/Swannanoa River Greenway Feasibility Study are to provide a conceptual plan, or, "Map of Possibilities" that describes the entire study area and the goal of a greenway/multi-use trail in the Swannanoa/US 70 Corridor; create trail alignment trails within each of the five sectors of the study area; work with the NCDOT, Norfolk Southern Railroad and the Metropolitan Sewerage District (MSD) to determine their rights-of-way boundaries; identify opportunities and constraints within each sector and possible resolutions for each; and to provide cost estimates for each sector.

General Opportunities & Challenges

Opportunities

The Swannanoa River is a valuable environmental resource to the citizens of the County. A summary of opportunities for trail development within the Swannanoa River/US 70 corridor include:

Existing Utility Easements & Rights-of-Ways

There are significant sections within the corridor which are already encumbered by a sewer easement or NCDOT ROW. Both NCDOT and MSD have expressed support for the project.

Community Connectivity & Access

The US 70/Swannanoa River Greenway has the potential to connect to population centers, public schools, colleges, surrounding neighborhoods, several parks, other greenway trails, business, and shopping. This would provide options for future users to safely and easily access the greenway offering a non-motorized transportation alternative.

Economic Growth

A complete greenway trails system that extends over 18 miles and connects to the Wilma Dykeman RiverWay Plan would provide significant economic benefits to the county and surrounding communities as it would enhance tourism and increase revenue from tourism and recreation. This corridor would also attract economic development, providing new business opportunities.

Environmental

There are opportunities to combine the efforts of the Flood Risk Management Study in which flood benefits can be provided in conjunction with the greenway system. As well by addressing water quality issues including protection and enhancements such as restoration or stormwater Best Management Practices (BMPs), additional funding opportunities for the greenway will become available.

Complete Streets

There is the potential to turn US 70 into a “complete street” making it a multimodal corridor that can promote safety, livability, and can be accessed by multiple users (young or old, motorist or bicyclist, walker or wheelchair user, bus rider or business owner).

Challenges

While opportunities are numerous, constraints exist within the corridor. Constraints affect greenway implementation, constructability and costs. General constraints include:

Topographic/Natural Landforms

Significant topographic features are found along a majority of the entire trail corridor creating constraints and increasing costs for trail development such as steep terrain, and floodway impacts, such as river and tributary crossings. In addition there are often spatial constraints in which a road is located close to the top of a steep bank or along the river in which there is not enough space for a multiple use pathway.

Private Property

There are a number of landowners that would require greenway easements which would require time and resources to acquire needed easements. Negotiations will need to occur between the private land owner and Buncombe County to secure an easement or purchase of land for the greenway. Also as landowners become more aware of the project, land speculation and negotiations for easements could become an issue as it has within the City of Asheville along the French Broad River and parts of the Swannanoa River due to the Wilma Dykeman RiverWay Plan.

Infrastructure

Despite the significant amount of natural undeveloped land along the study area, manmade infrastructure forms physical barriers for trail development. Infrastructure along the corridor includes: existing roadways and buildings, existing active railroads (Norfolk Southern), utility lines (sewer and water), drainage structures (culverts and pipes), and electrical utility lines (electrical, telephone and cable). For example, there may be challenges of working with NF Southern to allow the greenway within their ROW and for an at grade railroad crossing. As well, while NCDOT is supportive of the project, permission would need to be obtained in order to locate the greenway within NCDOT controlled access areas. There are also several sections within the corridor where NCDOT, MSD, and NF Southern have overlapping ROW.

The first phase of this plan, the Map of Possibilities, addresses the entire project area and presents a conceptual plan of the greenway/multi-use trail that will travel through two municipalities, Warren Wilson College, and unincorporated areas. It identifies existing greenways, proposed greenway alignments, proposed greenway spurs/secondary connections, opportunities, points of interest, challenge areas, and access area.

The second phase of this plan addresses specific challenges and obstacles and includes:

- Trail cross-sections that are appropriate to the environmental and urban character of the immediate, surrounding area;
- Feasible alignments with alternate options and possible connecting segments to potential trail users and destinations;
- Identification of rights-of-way availability;
- Cost estimates for trail construction within specific locations; and
- Recommendations for implementation.

Consideration is made of floodplain ordinances, other studies that were being conducted simultaneously to this study, and bridge construction. On-road bike lanes are considered as part of the connecting trail system in order to create a continuous trail alignment.

Overall Corridor Recommendations

- **FEMA Buyout Properties:** Buncombe County through the FEMA buy-out program has acquired several parcels along the greenway corridor that are important to the greenway. These parcels are/have been conveyed to RiverLink. It is recommended that RiverLink allow multiple-use trail(s) on FEMA buy-out properties.
- **Road Diet along US 70:** The regional greenway study should be included by the MPO as a specific project that is modeled in their Long Range Transportation Plan. The traffic model should evaluate a four lane cross section.
- Since much of the greenway corridor will be within the floodplain, stormwater treatment should be part of the greenway system. If US 70 is reduced in traffic lanes, then a “greenstreets” approach should be incorporated such that there is a bio-retention treatment island between the vehicular travel lane and the multi-use pathway. In other more rural and natural locations bio-retention areas, constructed wetland, and bio-swailes in natural forms should be used to address runoff and stormwater treatment. The focus on stormwater treatment and protection of riparian buffers will provide additional funding opportunities for the greenway.
- Prior to any approvals for greenways to be located within an MSD sewer easement, a “Greenway Agreement” must be entered into between Buncombe County and MSD. The agreement is based on liability and will hold MSD harmless for any accidents that may occur with use of the greenway.

- The greenway project will take several years to implement and be highly dependent on funding and the level of priority the County places on this greenway. While there are challenges, this greenway more so than any other greenway segment in the county has the ability to connect large population centers, provide key connections to parks, schools, business, and serve as a major alternative transportation option in the county and recreational amenity. It also serves as a major connection to the McDowell County and Morganton greenway system. The US 70/Swannanoa River Greenway corridor should be considered a top priority by the Buncombe County Greenways and Trails Commission.
- While the preferred route follows the Swannanoa River as much as possible, making the connections along the river may not be possible due to the need to acquire easements for the greenway from landowners and physical constraints of the corridor. There will be sections in which the greenway may need to follow a road and take the form of a sidewalk as an interim solution but the goal of an off-road greenway should be continuously pursued until it can be implemented. US 70 should also be evaluated for a “complete streets” approach and at minimum include sidewalks that connect.
- Detailed survey information should be obtained for areas in which additional work will be developed in future phases. The existing study is based on GIS information provided by the county such as NC DOT ROW, topography, and floodplain information and not surveyed data.
- Prior to acquiring greenway easements develop a program for acquiring easements which may include forming a partnership with a local land trust to hold easements for the greenway.
- Develop and adopt a landowner outreach strategy, process, and protocol to start landowner outreach and land acquisition for the greenway.
- Lands that are for sale in which the preferred alignment passes through should be acquired by the County as soon as they become available. As well, land for sale along the alternative greenway alignment should also be considered for purchase.
- The County should develop a strategy to address potential land speculation within the corridor which could drive cost up significantly for land acquisitions including greenway easements.
- Sections of the greenway should be built in one mile increments at minimum and engineering and design should not be pursued until all the land has been acquired or a one mile continuous greenway segment (may include sidewalks and bicycle lanes) is acquired.
- Utilize areas identified by the Flood Risk Management Study that overlap with the greenway to help get sections of the greenway implemented.
- Within the entire corridor there are four (4) recommended pilot projects or sections of the greenway that should be considered top priorities:
 - Ridgecrest to the Petty Bridge
 - Boulder Park to Owen Park
 - Owen Park to Warren Wilson
 - US 70 to Hardesty Land/Azalea Road

INTRODUCTION

Overview & Study Area

The Buncombe County Parks, Greenways and Recreation Department contracted Equinox Environmental Consultation and Design, Inc. and McGill Associates to conduct a greenway feasibility study for the US 70/ Swannanoa River corridor. Funding for the project was provided for this multi-jurisdictional project by the French Broad River Metropolitan Planning Organization (MPO) for the study along the US 70/ Swannanoa River Corridor. The study area begins/ends in the Ridgecrest community east of Black Mountain and continues west through Black Mountain, Swannanoa, East Asheville and ends/starts to the east of where the Wilma Dykeman Riverway Plan begins at the John B. Lewis soccer fields on Azalea Road in Asheville (See Appendix A: Context Map). This feasibility study is the very first step in the preliminary planning of the greenway corridor.

Background

The Towns of Black Mountain, Montreat, and Old Fort and the counties of Buncombe and McDowell are jointly participating in a regional trail planning process through the Rivers, Trails and Conservation Assistance Program of the US Park Service. As a result of this effort, the Point Lookout Trail was opened for public use in October of 2008. This trail is being extended on both ends to terminate at the depots of both Black Mountain and Old Fort. Thus, the extended trail is called the “Depot-to-Depot Trail.” Additionally, Buncombe County and Black Mountain participated in the MPO’s Corridor Study to look at future land use and roadway needs along US 70. As a result of that process, several recommendations were made concerning access management, landscaping, the use of zoning and the inclusion of a greenway connector and pedestrian and bicycle facilities along the corridor. Both the Town of Black Mountain and the Swannanoa Coalition requested consideration for sections of this trail in their request to the NCDOT under the stimulus package call for projects.

The Wilma Dykeman RiverWay Plan links the French Broad and Swannanoa Rivers into a 17-mile continuous greenway with separate walking and biking trails anchored in the “River Arts District” of the City of Asheville. The Wilma Dykeman RiverWay Plan consolidates 20 years of planning for the redevelopment of the urban riverfront corridor by the local non-profit group, RiverLink. RiverLink developed a broad spectrum of Design Guidelines for Open Space that addressed issues such as access to the river, signage, public art, landscaping, structures, support facilities and graphics. The Open Space Design Guidelines are now part of the zoning code of Asheville and have guided river park and river greenway development since their inception. The Buncombe County Greenways and Trails Program plan to use these same design standards in their greenway planning.

In March of 2008, the Buncombe County Commissioners passed the Buncombe County Greenways and Trails Program at which time the Buncombe County Greenways and Trails Commission was formed. The mission of the Commission is “to support and promote the development of an environmentally friendly system of connected trails and greenways to improve health, alternative travel, economic development, and recreation in coordination with towns, cities, communities, businesses, non-profit organizations and adjacent counties.” The Buncombe County Greenways and Trails Commission determined they would like to consider a more formal planning process to bring a regional multi-purpose trail from the county line, east of the Ridgecrest Conference Center, through Black Mountain and Swannanoa to connect to the Wilma Dykeman Riverway at Azalea Road in Asheville. The potential alignment generally runs along the Swannanoa River and US Highway 70 and is organized into the following community sectors or focus areas:

1. Ridgecrest and Black Mountain
2. Swannanoa
3. Warren Wilson College
4. Oteen/East Asheville
5. Azalea Road Connection

Project Purpose & Goals

The purpose of the feasibility study is to investigate the possibilities for a greenway including alternative greenway locations. This study considers physical issues such as land terrain, hydrology, steep slopes, and rights-of way. As well, the study identifies landownership for future landowner outreach efforts. The goal of the study is to determine the feasibility for having over 18 miles of greenways and trails for bicyclists and pedestrians to utilize for non motorized transportation and enjoyment within the US 70/ Swannanoa River Corridor. This regional corridor will provide positive impacts for recreation, the environment, local economy and business, transportation alternatives, and educational opportunities. The goals of the US 70/Swannanoa River Greenway Feasibility Study are as follows:

- Provide a “Map of Possibilities” that describes the entire study area and the goal of an 18 mile greenway/multi-use trail in the US 70/ Swannanoa River Corridor;
- Work with the five pre-determined sectors of the project area, developing feasible alternative routes for a multi-use trail or series of trails for bike and pedestrian use within each sector;
- Work with the NCDOT and the Railroad to determine the rights-of-way boundaries within the study area. Explore the feasibility of working within the rights-of-way at certain areas where it may be the most feasible alternative to implement;
- Work with the Metropolitan Sewerage District (MSD), to verify the sewer easements in the project area;
- Identify barriers (as well as opportunities) and possible resolutions within each sector; and
- Provide cost requirements for each sector.

This study evaluates possible trail alignments, costs, and design needs and solutions for this specific regional trail so it can be built in the future. The document is the first step in the planning process and should be used to guide future phases. The study will illustrate the feasibility for trail construction and the potential solutions for overcoming barriers and design issues for this trail to be implemented. It will also be used to work with stakeholders and local land owners, the NCDOT, MSD, and the Norfolk Southern Railway to secure needed right-of-way and trail segments as identified in the document.

General Opportunities & Challenges

Opportunities

The Swannanoa River is a valuable environmental resource to the citizens of the County. A summary of opportunities for trail development within the US 70/ Swannanoa River corridor include:

Existing Utility Easements & ROW

There are significant sections within the corridor which are already encumbered by a sewer easement or NCDOT ROW. The MSD easements often occur along flat sections suitable for a greenway. As well, NCDOT ROW along a few of the roads including US 70 provides excellent potential for a multiple use pathways including bicycle lanes. Both NCDOT and MSD have expressed support for the project.

Community Connectivity & Access

The US 70 Swannanoa River Greenway has the potential to connect to population centers, public schools, Warren Wilson College, surrounding neighborhoods, several parks, other greenway trails, business, and shopping. In addition, pedestrian and bike safety has plagued certain areas within this corridor. This corridor would provide options for future users to safely and easily access the greenway offering a non-motorized transportation alternative.

Economic Growth

A complete greenway trails system that extends over 18 miles and connects to the Wilma Dykeman RiverWay Plan would provide significant economic benefits to the county and surrounding communities as it would enhance tourism and increase revenue from tourism and recreation. This corridor would also attract economic development, providing new business opportunities.

Environmental

There are opportunities to combine the efforts of the Flood Risk Management Study in which flood benefits can be provided in conjunction with the greenway system. As well, by addressing water quality issues including protection and enhancements such as restoration or stormwater BMPs, additional funding opportunities for the greenway will become available.

Complete Streets

There is the potential to turn US 70 into a “complete street” making it a multimodal corridor that can promote safety, livability, and can be accessed by multiple users (young or old, motorist or bicyclist, walker or wheelchair user, bus rider or business owner).

Challenges

While opportunities are numerous, constraints exist within the corridor. Constraints affect greenway implementation, constructability and costs. General constraints include:

Topographic/Natural Landforms

Significant topographic features are found along a majority of the entire trail corridor creating constraints and increasing costs for trail development such as steep terrain, and floodway impacts, such as river and tributary crossings. In addition there are often spatial constraints in which a road is located close to the top of a steep bank or along the river in which there is not enough space for a multiple use pathway.

Private Property

There are a number of landowners that would require greenway easements which would require time and resources to acquire needed easements. Negotiations will need to occur between the private land owner and Buncombe County to secure an easement or purchase of land for the greenway. Also as landowners become more aware of the project, due to real estate speculation, negotiations for easements could become an issue as it has within the City of Asheville along the French Broad River and parts of the Swannanoa River due to the Wilma Dykeman RiverWay Plan.

Infrastructure

Despite the significant amount of natural undeveloped land along the study area, manmade infrastructure forms physical barriers for trail development. Infrastructure along the corridor includes: existing roadways and buildings, existing active railroads (Norfolk Southern), utility lines (sewer and water), drainage structures (culverts and pipes), and electrical utility lines (electrical, telephone and cable). For example, there may be challenges of working with NF Southern to allow the greenway within their ROW and for an at grade railroad crossing. As well, while NCDOT is supportive of the project, permission would need to be obtained in order to locate the greenway within NCDOT controlled access areas. There are also several sections within the corridor where NCDOT, MSD, and NF Southern have overlapping ROW.

FEASIBILITY STUDY

The project includes an overall Map of Possibilities (See Appendix B: Map of Possibilities) and an evaluation of feasibility for the five primary sectors (See Appendix C: Focus Area Maps). The Map of Possibilities addresses the project area and presents possible routes for the greenway/multi-use trail that will travel throughout the more than 18 mile stretch serving two municipalities, Warren Wilson College, and unincorporated areas of the County (See Map of Possibilities). This Map of Possibilities also identifies existing greenways, possible greenway alignments, possible greenway spurs/secondary connections, opportunities, points of interest, challenge areas, and access areas. The Feasibility Study also addresses specific challenges and obstacles and includes:

- Trail cross-sections that are appropriate to the environmental and urban character of the immediate, surrounding area;
- Feasible alignments with alternate options and possible connecting segments to potential trail users and destinations;
- Identification of rights-of-way availability;
- Cost estimates for trail construction within specific locations; and
- Recommendations for implementation.

For the greenway to connect from Point Look Out Trail to Azalea Park, the greenway will require sections of on-road greenway (sidewalks, bicycle lanes, bicycle routes) and off-road greenway (multiple-use pathways located a distance from the road system). The on-road sections will be utilized to make critical connections and to help serve the role as a multimodal transportation route. A multimodal system along US 70 is an option that can be pursued and help tie into an off-road greenway system. Such a system could include multiple-use pathways or sidewalks located along roads which should whenever possible have a minimum five foot (5') median, separating the road from the pathway or sidewalk. The off-road sections of the greenway should be located along the Swannanoa River as much as possible but in some areas this will not be possible due to the need to acquire greenway easements from landowners or physical limitations. For the sections of the greenway that are off-road the preferred trail alignment provides:

- Open viewsheds with frequent changes of scenery;
- A diversity and mix of land uses (town centers and rural sections);
- Connections from communities and neighborhoods with dense populations;
- Access points with parking that are also near commercial areas, parks, and main roads.

These are key factors that will translate into trail use which is, in the end, the ultimate goal of the greenway. A recent study regarding Urban Greenways, Trail Characteristics and Trail Use: Implication for Design, published in the Journal of Urban Design, noted that trail use is lower on segments without paved surfaces, with rail crossings, and with long stretches of consistent unchanging views, to achieve a greater experience for the user. The goal to provide a great experience for the user has been taken into consideration throughout the study and is reflected by the preferred alignment (See Appendix D: Focus Area Maps). These issues must also be balanced with landowner and stakeholder needs and desires to promote trail use such as the request by Warren Wilson College to provide an alternative and environmentally appropriate trail surface application.

Rights-of-Way

While Rights-of-Way (ROW) exist along the corridor for NCDOT and Norfolk Southern, the extent of the ROW varies throughout the corridor including NCDOT controlled access ROW in which approval from Raleigh would be needed in order to locate a greenway within the controlled access. The following identify the ROW for the different sections of the corridor.

Ridgecrest/Black Mountain

- 200' ROW Norfolk Southern
- Grovestone Road has a 60' ROW
- Highland Farms Road and Tabernacle Road have a 60' ROW
- Blue Ridge Road is historically maintained
- I-40 ROW extends to the south all the way to Old US 70 East including sections of Yates Avenue

Swannanoa

- Riverwood has a 40' ROW with an extra 30' on the Asheville Christian Academy side for a 70' ROW. At the intersection with US70 west across the bridge this extends to roughly 100'
- Old US 70 is an historically maintained ROW but at the intersection south there is a ROW that tapers down and ends past the house on the David & Wanda Duncan property on the east side and on the west side ends past the house of Harry Celwyn Gibbs
- There is a 100' ROW along US 70

Oteen/East Asheville/Azalea Road

- Moffit Road has a 45' ROW with 22.5 from the centerline on each side from US 70 to Eastmor
- There is a 100' ROW along US 70
- NC DOT owns 200' of ROW at the bridge entering the Anchor Steam Power Company, Inc. plant off Azalea Road
- The remaining section of Azalea Road does not have a documented ROW and is City maintained from edge-of-pavement to edge-of-pavement with an additional 5' on both sides

Topography

There are several sections within the study corridor in which there are limitations for a multi-use pathway due to steep topography. There are locations in which the preferred greenway alignment is along the top of bank of a river or road embankment. In such cases, there should be 5 feet of separation from the edge of the path to the beginning of the bank or slope, if this is not possible a physical barrier such as a safety rail should be used. As well, when there is less than 5 feet between the edge of the path and the roadway a divider should be used. This will be needed for the Oteen/East Asheville section.

Greenways in the Floodplain

The Swannanoa River is a significant resource and community asset that could become an environmental and recreational focal point for the greenway system. Not only does the greenway provide opportunities for walking, hiking, bicycling, jogging, and rollerblading along the Swannanoa River for a variety of users and age groups, it also offers opportunities for water based recreation including water trails or blueways. However, there are certain aspects of creating a greenway that must be addressed when building a multiple-use pathway within the floodplain or floodway of the Swannanoa River.

The City of Asheville has undergone the development of a revision to their stream buffer ordinance. It has been recently approved and allows greenways within thirty feet (30') of a water body. The Buncombe County stream easement requirement defaults to the state requirements which do not allow any permanent structure within 30' of a stream. Bill Diuguid, Staff Planner with NC DENR DWQ, indicated that greenways will be allowed within 30' even if it is a hard surface greenway as long as mitigative measures are taken. Mitigative measures will include provisions to address stormwater runoff from the trail such as stormwater best management practices. If a greenway needs to be located within 30' of the stream a variance may be granted, but would require 1:1 mitigation of impacts within the same basin. Insurance will typically not cover anything within the floodway. Cynthia Barcklow, Floodplain Administrator for Buncombe County stated that any structure located within the floodway such as a drinking fountain, kiosk, signage, including trails would require a no impact/no-rise study. A greenway can be located in the floodplain with the submittal of a flood permit application which requires a plan for the greenway, structures to be located with the greenway, and the location of the floodplain and floodway. For additional information including basic code requirements for Black Mountain and Buncombe County (See Appendix I: Code Requirements for Greenways in the Floodplain).

Bridges

Great efforts have been pursued to minimize the need for bridge crossings of water bodies (specifically the Swannanoa River). However, within the study area, there are several locations in which the preferred alignment crosses over the Swannanoa River and numerous other tributaries flowing into the Swannanoa, will be necessary. Specifically, the plan calls for pedestrian bridges to cross the Swannanoa River at the following locations:

1. In between US 70 and Old US 70 just upstream of the Whitson Bridge
2. The Whitson Bridge (Utilizing existing bridge with potential lane closure)
3. Downstream of the Riverwood Bridge
4. Up or downstream of the Davidson Road Bridge
5. At the Warren Wilson College east of Warren Wilson Road Bridge
6. Downstream of US 70 in Oteen (Utilizing existing abutments)

Although possibilities to attach pedestrian bridges to existing bridges exist, it is not the preferred approach by NCDOT. There is the potential to utilize the existing Davidson Bridge and Riverwood Bridge by building onto the existing bridge. This would require that the bridge has sufficient strength to hold the additional structure required for a pathway and would require an engineering study. However, the Davidson Bridge may support such a retrofit because at this location the floodway is extremely wide and would require a no impact/no-rise study for a bridge to be allowed. A bridge retrofit to allow pedestrian access would require that sufficient width exists on one side of the bridge or that the width can be obtained by widening or restriping lanes. Other retrofit designs should provide a physical separation from the pathway and vehicle lane and provide sufficient space for an access and exit ramp leading up to the bridge. The Whitson Bridge also provides another option for a retrofit which would require a lane reduction. Merging a multi-use greenway path onto

the roadway at either end of a bridge using a bicycle lane is generally not recommended but due to low traffic volumes it may be a viable option for the Davidson Bridge. This option is not recommended for the other bridge locations for safety reasons due to traffic volumes and bridge width.

On greenway and trail projects, a Federal Emergency Management Agency (FEMA) no rise certification is needed whenever modifications are made in the 100 year floodplain. Bridges over streams including the Swannanoa River would trigger the need for a no-rise analysis and report at each crossing. The FEMA no-rise report demonstrates, using modeling of FEMA stream data to reflect proposed changes in the 100 year floodplain, that there is no increase in the water depth at the 100 year storm. If the disturbance does cause a rise in the 100 year storm stream flood level, then a FEMA CLOMR (Conditional Letter of Map Revision prior to construction) and LOMR (Letter of Map Revision done post construction) is required. Because of both the expense and project delay associated with CLOMR and LOMR, the detailed designs for the greenway should endeavor to incorporate design elements which will meet the no-rise requirement and not trigger the more expensive and lengthy CLOMR permitting process. There is a fine balance between designing to avoid a CLOMR and adding additional cost to stream crossings to enable a no-rise or no-impact. It should also be noted that the Riverwood Bridge is a relatively new bridge. This may potentially indicate that additional abutments will not affect rise. Furthermore, the proposed crossing below Hwy 70 in Oteen would utilize existing abutments likely yielding the same results.

Swannanoa Flood Risk Management Study

During 2009 and 2010, the City of Asheville along with participation from Buncombe County and the Town of Black Mountain, have been undergoing a Flood Risk Management Study. As part of the project, areas that can provide flood benefits in conjunction with secondary recreational opportunities are being identified. There are four Potential Flood Improvement Areas that overlap with the US 70/Swannanoa River Greenway Study (See Focus Area Maps). These four potential areas include locations at:

1. Warren Wilson College- Includes potentially elevating Warren Wilson Road and providing box culverts to allow the greenway to pass under the road,
2. Charles Owen Park- Includes stabilization of the banks along the Swannanoa River and the park,
3. Blue Ridge Road- Includes elevating Blue Ridge Road and widening the road as well as constructed wetlands, and
4. Chevy/Ford Dealership in Black Mountain- Includes a constructed wetland which could also serve as a park along the greenway.

Coordination and communication with the City of Asheville or Black Mountain prior to the design and construction of Flood Improvement projects will be critical to ensure that the considerations for the greenway are provided in an adequate fashion. For example, if Warren Wilson Road is elevated and box culverts are utilized, these structures must provide at minimum 8' of overhead clearance and be at minimum 14' in width.

Bike Lanes

While bike lanes are not a focus of this greenway feasibility study, in the effort to make the connection from Old Fort to Azalea Road, bicycle lanes are a viable option to help make key connections when a multiple-use path option is not available or to provide additional user options. Most bicyclists will choose the route that best combines direct access with low traffic volumes. Strip development along sections of US 70 in Swannanoa with commercial uses and the numerous driveways add significant volumes of right-turning traffic which tend to make unsuitable locations for bicycle lanes. Multiple-lane roadways

with center turn lanes and high volumes of vehicle use such as those found along US 70 from Black Mountain to Azalea Road also make bike lanes a safety concern. Sidewalk connections may be a more suitable option in such locations. Bicycle lanes should be delineated with a minimum width of 4 feet. Additional bicycle lane width is recommended when the traffic lane is less than 12 feet in width. In town centers such as Black Mountain where there is on street parking, bicycle lanes should be located between the parking lane and the travel lane and not in-between the parking lane and the curb.

Greenway Facilities

Additional detailed studies will emerge as a result of this feasibility study which should address facilities such as park and ride areas, parking areas, trailheads, bicycle lockers, restrooms, lighting, landscape improvements, drinking fountains, rest areas, informational kiosks and more.

The Five Focus Areas

Focus Area I: Ridgecrest & Black Mountain

Black Mountain has developed a Greenway Master Plan completed in August of 2002, prepared by the Greenways, Walkability and Biking Task Force which the Town has been implementing for a number of years. They also have several greenway segments that have been planned, designed, and built. The Feasibility Study connects to these existing and proposed trails. Black Mountain's biggest challenge is the number of areas where an easement along NCDOT or railroad right-of-way is needed. The recommended greenway alignment includes potential access points for the trail and primary and secondary routes. The preferred greenway alignment route passes through downtown. Because of conflicts with buildings, on-road parking, in addition to the rights-of-way, a range of options including sidewalks, lane widening, bike lanes, and off-road sections are recommended.

Ridgecrest (Point Lookout Trail to Petty Bridge)

From Point Lookout Trailhead, the greenway should follow Old US 70 along the Ridgecrest property to Yates Avenue Bridge. The lanes on Yates Avenue Bridge should be reduced to accommodate multi-use access. After the Yates Avenue Bridge, the greenway is to connect to Tripoli Trail via the Boscobel House property, utilizing either the Ridgecrest campground property or a road expansion of Yates Avenue to Dunsmore Bridge. After an at grade railroad crossing west of the Dunsmore Bridge the preferred greenway alignment is located to the south side of I-40 between Old US 70 East and the Swannanoa River (See Appendix C: Maps 1-2). This section of the greenway will have a combination of on-road and off-road sections.

At grade railroad crossings can be safety hazards if not designed properly. This would require a realignment of the road to allow a safer crossing for the greenway or a widening of the trail to allow bicycles to cross as close to 90 degrees as possible. If the option to widen the greenway to allow a 90 degree crossing is pursued, warning signs should be used that state "bikes cross at right angle" to provide sufficient warning. As well, the use of filler strips between the rails should be explored with Norfolk Southern. This is a challenge area due to the fact that for "every at-grade pedestrian railroad crossing allowed, Norfolk Southern wants to decommission three more". The preferred greenway should be located within the NCDOT ROW and parallel Old US 70 East. The fence line within a portion of this section is located adjacent to the road and serves as the NCDOT controlled access and will require relocating the fence line.

Black Mountain East/Petty Bridge (Petty Bridge to Flat Creek Road Proposed Roundabout)

The petty bridge is a critical part of the greenway and is one of the challenge areas for the greenway corridor. It is a challenge area due to spatial constraints of the bridge abutment, on-ramp/road, river and the NCDOT fence line which will require one of the following alternatives illustrated in the cross sections (See Appendix D: Possible Cross Sections #1-3). NCDOT will allow passage of a greenway under the Petty Bridge but recommends doing so without having to request relocation of the fence line which serves as an NCDOT Controlled Access. However, it will not be possible to locate the greenway alignment without relocating the controlled access, which will require NCDOT authorization from Raleigh. To further compound the complexity of this location, Norfolk Southern's right-of-way in this location is 100', essentially located immediately behind the existing guardrail next to the roadway. The preferred alignment will require approval from NCDOT, MSD, and Norfolk Southern. As a side note, a review by Norfolk Southern for a greenway that crosses railroad tracks is costly. Therefore significant efforts to limit crossing of the railroad with the primary route of the greenway/trail corridor have been studied throughout this project.

In the French Broad River Metropolitan Planning Organization's (MPO) US 70 Corridor Study, narrowing of US 70, east of the Flat Creek and Padgett Road intersections was recommended. This reduced cross section would provide ample space for the preferred greenway alignment as it passes under the Petty Bridge and moves towards Black Mountain. If this road work is not pursued the greenway could follow the MSD easement that parallels US 70 in this section of the corridor.

Downtown Black Mountain (Roundabout to the In-The-Oaks Trail)

The preferred greenway alignment will pass through downtown and connect to the existing In-the-Oaks Trail, from Flat Creek where a roundabout is proposed as part of the US 70 Corridor Study. It would follow the river and connect to Sutton Avenue which would tie into the sidewalk along Highway 9. The greenway would cross at the intersection of Highway 9 with Vance Avenue. The greenway would then follow the alignment of the “Polk Connector” identified in the Town of Black Mountain Greenway Master Plan which parallels a portion of the MSD sewer easement and utilizes existing rights-of-way. The trail would tie into the In-the-Oaks trail and the trail around the ball fields at Recreation Park. The greenway system through the Town would be predominately comprised of a sidewalk system with bike lanes to continue the greenway system. The sidewalk system is appropriate for this town center location for the greenway. There are several alternative routes for this section of the greenway system (See Appendix C: Map 3).

Black Mountain West (In-The-Oaks Trail to Grovestone Road)

The preferred greenway alignment as the greenway leaves Recreation Park heading west is to follow the Swannanoa River along the south side of the river (See Appendix C: Map 4). This would require passing through private property and creating a trail alignment that would avoid potential vehicle conflicts with the Ingles warehouse. This alignment would pass through wetlands and would provide a different user experience as a boardwalk system would be needed to sensitively traverse the wetland habitat. As well, a sidewalk has been recently built along US 70 and this should serve as the beginning of the sidewalk system that should parallel US 70 and provide an alternative alignment throughout the entire corridor.

Another option is to reduce US 70 by one lane at various stretches between Black Mountain and Oteen in order to accommodate a multi-modal trail facility that runs parallel to US 70 and within the right-of-way. This could be done by selectively eliminating the center lane that runs the course of the roadway between Cragmont Road in Black Mountain and Azalea Road in Asheville and implementing an access management plan. The design concept for this section would include a physical separation from the multimodal trail system such as a median which could also provide an environmental benefit by serving as a stormwater treatment area. The trail could become a sidewalk connection at urbanized areas within Swannanoa and Oteen where turning movements increase.

If it can be illustrated in a traffic model that a decrease of roadway width along US 70 would not decrease its capacity rating, then NCDOT might allow a re-design of the US 70 cross section to allow a trail within US 70 right-of-way. Therefore a trail alignment along US 70 has been provided with the intention for this greenway to be part of an MPO study to evaluate this option in their Traffic and Congestion Management System Planning (See Appendix H: Evaluation of Lane Reduction).

A final alternative provided includes the use of ROW along Tabernacle Road and Highlands Farm Road, in which the greenway would pass along Highland Farms and the Black Mountain Center. All alternatives tie into the Grovestone/Hedrick Industries property.

Significant Opportunities

- Existing I-40 ROW extends to Old US 70 E Hwy providing ample space for a greenway trail
- Government owned parcels along preferred alignment
- Connecting to Village Way and Flat Creek Greenway
- Several alternatives through downtown exist
- Support from Grovestone/Hedrick Industries property for a greenway
- Connecting to In-the-Oaks Trail

Significant Challenge Areas

- On-Grade Norfolk Southern Railroad Crossing near Dunsmore bridge
- Petty Bridge & NCDOT Controlled Access within this area and along Old US 70 East
- Need for a multiple ROW agreements from both NF Southern & NCDOT along several sections
- Passing under Highway 9 along the Swannanoa River

Recommendations:

- Back country railroad crossing permitting will be time consuming and new crossings are discouraged by Norfolk Southern. It is recommend that fencing be provided along the rails for some distance each side of the railroad crossing to keep greenway uses on the path. Also, pedestrian cross arms may be required. Work with Norfolk Southern to gain permission for an on-grade crossing near the Dunsmore Bridge. The use of bollards, signage and flangeway fillers will provide a safe intersection for trail users that will not interfere with train operation. It is important that the trail be designed to cross the railroad at a right angle. This will prevent trail users’ bicycle or wheelchair wheels from getting trapped in the rail flangeway as well.
- Work with NCDOT to allow the greenway within the Controlled Access and relocate fence line that delineates the controlled access (Petty Bridge and sections adjacent to I-40)
- Start to acquire land for the greenway section starting with the largest landowners as a first priority including Ingles, and the Black Mountain Commerce Park, if these landowners are not willing to work with the County towards the provision of a greenway easement then the alternative options should be pursued.
- The greenway system through downtown Black Mountain should be predominately comprised of a sidewalk system with bike lanes to continue the greenway system.
- The regional greenway study should be included in the French Broad River MPO’s (FBRMPO) Long Range Transportation Plan (LRTP) as a specific project that is modeled and studied for a road diet along US 70. The French Broad River MPO is currently updating its Long Range Transportation Plan (LRTP) that examines current and future transportation system needs in the FBRMPO region. The time horizon for the updated plan goes up to 2035. This option should be pursued regardless of the other greenway options as it could be a multimodal component to this regional greenway corridor. Specifically the traffic model should evaluate a four lane cross section that has the following:
 - o Six lanes immediately in front of the current Ingles Warehouse entrance;
 - o Limited access points to the south because of the railroad between Black Mountain and Asheville;
 - o Limited access points to the north between Black Mountain and Swannanoa; and
 - o Already been reduced to a three lane cross section within downtown Black Mountain.
- Grovestone/Hedrick Industries are potential supporters of the greenway project. A greenway easement should be secured for this property. Hedrick Industries will need a preliminary map indicating the preferred alignment, so they can review it and provide comments (See Appendix E: Map I).

Focus Area 2: Swannanoa

Buncombe County Greenways and Trails Commission has identified Swannanoa as the first priority area for a greenway in the County. The first segment of this project is called the “Pool to Park” segment and runs from the Owen Pool to Owen Park. The Swannanoa Pride Community Coalition and the Asheville Flood Damage Reduction Task Force, developed a conceptual Phase One Study for Owen Park to Own Pool, this project takes this study a step further. The Swannanoa corridor contains significant parcels of undeveloped land along the river and a number of schools and County facilities along or near the river, such as schools, a park, a pool, and FEMA buyout lands. In the Swannanoa sector, the greenway route follows the river and MSD right-of-way as much as possible. In areas where remaining next to the river is difficult,

identification of alternative routes have been provided with the goal of returning to the river as soon as possible. Due to past efforts in Swannanoa including an attempt for incorporation and a Vision process by NC State, a voice of “no change” has been expressed by a few proponents of changing Swannanoa, which includes the greenway. In these cases, this information was considered in the development of the preferred alignment. The recommended alignment for the Pool to Park segment includes primary and alternative alignments, location for bridge crossing, identification of pocket parks and access areas, and spurs to local schools and other public buildings/parks.

Swannanoa East (Grovestone Road to Whitson Ave Bridge)

From Owen Pool and Owen Middle School, the preferred greenway alignment runs westward. The suggested trail alignment connects to Ridgewood Park, a County-owned property, that can provide public access to the greenway as well as other greenway facilities including trailhead parking. The preferred greenway would then follow the Swannanoa River with the secondary route serving as a sidewalk along US 70. A spur trail that connects to Owen High School, the 4H Camp and Camp Rockmount is also provided.

Central Swannanoa (Whitson Ave Bridge to Boulder Creek Park)

As the greenway corridor continues along the north side of the river a crossing is proposed across from the Grovemont neighborhood on a FEMA Buyout parcel (See Appendix C: Map 6). An on-road section that runs along Old US 70 to the Whitson Bridge does not have sufficient space to accommodate greenway facilities. Prior to the bridge crossing a spur trail that connects the Grovemont neighborhood to the commercial district is proposed. This is needed as there is an existing and well worn path in the narrow shoulder of Old US 70 which is a safety hazard. Once the greenway crosses to the south side of the river across a proposed bridge, it continues to the Whitson Bridge. The Whitson Bridge is a challenge area (Appendix D: Possible Cross Section #4 and Appendix E: Map 2) and will require a Traffic Impact Analysis. This intersection would require additional design and engineering to provide a safe pedestrian link. Another reason for a re-design of this intersection is the site of the former Beacon Plant which has been identified for future redevelopment. A spur trail connecting to the south side of US 70 is proposed to help support new business ventures. A sidewalk along US 70 from Whitson Avenue to Riverwood would also promote better walkability and connectivity for residents.

From Whitson Bridge the preferred greenway alignment follows Old US 70 connecting to the Community School & Garden and W.D. Williams Elementary School (See Appendix D: Possible Cross Section #5). The greenway would then cross the river via a pedestrian bridge parallel to the Riverwood Bridge and connect to Boulder Creek Park. Our site assessment revealed that the current Riverwood Bridge is not wide enough for a greenway trail and would require a pedestrian bridge (See Appendix E: Map 3). Boulder Park can serve as a pocket park providing greenway access and trailhead parking. From this point the greenway follows the MSD sewer easement located on the south side of the Swannanoa River. An alternative alignment has been provided after crossing the Whitson Bridge which follows the MSD sewer easement located to the north of the river; there are some spatial challenges however including the limited space available between the top of the bank, the building, and the river.

Swannanoa West/Warren Wilson College (Boulder Creek Park to Owen Park)

The preferred greenway alignment continues along the south side of the river and connects to Davidson Road, at this location the greenway will cross to the north to be located on the same side of the river as Charles Owen Park (See Appendix C: Map 7). Charles Owen Park is the largest park along the greenway corridor in Swannanoa and will serve as a major access point for the greenway corridor. The park will provide parking and already offers amenities such as pavilions, lighted baseball fields, basketball courts, restrooms, playground, picnic tables, grills, and a walking and bird watching trail. The Swannanoa River is a fish hatchery supported river, and the two lakes at Owen Park are open for lakeside fishing. River access should also be considered at this park to provide a location for boaters to put-in or take-out. The greenway would tie into the existing loop trail along the river. From this location the greenway would continue and pass through Warren Wilson College.

Significant Opportunities

- Within the Swannanoa section, there are six schools, two parks, a community pool, and four County-owned properties that should be incorporated into the greenway.
- Providing key connections to schools and parks (options for Safe Routes to School grants)
- Providing key connections to Grovemont and Beacon Village
- New Crosswalks to promote safer pedestrian environment

Significant Challenge Areas

- Bridges & River Crossings
- Development along the Swannanoa River
- Strip Development Pattern for bicycle lanes
- Property Ownership
- Safety

Recommendations:

- In this sector, the greenway route should follow the river and MSD right-of-way as much as possible (See Appendix D: Possible Cross Section #6);
- Since the Buncombe County Greenways and Trails Commission has identified Swannanoa as the first priority area for a greenway in the County, landowner outreach should start in this section;
- A Traffic Impact Study should be pursued to explore a road diet along US 70 and address modifications to the Whitson Bridge, the intersection for safe pedestrian crossing, and road modification for a sidewalk connection to Beacon Village;
- A proactive and organized approach to landowner outreach is needed as soon as the County is in the position to approach property owners;
- A focus in this corridor should be placed on safety and making safe connections for pedestrians and bicyclists. Due to the number of turning lanes a simple bicycle lane is not recommended unless a lane closure is possible along the north side of US 70. The lane closure, if approved by NCDOT, would allow for a median separation from the traffic and provide additional reaction time to minimize conflicts from turning vehicles passing through the bicycle lane. As well in such a scenario reducing the number of turning movements by consolidating driveway cuts would also provide a safer environment for a bicycle lane on the north side of US 70. There are fewer conflicts with turning lanes along the south side of US 70 in which a bicycle lane may be possible;
- Provide sidewalks on both sides of US 70 from Whitson Avenue to Riverwood Road. The sidewalks when possible should have a five foot median separation between the road and the sidewalk;
- Several crosswalks at intersections should be provided including Whitson Avenue, Patton Cove Road, and Riverwood Road to provide safer pedestrian connections.

Focus Area 3: Warren Wilson College

Warren Wilson College endeavors to maintain a mission of sustainability and sensitivity to the natural environment of their agricultural campus. However Warren Wilson College does have some concerns in allowing a greenway trail through their campus. They have concerns like most landowners regarding the potential impacts of public access, in this case to their private campus. Another concern of the school is the materials used to construct the trails. They are not willing to have their existing paths paved and are interested in ecologically sensitive alternatives to asphalt. A detailed listing of trail surfaces and their costs, environmental impacts and more is provided in (See Appendix G: Trail Surface Chart). The

preferred alignment through Warren Wilson owned land starts on the north side of the Swannanoa River but crosses to the south side at which time the alignment follows the MSD sewer easement as it continues westward (See Appendix C: Map 8). This will require a bridge over the Swannanoa River. The bridge is intended to discourage pedestrian traffic and reduce impacts within Warren Wilson property, as well as transition to MSD ROW. This corridor would provide many opportunities for students to choose a bicycle over a car for a trip and significantly help reduce automobile usage on campus. This combined with the marketing advantages of having a regional greenway corridor that would connect the campus to Asheville and Black Mountain and other recreational areas would be a major advantage for the college. The study for this section of the greenway is conceptual in nature.

Significant Opportunities

- Warren Wilson has a strong environmental focus and they could prove to be a major proponent of the greenway system.
- Since land acquisition for the greenway will be one of the biggest challenges, the Warren Wilson section could provide one mile of greenway with a single landowner’s commitment.
- MSD line along the south side of the river could be utilized for the greenway
- This section is one of the more scenic sections of the entire greenway corridor and would be well used by students, faculty and others.

Significant Challenge Areas

- Bridge crossing
- Property ownership

Recommendations:

- To address some of the concerns that Warren Wilson College identified in the stakeholder meeting a focused outreach effort to address these issues and concerns should be pursued. Several meetings should be planned with the goal of working towards an agreement with the college. As part of this, detailed designs which address many of the concerns of the college should be provided. Many if not all of the concerns expressed by the college can be addressed through proper design.
- Warren Wilson is a major landowner within this corridor and could prove to be a major proponent of the greenway system. A focused effort to gain their support and commitment should be pursued immediately. This section of greenway should be considered as a “pilot project” for the corridor as it will provide 1 mile of greenway by a single landowner. This “pilot project” should extend to Charles Owen Park.
- This section of greenway should include a trailhead at Charles Owen Park so trailhead parking can be provided at the park. Warren Wilson College does not want additional parking facilities built on campus for the greenway and trailhead parking directed to Charles Owen Park should help prevent on-road parking near the greenway on campus.
- The Swannanoa Flood Risk Management Project has identified Warren Wilson Road as a potential flood project which might include raising the elevation of Warren Wilson Road. At this point in time this project has been identified as a potential project and overhead clearance of a minimum of 8’ with a desirable clearance of at least 9’ is recommended in order to allow the multi-use pathway to pass under the road if it is elevated.

Focus Area 4: Oteen/East Asheville

As one of the least studied areas within the corridor, a preliminary study of the area has been provided to examine trail placement and alignment for connections to Warren Wilson College and Azalea Park. Topographic challenges are the most prevalent issue surrounding this section of the greenway corridor (See Appendix C: Maps 8-9). In several areas the road is

cut into the slope with a steep cut slope which falls quickly to the river below. In this section an uphill bicycle lane will be the best option, with a shared pathway separated from the road by 3-5'. Ideally the shared pathway would be 8-10' wide and this could be possible with some road re-alignment work and significant use of retaining walls. This would be costly and further detailed grading studies of this corridor would be needed. In other sections of this corridor there is an MSD sewer easement with a bench that would be suitable for a multiple-use pathway. This occurs on sections between the road and the river. Finally one of the most significant challenges within this corridor is safely connecting the greenway at the intersection with US 70. A low flow bridge/ boardwalk that passes under US 70 may be the most feasible as well as the safest solution.

Significant Opportunities

- The MSD Sewer Easement and bench that has been created for the sewer line
- The NCDOT ROW along Moffit Road

Significant Challenge Areas

- Topography
- Spatial Constraint of road location in combination with topography
- US 70 Bridge & Swannanoa/Connection
- Landowner concerns / Property ownership

Recommendations:

- The greenway should follow the existing bench and sewer easement as much as possible which is located between the river and Moffit Branch Road.
- In areas in which the greenway must follow the road due to topographic constraints the road should be realigned and the pathway should be provided immediately adjacent to the road with a barrier of 5' separation. The pathway should be located to the west side of the road to prevent the need to crisscross Moffit branch road in several locations and to provide a much safer alignment.
- An uphill bicycle lane should be provided at a minimum width of 4'.
- Pursue detailed grading studies, geo-technical studies and work with NCDOT to identify and gain support for re-aligning the road within the right-of-way where needed. Other than US 70 which has a 100' ROW, Moffit Branch Road is one of the only other roads with a ROW within the study area (45' ROW with 22.5 from the centerline on each side of Moffitt Road which extends from US 70 to Eastmor).
- At the US 70 bridge crossing the Swannanoa River in Oteen, a bridge that passes under US 70 is recommended by NCDOT. An existing bridge abutment can be used to cross to the east side of the river before going underneath the bridge (See Appendix E: Map 4). Due to the existing bridge abutment a no-rise/no-impact study may not be required for this bridge crossing but one would be needed to pass under US 70.

Focus Area 5: Azalea Road Connection

The final connection for the US 70/Swannanoa River Greenway Corridor is from US 70 to Azalea Road Park. Once the greenway passes under US 70 and then utilizes the existing bridge abutment to cross to the west side of the river, the preferred alignment continues along the Swannanoa River and joins with Azalea Road at the Anchor Power Company Plant (See Appendix C: Map 9). There are spatial constraints within this area such as the location of the road in proximity to the Swannanoa River. Therefore this section will combine a bike lane and when space allows a multiple-use pathway adjacent to the road with a minimum 3' and ideally 5' median separation. The road could be re-aligned in this area which would require

grading and earthwork to provide additional space for a multiple-use pathway however there is not a ROW for Azalea Road except for a 200' section of ROW at the bridge entering the Anchor Steam Power Company Plant. The alignment continues along Azalea Road and ends just prior to the Blue Ridge Parkway at Hardesty Lane.

Significant Opportunities

- Provides a tie in with the Wilma Dykeman Riverway plan with a connection to the John B. Lewis Soccer complex.
- Provides additional recreational opportunities that originate at Azalea Road Park and also serve to connect Azalea Road Park to students at Warren Wilson College, and numerous others in Swannanoa and Black Mountain.
- Greenway along the Swannanoa River
- Plenty of space behind business along US 70 for an off-road greenway
- Sidewalks along US 70 on the south side where being constructed during the course of this study which would provide additional connectivity to businesses and communities in Oteen and East Asheville.

Significant Challenge Areas

- Spatial Constraint of road location in combination with topography and proximity to the Swannanoa River
- Limited ROW along Azalea Road for re-alignment
- Property Ownership

Recommendations:

- RiverLink may own or hold conservation easements on several parcels in this section. Contact RiverLink to confirm they own land in this section. RiverLink was contacted regarding potential landownership/conservation easements which have not been confirmed to date.
- Contact the Anchor Steam Plant to determine their interest in a greenway.
- Follow the MSD easement when it overlaps the preferred alignment.

Public Process

During the planning process, the consultant in conjunction with the Buncombe County Parks, Greenways and Recreation department formed a technical advisory committee and conducted meetings with key stakeholder groups including the Asheville Greenway Commission, Buncombe County Greenways and Trails Commission, Warren Wilson College, the Swannanoa Greenways Committee, and the Black Mountain Greenway Commission. The Technical Advisory Committee was comprised of representatives from the different towns and communities within the study area

The Stakeholder meetings were conducted in order to gain feedback, build consensus and obtain direction for the planning effort. Greenway alignments were presented to the stakeholders and preferred alignments were identified during these meetings. In addition to the Technical Advisory Committee Meetings and Stakeholder meetings, two public community meetings were conducted.

The first community meeting included a presentation and breakout sessions for soliciting input for the entire greenway corridor. The presentation included general introductions from the client and select stakeholders, the need for the study, benefits of greenways, and a description of the project. The consultant conveyed to the participants the study area, goals and objectives of the project, and the site assessment findings. After the presentation, participants broke into groups and feedback was provided. The break-out sessions included focus area maps of the study corridor with the goal of getting “pens in people’s hands”. Participants were asked to record the following:

- Locations for the greenway
- Connections they want to see to schools, parks, businesses, etc.
- Any known safety challenges
- Any known “general” challenges
- “What the greenway is like when they are walking or riding on it 10 years from now”

At the “greenway features” station the greenway features and amenities that participants wanted to see included within the corridor were identified and recorded (See Appendix F: Results of Public Process). As well, the question was also asked, “Are there any greenway elements or features you want us to avoid”. There was also a “General Greenway Information” station which contained handouts for participants to take home that include the benefits of greenways. The community meeting ended with a summary of the key results from the input sessions.

Prior to the consultants completing the feasibility study, a final community meeting was held with an Open House format. This meeting was conducted for community members to comment on the results of the conceptual planning efforts. The meeting also allowed the community to learn about the proposed design project, provide comment on the direction of the project, and provide input regarding design considerations for the entire corridor. A Comment Form was given to all participants to gain final input (See Appendix F) and presentations were given every hour during the open house that identified the possible routes, possible cross sections, and possible solutions to challenge areas within the corridor.

Cost Estimates

Focus Area 1: Ridgecrest & Black Mountain	\$3,288,251
Focus Area 2: Swannanoa (Pool to Park)	\$2,313,182
Focus Area 3: Warren Wilson College	\$859,428
Focus Area 4: Oteen/East Asheville	\$2,845,937
Focus Area 5: Azalea Road Connection	\$1,002,563
	\$10,309,361

Focus Area 1: Ridgecrest & Black Mountain

Probable Cost Estimate

Cost estimates are preliminary and subject to change

	Units	Quantity	Cost Per Unit	Costs
Grading & Trail Development				
Clearing and Grubbing (30')	AC	22	\$5,000.00	\$109,063
10' Asphalt Trail	LF	31,672	\$35.00	\$1,108,520
			<i>SUB-TOTAL</i>	\$1,217,583
Planning, Design, Permitting & Engineering				
Environmental Permitting (phase I EA)	LS	3	\$5,000.00	\$15,000
Controlled access (Petty bridge & behind Ingles Distribution Ctr.)	EA	2	\$15,000.00	\$30,000
No-Rise Studies & Permitting***	EA	4	\$6,000.00	\$24,000
Design & Engineering (12% of Construction)		12%		\$255,285
Surveying	LF	31,672	\$0.78	\$24,704
Railroad on-grade crossing**	EA	2	\$100,000.00	\$200,000
			<i>SUB-TOTAL</i>	\$548,989
Trailhead				
Kiosks (educational/maps)	EA	3	\$7,500.00	\$22,500
Signage	EA	2	\$2,500.00	\$5,000
Trash Receptacles (trailheads)	EA	3	\$300.00	\$900
Trailhead Parking Space	PS	30	\$5,000.00	\$150,000
Stone Columns (located @ key intersections & trailheads)	EA	6	\$800.00	\$4,800
			<i>SUB-TOTAL</i>	\$183,200
Trail Amenities				
Fence (anticipated for safety and landowner buffers)	LF	8,619	\$4.50	\$38,786
Multi-Use Bridge (assumed pre-manufactured)*	LF	60	\$1,500.00	\$90,000
Culverts (incidental-avg of 30lf/culvert)	LF	50	\$1,500.00	\$75,000
Removable Bollards (3 per trail/road intersection)	EA	30	\$500.00	\$15,000
Retaining Walls	FF	11,200	\$25.00	\$280,000
Benches (1 per 1/2 mile)	EA	12	\$800.00	\$9,598
Trash Receptacles (1 per 1/2 mile)	EA	12	\$300.00	\$3,599
Warning & Directional Signage	EA	10	\$300.00	\$3,000
Mile Markers (rounded up from trail length)	EA	6	\$400.00	\$2,399
Bicycle Rack (at trailheads)	EA	3	\$800.00	\$2,400
			<i>SUB-TOTAL</i>	\$519,782
Site Improvements				
Landscape/Plantings Enhancements	LS		\$30,000.00	\$30,000
Stormwater BMPs	LF	31,672	\$11.36	\$359,794
			<i>SUB-TOTAL</i>	\$389,794

\$2,859,348	SUBTOTAL
--------------------	-----------------

\$428,902	15% Contingency
------------------	------------------------

\$3,288,251	TOTAL
--------------------	--------------

Italicized cells indicate items considered as part of "construction" that will require design & engineering

* Pedestrian only suspension bridge would be significantly less.

**Permitting will be time consuming and new crossings are discouraged by the rail road. It is recommend to include fencing along the rails for some distance each side of the crossing to keep greenway uses on the path. Also, pedestrian cross arms may be required

*** if multiple locations are within a phase, cost may be reduced if they can be combined into one study. Cost is assuming necessary surveying is obtained with surveying for the base project.

UNITS:

FF= Face Foot (length x avg 4' height)

EA= each

LS= lump sum

LF= linear foot

SF= square foot

AC= acre

PS=parking space (includes access & drive isles)

Notes: 1.)Cost estimate does not include the following: landowner outreach, traffic impact studies, land acquisition, wetland determination/delineation, potential rock and unsuitable soils excavation, permitting fees, mobilization, utility coordination, attorney costs, transactional fees and taxes. 2.)Trail costs include sub-base and surfacing. 3.) Bridge engineering is included by bridge manufacturer when pre-manufactured bridges are used. 4.) Cost estimate does not include approximately 5,000 LF of road improvements from the Buncombe County Line to the Point Lookout Trailhead.

Focus Area 2: Swannanoa (Pool to Park)

Probable Cost Estimate

Cost estimates are preliminary and subject to change

	Units	Quantity	Cost Per Unit	Costs
Grading & Trail Development				
Clearing and Grubbing (30')	AC	16	\$5,000.00	\$79,869
10' Asphalt Trail	LF	23,194	\$35.00	\$811,790
			<i>SUB-TOTAL</i>	\$891,659
Planning, Design, Permitting & Engineering				
Environmental Permitting (phase I EA)	LS	1	\$5,000.00	\$5,000
No-Rise Studies & Permitting***	EA	3	\$6,000.00	\$18,000
Design & Engineering (12% of Construction)		12%		\$164,057
Surveying	LF	23,194	\$0.78	\$18,091
			<i>SUB-TOTAL</i>	\$205,148
Trailhead				
Kiosks (educational/maps)	EA	4	\$7,500.00	\$30,000
Signage (interpretive)	EA	6	\$2,500.00	\$15,000
Trash Receptacles (trailheads)	EA	3	\$300.00	\$900
Trailhead Parking Space	PS	20	\$5,000.00	\$100,000
Stone Columns (located @ key intersections & trailheads)	EA	14	\$800.00	\$11,200
			<i>SUB-TOTAL</i>	\$157,100
Trail Amenities				
Fence (anticipated for safety and landowner buffers)	LF	500	\$4.50	\$2,250
Multi-Use Bridge (assumed pre-manufactured)*	LF	240	\$1,500.00	\$360,000
Culverts (incidental-avg of 30lf/culvert)	LF	50	\$1,500.00	\$75,000
Removable Bollards (3 per trail/road intersection)	EA	9	\$500.00	\$4,500
Retaining Walls	FF	500	\$25.00	\$12,500
Benches (1 per 1/2 mile)	EA	9	\$800.00	\$7,028
Trash Receptacles (1 per 1/2 mile)	EA	9	\$300.00	\$2,636
Warning & Directional Signage	EA	12	\$300.00	\$3,600
Mile Markers (rounded up from trail length)	EA	4	\$400.00	\$1,757
Bicycle Rack (at trailheads)	EA	6	\$800.00	\$4,800
			<i>SUB-TOTAL</i>	\$474,071
Site Improvements				
Landscape/Plantings Enhancements	LS		\$20,000.00	\$20,000
Stormwater BMPs	LF	23,194	\$11.36	\$263,484
			<i>SUB-TOTAL</i>	\$283,484

\$2,011,463	SUBTOTAL
--------------------	-----------------

\$301,719	15% Contingency
------------------	------------------------

\$2,313,182.17	TOTAL
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Italicized cells indicate items considered as part of "construction" that will require design & engineering

* Pedetrian only suspension bridge would be significantly less. Bridge engineering is included by bridge manufacturer when pre-manufactured bridges are used.

**Permitting will be time consuming and new crossings are discouraged by the rail road. It is recommend to include fencing along the rails for some distance each side of the crossing to keep greenway uses on the path. Also, pedestrian cross arms may be required.

*** if multiple locations are within a phase, cost may be reduced if they can be combined into one study. Cost is assuming necessary surveying is obtained with surveying for the base project.

UNITS:

FF= Face Foot (length x 4' height)

EA= each

LS= lump sum

LF= linear foot

SF= square foot

AC= acre

PS=parking space (includes access & drive isles)

Notes: 1.)Cost estimate does not include the following: landowner outreach, traffic impact studies, land acquisition, wetland determination/delineation, potential rock and unsuitable soils excavation, permitting fees, mobilization, utility coordination, attorney costs, transactional fees and taxes. 2.)Trail costs include sub-base and surfacing. 3.) Improvements to Whitson Bridge (lane reductions, etc.) is included as a proposed bridge line item

Focus Area 3: Warren Wilson College

Probable Cost Estimate

Cost estimates are preliminary and subject to change

	Units	Quantity	Cost Per Unit	Costs
Grading & Trail Development				
10' Trail	MI	1.14	\$400,000.00	\$456,515
			<i>SUB-TOTAL</i>	\$456,515
Planning, Design, Permitting & Engineering				
No-Rise Studies & Permitting***	LS	1	\$6,000.00	\$6,000
Design & Engineering (12% of Construction)		12%		\$64,919
Surveying	LF	6026	\$0.78	\$4,700
			<i>SUB-TOTAL</i>	\$75,619
Trailhead				
Information/Map Kiosks	EA	1	\$7,500.00	\$7,500
River Put-in/Take-Out (Improvements)	EA	2	\$3,000.00	\$6,000
Removable Bollards	EA	9	\$500.00	\$4,500
			<i>SUB-TOTAL</i>	\$18,000
Trail Amenities				
Fence	LF	6026	\$4.50	\$27,117
Multi-Use Bridge*	LF	60	\$1,500.00	\$90,000
Bicycle Rack	EA	2	\$800.00	\$1,600
			<i>SUB-TOTAL</i>	\$118,717
Site Improvements				
Landscape/Plantings Enhancements	LS		\$10,000.00	\$10,000
Stormwater BMPs/MI	MI	1.14	\$60,000.00	\$68,477
			<i>SUB-TOTAL</i>	\$78,477
			\$747,329	SUBTOTAL
			\$112,099	15% Contingency
			\$859,428	TOTAL

Italicized cells indicate items considered as part of "construction" that will require design & engineering

*Pedestrian only suspension bridge would be significantly less. Bridge engineering

*** if multiple locations are within a phase, cost may be reduced if they can be combined into one study. Cost is assuming necessary surveying is obtained with surveying for the base project.

Units:

EA= each

LS= lump sum

LF= linear foot

MI= Mile

Notes: Notes: 1.)Cost estimate does not include the following: landowner outreach, traffic impact studies, land acquisition, wetland determination/delineation, potential rock and unsuitable soils excavation, permitting fees, mobilization, utility coordination, attorney costs, transactional fees and taxes 2.)Trail costs are based on historic project costs with varying conditions. Costs include clearing and grubbing, paving, base, geogrid, minor storm drain pipe, erosion control features, plantings, signs, pavement markings, minor modular retaining walls.

Focus Area 4: Oteen/East Asheville

Probable Cost Estimate

Cost estimates are preliminary and subject to change

	Units	Quantity	Cost Per Unit	Costs
Grading & Trail Development				
10' Asphalt Trail	MI	4.58	\$400,000.00	\$1,833,409
			<i>SUB-TOTAL</i>	\$1,833,409
Planning, Design, Permitting & Engineering				
No-Rise Studies & Permitting***	LS	1	\$6,000.00	\$6,000
Design & Engineering (12% of Construction)		12%		\$260,930
Surveying	LF	24201	\$0.78	\$18,877
			<i>SUB-TOTAL</i>	\$285,807
Trailhead				
Trailhead Parking Space	EA	10	\$5,000.00	\$50,000
Information/Map Kiosks	EA	1	\$7,500.00	\$7,500
River Put-in/Take-Out (Improvements)	EA	2	\$3,000.00	\$6,000
Removable Bollards	EA	9	\$500.00	\$4,500
			<i>SUB-TOTAL</i>	\$68,000
Trail Amenities				
Fence	LF	200	\$4.50	\$900
Bicycle Rack	EA	2	\$800.00	\$1,600
			<i>SUB-TOTAL</i>	\$2,500
Site Improvements				
Landscape/Plantings Enhancements	LS		\$10,000.00	\$10,000
Stormwater BMPs/MI	MI	4.58	\$60,000.00	\$275,011
			<i>SUB-TOTAL</i>	\$285,011
				\$2,474,728 SUBTOTAL
				\$371,209 15% Contingency
				\$2,845,937 TOTAL

Italicized cells indicate items considered as part of "construction" that will require design & engineering

* Pedestrian only suspension bridge would be significantly less.

*** if multiple locations are within a phase, cost may be reduced if they can be combined into one study. Cost is assuming necessary surveying is obtained with surveying for the base project.

Units:

EA= each

LS= lump sum

LF= linear foot

MI= Mile

Notes: 1.) Cost estimate does not include the following: landowner outreach, re-alignment of roads, land acquisition, wetland determination/delineation, potential rock and unsuitable soils excavation, permitting fees, mobilization, utility coordination, attorney costs, transactional fees and taxes. 2.) Trail costs include clearing and grubbing, paving, base, geogrid, minor storm drain pipe, erosion control features, plantings, signs, pavement markings, minor modular retaining walls.

Focus Area 5: Azalea Road Connection

Probable Cost Estimate

Cost estimates are preliminary and subject to change

	Units	Quantity	Cost Per Unit	Costs
Grading & Trail Development				
Clearing and Grubbing	AC	4	\$5,000.00	\$20,634
10' Asphalt Trail	LF	5,992	\$35.00	\$209,720
			<i>SUB-TOTAL</i>	\$230,354
Planning, Design, Permitting & Engineering				
Environmental Permitting (phase I EA)	LS	1	\$5,000.00	\$5,000
No-Rise Studies & Permitting***	EA	1	\$6,000.00	\$6,000
Design & Engineering (12% of Construction)		12%		\$54,351
Surveying	LF	5,992	\$0.78	\$4,674
			<i>SUB-TOTAL</i>	\$70,024
Trailhead				
Kiosks (educational/maps)	EA	2	\$7,500.00	\$15,000
Signage	EA	2	\$2,500.00	\$5,000
Trash Receptacles (trailheads)	EA	2	\$300.00	\$600
Trailhead Parking Space	PS	5	\$5,000.00	\$25,000
Stone Columns (located @ key intersections & trailheads)	EA	2	\$800.00	\$1,600
			<i>SUB-TOTAL</i>	\$47,200
Trail Amenities				
Fence (anticipated for safety and landowner buffers)	LF	100	\$4.50	\$450
Multi-Use Bridge (assumed pre-manufactured)*	LS	210	\$1,500.00	\$315,000
Culverts (incidental-avg of 30lf/culvert)	LF	10	\$1,500.00	\$15,000
Removable Bollards (3 per trail/road intersection)	EA	9	\$500.00	\$4,500
Retaining Walls	FF	4,000	\$25.00	\$100,000
Benches (1 per 1/2 mile)	EA	2	\$800.00	\$1,816
Trash Receptacles (1 per 1/2 mile)	EA	2	\$300.00	\$681
Warning & Directional Signage	EA	6	\$300.00	\$1,800
Educational Signage & Stands (1/mile)	EA	1	\$4,500.00	\$4,500
Mile Markers (rounded up from trail length)	EA	2	\$400.00	\$800
Bicycle Rack (at trailheads)	EA	2	\$800.00	\$1,600
			<i>SUB-TOTAL</i>	\$446,147
Site Improvements				
Landscape/Plantings Enhancements	LS		\$10,000.00	\$10,000
Stormwater BMPs	LF	5,992	\$11.36	\$68,069
			<i>SUB-TOTAL</i>	\$78,069
			\$871,794	SUBTOTAL
			\$130,769	15% Contingency
			\$1,002,563	TOTAL

Italicized cells indicate items considered as part of "construction" that will require design & engineering

* Pedestrian only suspension bridge would be significantly less. This cost also includes potential decking beneath US 70.

**Permitting will be time consuming and new crossings are discouraged by the rail road. It is recommend to include fencing along the rails for some distance each side of the crossing to keep greenway uses on the path. Also, pedestrian cross arms may be required

*** if multiple locations are within a phase, cost may be reduced if they can be included into one study. Cost is assuming necessary surveying is obtained with surveying for the base project.

UNITS:

FF= Face Foot (length x 4' height)

EA= each

LS= lump sum

LF= linear foot

SF= square foot

AC= acre

PS=parking space (includes access & drive isles)

Notes: 1.)Cost estimate does not include the following: landowner outreach, re-alignment of road, traffic impact studies, Hwy 70 underpass (low flow alignment), land acquisition, wetland determination/delineation, potential rock and unsuitable soils excavation, permitting fees, mobilization, utility coordination, attorney costs, transactional fees and taxes. 2.)Trail costs include sub-base and surfacing. 3.) Bridge engineering is included by bridge manufacturer when pre-manufactured bridges are used.

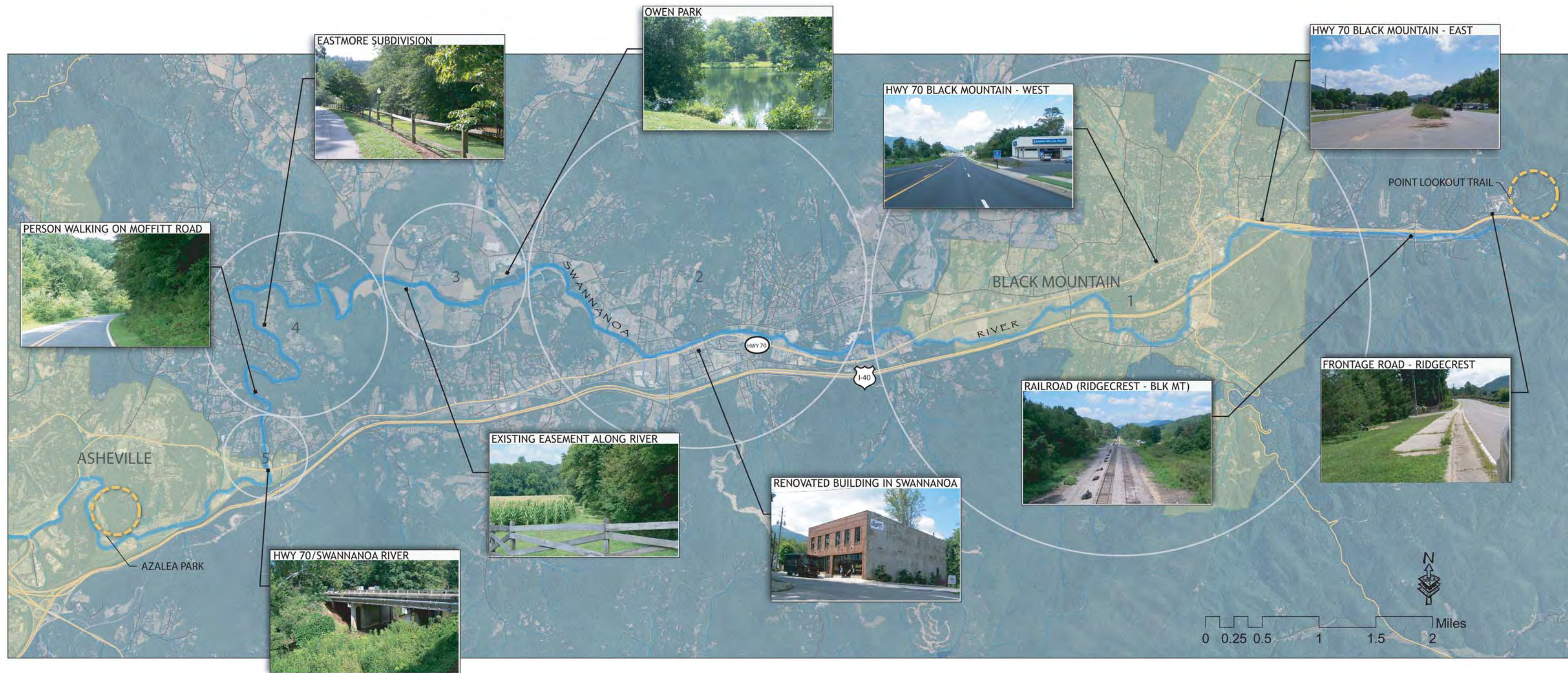
Overall Corridor Recommendations

- **FEMA Buyout Properties:** Buncombe County through the FEMA buy-out program has acquired several parcels along the greenway corridor that are important to the greenway. These parcels are/have been conveyed to RiverLink. It is recommended that RiverLink allow multiple-use trail(s) on FEMA buy-out properties.
- **Road Diet along US 70:** The regional greenway study should be included by the MPO as a specific project that is modeled in their Long Range Transportation Plan. The traffic model should evaluate a four lane cross section.
- Since much of the greenway corridor will be within the floodplain, stormwater treatment should be part of the greenway system. If US 70 is reduced in traffic lanes, then a “greenstreets” approach should be incorporated such that there is a bio-retention treatment island between the vehicular travel lane and the multi-modal pathway. In other more rural and natural locations bio-retention areas, constructed wetland, and bio-swailes in natural forms should be used to address runoff and stormwater treatment. The focus on stormwater treatment and protection of riparian buffers may provide additional funding opportunities for the greenway.
- Prior to any approvals for greenways to be located within an MSD sewer easement, a “Greenway Agreement” must be entered into between Buncombe County and MSD. The agreement is based on liability and will hold MSD harmless for any accidents that may occur with use of the greenway.
- The greenway project will take years to implement and be highly dependent on funding and the level of priority the county places on this greenway. While there are challenges, this greenway more so than any other greenway segment in the county has the ability to connect large population centers, provide key connections to parks, schools, business, and serve as a major alternative transportation option and recreational amenity in the county. It also serves as a major connection to the McDowell County and Morganton greenway system. The US 70/Swannanoa River Greenway corridor should be considered a top priority by the Buncombe County Greenways and Trails Commission.
- While the preferred route follows the Swannanoa River as much as possible, making the connections along the river may not be possible due to the need to acquire easements for the greenway from landowners and physical constraints of the corridor. There will be sections in which the greenway may need to follow a road and take the form of a sidewalk as an interim solution but the goal of an off-road greenway should be pursued. US 70 should also be evaluated for a “complete streets” approach and at minimum, include sidewalks.
- Detailed survey information should be obtained for areas in which additional work will be developed in future phases. The existing study is based on GIS information provided by the county such as NC DOT ROW, topography, and floodplain information and not surveyed data.
- Prior to acquiring greenway easements develop a program for acquiring easements which may include forming a partnership with a local land trust to hold easements for the greenway.
- Develop and adopt a landowner outreach strategy, process, and protocol to start landowner outreach and land acquisition for the greenway.
- Lands that are for sale in which the preferred alignment passes through should be acquired by the County as soon as they become available. As well, land for sale along the alternative greenway alignment should also be considered for purchase.
- The County should develop a strategy to address potential land speculation within the corridor which could drive cost up significantly for land acquisitions including greenway easements.
- Sections of the greenway should be built in one mile increments at minimum and engineering and design should not be pursued until all the land has been acquired or a one mile continuous greenway segment (may include sidewalks and bicycle lanes).
- Utilize areas identified by the Flood Risk Management Study that overlap with the greenway to help get sections of the greenway implemented.

- Within the entire corridor there are four (4) recommended pilot projects or sections of the greenway that should be considered top priorities:
 - Ridgecrest to the Petty Bridge
 - Boulder Park to Owen Park
 - Owen Park to Warren Wilson
 - US 70 to Hardesty Land/Azalea Road

Appendix A: Context Map

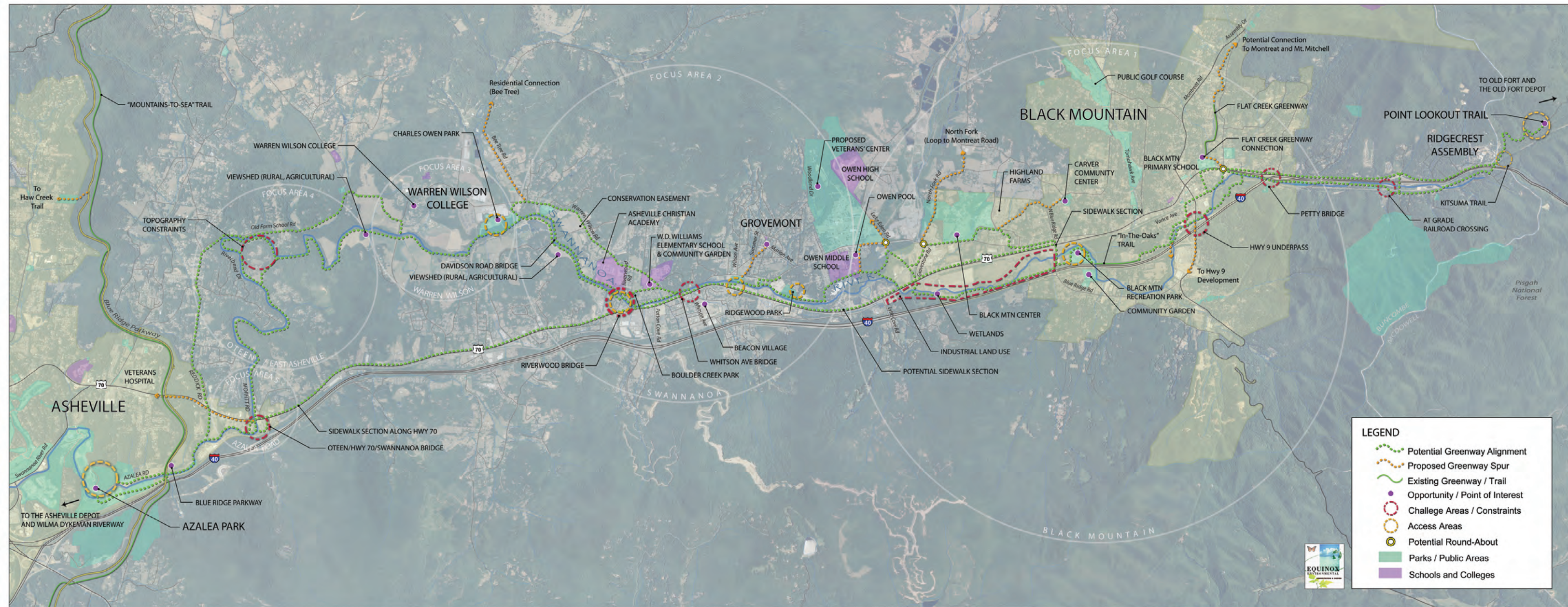
Project Understanding



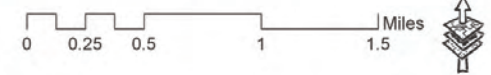
The US 70/Swannanoa River Greenway

Appendix B: Map of Possibilities

MAP OF POSSIBILITIES

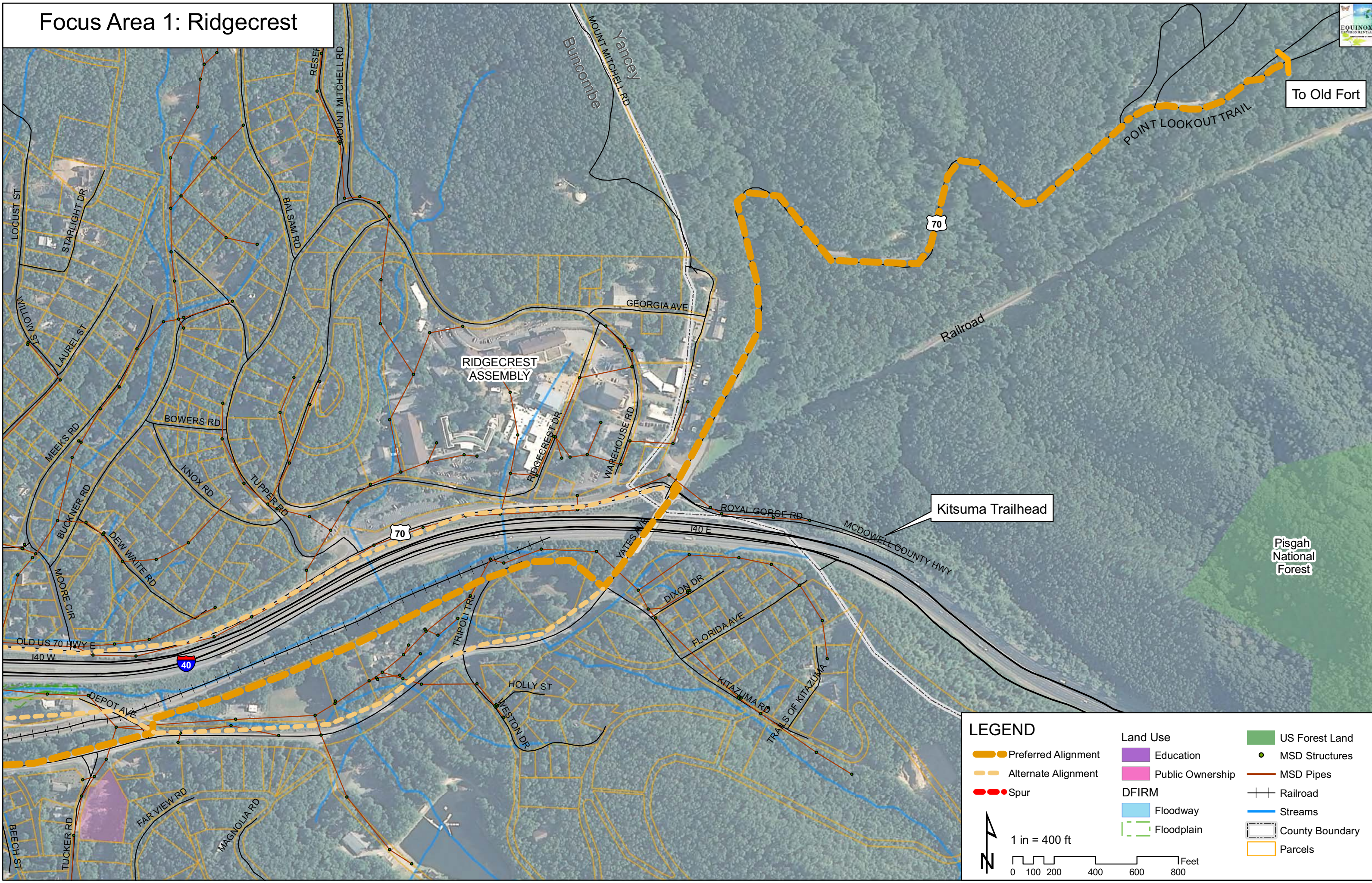


The US 70/Swannanoa River Greenway Feasibility Study



Appendix C: Focus Area Maps

Focus Area 1: Ridgecrest



To Old Fort

70

Railroad

RIDGECREST ASSEMBLY

Kitsuma Trailhead

Pisgah National Forest

LEGEND

- - - Preferred Alignment
- - - Alternate Alignment
- . . . Spur

- Land Use
- Education
 - Public Ownership
- DFIRM
- Floodway
 - - - Floodplain

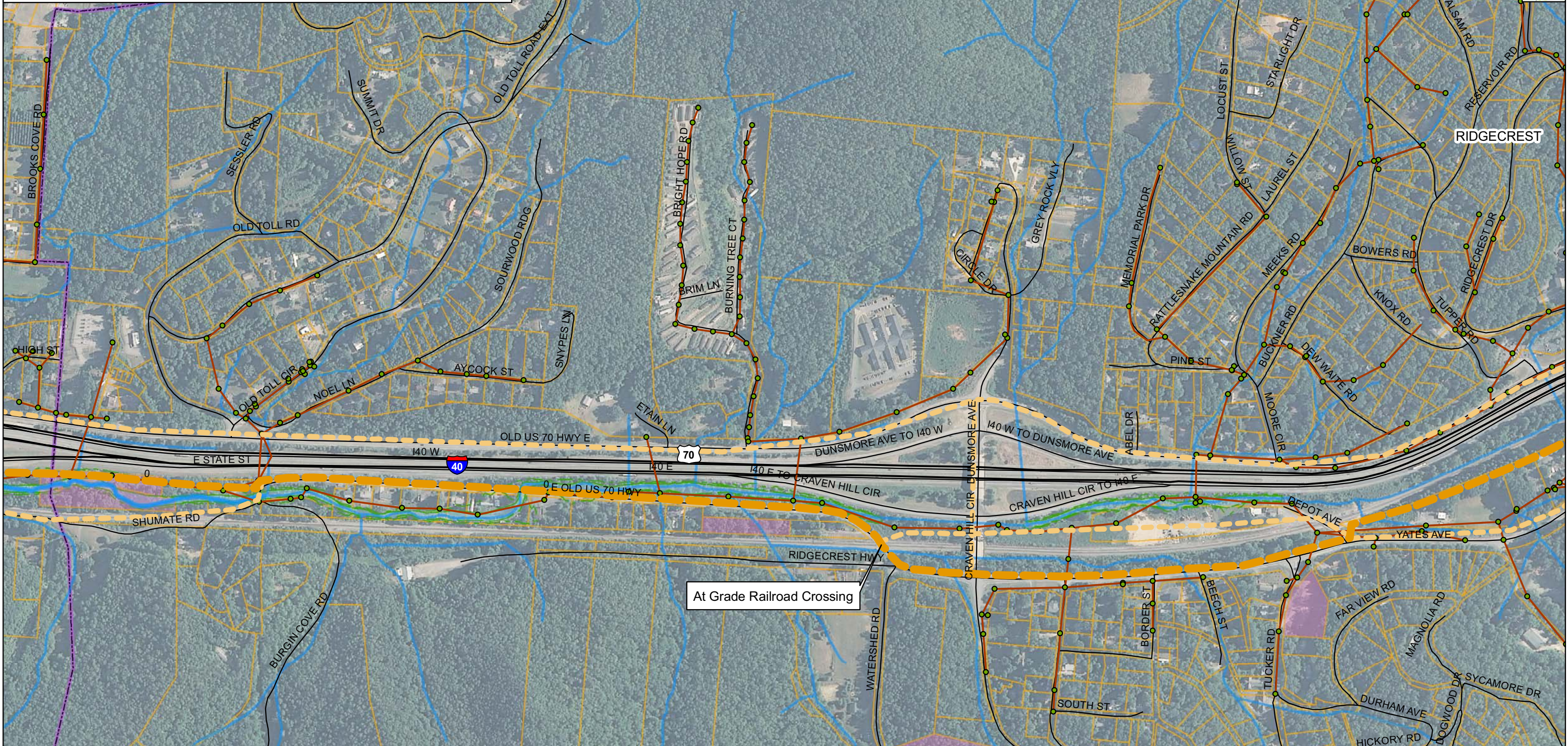
- US Forest Land
- MSD Structures
- MSD Pipes
- + + Railroad
- Streams
- County Boundary
- Parcels



1 in = 400 ft

0 100 200 400 600 800 Feet

Focus Area 2: Black Mountain-Ridgecrest

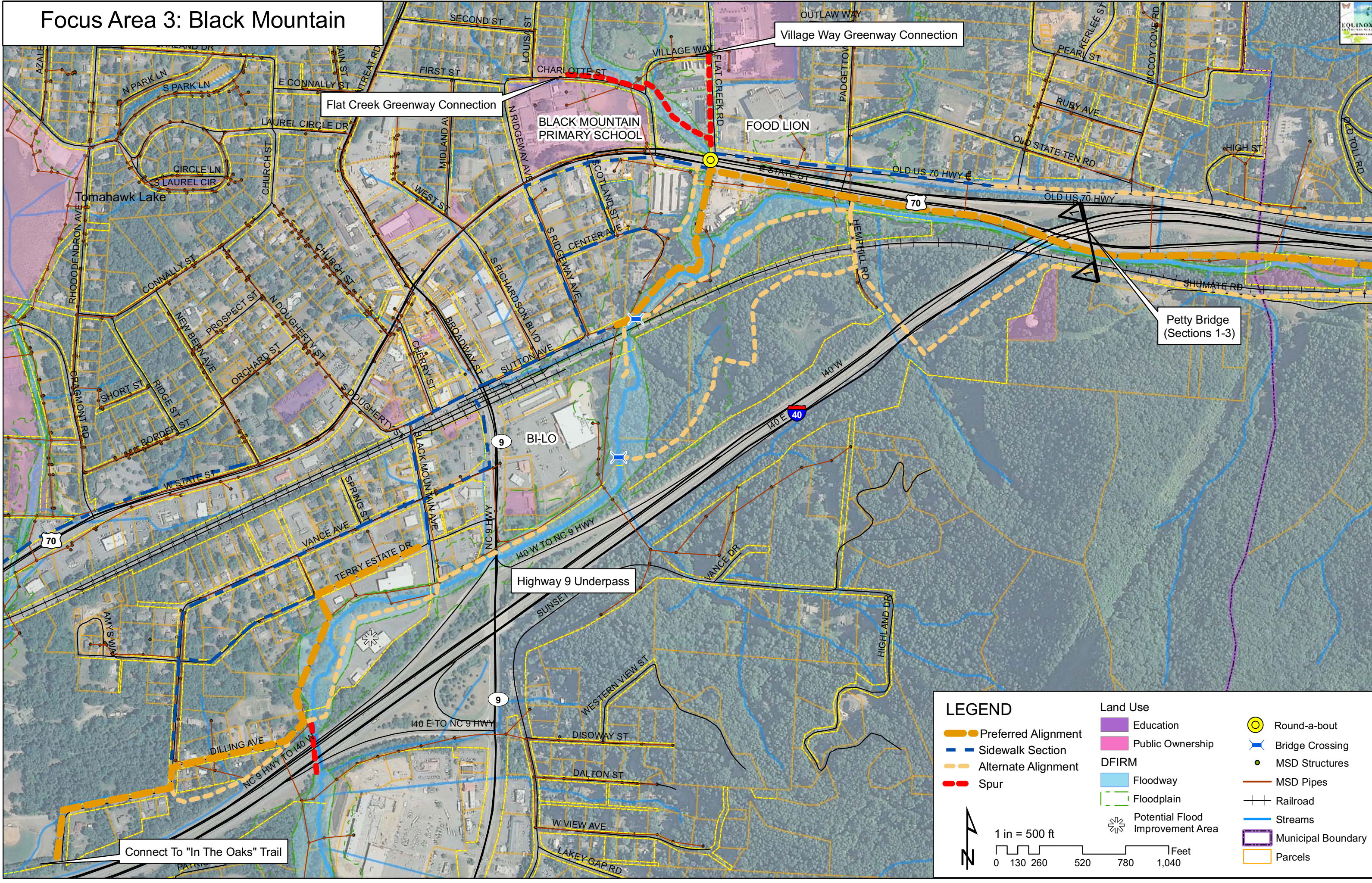


LEGEND

Potential Alignment	Education	MSD Structures
Alternate Alignment	Public Ownership	MSD Pipes
Spur	DFIRM	Railroad
	Floodway	Streams
	Floodplain	Municipal Boundary
		Parcels

1 in = 500 ft

Focus Area 3: Black Mountain



Flat Creek Greenway Connection

Village Way Greenway Connection

BLACK MOUNTAIN
PRIMARY SCHOOL

FOOD LION

Petty Bridge
(Sections 1-3)

Highway 9 Underpass

Connect To "In The Oaks" Trail

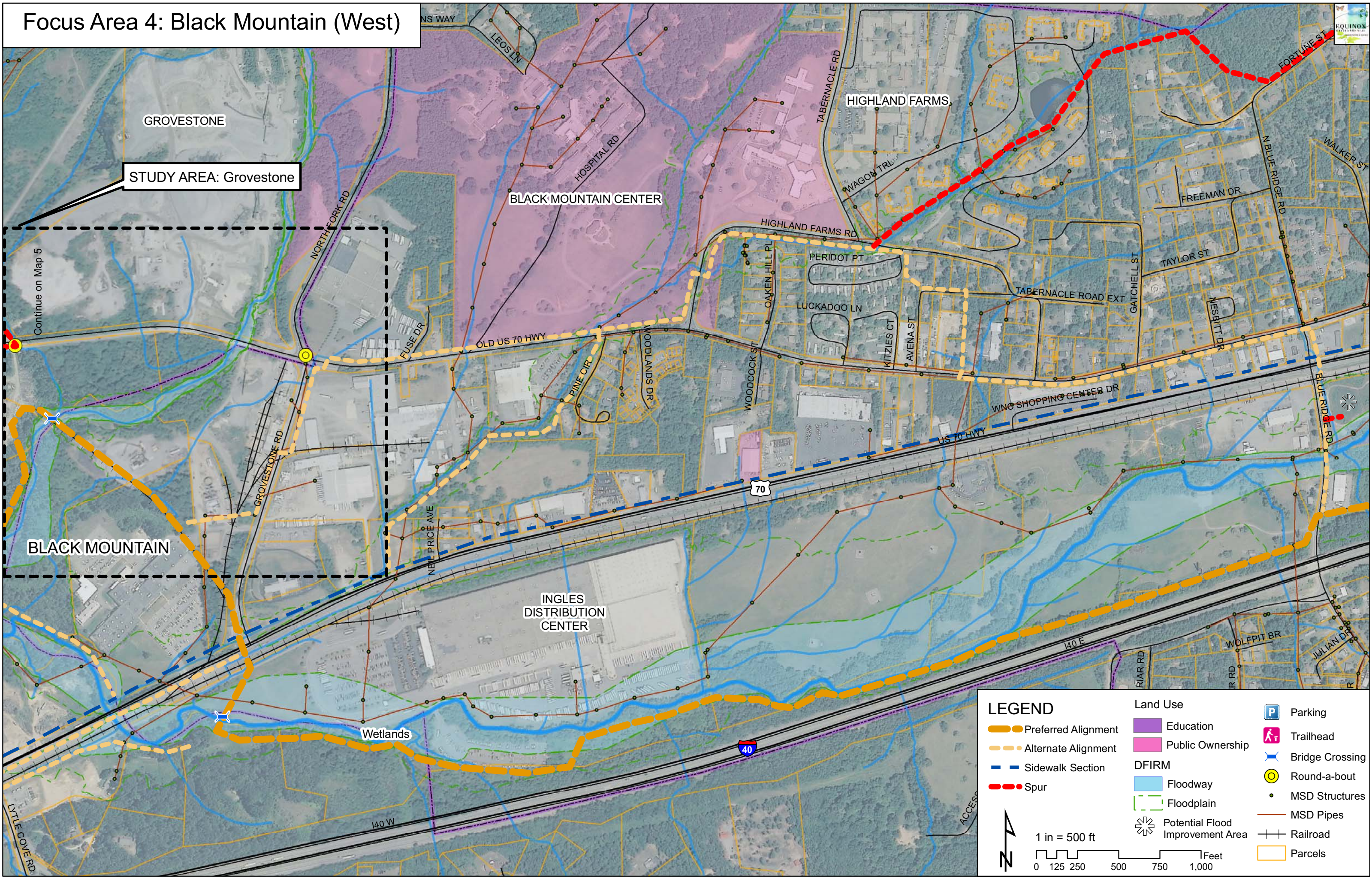
LEGEND

Preferred Alignment	Education	Round-a-bout
Sidewalk Section	Public Ownership	Bridge Crossing
Alternate Alignment	DFIRM	MSD Structures
Spur	Floodway	MSD Pipes
	Floodplain	Railroad
	Potential Flood Improvement Area	Streams
		Municipal Boundary
		Parcels

1 in = 500 ft

0 130 260 520 780 1,040 Feet

Focus Area 4: Black Mountain (West)



STUDY AREA: Grovestone

Continue on Map 5

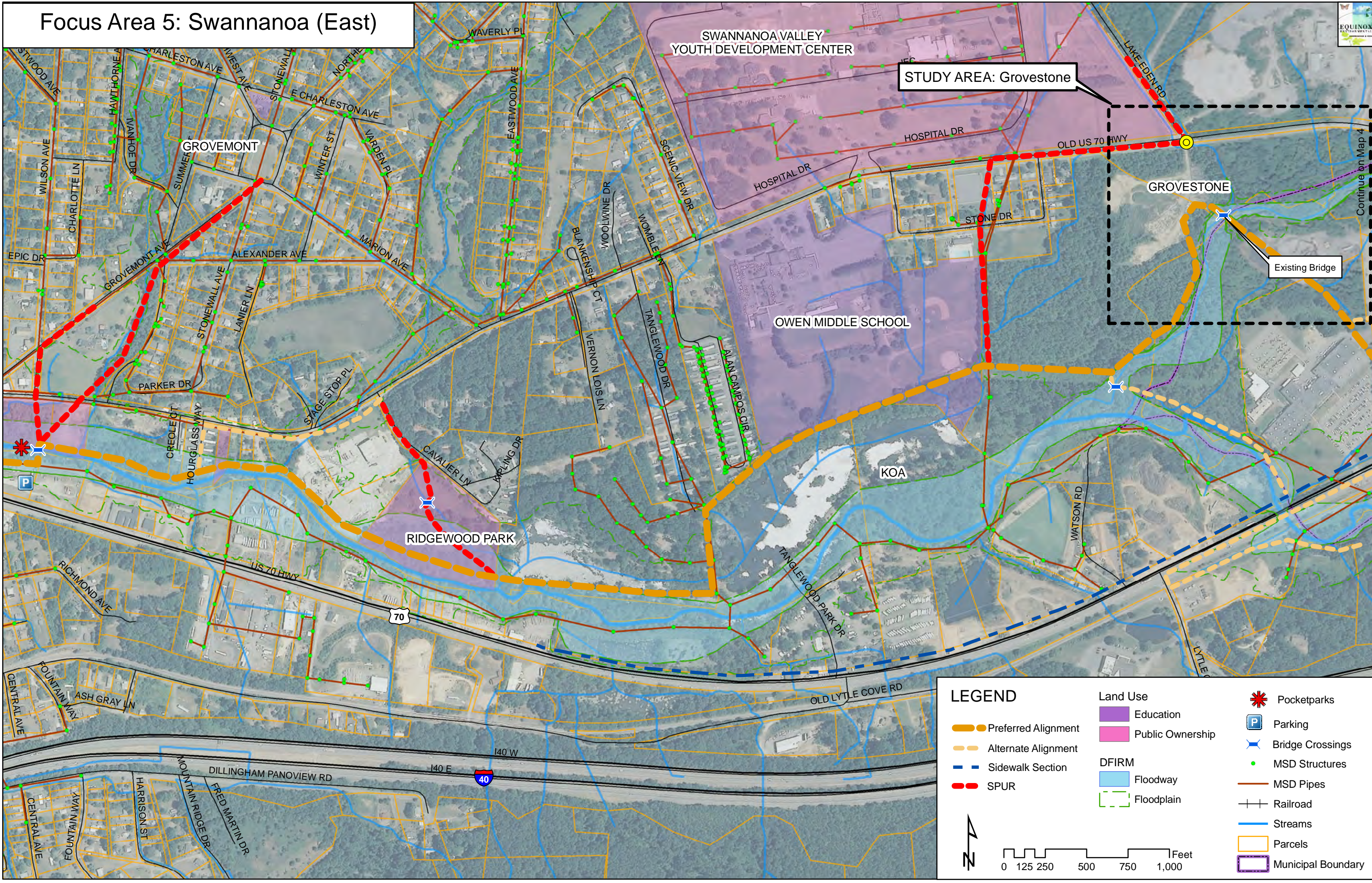
LEGEND

- | | | |
|---------------------|----------------------------------|-----------------|
| Preferred Alignment | Education | Parking |
| Alternate Alignment | Public Ownership | Trailhead |
| Sidewalk Section | DFIRM | Bridge Crossing |
| Spur | Floodway | Round-a-bout |
| | Floodplain | MSD Structures |
| | Potential Flood Improvement Area | MSD Pipes |
| | | Railroad |
| | | Parcels |



1 in = 500 ft
 0 125 250 500 750 1,000 Feet

Focus Area 5: Swannanoa (East)



STUDY AREA: Grovestone

GROVESTONE

Existing Bridge

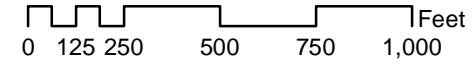
OWEN MIDDLE SCHOOL

KOA

RIDGEWOOD PARK

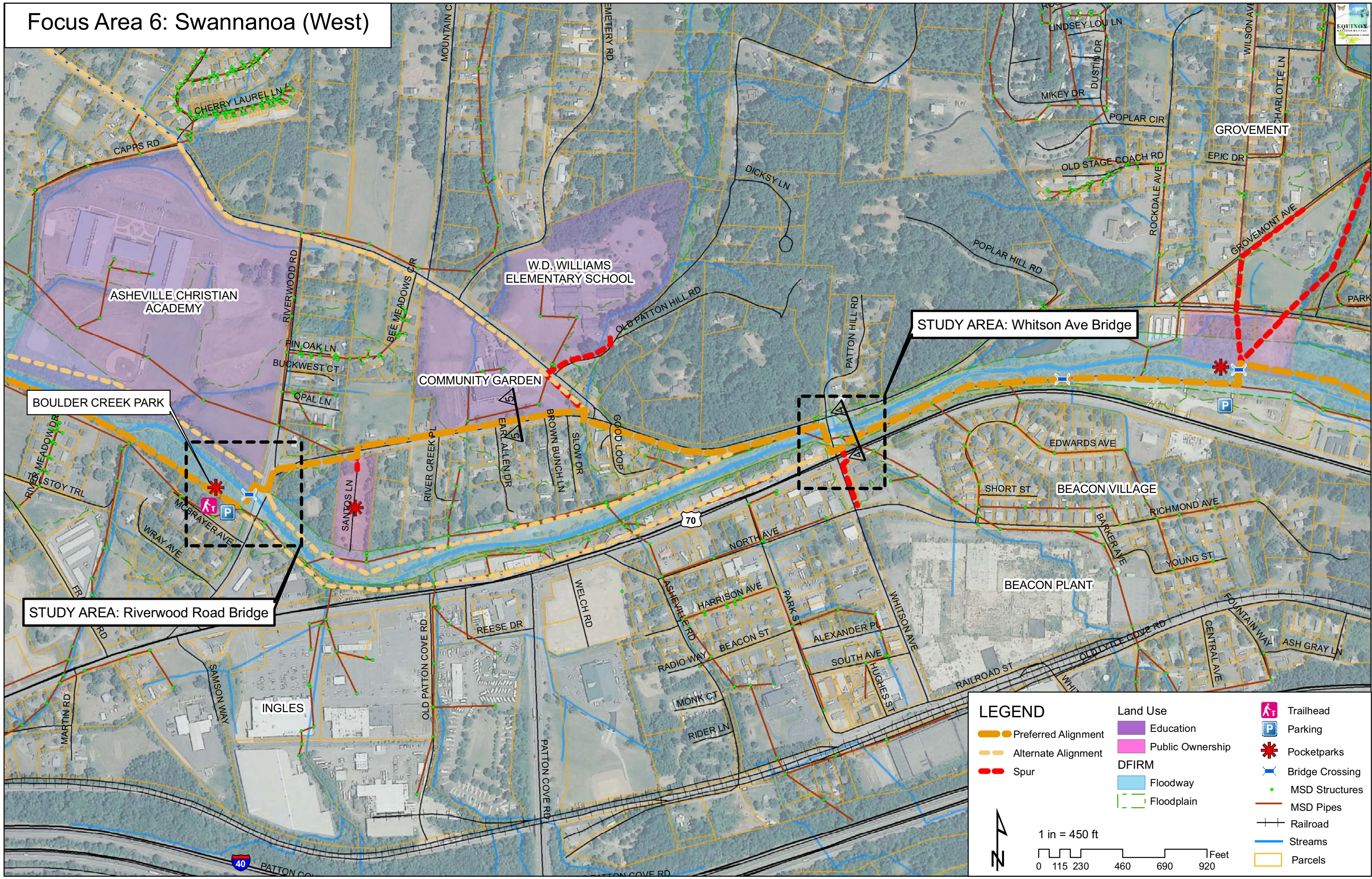
LEGEND

- | | | | | | |
|--|---------------------|--|--------------------|--|------------------|
| | Preferred Alignment | | Education | | Pocketparks |
| | Alternate Alignment | | Public Ownership | | Parking |
| | Sidewalk Section | | Floodway | | Bridge Crossings |
| | SPUR | | Floodplain | | MSD Structures |
| | | | MSD Pipes | | Railroad |
| | | | Streams | | Parcels |
| | | | Municipal Boundary | | |



Continue on Map 4

Focus Area 6: Swannanoa (West)



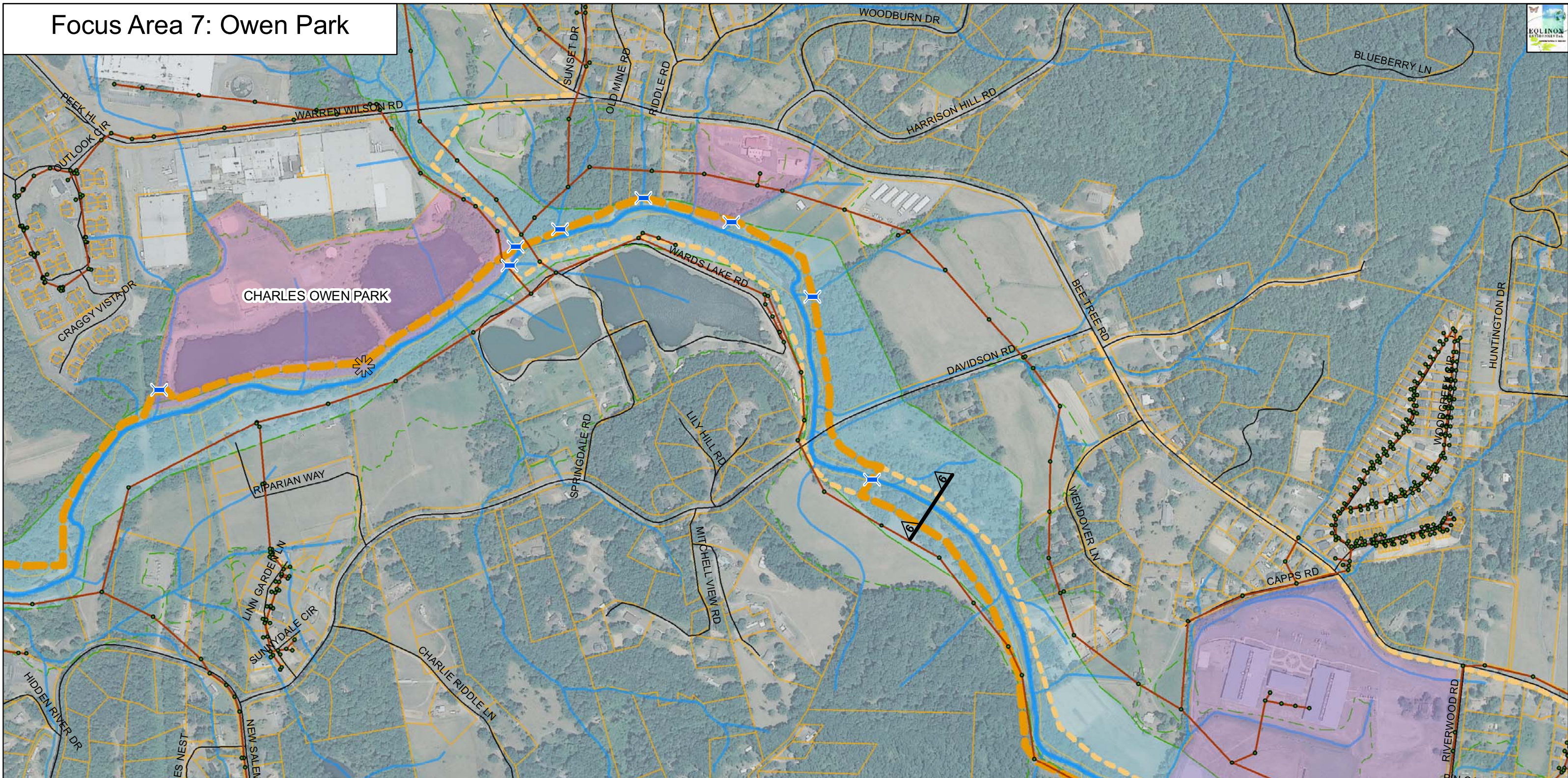
LEGEND

Preferred Alignment	Education	Trailhead
Alternate Alignment	Public Ownership	Parking
Spur	DFIRM	Pocketparks
	Floodway	Bridge Crossing
	Floodplain	MSD Structures
		MSD Pipes
		Railroad
		Streams
		Parcels

1 in = 450 ft

0 115 230 460 690 920 Feet

Focus Area 7: Owen Park

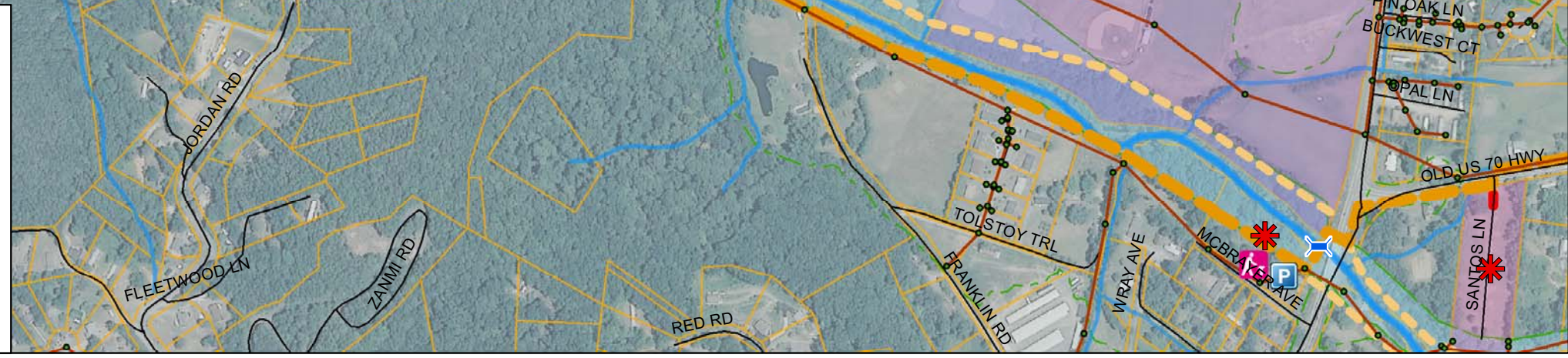


LEGEND

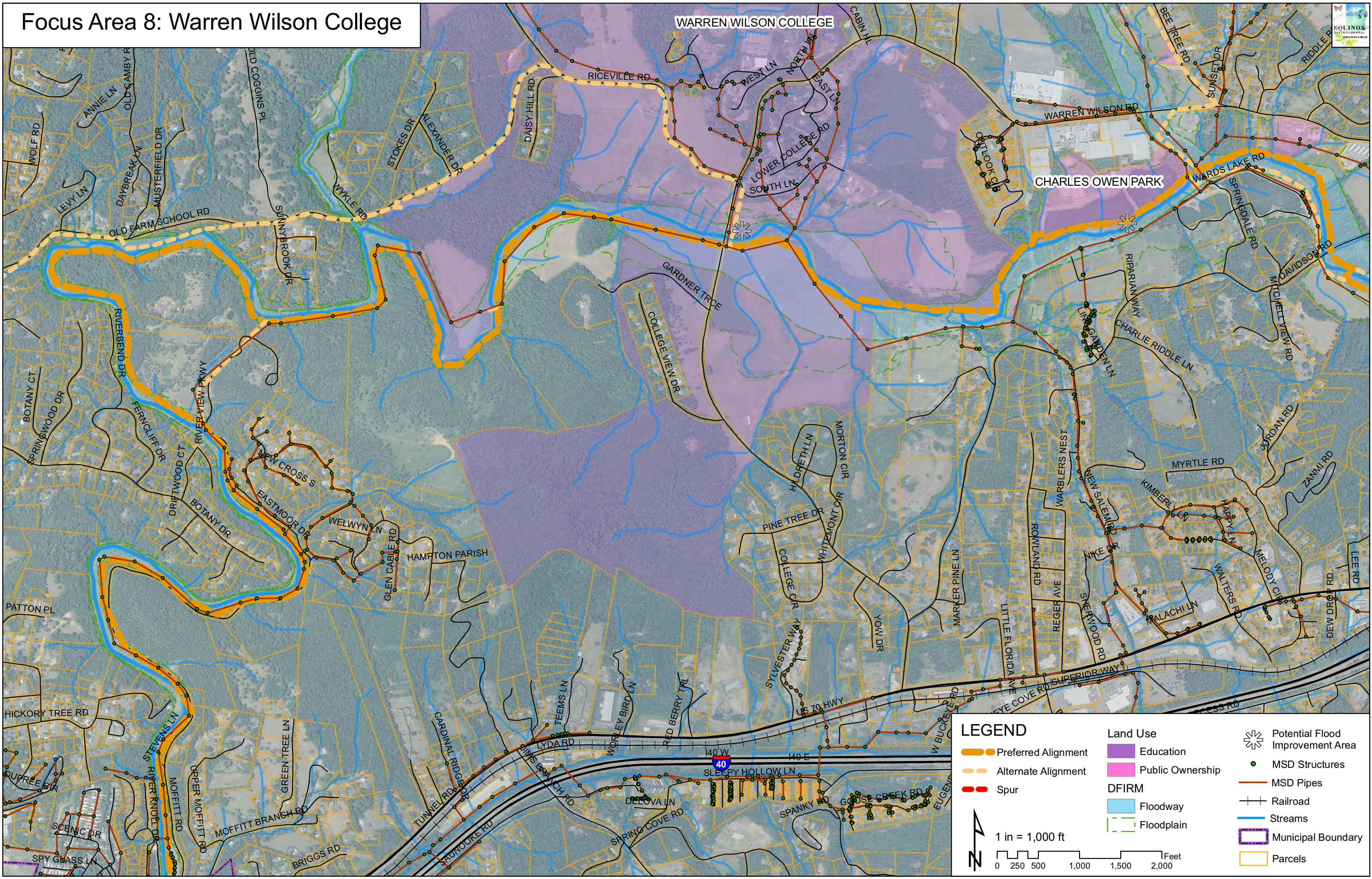
Preferred Alignment	Pocketpark	Education
Alternate Alignment	Potential Flood Improvement Area	Public Ownership
Spur	Trailhead	DFIRM
Parking	Round-a-bout	Floodway
	Bridge Crossing	Floodplain
	MSD Structures	Railroad
	MSD Pipes	Streams
		Municipal Boundary

1 in = 500 ft

0 125 250 500 750 1,000 Feet



Focus Area 8: Warren Wilson College



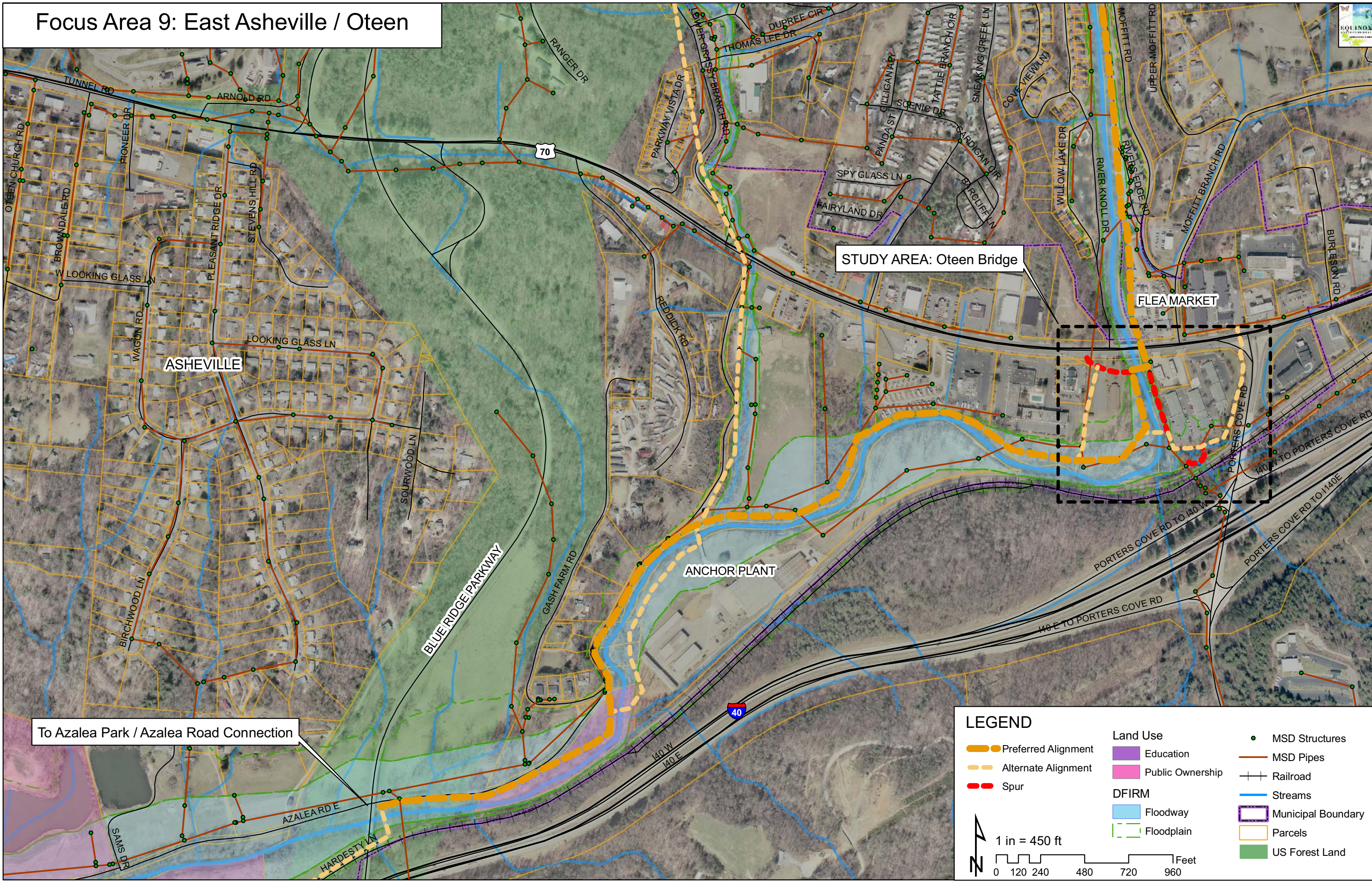
LEGEND

	Preferred Alignment		Education		Potential Flood Improvement Area
	Alternate Alignment		Public Ownership		MSD Structures
	Spur		Floodway		MSD Pipes
			Floodplain		Railroad
					Streams
					Municipal Boundary
					Parcels

1 in = 1,000 ft

0 250 500 1,000 1,500 2,000 Feet

Focus Area 9: East Asheville / Oteen



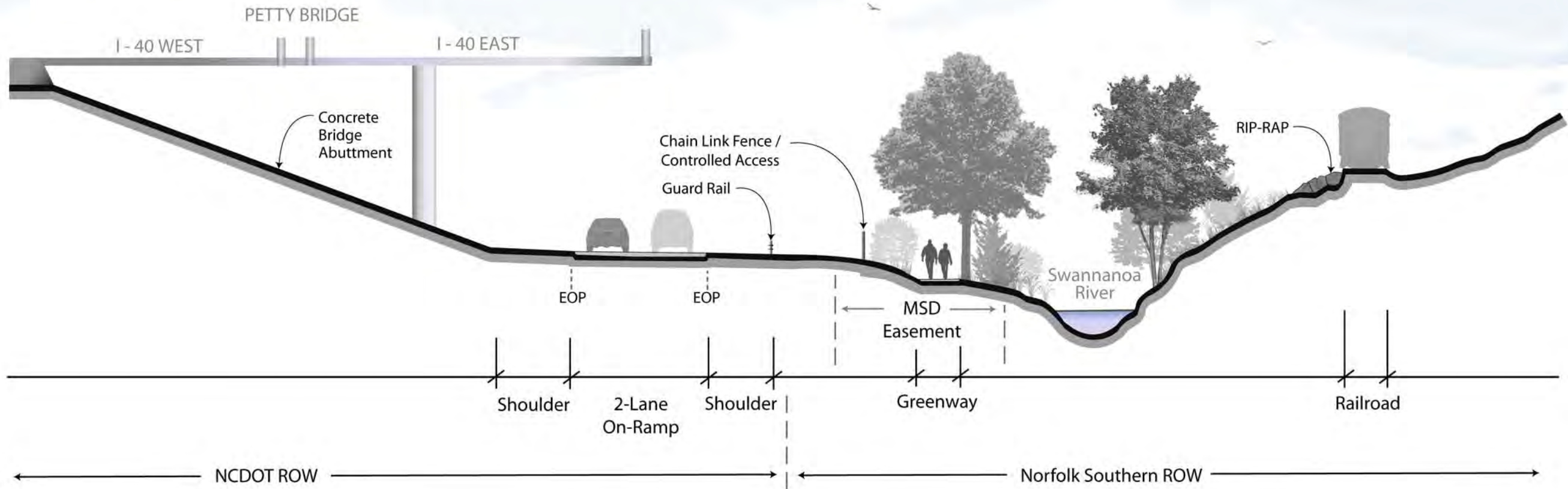
LEGEND

Preferred Alignment	Education	MSD Structures
Alternate Alignment	Public Ownership	MSD Pipes
Spur	DFIRM	Railroad
	Floodway	Streams
	Floodplain	Municipal Boundary
		Parcels
		US Forest Land

1 in = 450 ft

0 120 240 480 720 960 Feet

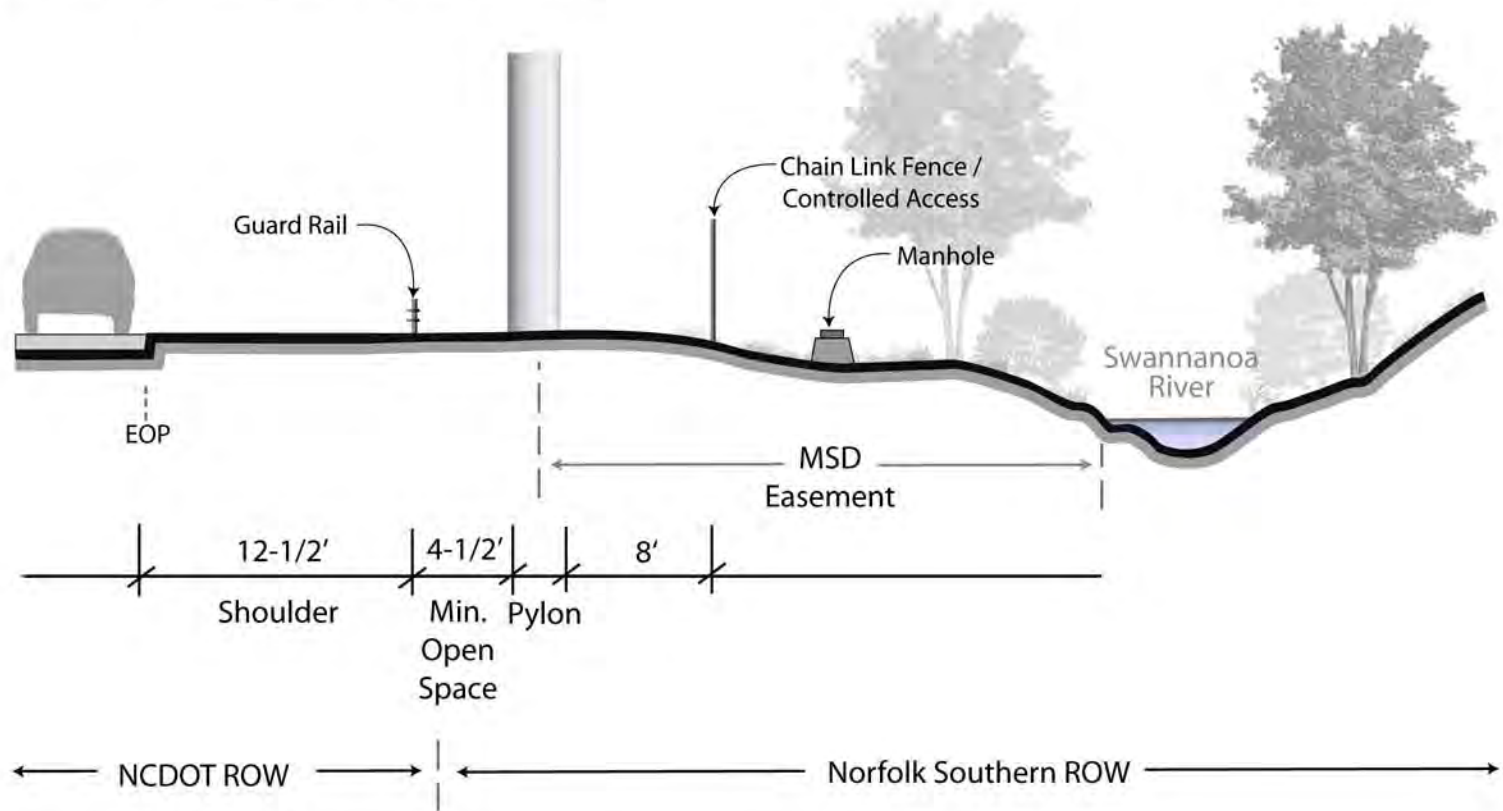
Appendix D: Possible Cross Sections



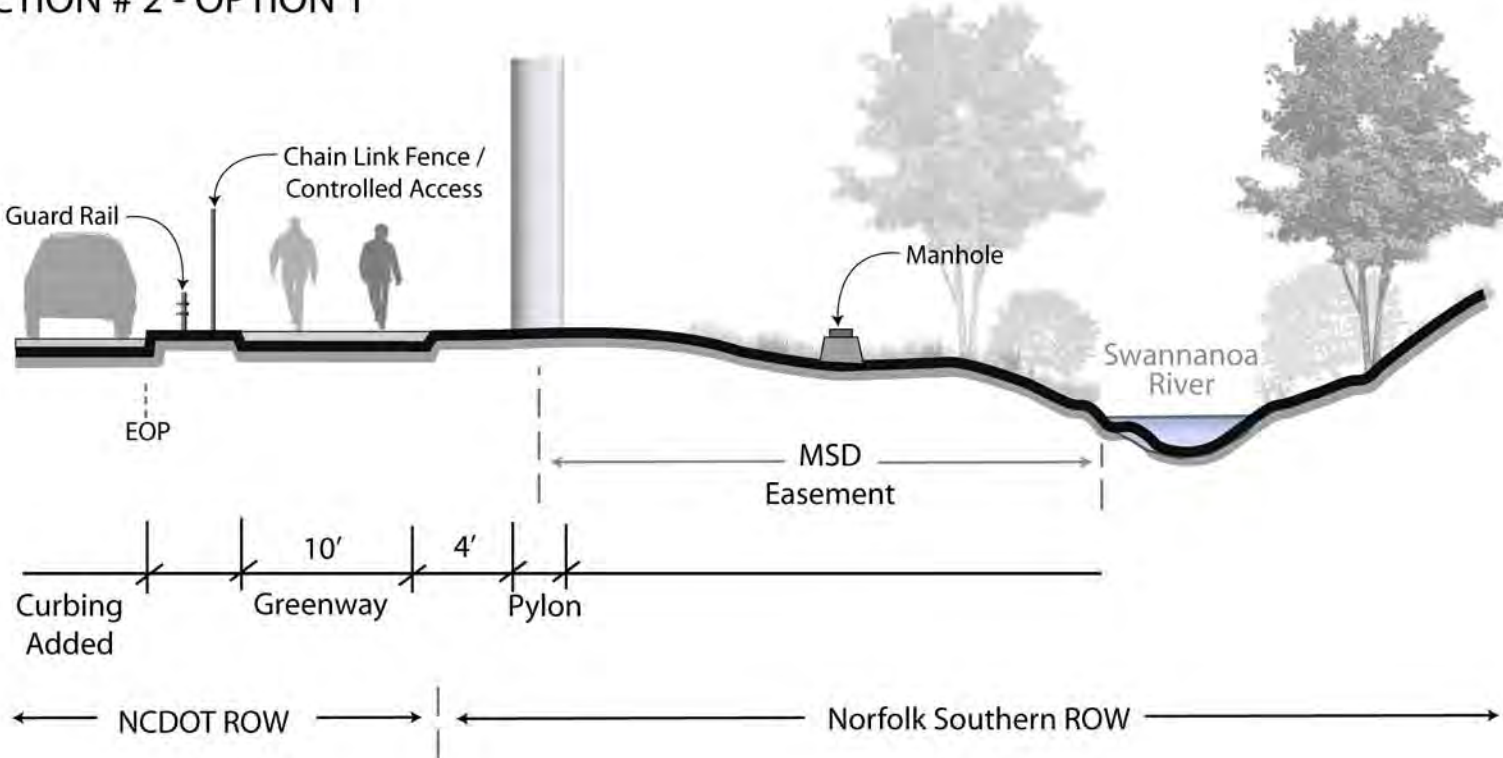
CROSS SECTION # 1 - PETTY BRIDGE
 US 70 / SWANNANOVA RIVER GREENWAY



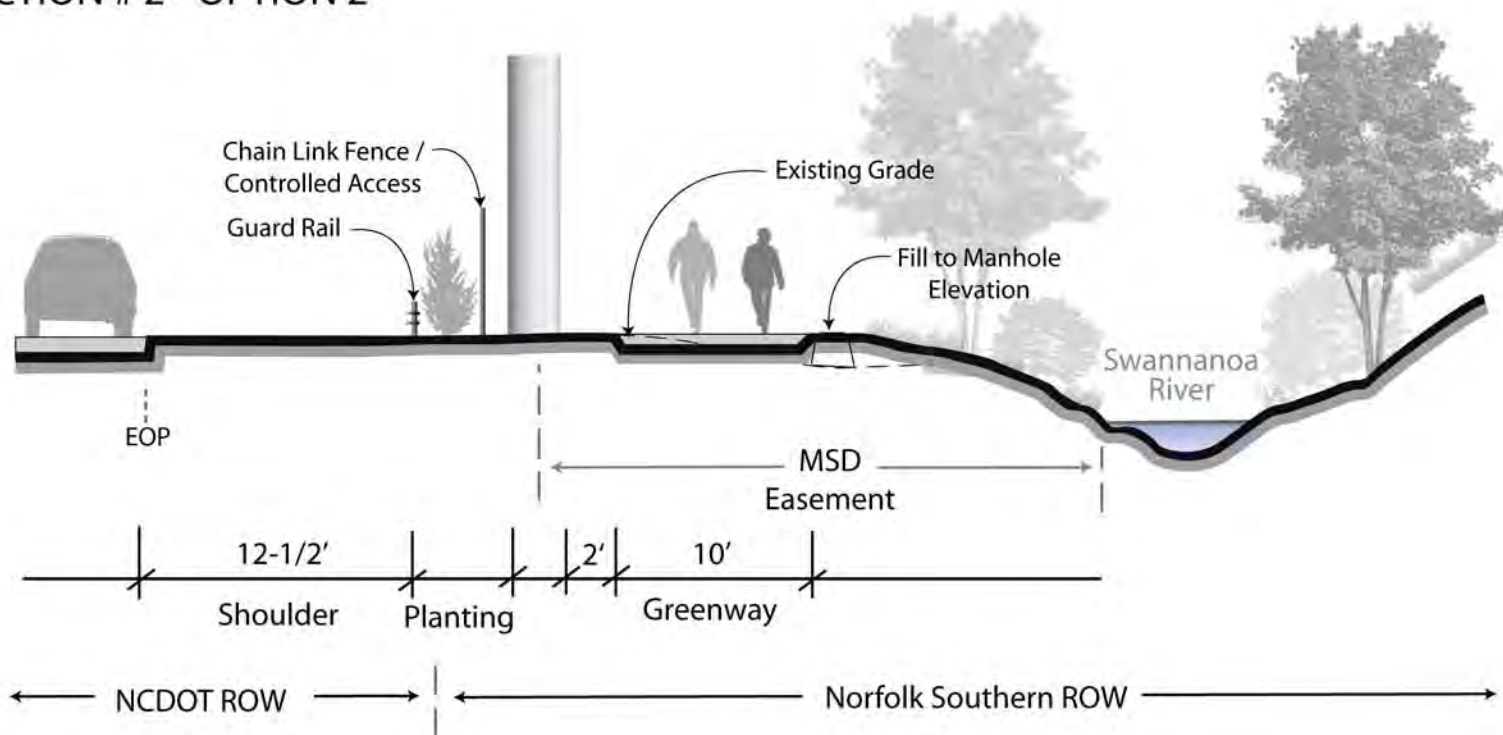
CROSS SECTION # 2 - EXISTING CONDITIONS



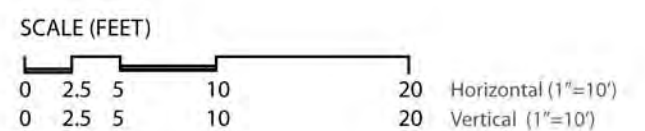
CROSS SECTION # 2 - OPTION 1



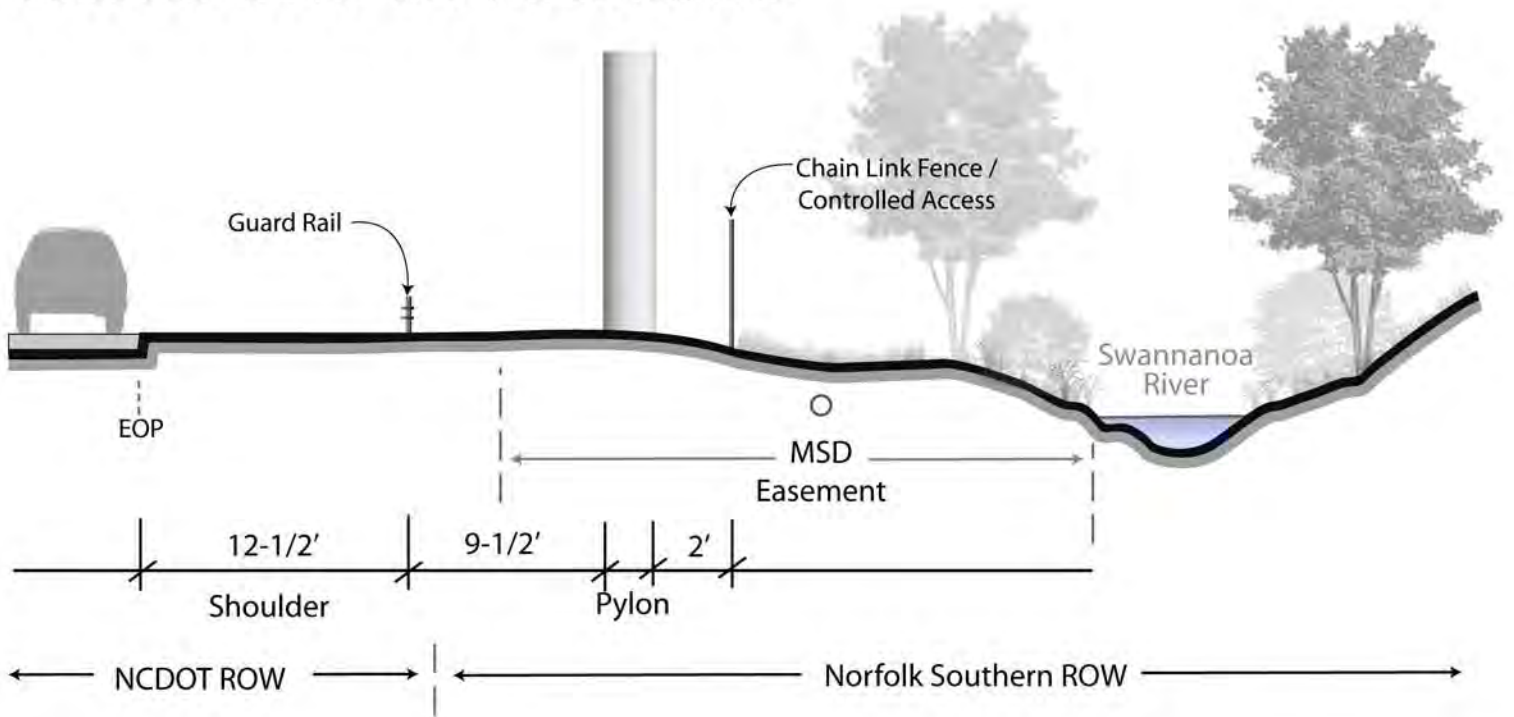
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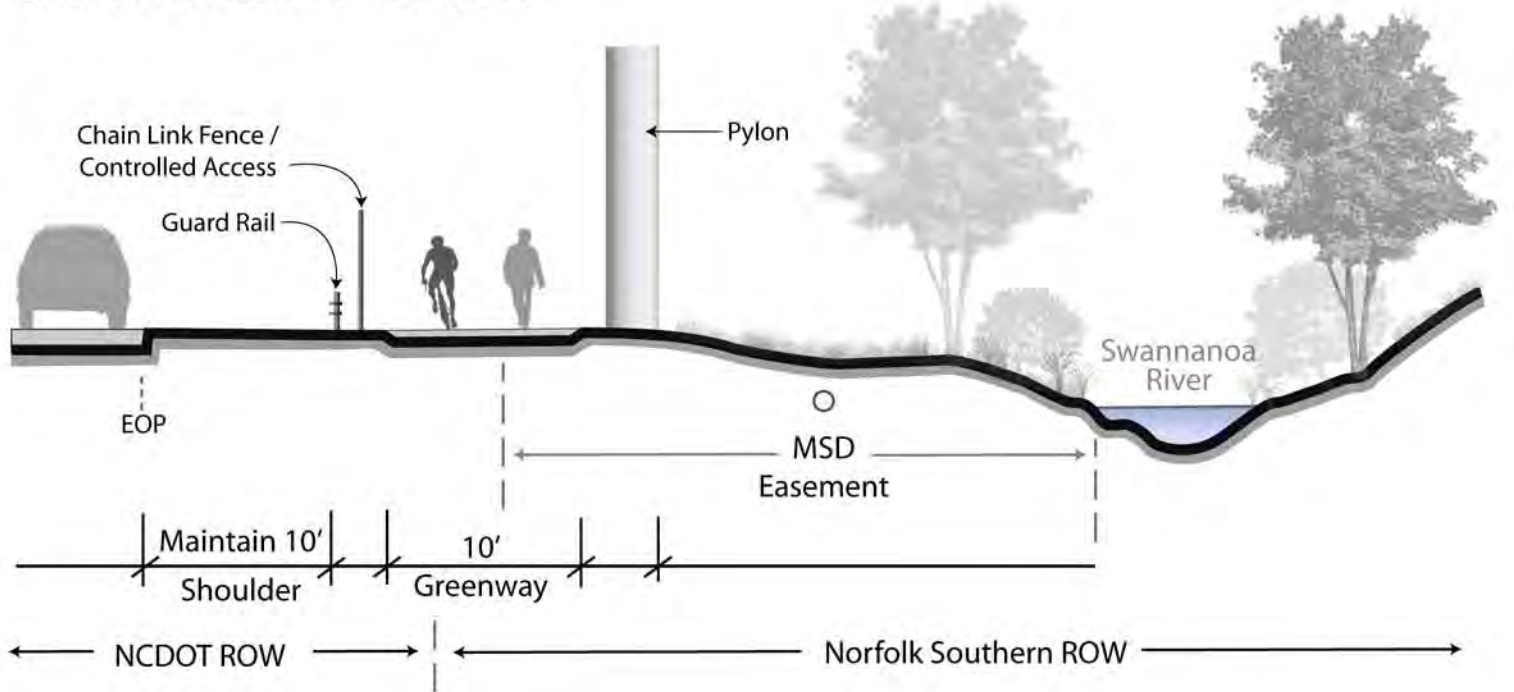
CROSS SECTION # 2 - PETTY BRIDGE OPTIONS
US 70 / SWANNANOVA RIVER GREENWAY



CROSS SECTION # 3 - EXISTING CONDITIONS



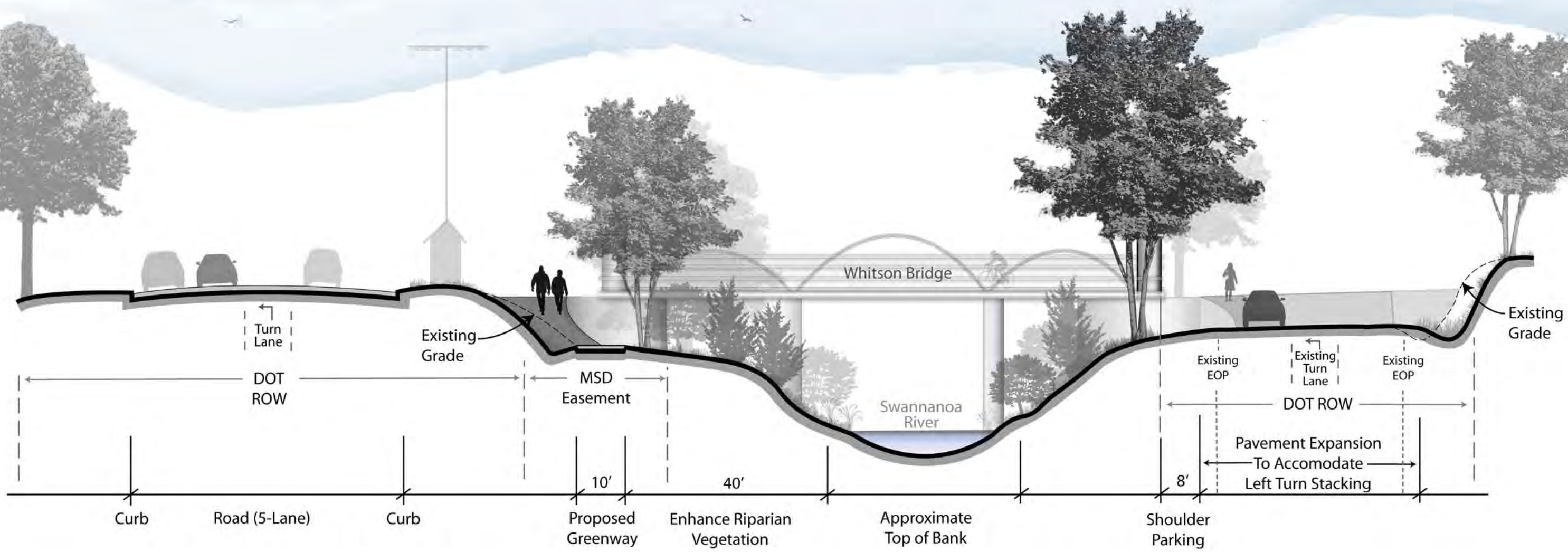
CROSS SECTION # 3 - OPTION 1



SCALE (FEET)

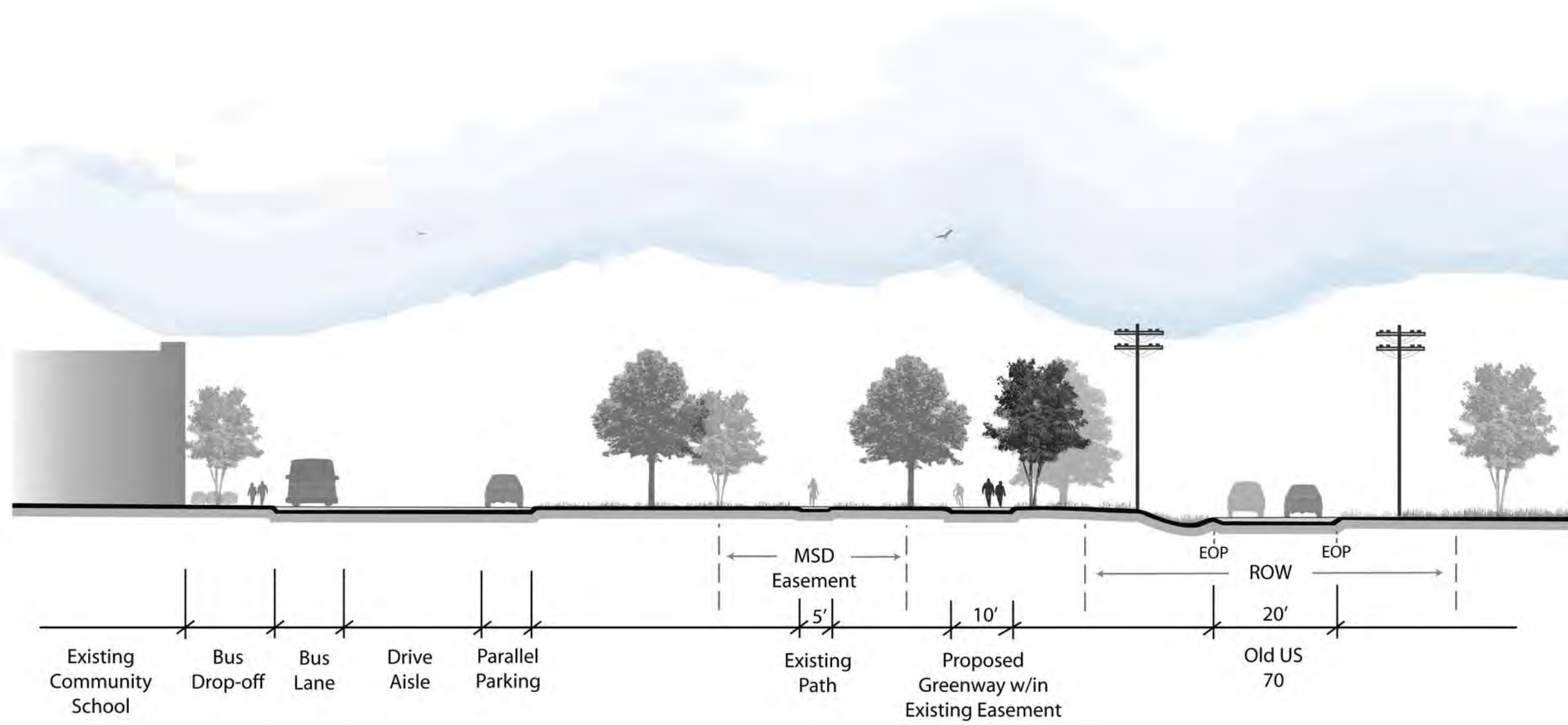


CROSS SECTION #3 - PETTY BRIDGE OPTION US 70 / SWANNANOVA RIVER GREENWAY

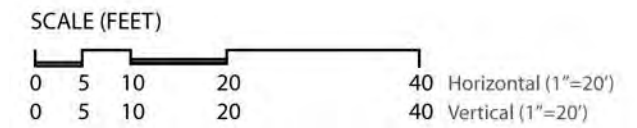


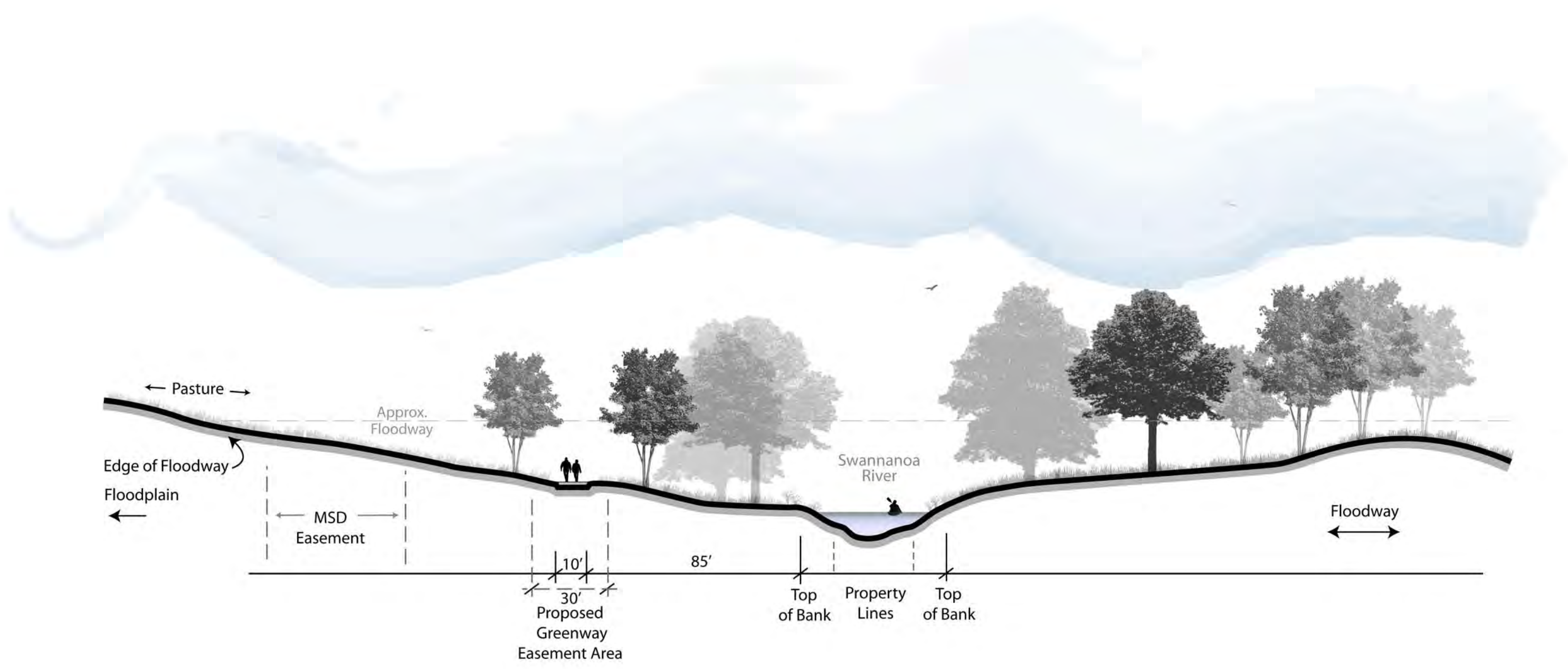
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 US 70 / SWANNANOA RIVER GREENWAY



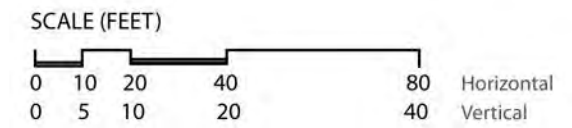


CROSS SECTION #5 - COMMUNITY SCHOOL
 US 70 / SWANNANOVA RIVER GREENWAY

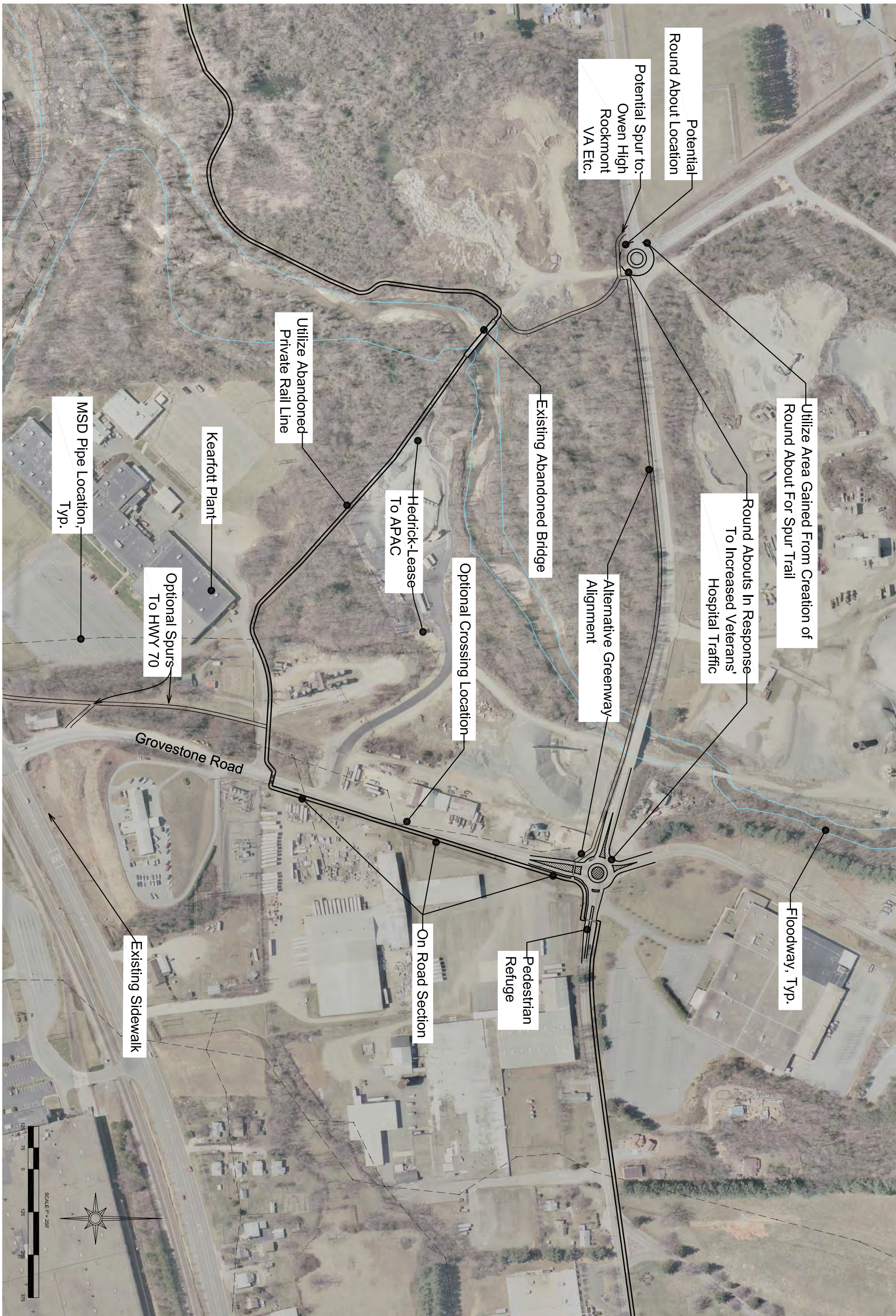




CROSS SECTION #6 - UPSTREAM OF DAVIDSON ROAD
 US 70 / SWANNANOA RIVER GREENWAY



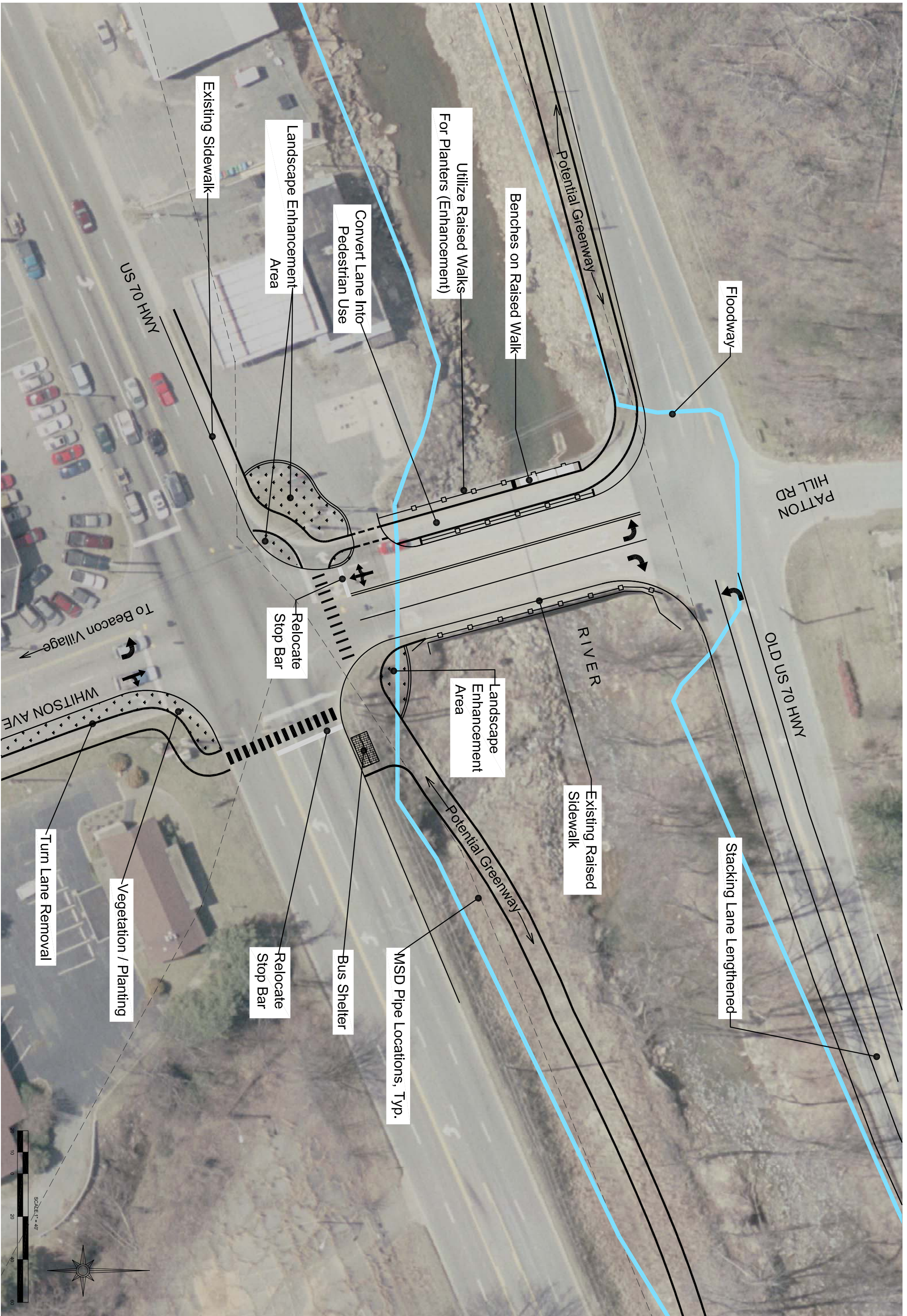
Appendix E: Study Areas



Study Area: Grovestone
US 70 / Swannanoa River Greenway Feasibility Study

EQUINOX
 ENVIRONMENTAL
 CONSULTATION & DESIGN
37 Haywood St., Asheville, NC 28801 828-253-6856

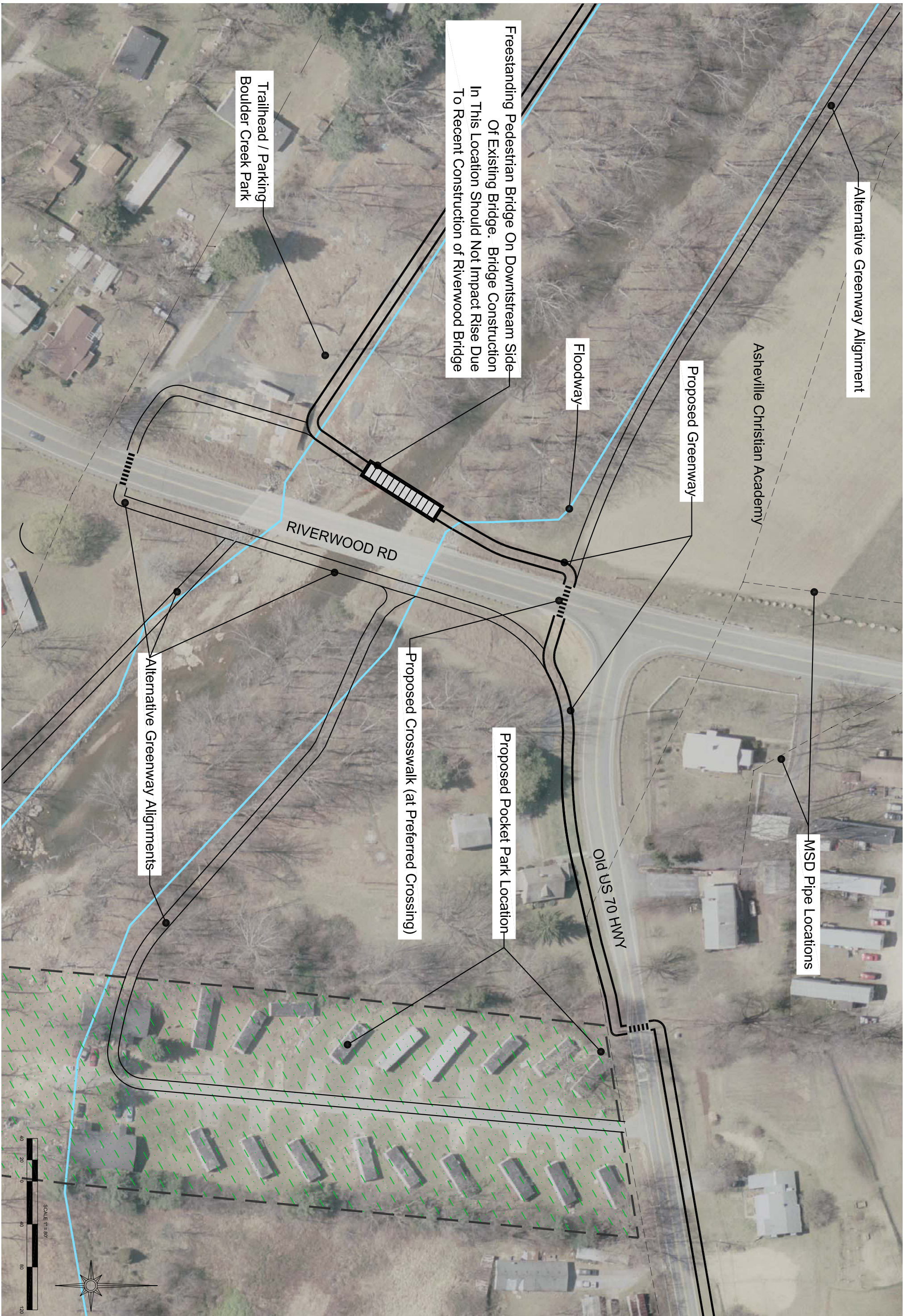
Map 1



Study Area: Whitson Ave Bridge
US 70 / Swannanoa River Greenway Feasibility Study

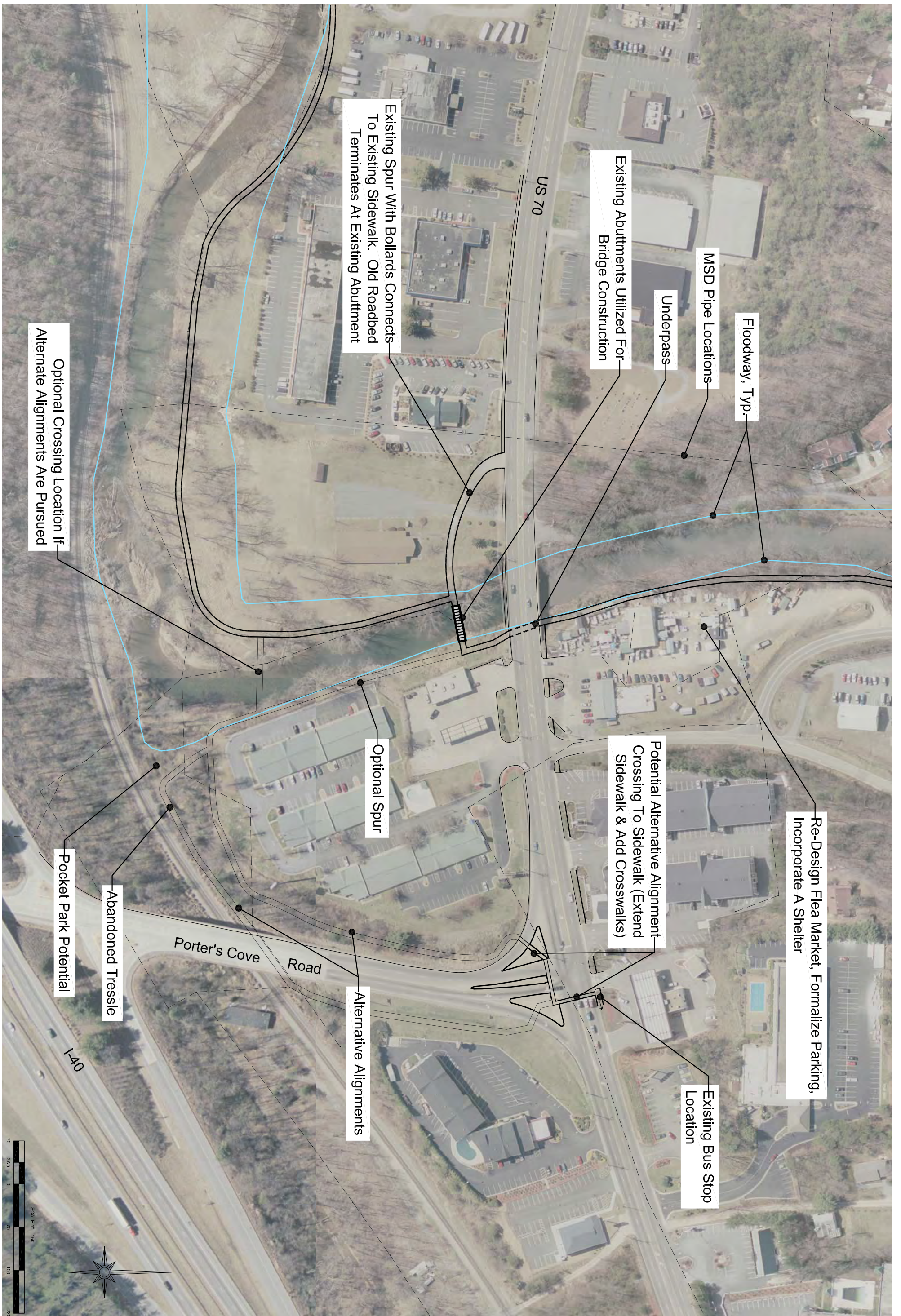
EQUINOX
 ENVIRONMENTAL
 CONSULTATION & DESIGN
37 Haywood St. Asheville, NC 28801 (828)253-6056

Map 2



Study Area: Riverwood Road Bridge
US 70 / Swannanoa River Greenway Feasibility Study

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 CONSULTATION & DESIGN
37 Haywood St., Asheville, NC 28801 (828) 255-6856



Study Area: Oteen Bridge
US 70 / Swannanoa River Greenway Feasibility Study

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 ENVIRONMENTAL
 CONSULTATION & DESIGN
37 Haywood St. Asheville, NC 28801 | (828) 253-6456



Appendix F: Results of Public Process

Results of Public Process

US 70/Swannanoa River Greenway Feasibility Study

Public Meeting #1 Comments

05.20.10

“Things you would like to see with the Greenway”

- Connectivity to shops, schools, parks, places people want/need to go
- Public Art - sculpture, mosaic, water features, stonework
- Lots of trees, shrubs, flowers, herbs, native plants
- Educational signage/historical info
- Restrooms and/or port-a-johns
- Good neighbors
- Accessible points for disabled greenway users
- Fishing sites along the river
- Safety/security for users
- Individual or small clusters of picnic table sites
- Occasionally spaced benches
- Where desirable/appropriate: trash and recycling bins
- Clear signage indicating links to key places (Item #1), mileage to various points and sites/key places
- Some fountains or spickets for drinking water
- Stones/blocks with fun/inspirational quotes (nature...)
- You need to talk to land owners first
- Links and shortcuts to US 70
- Fences and hedges for “sensitive” neighbors

“Things you do not want to see with the Greenway”

- Not all concrete; some softscape
- Monotonous, sameness across broad stretches
- Huge barriers b/t greenway and private property (i.e. unfriendly neighbors who oppose greenway)
- Monocultures in landscape
- Major or frequent articulations with motor vehicle traffic (flow w/ or crossing of)
- The future taking of land for greenways

Are there any additional connections along the U.S 70/ Swannanoa River Corridor you would like to see made that have not been shown?

Maps are missing the county owned flood plain purchased across river from Dr. Kelly's along old U.S. 70. Dr. Kelly is OK with easment Bee Tree Rd through watershed to parkway

Lake Tomahawk to greenway by CVS

Connection with boy camp in Ridgecrest which may allow connection to the Catawba River

Connection via Flat Creek Greenway in Black Mountain to Montreat & Montreat Trails

Look at the possibility of adding a spur north of 40 possibly bike lanes/sidewalks

Lake Tomahawk

If the trail was built as shown on the Map of Possibilities, how would you use the US/70 Swannanoa River Corridor

Bicycling, jogging, and Walking

Would not use the highway plan but would walk along the river

I would walk toward Black Mountain and Warren-Wilson College

Biking and hiking

2-4 hour "pleasure" hikes and photography

Walking/exercise

Walking

"Stick to the Swannanoa River. US 70= too busy"

Recreation

Commute to work, recreational cycling and walking

Recreation

Recreation access- bee Tree toward Black Mountain

"Stay off private land"

"to travel towards Asheville and Black Mountain on my bike"

Recreational hiking

Recreational biking, commuter access from Black Mountain to work in Asheville, convenient access to shopping and meetings, etc.

Convenient access to Asheville on a bicycle, recreational use, local commuting on foot

Biking, walking, and jogging

Biking and walking

biking

Dog walking, biking, running, and walking

Walking, biking, pushing stroller, recreation, commute/walk from Grovemont to Beacon Village

Do you support the U.S. 70/Swannanoa River Greenway Feasibility Study that you have seen today?

YES	NO
29	2

Comments: One survey taker responded that they would possibly be in approval of the plan but they need to see how access to private property will be handled (response classified as no). An additional survey respondent asserted that they have reservations about a greenway coming through their backyard at WWC.

Access Areas such as trailheads provide features for greenways such as parking, drinking fountains, trash receptacles, restrooms and kiosks. Based on the proposed number and location of access areas shown on the Map, please select the following:

I would like to see fewer access areas	I am happy with the amount of proposed access areas	I would like to see more access areas
2	24	3

Comments: one respondent indicated that they would like to see an additional access point made between Westernmost2 and an additional access point made between easternmost 2. One respondent did not answer the question.

To provide multiple uses and handicap accessibility, surfacing on greenways that will accommodate all non-motorized users (including bicycles, wheelchairs, and strollers) is desirable. What type of surfacing do you prefer for the U.S 70/Swannanoa Greenway? (select one)

Asphalt	Concrete	Recycled Material	Other (please specify)
5	1	22	2

Comments: The respondent who identified concrete as their preferred surface commended that the concrete has a longer lifespan w/reclaimed aggregate. Another respondent commented that they would NOT like to see the surface made out of concrete. Two additional respondents identified that they would prefer mixed trail surfaces including mulch or stone.

Goals of the U.S. 70 Swannanoa River Greenway project are to investigate the possible locations for a greenway and to determine the feasibility for having over 11 miles of greenways and trails for bicyclists and pedestrians to utilize for non motorized transportation and enjoyment within the Swannanoa River/U.S. 70 Corridor. Based on your understanding of the project, are these goals being met?

YES	I DON'T KNOW
27	4

There is the possibility to have a greenway that is off road and follows the Swannanoa River or a greenway/multiple use pathway/sidewalk along U.S. 70. Which do you prefer? (Select as many as you like)

A greenway along the Swannanoa River	A multiple use pathway along U.S. 70	A sidewalk along U.S. 70
--------------------------------------	--------------------------------------	--------------------------

27

20

7

Comments: One respondent identified that he/she would like to see a combination of a multi-use path on U.S. 70 and a greenway along the Swannanoa River.

**In an effort to communicate effectively within the community, we would like to understand how you heard about the project.
How did you hear about this project meeting?**

Options	Number of Responses
Newspaper	10
ACT	5
Black Mountain Paper	5
Swannanoa Pride Community Coalition Newsletter	3
Swannanoa Greenway Committee	1
BCTV	0
Buncombe County E-news	1
Email	8
Flyers	1
Letter	1
Work of Mouth	3

(Responses: Newspapers, e-mail, newspaper, ad in the Asheville Citizen-Times, newspaper, E-mails and ad in Black Mountain News, through Swannanoa Pride Community Coalition, Newspaper/flyers, Buncombe County E-News, newspaper, Asheville Citizen-Times, Asheville Citizen-Times, Swannanoa Pride Community Coalition, e-mail, Black Mountain News, E-mail distribution lists and word of mouth, letter, newspaper and local community, Black Mountain News, e-mail, e-mail, friends/colleagues, from staff at BCPG&R, newspaper, newspaper and e-mail, newspaper (Mountain Xpress, Black Mountain News, Asheville Citizen-Times), newspaper, SPCC, e-mail, notice in the Asheville Citizen-Times today (July 28th) and also the Black Mountain News, e-mail from Paul Muller.)

Do you have any comments?

Black Mountain **needs** more places for information handouts. The local newspaper is not enough. If any of this plan **occurs it** will give students a way to walk to school, it will be successful.

This plan is very important to our community.

A concern is the path being constructed along U.S. 70 and DOT has done nothing (yet) about the area of Whitson Bridge and crossing.

Continue and move the project along A.S.A.P.

This is an important and highly desirable amenity/**necessity** for **eastern** Buncombe County.

Let's hurry!

Take the path of least resistance- Hwy 70- bike/multiuse lane. Use off highway as able.

Found the chart on greenway surfaces very interesting. Found the **focus** areas to be a functional planning too; The presentation was very helpful in understanding this project at this point.

Please e-mail me the Commissioners email as I can voice my support more (address/info sent to Lucy/Jessica)

Good work so far!

When will this happen? Do not use concrete.

I **appreciate** the study and efforts of those involved to create a more desirable area of Buncombe County- especially in Swannanoa!

Please **consider** additional access and room for growth as use will likely increase over time.

Let's build it!

I am (so far) in **favor** of this **project** and would love to have the greenway as part of our community.

This will be a **huge** asset to all communities along it. I hope to live long enough to see it completed!

Any chance to utilize ROW along the Railroad would be useful.

Plan looks amazing!

Please show greenways in other locations to demonstrate what greenways can do for communities.

Would like an **electronic** copy of map 3 section 2 and the Top Stop program. Connie Gardi: cgardi@cadcon-e.com, cadconnie@msn.com

I am interested in the connection from **Azalea** Road to the Wilma Dykeman Riverway Plan

Hi Lucy, I had called earlier, explaining that I couldn't attend the meeting for the Swannanoa Greenway proposal due to work. Though I live in Weaverville, my **fiancé** lives in Swannanoa and we love to bicycle and walk. I and I'm sure many others, would love to see a Swannanoa greenway and hopefully, in the future, a sophisticated system of greenways. This would offer a safe, alternative method of travel from residential to shopping areas as well as opportunities for all ages of folks to get off the couch and walk, bike, run and hike. Sorry I couldn't make it to the meeting. Keep me posted. Peter Semanchuk peters@buncombe.main.nc.us

Appendix G: Trail Surface Chart

US 70 / SWANNANOA RIVER GREENWAY

Greenway Surface Options

Surface Type	Durability	Environmental Considerations	Maintenance	Meets ADA Accessibility Guidelines?	Additional Comments	User Groups	Cost (Per mile of 10 ft width, installed)
Asphalt	<ul style="list-style-type: none"> Texture: Flexible Hard Slope max: 20% Lifespan: 7-15 years 	<ul style="list-style-type: none"> Highest embodied energy Cold or warm mix to reduce emissions 	Low	Yes	<ul style="list-style-type: none"> Can use recycled aggregate (i.e., reclaimed pavement, furnace slag, crushed waste stone, etc) Variety of asphalt surface options 	All	<ul style="list-style-type: none"> \$200,000 - 300,000
Concrete	<ul style="list-style-type: none"> Texture: Hard Slope max: 20% Lifespan: 30+ years 	<ul style="list-style-type: none"> Use reclaimed or recycled aggregate to reduce embodied energy 	Low	Yes	<ul style="list-style-type: none"> Ideal in flood prone areas Hardest surface and easy to form Supports multiple users Expansion 	All	<ul style="list-style-type: none"> \$300,000 –500,000
Porous Asphalt	<ul style="list-style-type: none"> Texture: Flexible Hard Slope max: 9% Lifespan: unknown 	<ul style="list-style-type: none"> Cold or warm mix to reduce emissions Use reclaimed or recycled aggregate to reduce embodied energy 	Moderate: Must have surface vacuumed or cleaned to maintain porosity	Yes	<ul style="list-style-type: none"> Silt and sediment can clog pores, reducing porosity 	All, however not ideal for strollers, road Cyclists, and wheelchairs, (rougher surface reduces speed)	Varies, comparable to asphalt costs, up to 30% more
Porous Concrete	<ul style="list-style-type: none"> Texture: Hard Slope max: 7% Lifespan: unknown 	<ul style="list-style-type: none"> Use reclaimed or recycled aggregate to reduce embodied energy 	Moderate: Must have surface vacuumed or cleaned to maintain porosity	Yes	<ul style="list-style-type: none"> Silt and sediment can clog pores, reducing porosity 	All, however not ideal for strollers, road Cyclists, and wheelchairs, (rougher surface reduces speed)	Varies, comparable to concrete costs, up to 50% more
Rubber Asphalt Concrete (RAC), Rubberized Composite	<ul style="list-style-type: none"> Texture: Flexible Hard Lifespan: 15 + years 	<ul style="list-style-type: none"> Increases life of traditional surfacing due to flexibility Variety of low emission binders Uses recycled materials 	Low: Lifespan of RAC is 2xs traditional asphalt	Yes	<ul style="list-style-type: none"> Reuses waste tires Increased traction More common in asphalt applications 	All	Varies, comparable to concrete applications
Chip-n-Seal	<ul style="list-style-type: none"> Texture: Hard Slope max: 8% Lifespan: 3-7 years 	<ul style="list-style-type: none"> Reduces asphalt use if applied directly to aggregate base (low use only) Emulsified application; less energy and lower fumes (Calkins 2008) 	Low - Moderate: Must resurface every 3-7 years	Yes	<ul style="list-style-type: none"> Cape Seal is an alternative that may improve lifespan up to 15 years Rubberized Asphalt Chip Seal available 	All, however not typically ideal for strollers, road cyclists, and wheelchairs,(rougher surface reduces speed)	Varies, compare to asphalt applications or slightly lower
Soil Cement (Soil w/ Binding Agent)	<ul style="list-style-type: none"> Texture: Hard Slope max: 8% Lifespan: 3-7 years 	<ul style="list-style-type: none"> Low embodied energy Low transport costs Stabilizer options can increase or decrease impact 	Low - Moderate	Yes	<ul style="list-style-type: none"> Not ideal for heavy use Bicyclists and horseback riders have biggest impact Can erode over time Low cost 	All	Soil Cement <ul style="list-style-type: none"> \$60,000 - 100,000
Crushed Rock, Granular Stone (< 3/8")	<ul style="list-style-type: none"> Texture: Loose - Firm Slope max: 5% Lifespan: 7-10 years 	<ul style="list-style-type: none"> Low impact and low embodied energy Can use stone, materials from site 	Low - Moderate: Additional stone every 7 - 10 yrs	Varies	<ul style="list-style-type: none"> Can be compacted with dust as binding agent Tree resin emulsion can also be used for a harder surface 	Not appropriate for uses such as road cycling, strollers, wheelchairs and other uses requiring stable, hard surfaces	Crushed limestone <ul style="list-style-type: none"> \$80,000 - 120,000

* Surface types highlighted in green are recommended surfaces for the greenway corridor. The surface type highlighted in blue is recommended for the Warren Wilson section(s) only.

Appendix H: Evaluation of Lane Reduction

The Highway Safety Information System (HSIS) is a multi-State safety database that contains crash, roadway inventory, and traffic volume data for a select group of States. The participating States—California, Illinois, Maine, Michigan, Minnesota, North Carolina, Ohio, Utah, and Washington—were selected based on the quality of their data, the range of data available, and their ability to merge the data from the various files. The HSIS is used by FHWA staff, contractors, university researchers, and others to study current highway safety issues, direct research efforts, and evaluate the effectiveness of accident countermeasures.



U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike • McLean, VA 22101-2296

SUMMARY REPORT

Evaluation of Lane Reduction “Road Diet” Measures on Crashes

This Highway Safety Information System (HSIS) summary replaces an earlier one, Evaluation of Lane Reduction “Road Diet” Measures and Their Effects on Crashes and Injuries (FHWA-HRT-04-082), describing an evaluation of “road diet” treatments in Washington and California cities. This summary reexamines those data using more advanced study techniques and adds an analysis of road diet sites in smaller urban communities in Iowa.

A road diet involves narrowing or eliminating travel lanes on a roadway to make more room for pedestrians and bicyclists.⁽¹⁾ While there can be more than four travel lanes before treatment, road diets are often conversions of four-lane, undivided roads into three lanes—two through lanes plus a center turn lane (see figure 1 and figure 2). The fourth lane may be converted to a bicycle lane, sidewalk, and/or on-street parking. In other words, the existing cross section is reallocated. This was the case with the two sets of treatments in the current study. Both involved conversions of four lanes to three at almost all sites.

Road diets can offer benefits to both drivers and pedestrians. On a four-lane street, speeds can vary between lanes, and drivers must slow or change lanes due to slower vehicles (e.g., vehicles stopped in the left lane waiting to make a left turn). In contrast, on streets with two through lanes plus a center turn lane, drivers’ speeds are limited by the speed of the lead vehicle in the through lanes, and through vehicles are separated from left-turning vehicles. Thus, road diets may reduce vehicle speeds and vehicle interactions, which could potentially reduce the number and severity of vehicle-to-vehicle crashes. Road diets can also help pedestrians by creating fewer lanes of traffic to cross and by reducing vehicle speeds. A 2001 study found a reduction in pedestrian crash risk when crossing two- and three-lane roads compared to roads with four or more lanes.⁽²⁾

Under most annual average daily traffic (AADT) conditions tested, road diets appeared to have minimal effects on vehicle capacity because left-turning vehicles were moved into a common two-way left-turn lane (TWLTL).^(3,4) However, for road diets with AADTs above approximately 20,000 vehicles, there is an increased likelihood that traffic congestion will increase to the point of diverting traffic to alternative routes.

While potential crash-related benefits are cited by road diet advocates, there has been limited research concerning such benefits. Two prior studies were conducted using data from different urbanized areas. The first, conducted by HSIS researchers, used data from treatment sites in eight cities in California and Washington.⁽⁵⁾ The second study analyzed data from treatment sites in relatively small towns in Iowa.⁽⁶⁾ While the nature of the treatment was the same in both studies (four lanes reduced to three), the settings, analysis methodologies, and results of the studies differed. Using a comparison of treated and matched comparison sites before and after treatment and the development of negative binomial regression models, the earlier HSIS study found a 6 percent reduction in crash frequency per mile and no significant change in crash rates at the California and Washington sites. Using a long-term (23-year) crash history for treated and reference sites and the development of a hierarchical Poisson model in a Bayesian approach, the later Iowa study

Figure 1. Photo. Four-lane configuration before road diet.



Source: Pedestrian Bike Information Center, "Road Diets" training module, 2009.

Figure 2. Photo. Three-lane configuration after road diet.



Source: Pedestrian Bike Information Center, "Road Diets" training module, 2009.

found a 25.2 percent reduction in crash frequency per mile and an 18.8 percent reduction in crash rate. Because of these differences, researchers from the National Cooperative Highway Research Program (NCHRP) 17-25 project team obtained and reanalyzed both data sets using a common methodology.⁽⁷⁾ This summary documents the results of that reanalysis.

Methodology

Research Design

The basic objective of this reanalysis effort was to estimate the change in total crashes resulting from the conversions in each of the two databases and to combine these estimates into a crash modification factor (CMF). To do this, the empirical Bayes (EB) methodology described by Hauer was used.⁽⁸⁾ A prediction of what would have happened at the treatment sites in the after period without treatment is based on a weighted combination of the following two factors: (1) the frequency of crashes on the treated sites in the before period and (2) the crash-frequency predictions from regression models developed with data from similar untreated reference sites. The prediction of what would have happened without treatment is then compared to what actually happened with treatment to estimate the safety effect of the treatment. The methodology corrects for the regression bias, changes in traffic volume at the treatment sites, and other possible confounding factors as well as provides a method for combining results from different jurisdictions by accounting for differences in crash experience and reporting practice. Details of the methodology are in appendix C of *NCHRP Report 617*.⁽⁷⁾

Databases Used

The two databases used were obtained from the original study authors. Both databases provided data on site characteristics for treatment and comparison or reference sites and on crashes and AADT for both the before and after periods.

The HSIS study database contained data on treatment and comparison sites obtained from local traffic engineers in six

cities in California—Mountain View, Oakland, Sacramento, San Francisco, San Leandro, and Sunnyvale—and two cities in Washington—Bellevue and Seattle.⁽⁵⁾ The data included 30 treatment sites and 51 reference sites. The reference sites were matched by the local traffic engineer to be similar to the treatment sites in terms of functional class, type of development, speed limit, intersection spacing, and access control.

The Iowa database included data from the original study for 15 treatment and 15 reference sites from U.S. and State routes in small urban towns with an average population of 17,000.⁽⁶⁾ These data were supplemented with additional information provided by the Iowa Department of Transportation for 281 similar reference sites.

As noted earlier, the road diet treatment was very similar at the sites in both databases. All 15 of the Iowa treatment sites involved conversion from four lanes to three lanes, with the third lane being a TWLTL. Bike lanes were installed in only one case, and parallel parking was retained for a section within one other site. In the HSIS database, most treatment sites involved the same conversion from four lanes to three lanes as at the Iowa sites. At one site, the after condition included a raised median and left-turn pockets at intersections rather than a TWLTL.

Table 1 provides descriptive characteristics for the treatment and control sites from each database. Crash statistics are also provided. In both data sets, the treatment and reference segments were divided into "homogeneous sites" for analysis purposes, and the average length was approximately 1 mi in all cases. In the Iowa data, the mean AADT for the reference sites was approximately the same as for the treatment sites, and the resulting crashes per mile-year for the reference sites and the before-period treatment sites were very similar. In the HSIS data, the mean AADT and the crashes per mile-year for the reference sites were somewhat higher than for the treatment sites. However, the AADT range in the reference site data included the AADT range in the treatment data, making it suitable for the predictive models produced.

Table 1. Descriptive statistics of evaluation sites

DATABASE/SITE TYPE	CHARACTERISTIC	MEAN	MINIMUM	MAXIMUM
Iowa Treatment (15 sites)	Years before	17.53	11.00	21.00
	Years after	4.47	1.00	11.00
	Crashes/mile-year before	23.74	4.91	56.15
	Crashes/mile-year after	12.19	2.27	30.48
	AADT before	7,987	4,854	11,846
	AADT after	9,212	3,718	13,908
	Average length (mi)	1.02	0.24	1.72
Iowa Reference (296 sites)	Years	21.8	5	23
	Crashes/mile-year	26.8	0.2	173.7
	AADT	8,621	296	27,530
	Average length (mi)	0.99	0.27	3.38
HSIS Treatment (30 sites)	Years before	4.7	1.8	8.5
	Years after	3.5	0.6	8.8
	Crashes/mile-year before	28.57	0.00	111.10
	Crashes/mile-year after	24.07	0.00	107.62
	AADT before	11,928	5,500	24,000
	AADT after	12,790	6,194	26,376
	Average length (mi)	0.84	0.08	2.54
HSIS Reference (51 sites)	Years	7.82	4.50	12.17
	Crashes/mile-year	42.19	5.96	169.73
	AADT	15,208	1,933	26,100
	Average length (mi)	0.95	0.10	3.31

Analysis

As previously noted, one component of the prediction of after-period accident frequencies at the treatment sites without treatment is a regression model developed using data from the untreated reference sites. This model is referred to as a safety performance function (SPF). In this study, generalized linear modeling was used to estimate the SPF coefficients using the software package SAS® and assuming a negative binomial error distribution, all consistent with the state of research in developing these models. Examination of several model forms indicated that the most appropriate and useful models for both databases included AADT and segment length. The final model form and coefficients differed for the two databases. The final model for the Iowa data is shown in equation 1, where a_y is a series of yearly calibration factors developed to account for the safety effect of changes other than AADT (e.g., accident reporting practices, demography, weather).

The final model for the HSIS data is shown in equation 2. The HSIS data did not allow the development of yearly calibration factors.

$$\text{Expected number of accidents per year} = a_y(\text{length})\exp(-8.4439)(\text{AADT})^{1.2917} \tag{1}$$

$$\text{Expected number of accidents per year} = \exp(-3.6323)(\text{length})^{0.7182}(\text{AADT})^{0.5722} \tag{2}$$

Results

The EB evaluation of total crash frequency indicated a statistically significant effect of the road diet treatment in both data sets and when the results are combined. Table 2 shows the results from each of the two studies and the combined results—the CMFs and their standard deviations.

Table 2. Results of the EB analysis for the Iowa and HSIS data concerning 4-lane to 3-lane road diets.^(5,6,7)

CRASH TYPE STUDIED AND ESTIMATED EFFECTS			
STATE/ SITE CHARACTERISTICS	ACCIDENT TYPE	NUMBER OF TREATED SITES	CMF (STANDARD DEVIATION)
Iowa: Predominately U.S. and State routes within small urban areas (average population of 17,000)	Total crashes	15 (15 mi)	0.53 (0.02)
California/Washington: Predominately corridors within suburban areas surrounding larger cities (average population of 269,000)	Total crashes	30 (25 mi)	0.81 (0.03)
All sites	Total crashes	45 (40 mi)	0.71 (0.02)

The Iowa data indicate a 47 percent reduction in total crashes while the HSIS (California and Washington) data indicate a 19 percent decrease—a substantial difference. These reanalysis results also differ from the original Iowa study results (a 25 percent reduction) and from the original HSIS results (a 6 percent reduction). Combining both data sets results in a 29 percent reduction in total crashes.

Discussion and Recommendations

The authors identified two likely reasons the reanalysis differed from the original Iowa results. First, the reanalysis involved a much larger reference group than was available in the original study. Second, while the results of the original study weighted all treatment sites equally regardless of length, the reanalysis results provided more weight to longer sites. While not stated in the reanalysis report, the difference in the two analyses of the HSIS data could have resulted from the use of improved methodology (the EB method) in the reanalysis effort. This methodology made it possible to use all 30 treatment sites and 51 reference sites. In the original study, data from only 11 treatment sites and 24 reference sites were used, with the remaining sites being omitted due to small sample sizes of crashes because of short segment lengths, short data periods, or low average daily traffic.

Of more importance than the differences between the original and current study efforts are the differences between the Iowa and HSIS treatment effects estimated in the reanalysis effort. These differences may be a function of traffic volumes and characteristics of the urban environments where the road diets were implemented. The sites in Iowa ranged in AADT from 3,718 to 13,908 and were predominately on U.S. or State routes passing through small urban towns with an average population of 17,000. The sites in Washington and California ranged in AADT from 6,194 to 26,376 and were predominately on corridors in suburban environments that surrounded larger cities with an average population of 269,000. In addition, based on a separate study of one site in Iowa, there appeared to be a traffic calming effect that resulted in a 4–5 mi/h reduction in 85th percentile free-flow speed and a 30 percent reduction in the percentage of vehicles traveling more than 5 mi/h over the speed limit (i.e., vehicles traveling 35 mi/h or higher).⁽⁹⁾ The reanalysis authors speculated that while there could have been significant differences in speeds between the rural U.S. or State highway approaching a small town and the road diet section, this calming effect would be less likely in the larger cities in the HSIS study, where the approaching speed limits (and traffic speeds) might have been lower before treatment.

Given these differences, it is recommended that the choice of which CMF to use should be based on the characteristics of the site being considered. If the proposed treatment site is more like the Iowa sites (i.e., U.S. or State routes with moderate AADTs in small urban areas), then the 47 percent reduction found in Iowa should be used. If the treatment site is part of a corridor in a suburban area of a larger city, then the 19 percent reduction should be used. If the proposed site matches neither of these site types, then the combined 29 percent reduction is most appropriate.

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FOR MORE INFORMATION

The research combining both databases was conducted by Bhagwant Persaud and Craig Lyon of Ryerson University, Toronto, Canada, as part of *NCHRP Report 617*.⁽⁷⁾ The full study and appendix C can be downloaded from the Web address shown in the reference list. References to the initial studies that generated the two databases are also included in that list.^(5,6) For more information about HSIS, contact Carol Tan, HSIS Program Manager, HRDS, (202) 493-3315, carol.tan@dot.gov.

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**Appendix I: Code Requirements for
Greenways in the Floodplain**

Code Requirements for Greenways in the Floodplain

Selected Excerpts from the Buncombe County Code of Ordinances

The following is a summary of some portions of the Buncombe County Code of Ordinances that may apply to greenway paths placed in the regulatory floodplains:

“An erosion control plan shall be required for... any land disturbing activity which uncovers one or more acres” (Sec 26-211).

“In order to reduce drainage related damage and hazards, adequate natural drainage systems or stormwater management installations are required to collect and transmit stormwater flows into either existing drainage facilities or a natural drainage system” (Sec 26-361).

Where a floodplain with BFE has been established without a floodway or non-encroachment area, “no encroachment, including fill... or other development, shall be permitted unless certification... is provided demonstrating that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community” (Sec 34-69).

Where a floodway or non-encroachment area has been established, “No encroachments, including fill... and other developments shall be permitted unless:

- a. It is demonstrated that the proposed encroachment would not result in any increase in the flood levels during the occurrence of the base flood...; or
- b. A Conditional letter of map revision (CLOMR) has been approved by FEMA” (Sec 34-70).

“No new development is allowed in the buffer except for... public projects such as... greenways where no practical alternative exists. These activities should minimize built-upon surface area, direct runoff away from the surface waters and maximize the utilization of stormwater best management practices” (Sec 78-79).

Selected Excerpts from the Black Mountain Code of Ordinances

The following is a summary of some portions of the Black Mountain Code of Ordinances that may apply to greenway paths placed in the regulatory floodplains:

“No encroachments, including fill, new construction, substantial improvements or new development shall be permitted within a distance of thirty (30) feet landward each side from top of bank or five times the width of stream, whichever is greater, unless certification with supporting technical data by a registered professional engineer is provided demonstrating that such encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge” (Sec 151.5.D.1).

“No encroachments including fill... shall be permitted unless it has been demonstrated that: (a) the proposed encroachment would not result in any increase in the flood levels during the occurrence of the base flood...” (Sec 151.5.F.1).

“A written or graphic concept plan of the proposed post-development stormwater management system including... preliminary location of proposed... bridge or culvert crossings” (Sec 157.09.H.3).

“All built-upon area shall be at a minimum of 30 feet landward on all sides of any surface water as measured horizontally on a line perpendicular to a vertical line marking the edge of the top of the bank” (Sec 157.10.A).

“All development... projects which cumulatively disturb more than 12,000 square feet... shall implement stormwater control measures that comply with the following standards: (1) Project sites must employ Low Impact Development (LID) practices... (3) All structural stormwater treatment systems used to meet the requirements of the program shall be designed to have a minimum of 85% average annual removal for [TSS]” (Sec 157.10.E).

“Grading permits shall be required whenever 5,000 square feet or more of land is disturbed” (Sec 158.02.B).

“Land disturbing activity shall not take place within twenty-five feet of a stream or otherwise result in a violation of rules adopted by the State Environmental Management Commission to protect riparian buffers along State surface waters. In accordance with State and local stormwater management regulations, no built-upon area shall be within 30’ of a stream” (Sec 158.04.B)