WK DICKSON

AN ARDURRA COMPANY



TOWN OF BLACK MOUNTAIN

BLACK MOUNTAIN STORMWATER MASTER PLAN

Draft Report | December 2025









DRAFT

TOWN OF BLACK MOUNTAIN

STORMWATER MASTER PLAN

WK Dickson/Ardurra Project No. 20230691.00.GV

December 2025

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1. INTRODUCTION

The Town of Black Mountain (Town) Stormwater Master Plan (SWMP) is funded by a Local Assistance for Stormwater Infrastructure Investments (LASII) from the American Rescue Plan Act (ARPA). The purpose of the SWMP is to develop a GIS map of the Town's stormwater system, identify flooding issues, assess the existing conveyance system capacity and infrastructure condition, develop and prioritize flood reduction projects, and establish an implementation strategy for the recommended capital infrastructure projects.

The Study Area for the SWMP includes the following:

- Secondary stormwater conveyance system in the Downtown corridor,
- Tomahawk Branch watershed, both the primary system culvert crossings and the secondary stormwater conveyance system located in the surrounding residential areas of Lake Tomahawk,
- Flat Creek Tributary 1 primary system culvert crossings in the vicinity of Portmanvilla, Sixth, and Seventh Street roads, and
- Tributary 35 (of the Swannanoa River) primary system culvert crossings in the vicinity of Avena and Padgettown roads.

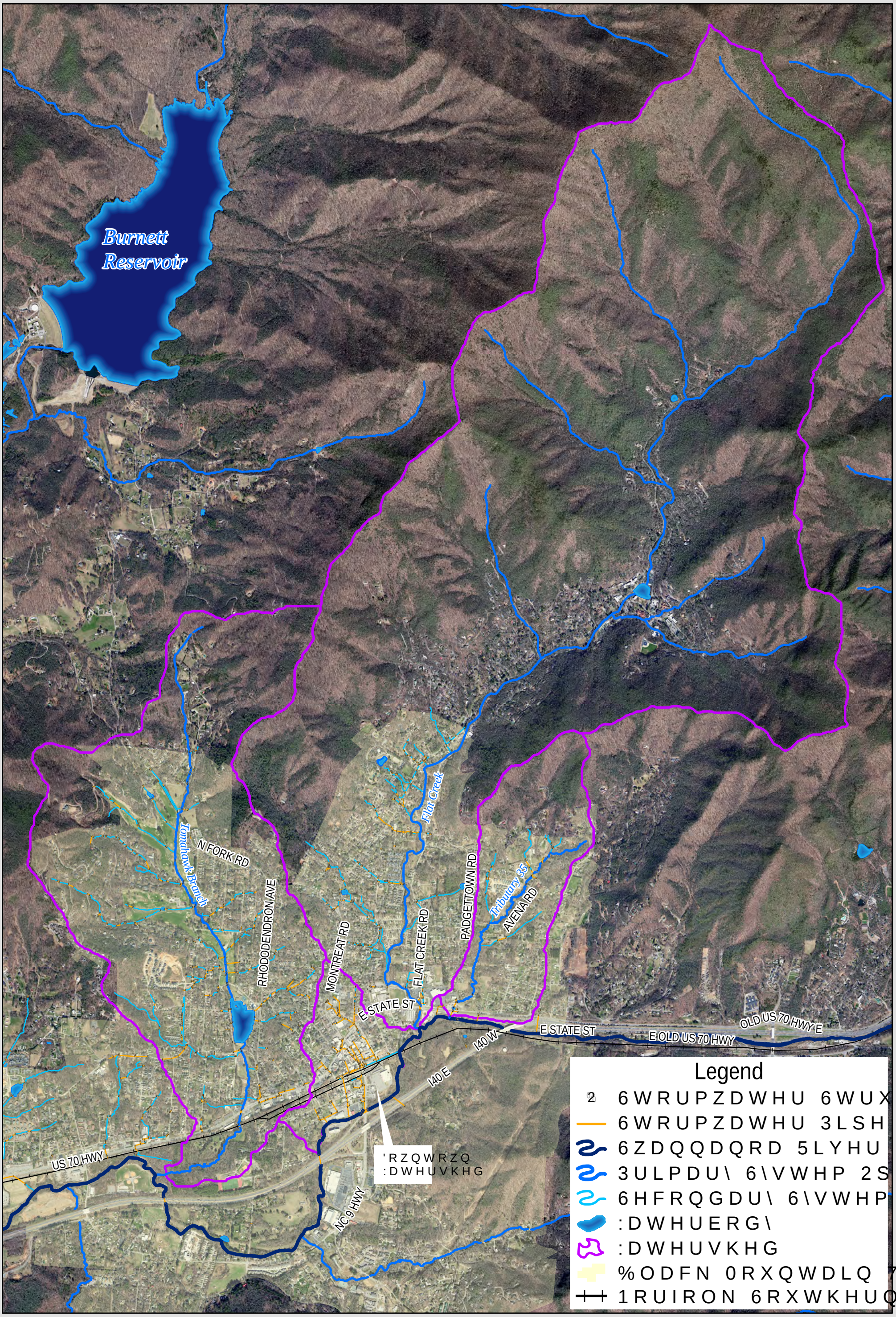
The watersheds within the Town are all tributary to the Swannanoa River. In some cases, the closed system stormwater outfalls are located very closely to or directly into the Swannanoa River. As shown in Exhibit 1, the main outfall for the downtown commercial area from Broadway Street and westward is a corrugated plastic 18-inch pipe outfall to an open channel. This open channel runs parallel to Sutton Avenue from Broadway Street down to its confluence with the Swannanoa River, collecting runoff from the downtown corridor north of the railroad via four additional outfalls.



Exhibit 1
18-inch CPP outlet to Sutton Ave Open Channel

Based on historical records obtained from the National Oceanic and Atmospheric Administration (NOAA) online national climate data service[1], Hurricane Helene brought over 14 inches of rainfall in a span of three days to the mountains in September 2024, resulting in catastrophic flooding along the Swannanoa River corridor. Many roadways and bridges within the Town of Black Mountain were impacted. As a result, the Town desired to develop projects that would meet the 50-year level of service where feasible. All proposed projects were evaluated and developed with this goal. However, there are a few areas where downstream hydraulic conditions and/or available cover prevent this level of flood reduction.

The Study Area for the Town's SWMP is shown in Figure 1-1.


Burnett Reservoir
Flat Creek
Tomahawk Branch
Tributary 35
N FORK RD
RHODODENDRON AVE
MONTREAT RD
FLAT CREEK RD
PADGETTOWN RD
AVENA RD
E STATE ST
E STATE ST
E OLD US 70 HWY
OLD US 70 HWY E
I40 W
I40 E
US 70 HWY
NC 9 HWY
'RZQWRZQ
:DWHUVKHG
Legend
2 6WRUPZDWHU 6WUXFW
6WRUPZDWHU 3LSH
6ZDQQDQRD 5LYHU
3ULPDU\ 6\VWHP 2SH
6HFRQGDU\ 6\VWHP 2
:DWHUERG\
:DWHUVKHG
%ODFN 0RXQWDLQ 7R
1RUIRON 6RXWKHUQ 5
WK DICKSON
AN ARDURRA COMPANY
)LJXUH 3URMHFW /RFDWLRQ
72:1 2) %/$&. 02817$,1 1&
)HHW
7RZQ RI %ODFN 0RXQWDLQ 6WRUPZDWHU

2. EXISTING WATERSHED CONDITIONS

2.1. Existing Conditions Survey and Field Data Collection

Stormwater utility infrastructure throughout the Town was collected by Kee Mapping and Survey (Kee) personnel to compile a GIS stormwater inventory database for the Town. This was accomplished by using survey-grade Global Positioning Systems (GPS) as the primary means of data capture to locate the x, y, and z coordinates of each visible stormwater system structure. Conventional surveying techniques were used to obtain attributes, including but not limited to size, material, slope, and length. All coordinate system data were collected using horizontal datum NAD 1983 and vertical datum NAVD 1988. A total of 1195 closed system structures were surveyed and/or inventoried. Figure 2-1 shows the Town's surveyed and inventoried stormwater system. A summary of closed system structures is noted in Table 2.1.

TABLE 2.1: INVENTORY SUMMARY – CLOSED SYSTEM STRUCTURES

STRUCTURE TYPE	NUMBER SURVEYED
Culvert Pipe Ends	505
Closed System Pipe Ends	126
Inlets	247
Junction Boxes	52
Manholes	14
Unknown Structures	251

As noted in Table 2.1, there are a significant number of unknown structures. These were included when field crews found different pipe sizes and/or materials between surveyed stormwater structures. CCTV will be required to obtain additional information on stormwater systems with unknown structures prior to any project design and construction.

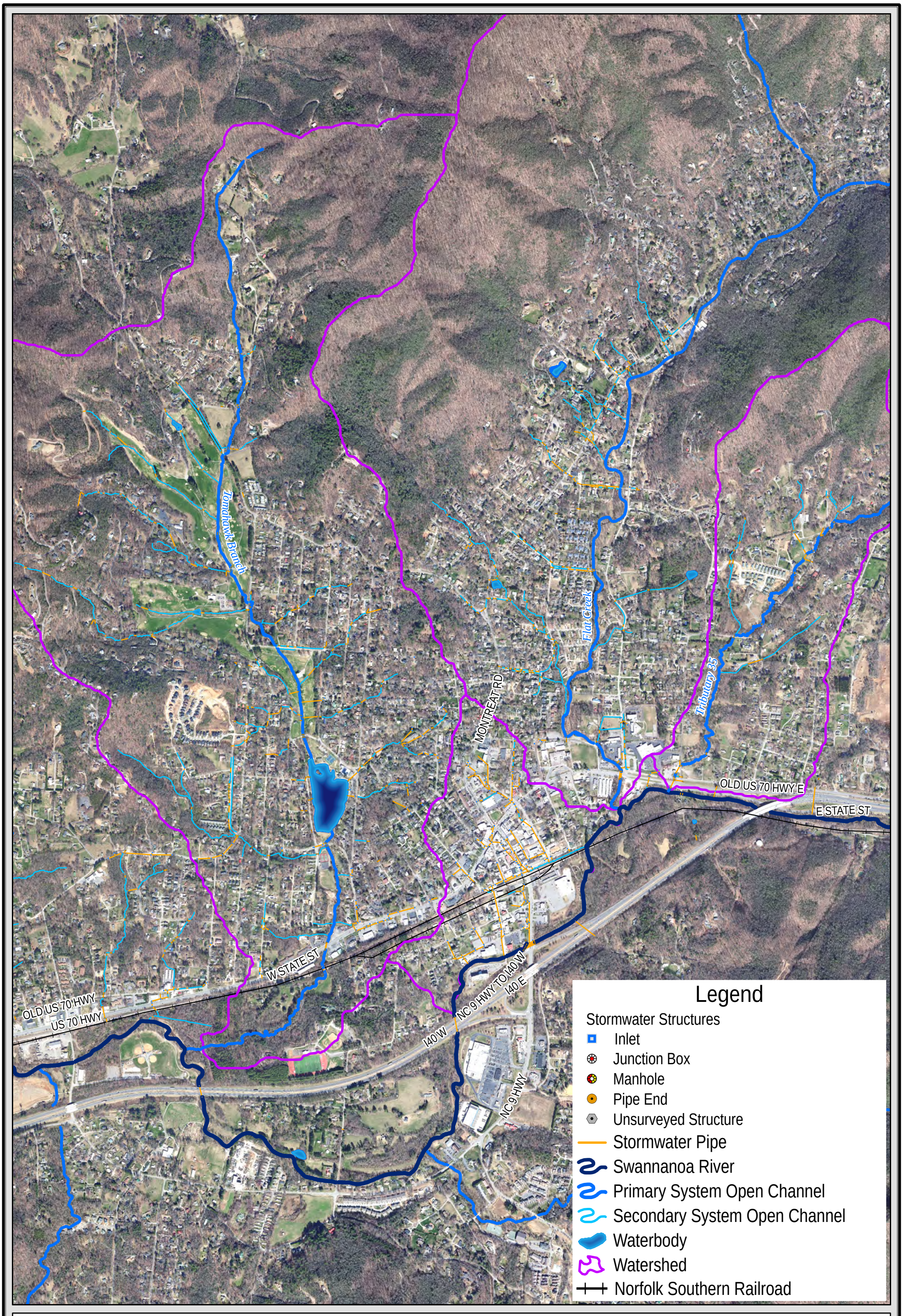
Additionally, numerous structures were found to be obstructed with sediment and/or debris during the field data collection. These are identified in the stormwater inventory GIS geodatabase provided to the Town and are also shown in Figure 2-2. Obstructed structures by watershed are provided in Appendix A.

Over 46,500 linear feet of pipe were also collected as part of the Town's infrastructure inventory. Unknown pipe sizes were documented because of difficult access or obstructed structures. A summary of the Town's infrastructure is noted in Table 2.2 and shown in Figure 2-1.

TABLE 2.2: INVENTORY SUMMARY – PIPES

PIPE DIAMETER	% OF INVENTORY
<= 15-inch	28%
18- to 24-inch	30%
30- to 36-inch	10%
42- to 90-inch	3%
Pipe Size Unknown	29%

An additional 108,000 linear feet of open channel are included in the Town inventory as identified by the survey or in GIS for connectivity.

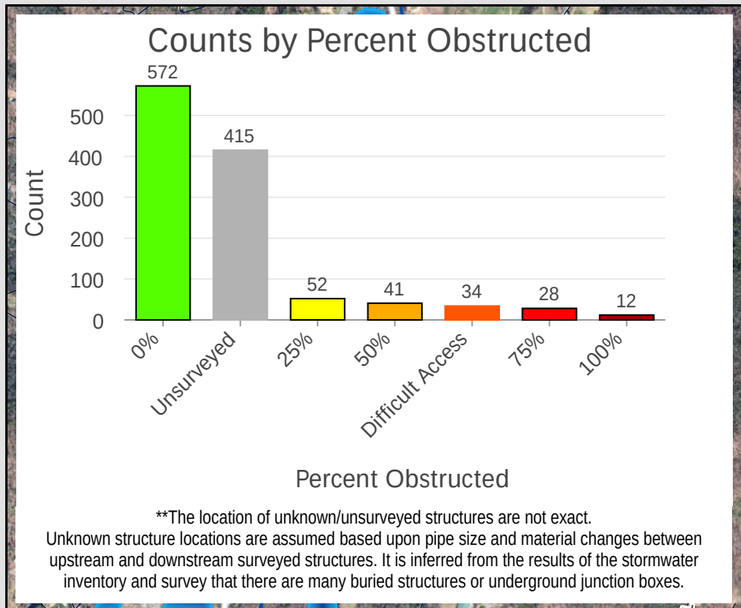


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Figure 2-1: Stormwater Inventory
TOWN OF BLACK MOUNTAIN, NC
Town of Black Mountain Stormwater Master Plan

0 600 1,200
Feet
1 in = 1,200 ft

N
W E
S



**The location of unknown/unsurveyed structures are not exact.
Unknown structure locations are assumed based upon pipe size and material changes between upstream and downstream surveyed structures. It is inferred from the results of the stormwater inventory and survey that there are many buried structures or underground junction boxes.

Legend

Stormwater Structures
Percent Obstructed
- 0%
- 25%
- 50%
- 75%
- 100%
- # Difficult Access Structure
- 2 Unsurveyed Structure

- Waterbody
- Stormwater Pipe
- Minor Channel
- Major Channel
- Road
- Watershed

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TOWN OF BLACK MOUNTAIN 1893 NORTH CAROLINA

Figure 2-2: Obstructed & Difficult Access Stormwater Structures
TOWN OF BLACK MOUNTAIN, NC
Town of Black Mountain Stormwater Master Plan

0 1,250 2,500 Feet

1 in = 1,250 ft

N

2.2. Hydrology and Flood Zones

The Town is generally located north of I-40 and the Swannanoa River. The Town primarily encompasses three tributaries to the Swannanoa River: Tomahawk Branch, Flat Creek, and Tributary 35 (of the Swannanoa River), as identified by Federal Emergency Management Agency (FEMA). Known flooding locations from the Town's 2022 Stormwater Master Plan Update[2] and meetings with Town staff were used to identify areas to model and evaluate the Town's existing stormwater conveyance system.

Additionally, FEMA models for Tomahawk Branch, Flat Creek, Tributary 35, and the Swannanoa River were downloaded from the North Carolina Flood Risk Information System (FRIS)[3] system and the bridge data and water surface elevations were used in modeling and evaluating the primary open channel systems.

The hydrologic make-up of the Town is shown in Figure 2-3.

2.3. NOAA Precipitation

Precipitation data were obtained from National Oceanic and Atmospheric Administration (NOAA). 24-hour precipitation depths as shown in Table 2.2 were obtained from NOAA Atlas 14, Volume 2, Version 3 for the Town's North Fork 2 Station (Station ID 31-6236)[4]. This station was chosen as the basis for the storm events as it is located at a high elevation in the mountains and is representative of the intensity and depth of rainfall coming off the mountains and draining down to the Town proper.

TABLE 2.3: NOAA RAINFALL DEPTHS

RECURRENCE INTERVAL	ANNUAL EXCEEDANCE PROBABILITY	NOAA 24-HOUR RAINFALL DEPTH (in)
2-YR, 24HR	5%	3.39
10-YR, 24HR	10%	5.00
25-YR, 24HR	4%	5.98
50-YR, 24HR	2%	6.76
100-YR, 24HR	1%	7.57

2.4. Land Use and Soils

The Town has a mix of land uses, including substantial low intensity residential development, forested areas in the upper parts of Flat Creek, and significant commercial development in the downtown corridor. There are some on-going residential developments in the upper parts of the Tomahawk Branch and Tributary 35 watersheds. These developments were included as existing land use for the watershed characterization. For example, the Tudorcroft development in Tomahawk Branch was incorporated into the existing land use data set. The Town has a very well-developed impervious land cover dataset provided by Raftelis that was also incorporated into the watershed characterization. For the purposes of the modeled watersheds, the current land use was assumed to be the future land use.

General characteristics of the modeled watersheds are noted in Table 2.2. Overall land use and soils maps for the Town as well as additional detail on the hydrologic parameterization[5,6] of the watershed models is provided in Appendix B.

TABLE 2.4: WATERSHED CHARACTERISTICS SUMMARY

WATERSHED	DRAINAGE AREA (SQ MI)	PRIMARY LAND USE	WATERSHED PERCENT IMPERVIOUSNESS	PRIMARY HYDROLOGIC SOIL GROUP
Study Area	8.68	Forest	9.4%	B
Downtown	0.23	Impervious	52.6%	B and D
Tomahawk Branch	1.93	Low Intensity Residential	15.3%	B
Flat Creek	6.04	Deciduous Forest	5.9%	B and A
Tributary 35	0.48	Low Intensity Residential	12.4%	B

Flat Creek

Jonahawk Branch

Tributary 35

I40 W

I40 E

US 70 HWY

NC 9 HWY

E STAT

Legend

- Stormwater Pipe
- Swannanoa River
- Primary System Open Channel
- Secondary System Open Channel
- Waterbody
- Norfolk Southern Railroad
- Watershed
- HUC 12 Boundary (060101050602)
- Wetland (National Wetland Inventory)

FEMA National Flood Hazard Layer

- 0.2% Annual Chance Flood Hazard
- 1% Annual Chance Flood Hazard
- Regulatory Floodway

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Figure 2-3: Hydrology
TOWN OF BLACK MOUNTAIN, NC
Town of Black Mountain Stormwater Master Plan

0 1,000 2,000 Feet

1 in = 2,000 ft

N W E S

3. EXISTING STORMWATER SYSTEM ANALYSIS

The purpose of the stormwater system analysis is to determine the existing level of service for the Town's mapped stormwater conveyance system and to develop proposed solutions to mitigate flooding. The Town's stormwater system was modeled in 1D PCSWMM. PCSWMM analyzes both the hydrologic watershed conditions and the conveyance hydraulics. Bridge data for primary systems was imported from corresponding FEMA models. Additional information on the hydraulic analyses and input data[7] is provided in Appendix C. A hard copy of the PCSWMM input/output is available upon request. A summary of the existing conditions for each watershed is noted below.

3.1. Downtown System

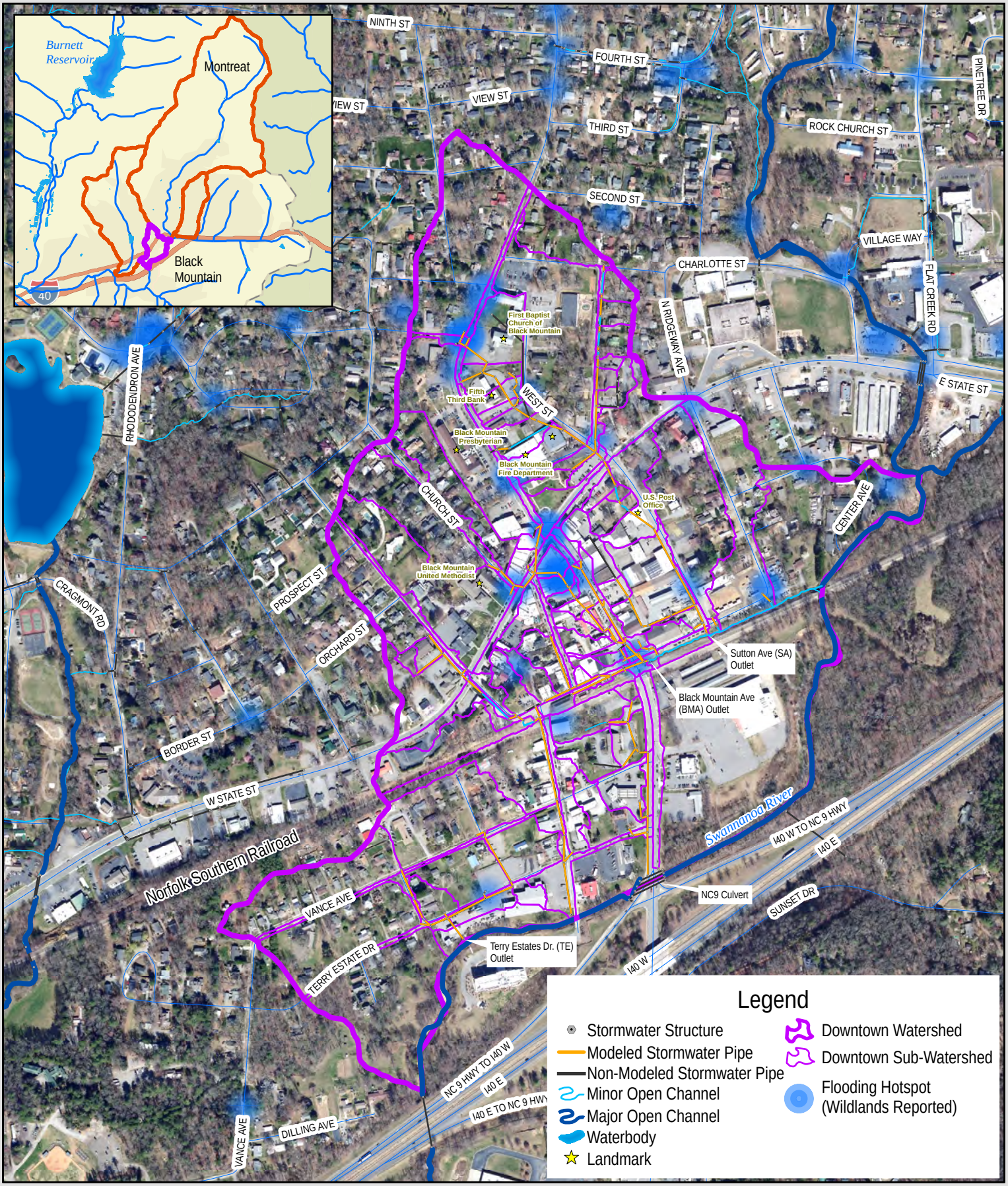
The downtown stormwater conveyance system consists of a significant amount of aged infrastructure that runs between public and private property. Several systems have pipes that convey public water underneath commercial and government buildings. The existing downtown stormwater, shown in Figure 3-1, has four primary outlets (three direct to the Swannanoa River and one to an open channel paralleling the railroad and Sutton Ave to the Swannanoa River). These are noted as the Sutton Ave outlet (SA), NC Highway 9 outlet (NC9), Black Mountain Ave outlet (BMA), and Terry Estates Drive outlet (TE).

Figure 3-1 also indicates locations of previously documented flooding issues at the intersection of Broadway and Sutton and along the following roads: W State St, West St, Montreat Rd, Richardson Blvd, Midland Ave, and Terry Estates Dr.

Model results for the existing system level of service are noted in Figures 3-2 and 3-3. The level of service for key locations in the downtown corridor is noted in Table 3.1.

TABLE 3.1: DOWNTOWN SECONDARY SYSTEM - EXISTING CONDITIONS LEVEL OF SERVICE

ROADWAY CROSSING	EXISTING PIPE	EXISTING SYSTEM LEVEL OF SERVICE
NORTH OF RAILROAD		
Sutton Ave (east of Cherry St)	15" RCP	< 2-YR
Sutton Ave (at Broadway St)	15" CMP	< 2-YR
Broadway St (north of Sutton Ave)	24" RCP	2-YR
Richardson Blvd (2 crossings at Sutton Ave)	30" RCP / 15" HDPE	< 2-YR
S. Ridgeway Dr (at Sutton Ave)	15" HDPE	< 2-YR
W. State St (at Church St)	18" RCP	< 2-YR
W. State St (at Cherry St)	18" VCP and PVC	< 2-YR
Cherry St (at W. State St)	18" RCP	< 2-YR
W. State St (at Broadway St)	18" and 24" RCP	2-YR
E. State St (at Richardson Blvd)	15" VCP	< 2-YR
Police Station (pipe under building)	15" RCP	< 2-YR
SOUTH OF RAILROAD		
Railroad Crossing - S. Dougherty St	12" VCP	< 2-YR
Black Mountain Ave (at Terry Estates Dr)	12" CMP	< 2-YR
Terry Estates Dr (5 crossings)	12" and 15" CPP	< 2-YR



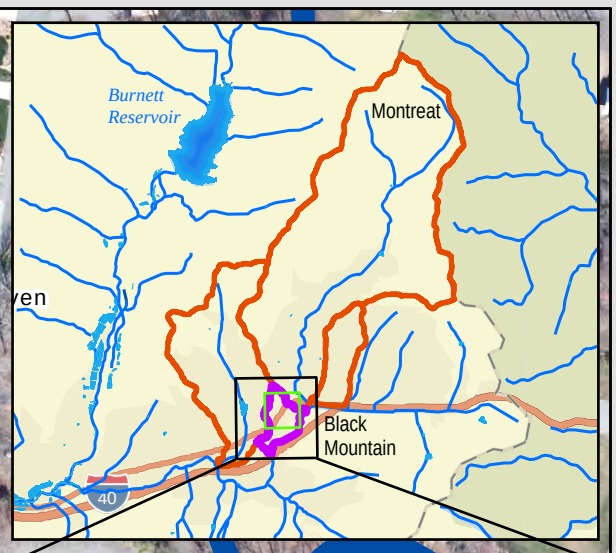
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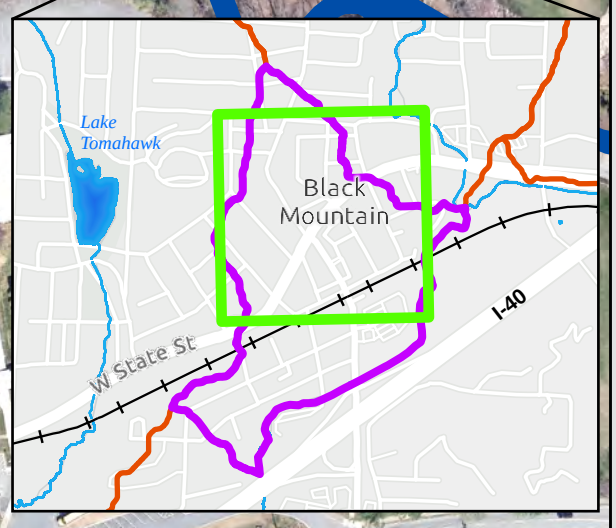
Figure 3-1: Downtown Secondary System
Town of Black Mountain Stormwater Master Plan

0 300 600 Feet
1 inch = 600 feet

N
W E
S

Sutton Avenue / Richardson Boulevard Outfall Systems	
ROADWAY	LEVEL OF SERVICE
Sutton Ave at S. Ridgeway Ave	< 2-YR
2 Sutton Ave at Richardson Blvd Crossings	< 2-YR
East State St at Richardson Blvd	< 2-YR
System between Montreat Rd and West St	2-YR
System along West Street at the Police Station	< 2-YR
Laurel Circle Dr at Montreat Rd	< 2-YR
West Street at Midland Ave	2-YR
First St at Midland Ave	2-YR
Sutton Ave east of NC 9	25-YR
Sutton Ave and Broadway St intersection	< 2-YR
Cherry St at Sutton Ave	< 2-YR
System along west side of Broadway St	< 2-YR
Cherry St at West State St	2-YR
West State St at Church St	< 2-YR
Church St at West State St	< 2-YR
Church St	< 2-YR
Montreat Rd at East State St	< 2-YR
24" System in Broadway to Cherry St	2-YR
24" System in Broadway north of Cherry St	25-YR





SECOND ST
N RIDGEWAY AVE
LAUREL CIRCLE DR
WEST ST
E STATE ST
SCOTLAND ST
Police Station
HONEYCUTT ST
MONTREAT RD
U.S. Post Office
S RIDGEWAY AVE
CENTER AVE
CHURCH ST
BROADWAY ST
S RICHARDSON BLVD
W STATE ST
CHERRY ST
SUTTON AVE
NC 9 HWY
Norfolk Southern Railway
Modeled as overland flow between pipes. No defined channel.

Legend

Stormwater Pipe Level of Service

- <2-YR
- 2-YR
- 10-YR
- 25-YR
- Modeled Open Channel
- Non-Modeled Pipe*
- Non-Modeled Swannanoa NC9 HWY Culvert

Stormwater Structures

- Pipe End
- Inlet
- Assumed Underground Junction Box
- Manhole
- Unsurveyed Structure
- Swannanoa River
- Norfolk Southern Railway

*Evidence of pipe in the field; survey/inventory data not sufficient enough to model

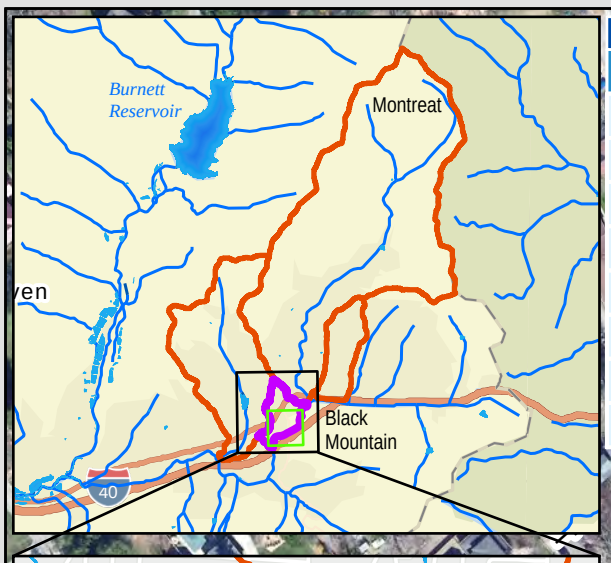
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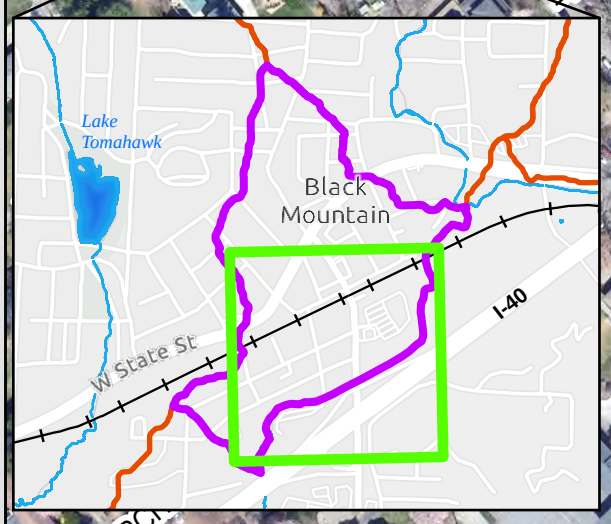
Figure 3-2: Existing Conditions Level of Service
DOWNTOWN (NORTH) DRAINAGE SYSTEM
Town of Black Mountain Stormwater Master Plan

0 100 200 Feet

1 in = 200 ft

N W E S





Black Mountain Avenue Outfall System	
ROADWAY	LEVEL OF SERVICE
Terry Estate Dr at Black Mtn Ave	< 2-YR
Black Mountain Ave at Terry Estate Dr	< 2-YR
Vance Ave at Black Mtn Ave	< 2-YR
Railroad Tracks at Black Mtn Ave	< 2-YR
S. Dougherty St at Black Mtn Ave	25-YR
S. Dougherty St Bend	< 2-YR
West State St (US 70)	25-YR
N. Dougherty St at West State St	25-YR

NC 9 Outfall System	
ROADWAY	LEVEL OF SERVICE
Terry Estate Dr west of NC 9	< 2-YR
Terry Estate Dr at NC 9	25-YR
Vance Ave at NC 9	25-YR
Vance Ave west of NC 9	2-YR

Bridge Street / Terry Estate Outfall System	
ROADWAY	LEVEL OF SERVICE
3 Terry Estate Dr Crossings near Bridge St	< 2-YR
2 Terry Estate Dr Crossings east of Bridge St	< 2-YR
Vance Ave at Bridge St	10-YR
Vance Ave near Spring St	2-YR

Legend

Stormwater Pipe Level of Service

- <2-YR
- 2-YR
- 10-YR
- 25-YR
- Modeled Open Channel
- Non-Modeled Pipe*
- Non-Modeled Swannanoa NC9 HWY Culvert

Stormwater Structures

- Pipe End
- Inlet
- Assumed Underground Junction Box
- Manhole
- Unsurveyed Structure
- Swannanoa River
- Norfolk Southern Railway

*Evidence of pipe in the field; survey/inventory data not sufficient enough to model

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Figure 3-3: Existing Conditions Level of Service
DOWNTOWN (SOUTH) DRAINAGE SYSTEM
Town of Black Mountain Stormwater Master Plan

0 100 200 Feet
1 in = 200 ft

N W E S

3.2. Tomahawk Branch Watershed

3.2.1 Primary System

Tomahawk Branch watershed is 1.93 square miles and encompasses several residential developments around Tomahawk Lake as shown in Figure 3-4. Known flooding locations along the primary system are concentrated at Laurel Circle Dr and Hiawassee Ave. Model results for the existing system level of service are noted in Figure 3-5. The level of service for key locations is noted in Table 3.2.

TABLE 3.2: TOMAHAWK PRIMARY SYSTEM - EXISTING CONDITIONS LEVEL OF SERVICE

ROADWAY CROSSING	EXISTING PIPE	EXISTING SYSTEM LEVEL OF SERVICE
Laurel Circle Dr (north of Lake Tomahawk)	Triple Arch CMP Culvert	< 2-YR
Cragmont Rd (south of Lake Tomahawk)	Twin 90" CMP Culvert	50-YR
W. State St	Twin 7' x 10' RCBC*	50-YR
Swannanoa Ave (south of Cragmont Rd)	30" CMP / 48" CMP	2-YR

**Reinforced Concrete Box Culvert*

3.2.2 Secondary System

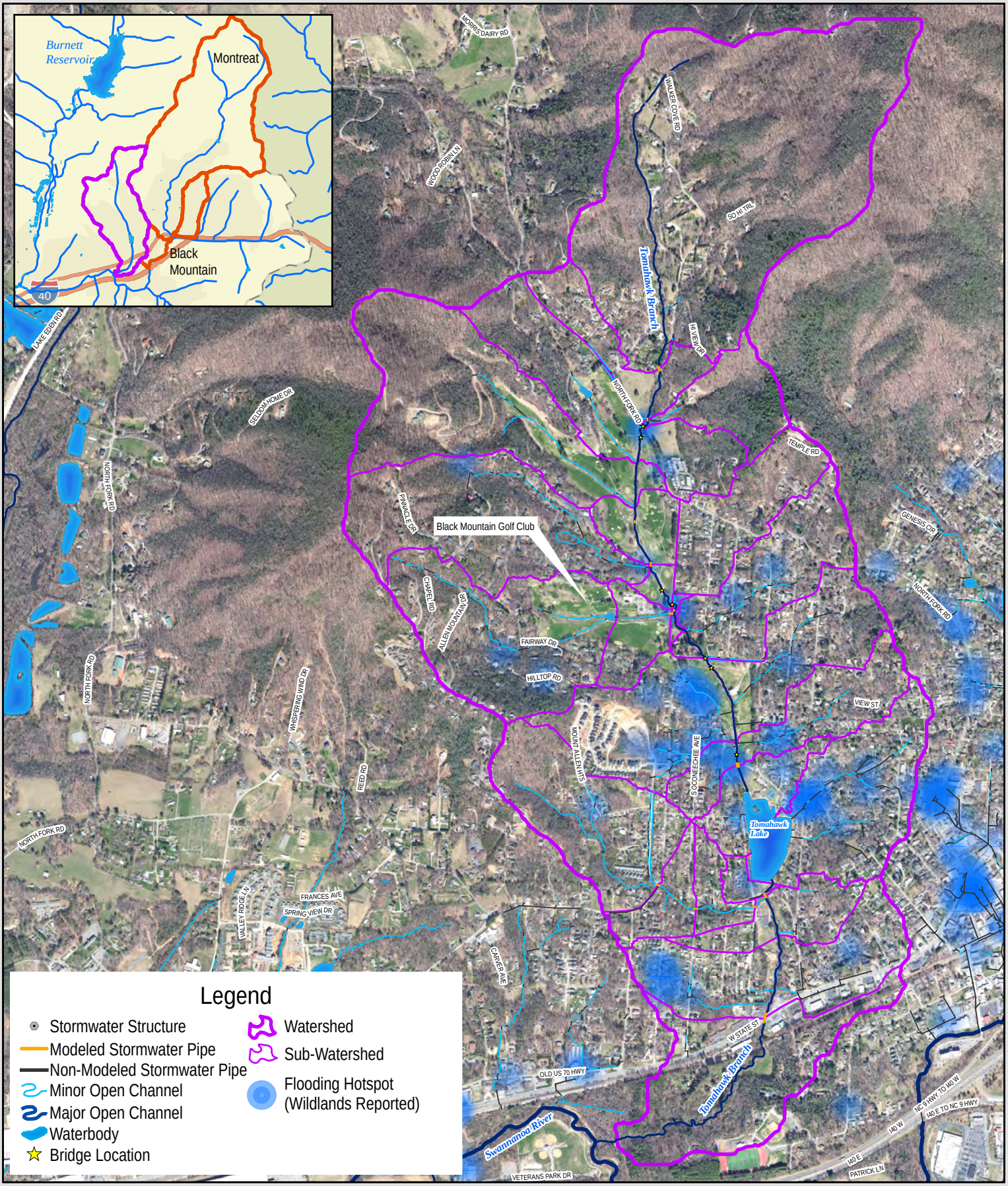
There are multiple secondary systems that drain to Tomahawk Branch north of Tomahawk Lake and directly to the lake itself as noted in Figure 3-6. 0.3 square miles of secondary system drainage area was modeled with seven (7) outfalls to Tomahawk Branch upstream of the lake and four (4) outfalls directly to Tomahawk Lake. One small system across Walnut St at Tomahawk Ave was also included in the secondary system model with an outlet to an open channel on the west side of Tomahawk Ave.

Runoff from the Tudorcroft residential development in the upper parts of the watershed have been a concern for downstream residents. Previously documented flooding locations are shown in Figure 3-6.

Model results for the existing system level of service are noted in Figure 3-7. The level of service for key locations is noted in Table 3.3.

TABLE 3.3: TOMAHAWK SECONDARY SYSTEM - EXISTING CONDITIONS LEVEL OF SERVICE

ROADWAY CROSSING	EXISTING PIPE	EXISTING SYSTEM LEVEL OF SERVICE
Stream crossing Byrd Rd, Hiawassee Ave, and S. Oconeechee Ave	18" and 24" CMP	< 2-YR
Tomahawk Ave (downstream of above system)	36" CMP	2-YR
Hiawassee Ave at Fairway Dr	18" CMP/HDPE	< 2-YR
Tomahawk Ave (just north of Fairway Dr)	18" CPP	2-YR
Tomahawk Ave and Hickory St	15" CPP/18" CMP	2-YR
Rhododendron Ave (at Eighth St)	24" CMP	2-YR
Rhododendron Ave (at Laurel Circle Dr to Lake)	24" CMP	< 2-YR
Azalea Ave (north of Ninth St)	18" CPP	< 2-YR
9th St (west of Azalea Ave)	18" CPP	< 2-YR
Laurel Ave (south of 9th St)	36" CMP	2-YR

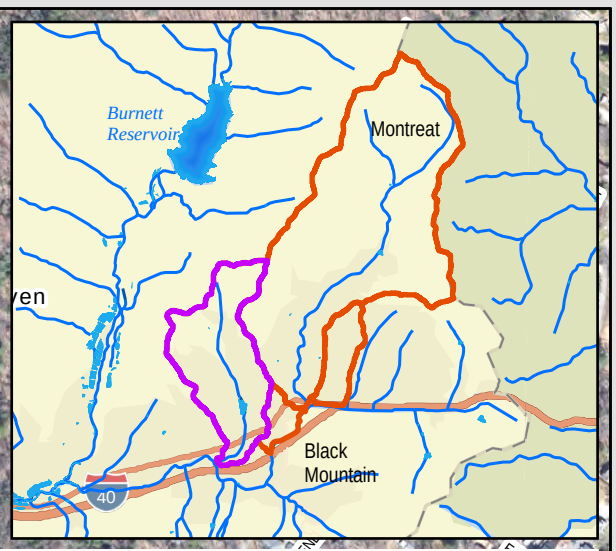


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Figure 3-4: Tomahawk Branch Primary System
Town of Black Mountain Stormwater Master Plan

0 750 1,500 Feet
1 in = 1,500 ft

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CULVERT CROSSING	LEVEL OF SERVICE
W State St (Hwy 70)	50-YR
Cragmont Rd	50-YR
Laurel Circle Dr	<2-YR
9th St Bridge	25-YR
Hiawassee Ave Bridge	25-YR
Chapel Rd	25-YR
Walker Cove Rd	50-YR
Hiawassee Ave (South of Ross Dr)	50-YR
Swannanoa Ave	2-YR
E College St	50-YR
Cragmont Rd (Secondary Crossing)	25-YR

Legend

Stormwater Pipe Level of Service

- <2-YR
- 2-YR
- 10-YR
- 25-YR
- 50-YR
- Modeled Open Channel
- Non-Modeled Open Channel
- Non-Modeled Pipe*
- Bridge Location

Stormwater Structures

- Pipe End
- Inlet
- Assumed Underground Junction Box
- Manhole
- Unsurveyed Structure
- Tomahawk Branch
- Tomahawk Lake

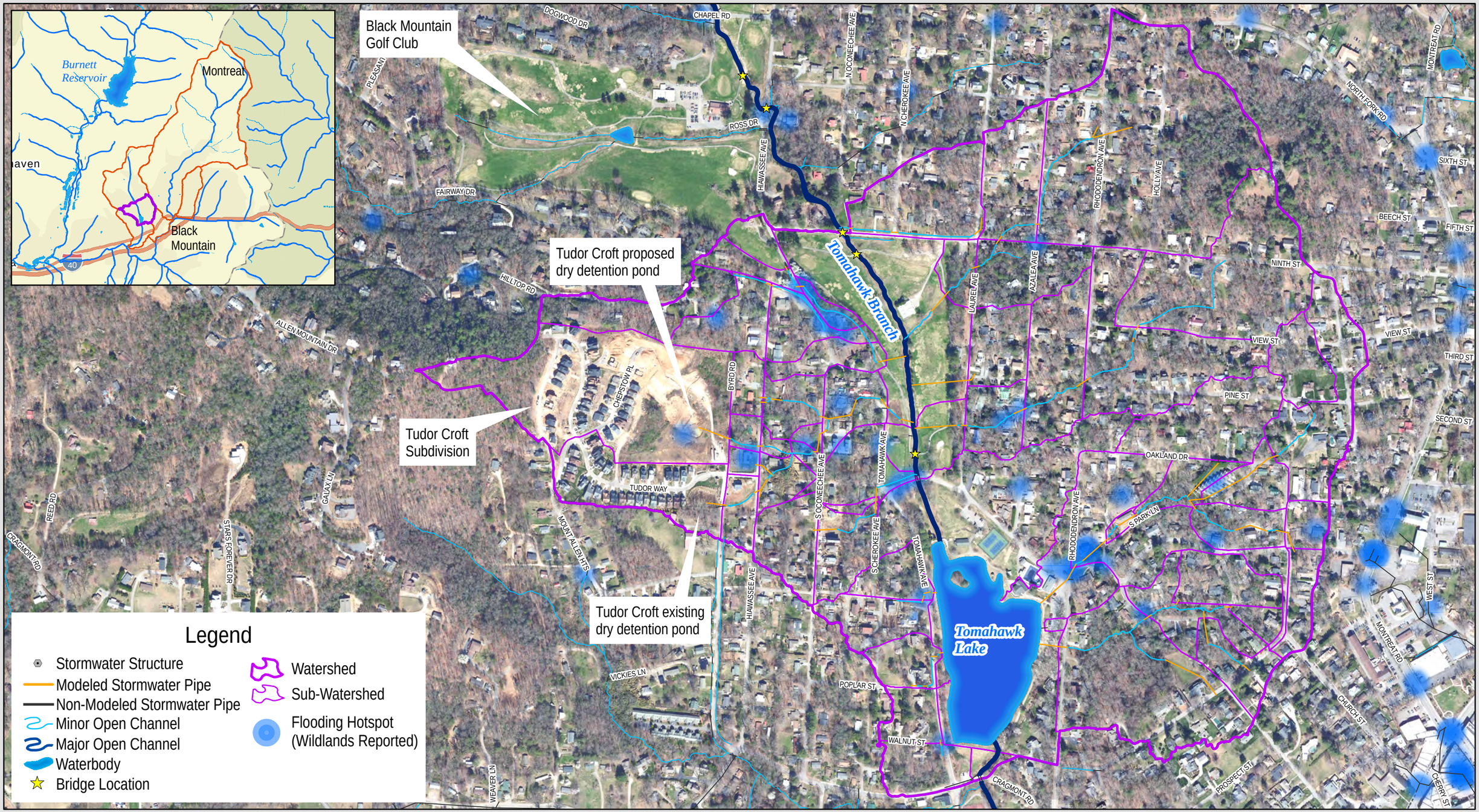
*Evidence of pipe in the field; survey/inventory data not sufficient enough to model

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Figure 3-5: Existing Conditions Level of Service
TOMAHAWK BRANCH PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 250 500 Feet
1 in = 500 ft

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TOWN OF BLACK MOUNTAIN 1893 NORTH CAROLINA

Figure 3-6: Tomahawk Branch Secondary System
Town of Black Mountain Stormwater Master Plan

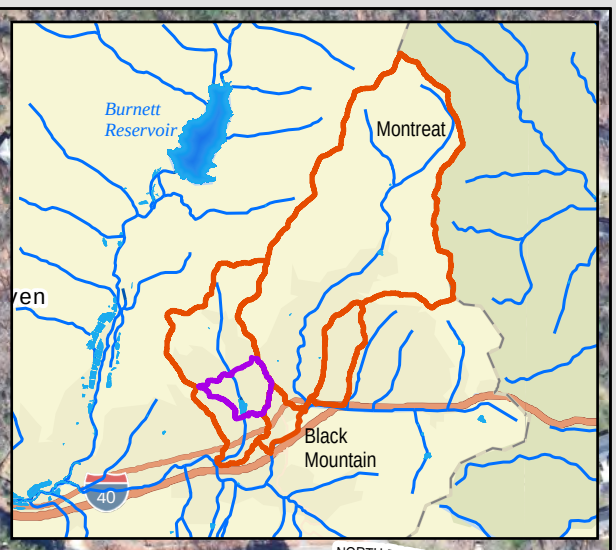
0 500 1,000 Feet

1 in = 500 ft

N W E S

East of Tomahawk Branch / Tomahawk Lake	
ROADWAY	LEVEL OF SERVICE
N. Cherokee Ave at 9th St	< 2-YR
Laurel Ave (north of 9th St)	25-YR
Laurel Ave (south of 9th St)	2-YR
9th Street	< 2-YR
Azalea Ave (north of 9th St)	< 2-YR
Rhododendron Ave (south of 10th St)	10-YR
Laurel Ave at 8th St	25-YR
8th St at Laurel Ave	2-YR
Laurel Ave (south of 8th St)	< 2-YR
Azalea Ave (south of 8th St)	< 2-YR
Rhododendron Ave (south of View St)	2-YR
View St	< 2-YR
Rhododendron Ave at Laurel Circle Dr	< 2-YR
N. Park Ln	2-YR
Oakland Dr	10-YR
S. Park Ln	25-YR
Church St	< 2-YR
Laurel Circle Dr at Church St	25-YR
Rhododendron Ave	10-YR
S Laurel Circle (west)	2-YR
Circle Ln	25-YR
S Laurel Circle (central)	25-YR
S Laurel Circle (east)	25-YR
Connally St (east of N Dougherty St)	25-YR
Connally St (west of N Dougherty St)	10-YR

West of Tomahawk Branch / Tomahawk Lake	
ROADWAY	LEVEL OF SERVICE
Fairway Dr at Hiawassee Ave	< 2-YR
Tomahawk Ave (north of Fairway Dr)	2-YR
Hiawassee Ave (parallel north)	25-YR
Hiawassee Ave (parallel south)	25-YR
S. Oconeechee Ave (north)	25-YR
Byrd Rd (north)	< 2-YR
Hiawassee Ave (north central)	< 2-YR
Hiawassee Ave (south central)	10-YR
Byrd Rd (south)	10-YR
Hiawassee Ave (south)	10-YR
S. Oconeechee Ave (central)	< 2-YR
Tomawhawk Ave	2-YR
S. Oconeechee Ave (south)	25-YR
Hickory St at Tomahawk Ave	2-YR
Tomahawk Ave north of Hickory Dr	2-YR
Tomahawk Ave south of Hickory Dr	2-YR
Walnut St at Tomahawk Ave	2-YR



Intersection of Fairway Dr and Tomahawk Ave and further south on Tomahawk Ave are known flooding locations. There is no stormwater infrastructure in this area. Runoff overflows the stormwater ditches flowing down Tomahawk Ave and across properties towards Tomahawk Branch.

Intersection of Laurel Circle Dr and Tomahawk Ave is a known flooding location. There is no stormwater infrastructure in this area. The pipes along S. Cherokee Ave end and runoff overflows into the intersection towards Tomahawk Branch.

Legend

Stormwater Pipe Level of Service

- <2-YR
- 2-YR
- 10-YR
- 25-YR
- Modeled Open Channel
- Non-Modeled Open Channel
- Non-Modeled Pipe*
- Primary System Culvert**

Stormwater Structures

- Pipe End
- Inlet
- Assumed Underground Junction Box
- Manhole
- Unsurveyed Structure
- Tomahawk Branch
- Tomahawk Lake

*Evidence of pipe in the field; survey/inventory data not sufficient enough to model
**Level of Service for Primary System Culverts provided on a separate map

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Figure 3-7: Existing Conditions Level of Service
TOMAHAWK BRANCH SECONDARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 300 600 Feet

1 in = 300 ft

N
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3.3. Flat Creek Watershed

The Flat Creek watershed is six (6) square miles, including the 0.35 square mile Flat Creek Tributary 1 watershed. Most of the primary road crossings along Flat Creek are bridges, which were modeled using FEMA data as shown in Figure 3-8. The most downstream Flat Creek crossing prior to confluence with the Swannanoa River is at US 70 East and is a triple 11' x 10' Reinforced Concrete Box Culvert (RCBC). Known flooding concerns are primarily located along Flat Creek Tributary 1 from Portmanvilla Rd upstream to Montreat Rd.

Model results for the existing system level of service are noted in Figure 3-9. The level of service for key locations along Flat Creek Tributary 1 is noted in Table 3.4.

TABLE 3.4: FLAT CREEK PRIMARY SYSTEM - EXISTING CONDITIONS LEVEL OF SERVICE

ROADWAY CROSSING	EXISTING PIPE	EXISTING SYSTEM LEVEL OF SERVICE
Montreat Rd (NC 9)	24" CMP	2-YR
Seventh St	Triple 24" CMP	2-YR
Seventh St (west of Portmanvilla Rd)	15" PVC	< 2-YR
Sixth St	42" CMP	10-YR
Sixth St (west of Portmanvilla Rd)	15" CMP	< 2-YR
Portmanvilla Rd	30" CMP	2-YR
Portmanvilla Rd	15" CMP	< 2-YR
US 70 (E. State St)	Triple 11' x 10' RCBC	50-YR

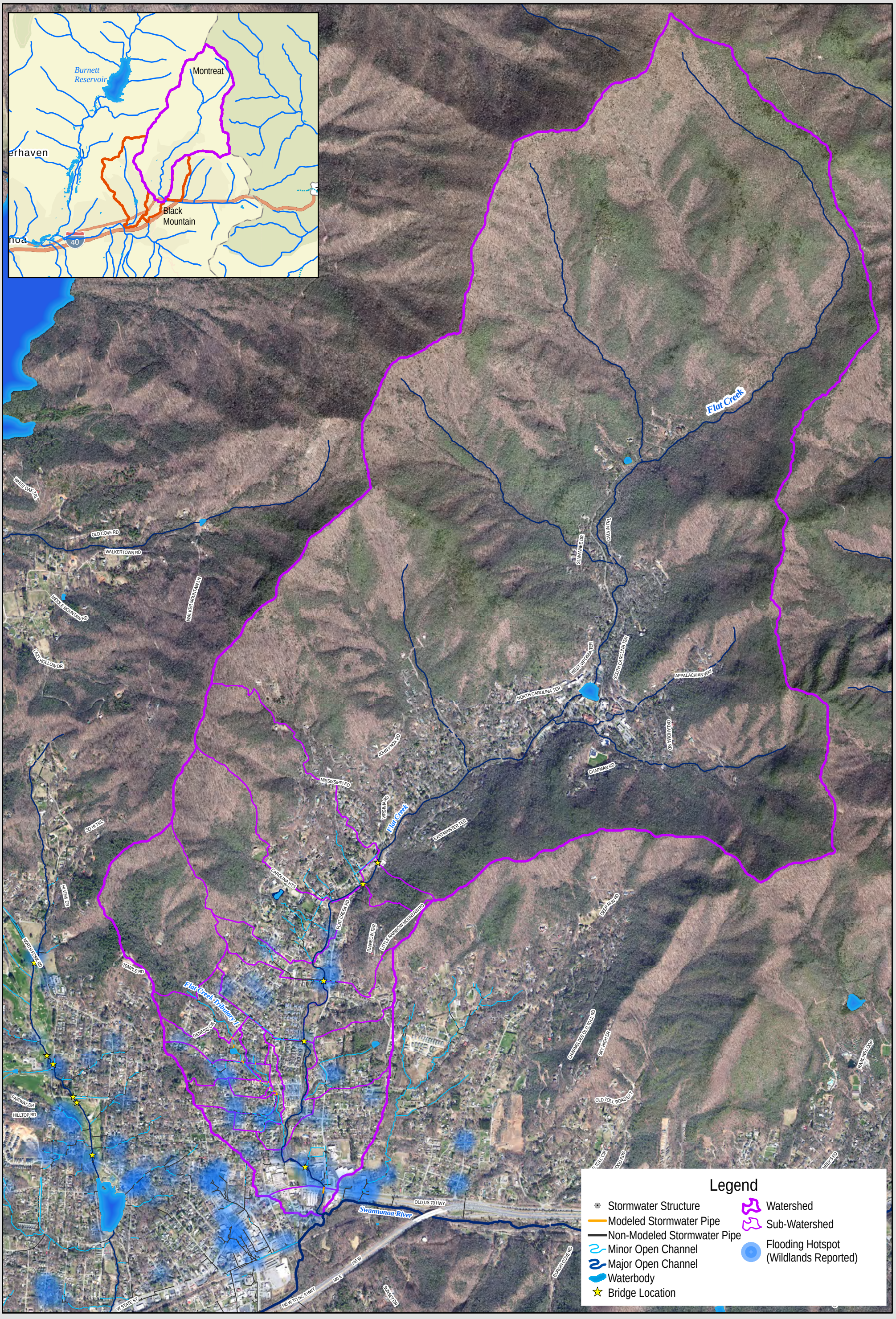
3.4. Tributary 35 / Avena Road Watershed

The Tributary 35 (of the Swannanoa River) watershed encompasses approximately 0.48 square miles and includes two primary thoroughfares: Avena Road and Padgettown Road. The stormwater conveyance system is comprised of open channel, culvert crossings, and outfalls to the Swannanoa River via a 6' x 7' RCBC underneath US 70 as shown in Figure 3-10. Primary flooding concerns within this watershed include the crossing at Old State 10 Rd and Padegettown Rd from Old State 10 Rd to Old US 70E.

Model results for the existing system level of service are shown in Figure 3-11 and noted in Table 3.5.

TABLE 3.5: TRIBUTARY 35 PRIMARY SYSTEM - EXISTING CONDITIONS LEVEL OF SERVICE

ROADWAY CROSSING	EXISTING PIPE	EXISTING SYSTEM LEVEL OF SERVICE
Avena Rd (near Bellgrove Rd)	48" CMP	2-YR
Bellgrove Rd	Twin 36" CMP	2-YR
Avena Rd	48" CMP	10-YR
Old State 10 Rd	Twin 36" HDPE/CPP	2-YR
Padgettown Rd (north of Old US 70 E)	Twin 36" CMP	< 2-YR
Old US 70 East	6' x 10' RCBC	25-YR
US 70 (E. State St)	6' x 7' RCBC	50-YR

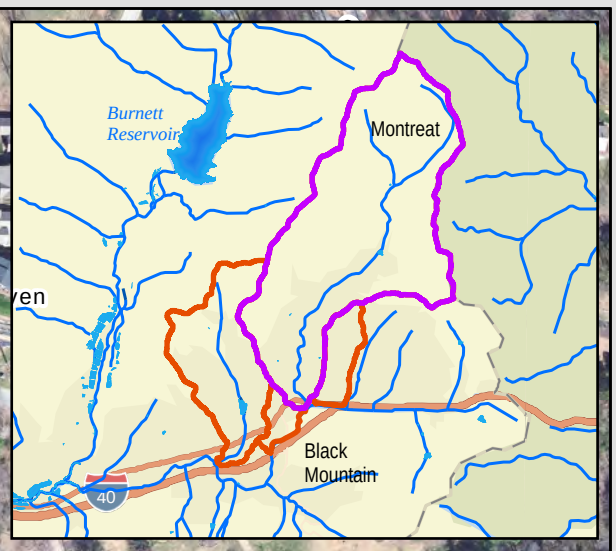


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Figure 3-8: Flat Creek Tributary 1 Primary System
Town of Black Mountain Stormwater Master Plan

0 750 1,500 Feet
1 in = 1,500 ft

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CUVLERT CROSSING	LEVEL OF SERVICE
US 70 (Triple 11'x10' RCBC)	50-YR
Flat Creek Tributary 1 Culverts	
Portmanvilla Rd (15" CMP)	< 2-YR
Portmanvilla Rd (30" CMP)	2-YR
6th Street near Portmanvilla Rd (15" CMP)	<2-YR
6th Street (42" CMP)	10-YR
7th Street near Portmanvilla Rd (15" CPP)	< 2-YR
7th Street (Triple 24" CMP)	2-YR
Montreat Rd (24" CMP)	2-YR

Legend

Stormwater Pipe Level of Service

- <2-YR
- 2-YR
- 10-YR
- 25-YR
- 50-YR
- Modeled Open Channel
- Non-Modeled Open Channel
- Non-Modeled Pipe*

Stormwater Structures

- Pipe End
- Inlet
- Assumed Underground Junction Box
- Manhole
- Unsurveyed Structure
- Swannanoa River
- Flat Creek
- Bridge Location

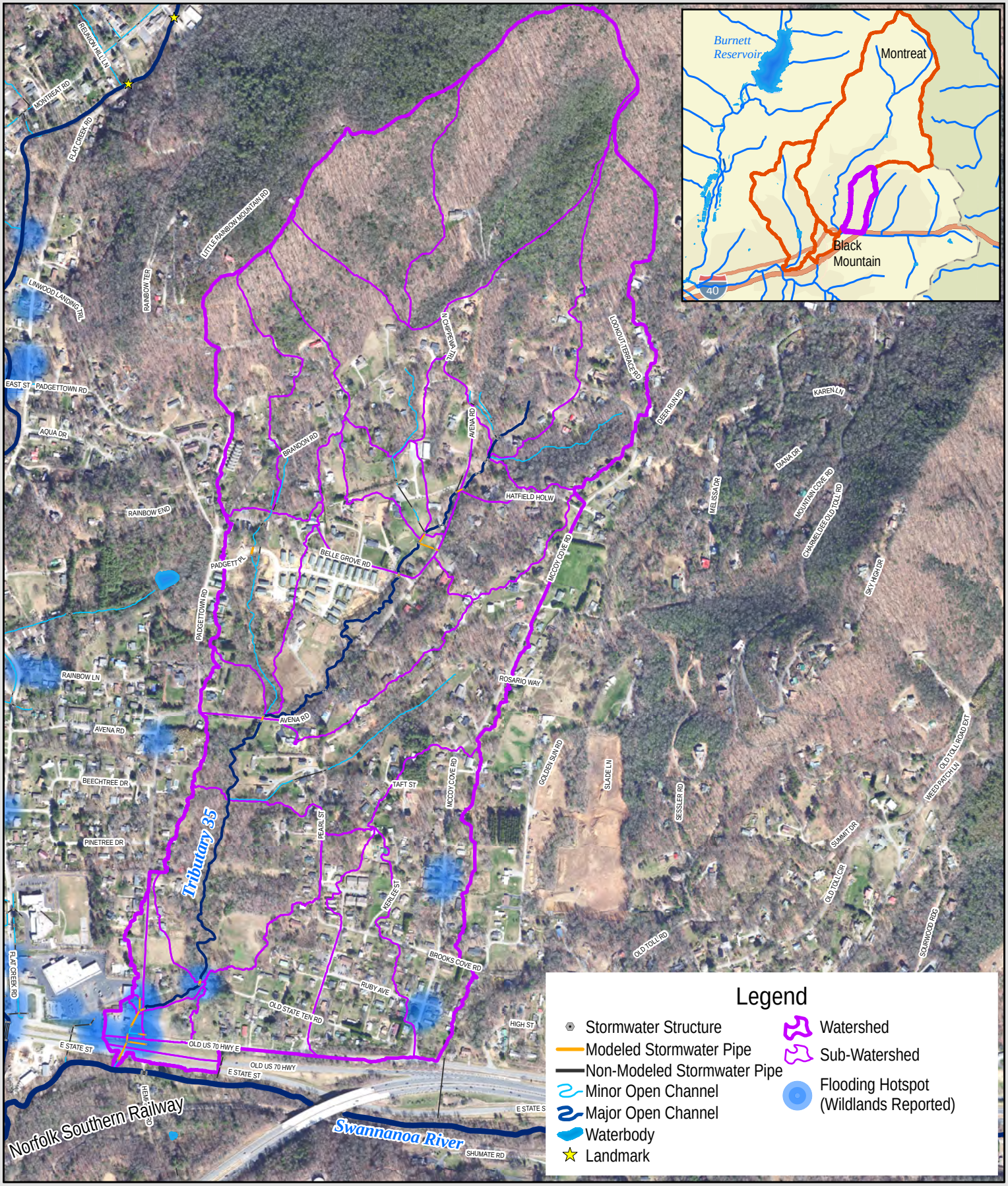
Evidence of pipe in the field; survey/inventory data not sufficient enough to model

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Figure 3-9: Existing Conditions Level of Service
FLAT CREEK TRIBUTARY 1 PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 125 250 Feet
1 in = 250 ft

N W E S

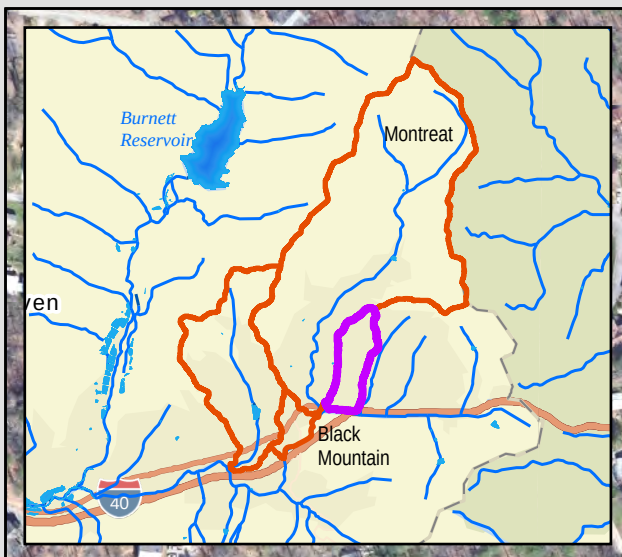


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Figure 3-10: Avena Rd./Tributary 35 Primary System
Town of Black Mountain Stormwater Master Plan

0 400 800 Feet
1 in = 800 ft

N
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CULVERT CROSSING	LEVEL OF SERVICE
US-70 (6'x7' RCBC)	50-YR
Old US-70 (6' x10' RCBC)	25-YR
Parking Lot (Twin 36" CMP)	2-YR
Padgettown Rd (Twin 36" CMP)	< 2-YR
Padgettown Rd (24" CMP)	2-YR
Old State Ten Rd (Twin 36" CPP)	2-YR
Avena Rd (48" CPP)	2-YR
Padgett Place (Twin 36" CPP)	50-YR
Belle Grove Rd (Twin 36" CPP)	2-YR
Avena Rd (24" CMP)	2-YR
Avena Rd (48" CMP)	50-YR

Legend

Stormwater Pipe Level of Service

- <2-YR
- 2-YR
- 10-YR
- 25-YR
- 50-YR
- Modeled Open Channel
- Non-Modeled Open Channel
- Non-Modeled Pipe*

Stormwater Structures

- Pipe End
- Inlet
- Assumed Underground Junction Box
- Manhole
- Unsurveyed Structure
- Swannanoa River

*Evidence of pipe in the field; survey/inventory data not sufficient enough to model

LOS results at US-70 include the use of the depression area between Old US-70 and US-70 as a storage area.

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Figure 3-11: Existing Conditions Level of Service
AVENA ROAD/TRIBUTARY 35 PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 150 300 Feet

1 in = 300 ft

N W E S

3.5. Intense Storm Analyses

The 2-yr and 5-yr, 6-hr storm events were also modeled as SCS Type II storm events to simulate high-intensity rainfall events for the purpose of developing projects more resilient to climate change. Storm events, in general, are becoming more frequent with higher intensity. These types of rainfall events tend to lead towards generating more runoff rather than less intense rains leading to more infiltration. The shorter rainfall events were modeled to evaluate the impact on the Town's infrastructure of a more frequent, higher-peaked storm event to assess the system's capacity to handle intense events that may generate more runoff than infiltration.

The rainfall depths are noted in Table 3.6 were obtained from NOAA Atlas 14, Volume 2, Version 3 for the Town's North Fork 2 Station (Station ID 31-6236).[4]

TABLE 3.6: NOAA RAINFALL DEPTHS - 6 HR STORMS[4]

RECURRENCE INTERVAL	NOAA 6-HOUR RAINFALL DEPTH (in)
2-YR, 6HR	2.23
5-YR, 6HR	2.79

In the Downtown corridor, the model results indicated that the level of service (LOS) for roadways in the 5-yr, 6-hr storm event mirrored that of the 2-yr, 24-hr storm. For a high-intensity rainfall, the existing system shows significant flooding across major roadways in and around Downtown. In the Tomahawk Branch secondary system, most roadways meet a level of service sufficient to handle the modeled 5-yr, 6-hr storm event.

As indicated by the modeling results, the following culverts along primary systems in the Tomahawk Branch, Flat Creek Tributary 1, and Tributary 35 / Avena Rd watersheds, do not provide a level of service to handle the 5-yr, 6-hr storm event:

- Sixth Street near Portmanvilla Road
- Portmanvilla Road
- Padgettown Road just south Old State 10 Road

4. CRITICALITY ANALYSIS

As part of the Town of Black Mountain Stormwater Master Plan, a preliminary condition assessment was completed to identify high priority areas for detailed CCTV and/or maintenance needs. Prioritization is based on the likelihood of asset failure, as well as the consequence of asset failure. By evaluating the likelihood of asset failure in relation to the consequence of asset failure, a combined criticality score is then developed for each asset. This criticality score can enable the Town to more strategically evaluate which assets to focus capital improvement resources on for repair, rehabilitation, or further condition assessments. This section summarizes the results of a GIS audit and the scoring criteria and methodology used in developing the condition assessment.

4.1. Project Background

WK Dickson (An Ardurra Company) collected and analyzed the stormwater infrastructure data which included GIS stormwater data, building and transportation locations, and geographic features. This data was audited to determine the availability of necessary attribute information to conduct the criticality analysis. Upon resolution of the identified data gaps, WK Dickson performed a criticality assessment by running the criticality toolset to generate results. The results of this prioritization are included in this report as the findings of asset criticality within the Town of Black Mountain. The detailed methodology for customizing the prioritization tool for the Town can be found in Appendix D.

4.2. Criticality Analysis

After the scoring criteria and attribute analysis was completed, the pipe and structure matrices were populated and the asset criticality analysis was run. As a result, the highest scoring assets indicate the most critical assets in terms of overall risk due to consequence and likelihood of failure. Since there are a different number of assets for each utility system grouping, the distribution range differs.

Table 4.1 summarizes the number of stormwater pipe assets falling into each scoring category. A single pipe asset is defined as a section of pipe between either two (2) structures or between a structure and an outfall. The table presents the total criticality score as well as the likelihood and consequence scores.

When reviewing the table, it is noticeable that the class ranges are not uniform. The data was evaluated and confirmed that the criticality analysis followed a normal distribution. In an effort to highlight the infrastructure at both ends of the spectrum, the following class ranges were devised based on a modified bell curve: the top and bottom 5% of total scores were classified as ‘High’ and ‘Low’, the middle 63% as ‘Medium’, and the remaining 13.5% on either side of the middle as ‘Medium-High’ and ‘Medium-Low’. The purpose of these class ranges is to assign a criticality level to each asset, which informs overall scoring for rehabilitation projects. Assets rated at criticality levels 4 or 5 are typically the highest priority for rehabilitation.

Table 4.1 also shows the criticality levels for stormwater pipes. Of the pipes evaluated, 20% scored in Level 4 or 5, indicating the highest need for stormwater rehabilitation efforts. Exhibit 4.1 shows the distribution graphically.

TABLE 4-1: STORMWATER PIPES SCORING SUMMARY AND DISTRIBUTION

CATEGORIES ASSIGNED					
	Low (1)	Medium-Low (2)	Medium (3)	Medium-High (4)	High (5)
TOTAL CRITICALITY SCORE DISTRIBUTION					
	40-180	181-220	221-390	391-480	481-700
Stormwater Pipes	46	121	405	126	45
LIKELIHOOD SCORE DISTRIBUTION					
	20-108	109-196	197-284	285-372	373-460
Stormwater Pipes	82	288	256	103	14
CONSEQUENCE SCORE DISTRIBUTION					
	0-88	89-176	177-264	265-352	353-440
Stormwater Pipes	266	333	128	13	3

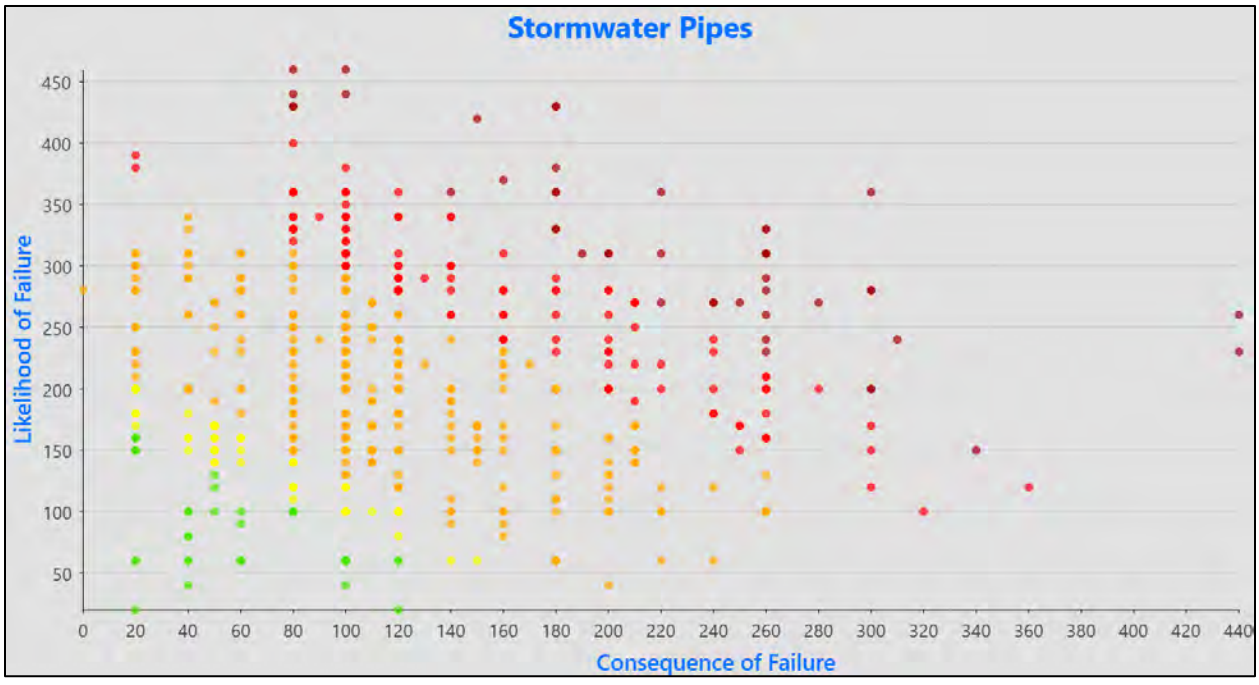


Exhibit 4.1
Stormwater Pipe Scoring Results

Table 4.2 shows the criticality levels for stormwater structures. Within the structures evaluated, 21% scored in Level 4 or 5, indicating the highest need for stormwater structure rehabilitation efforts. Exhibit 4.2 shows the distribution graphically.

TABLE 4.2: STORMWATER STRUCTURES SCORING SUMMARY AND DISTRIBUTION

CATEGORIES ASSIGNED					
	Low (1)	Medium-Low (2)	Medium (3)	Medium-High (4)	High (5)
TOTAL CRITICALITY SCORE DISTRIBUTION					
	60-155	**156-185**	**186-315**	**316-400**	**401-585**
Stormwater Structures	48	180	719	190	57
LIKELIHOOD SCORE DISTRIBUTION					
	20-98	**99-176**	**177-254**	**255-332**	**333-410**
Stormwater Structures	77	767	252	78	20
CONSEQUENCE SCORE DISTRIBUTION					
	0-62	**63-124**	**125-186**	**187-248**	**249-310**
Stormwater Structures	593	370	182	40	9

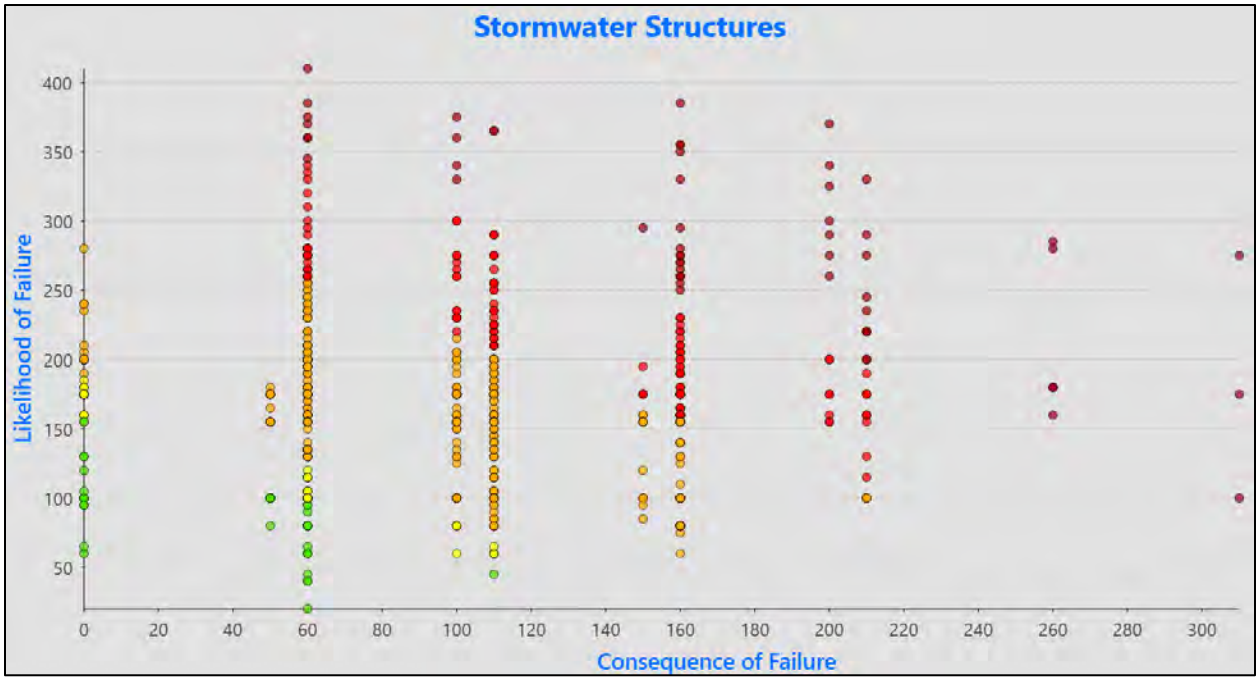


Exhibit 4.2
Stormwater Structure Scoring Results

4.3. Operations and Maintenance Recommendations

The stormwater drainage systems evaluated in this report are composed of a series of culverts, closed drainage systems, and open channels. It is recommended that properly scheduled maintenance be conducted at routine intervals to prolong system life and to identify and address system failures in a timely manner.

The condition assessment evaluated pipes and structures based on likelihood and consequence of failure. It is recommended that the Town prioritize the areas with high-risk infrastructure shown in red and dark red in Figures 4-1 through 4-4 for repair, rehabilitation, or further conditions assessment.

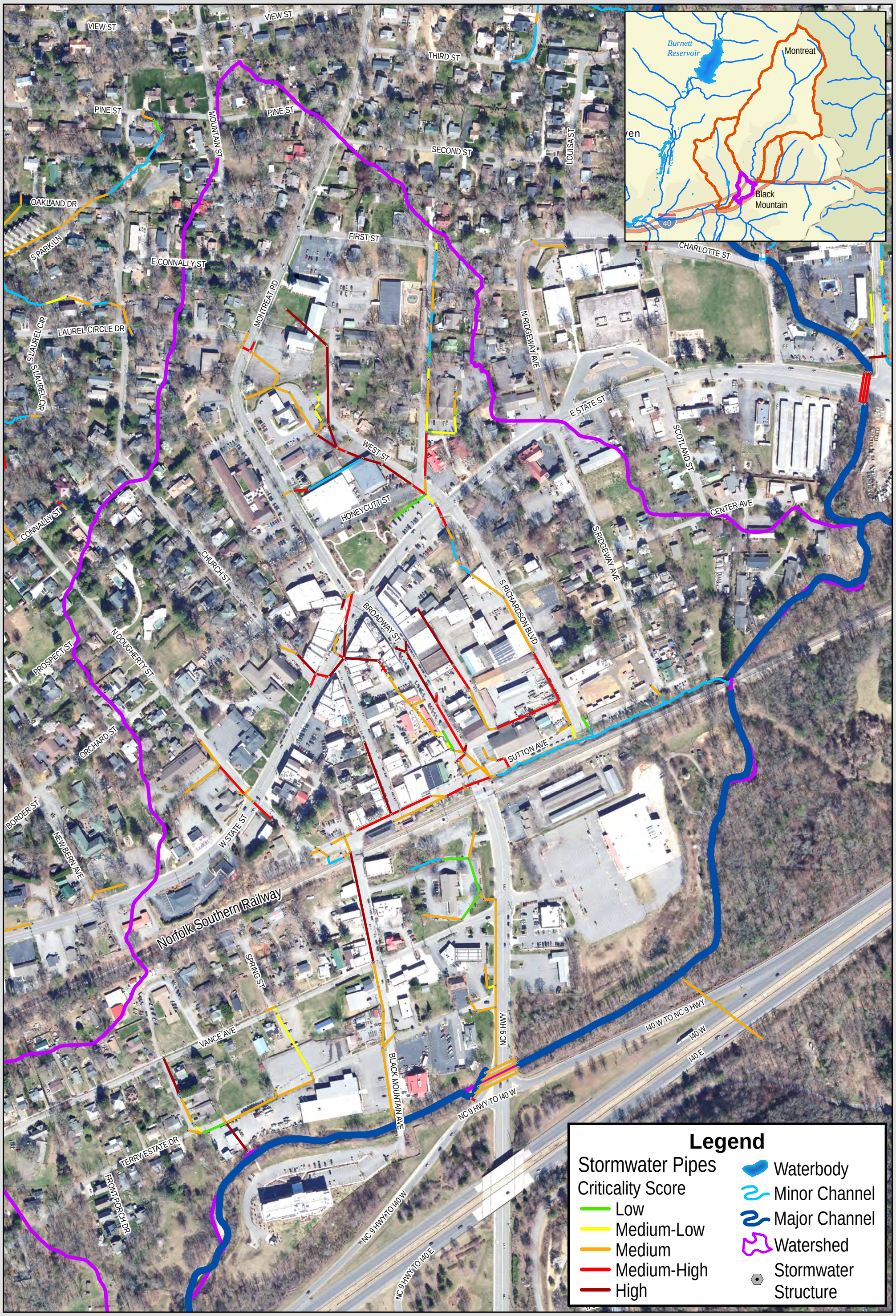
Stormwater structure result maps indicating high-risk structures are provided in Appendix D. Additional detail on the scoring criteria is also provided in Appendix D.

4.4. Criticality Analysis as an Ongoing Process

Because the data in the GIS database are dynamic, the results of the prioritization tool are a static representation based upon when the tool is run. As data are updated in the database, the tool can be utilized, and the results of the prioritization process can be updated easily. Typically, a jurisdiction may use a prioritization tool such as this on an annual or semi-annual basis as budgets are developed and capital plans and O&M plans are revised.

It should be noted that the criticality rating system will always generate assets that are rated as high-risk components. The rating system is a relative one, where the risk of a particular asset is rated relative to the other assets that are also evaluated. Therefore, the Town will always have assets that rank in the Level 4 or Level 5 risk category. As these assets are rehabilitated, replaced or repaired their likelihood of failure score will improve and their total risk rating can be reduced. Meanwhile, lower at-risk components will age and deteriorate over time and their risk scores will increase.

A valuable component of this dynamic prioritization tool is the ability to quickly perform different scenario analyses to determine the relative benefit of capital and operation and maintenance (O&M) projects. The Town can determine if the at-risk score of a particular component can be dramatically reduced by improvement. In some cases, the consequence of failure score is so high that an improved asset will always remain in the high-risk category. These assets can be monitored on a frequent basis to consistently check their condition and proactively work to prevent a failure. Conversely, assets with the greatest likelihood of failure scores are often the target of initial condition assessment and rehabilitation programs. Town staff can perform scenario analyses to determine where condition assessment and rehabilitation programs can most reduce the at-risk scores of critical assets.

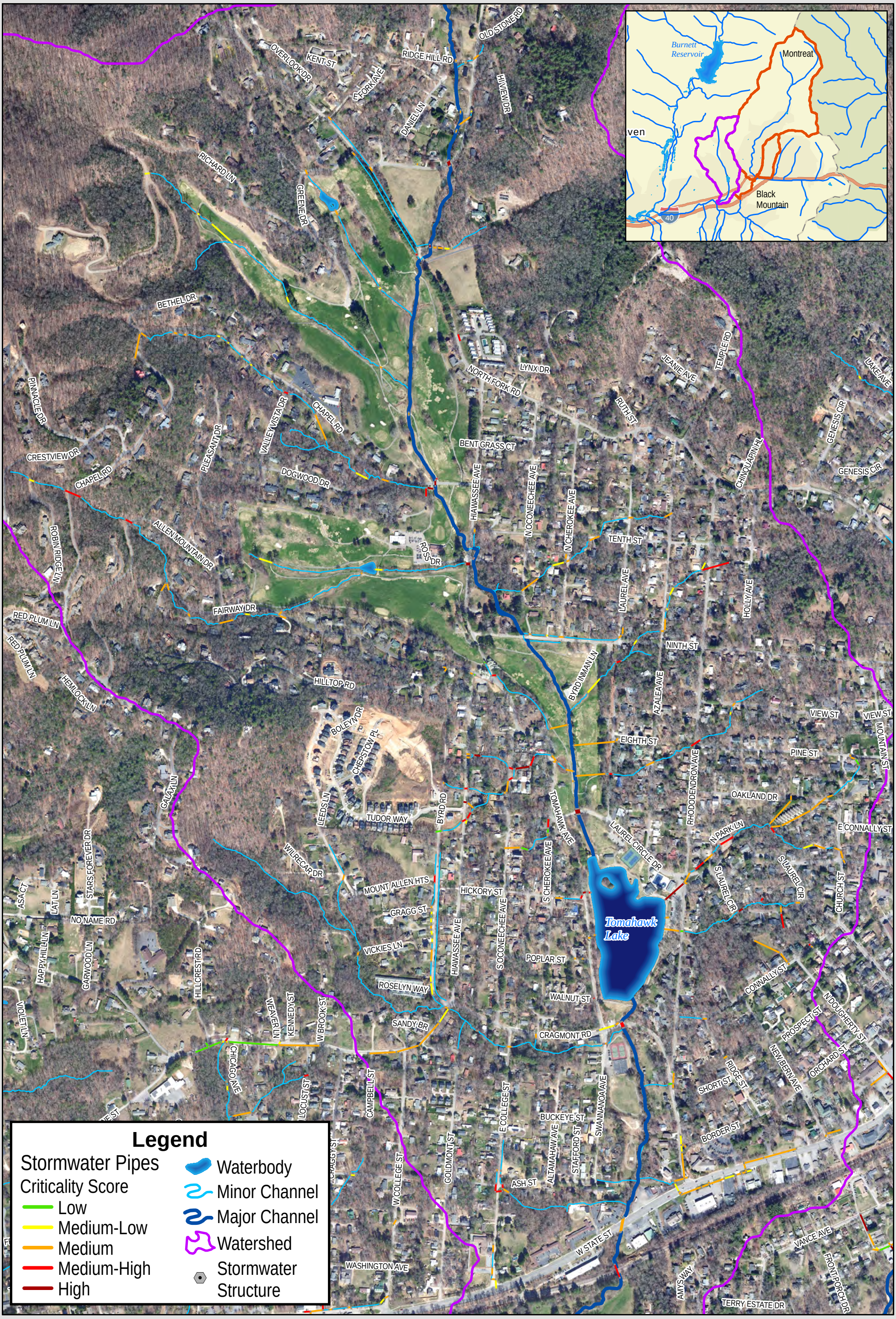


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Figure 4-1: Criticality Analysis Results - Stormwater Pipes
DOWNTOWN SYSTEM
Town of Black Mountain Stormwater Master Plan

0 150 300 Feet
1 in = 300 ft

N W E S



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Figure 4-2: Criticality Analysis Results - Stormwater Pipes
TOMAHAWK BRANCH PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 300 600 Feet
1 in = 600 ft

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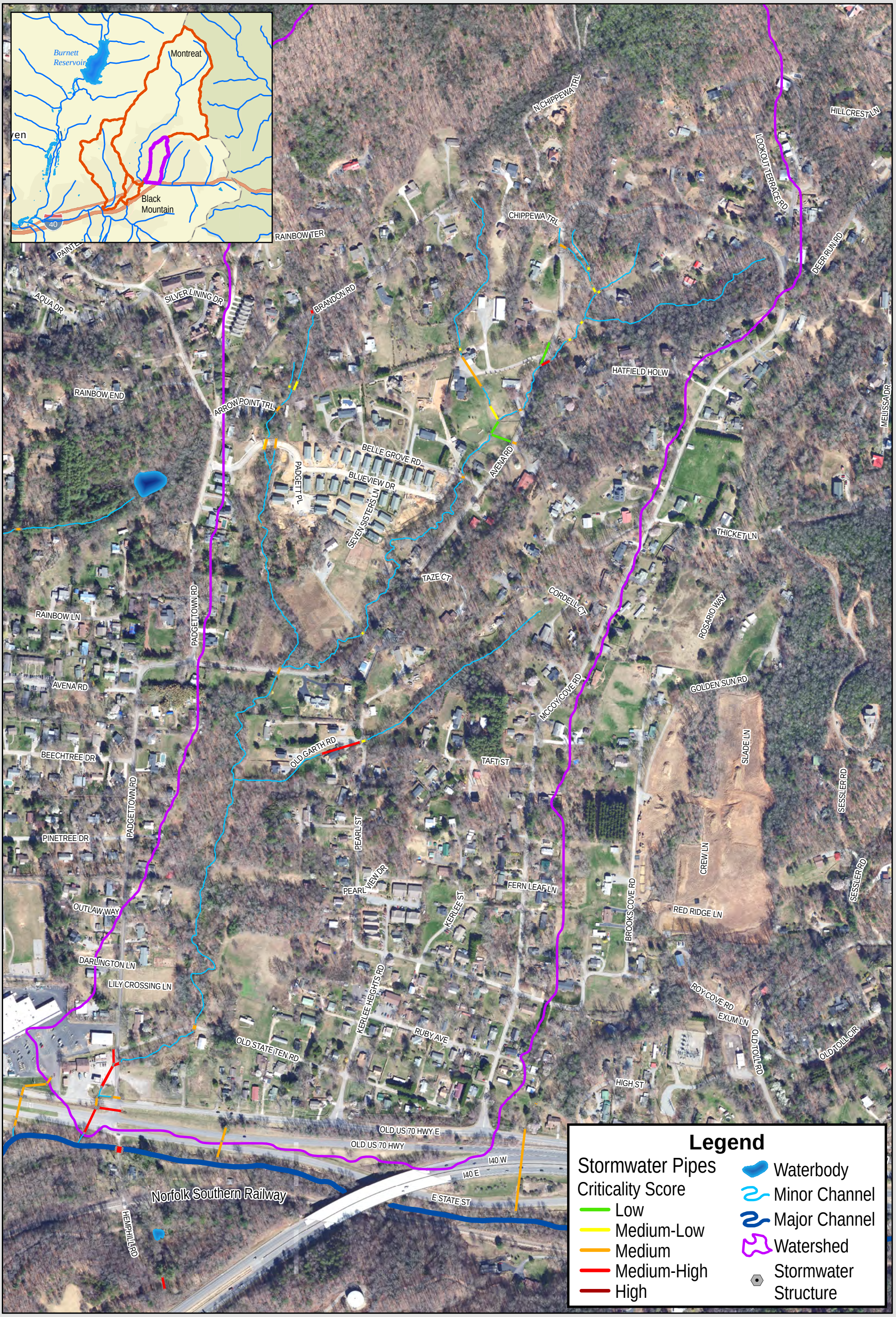
WK DICKSON
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Figure 4-3: Criticality Analysis Results - Stormwater Pipes
FLAT CREEK TRIBUTARY 1 PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 250 500 Feet

1 in = 500 ft

N W E S



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Figure 4-4: Criticality Analysis Results - Stormwater Pipes
AVENA ROAD/TRIBUTARY 35 WATERSHED
Town of Black Mountain Stormwater Master Plan

0 200 400 Feet
1 in = 400 ft

N
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5. PROPOSED CAPITAL IMPROVEMENT PLAN

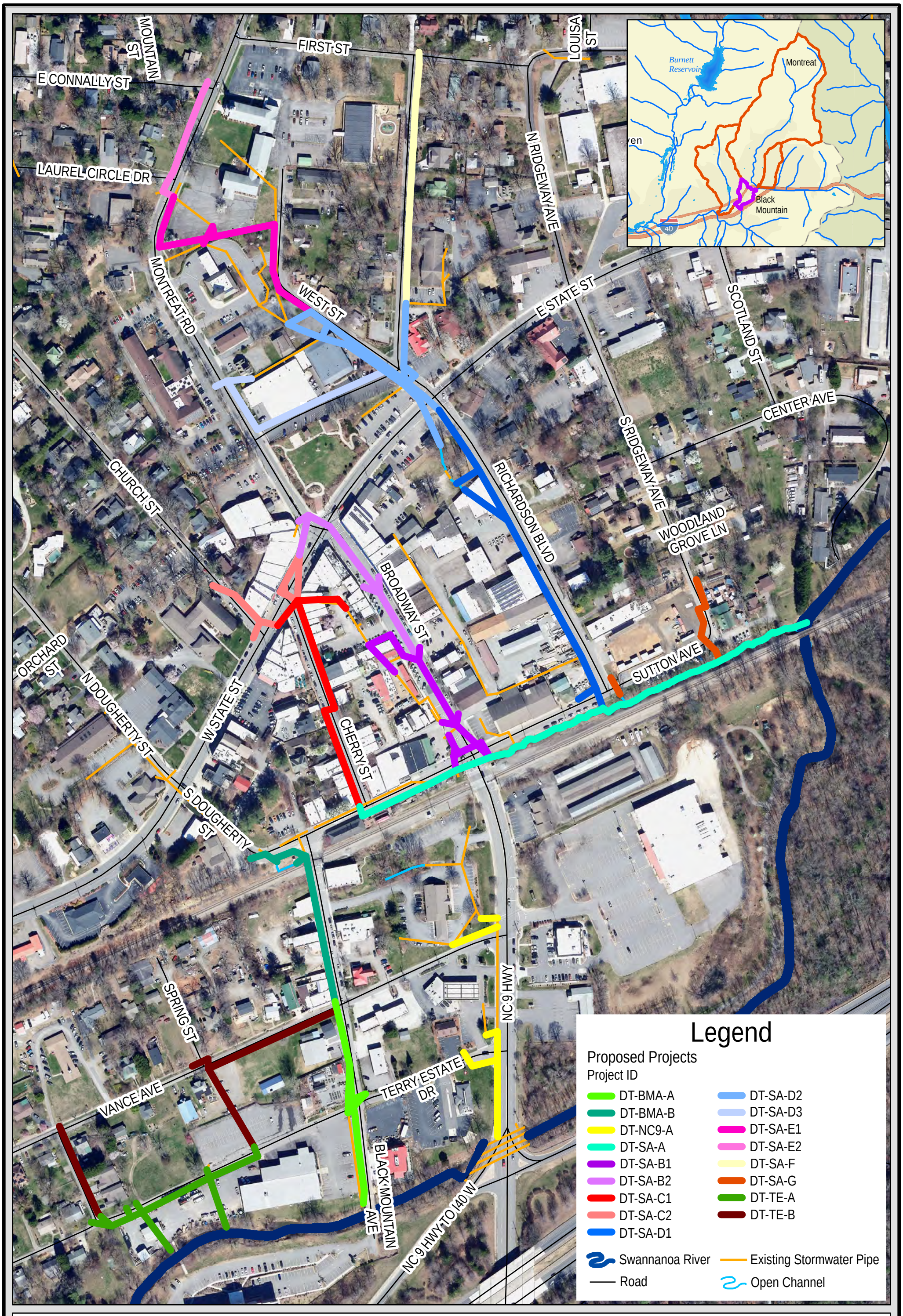
Developing flood mitigation alternatives in an urban environment is a complex process based on limitations imposed by the constraints within the environment, such as floodplain encroachments, increased peak flows due to impervious areas, public and private utilities, and private property. Improvements in this portion of the study were identified through an iterative process of infrastructure improvements, open channel improvements, floodplain benching, and detention options where feasible. As previously noted, the Town desired to focus the stormwater capital projects towards achieving a goal of a 50-YR LOS. In some cases, existing conditions limit options to plan for the desired LOS. Options for providing a high LOS are presented herein.

5.1. Downtown System

The Downtown system is a complex network of pipes in a limited space, combined with nearby utilities, businesses, and the railroad. Much of the Downtown stormwater conveyance system currently runs through private property, with several stormwater pipes located under commercial and critical Town facilities. The proposed improvements focused on re-aligning stormwater infrastructure to the public right-of-way, removal of public water from private systems where feasible, removing pipes underneath structures, providing a greater LOS for roadways, and providing flood reduction to nearby businesses and property owners. The proposed projects are shown in Figure 5-1. The proposed LOS for the Downtown corridor is shown in Figures 5-2 and 5-3 for areas north and south of the railroad. A summary of the proposed stormwater improvements and proposed LOS is provided in Table 5.1.

TABLE 5.1: DOWNTOWN SECONDARY SYSTEM - PROPOSED LEVEL OF SERVICE

ROADWAY CROSSING	PROPOSED PIPE	EXISTING SYSTEM LEVEL OF SERVICE	PROPOSED SYSTEM LEVEL OF SERVICE
NORTH OF RAILROAD			
Sutton Ave (east of Cherry St)	42" RCP	< 2-YR	50-YR
Sutton Ave (at Broadway St)	48" RCP	< 2-YR	50-YR
Broadway St (north of Sutton Ave)	42" RCP	2-YR	50-YR
Richardson Blvd (2 crossings at Sutton Ave)	3' x 7' RCBC / 30" RCP	< 2-YR	50-YR
S. Ridgeway Dr (at Sutton Ave)	36" RCP	< 2-YR	50-YR
W. State St (at Church St)	36" RCP	< 2-YR	50-YR
W. State St (at Cherry St)	18" RCP	< 2-YR	50-YR
Cherry St (at W. State St)	36" RCP	< 2-YR	50-YR
W. State St (at Broadway St)	30" RCP	2-YR	50-YR
E. State St (at Richardson Blvd)	42" RCP	< 2-YR	50-YR
Police Station (pipe under building)	36" RCP	< 2-YR	50-YR
SOUTH OF RAILROAD			
Railroad Crossing - S. Dougherty St	30" RCP	< 2-YR	50-YR
Black Mountain Ave (at Terry Ests.)	42" RCP	< 2-YR	50-YR
Terry Estates Dr (5 crossings)	24", 30", 36" RCP	< 2-YR	25-YR / 50-YR



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Figure 5-1: Proposed Stormwater Improvement Projects
DOWNTOWN DRAINAGE SYSTEM
Town of Black Mountain Stormwater Master Plan

0 100 200 Feet
1 in = 200 ft

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Sutton Avenue / Richardson Boulevard Outfall Systems	
ROADWAY	LEVEL OF SERVICE
Sutton Ave at S. Ridgeway Ave	50-YR
2 Sutton Ave at Richardson Blvd Crossings	50-YR
East State St at Richardson Blvd	50-YR
System between Montreat Rd and West St	50-YR
System along West Street at the Police Station	50-YR
Laurel Circle Dr at Montreat Rd	25-YR
West Street at Midland Ave	50-YR
First St at Midland Ave	50-YR
Sutton Ave east of NC 9	50-YR
Sutton Ave and Broadway St intersection	50-YR
Cherry St at Sutton Ave	50-YR
System along west side of Broadway St	50-YR
Cherry St at West State St	50-YR
West State St at Church St	50-YR
Church St at West State St	50-YR
Church St	50-YR
Montreat Rd at East State St	50-YR
24" System in Broadway to Cherry St	50-YR
24" System in Broadway north of Cherry St	50-YR

Legend

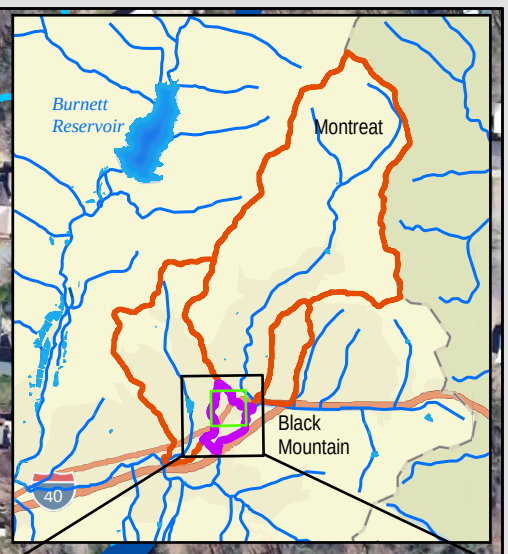
Stormwater Pipe Level of Service

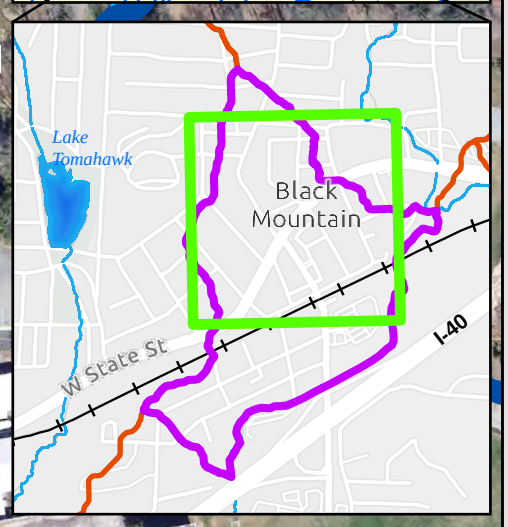
- <2-YR
- 2-YR
- 10-YR
- 25-YR
- 50-YR
- Proposed Pipe Abandonment
- Non-Modeled Swannanoa NC9 HWY Culvert
- Non-Modeled Pipe*

*Evidence of pipe in the field; survey/inventory data not sufficient enough to model

Stormwater Structures

- Existing Structure
- Proposed Structure
- Proposed Structure Abandonment
- Proposed Channel Improvements
- Existing Open Channel
- Swannanoa River
- Norfolk Southern Railway





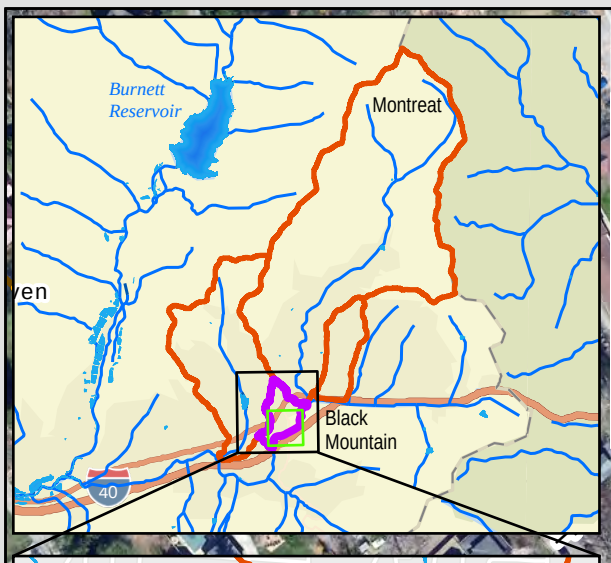
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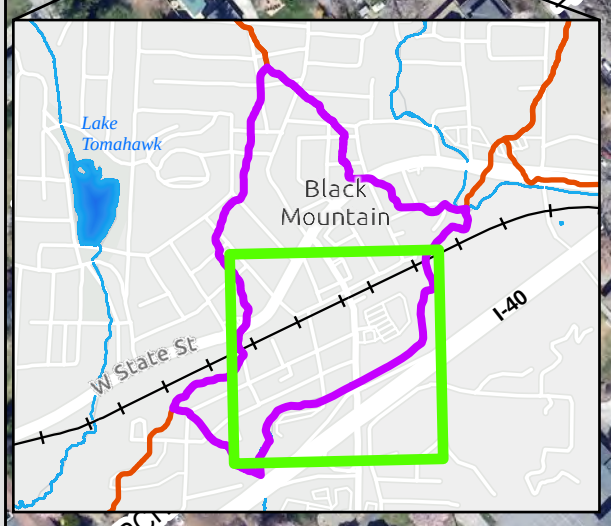
Figure 5-2:Proposed Conditions Level of Service
DOWNTOWN (NORTH) DRAINAGE SYSTEM
Town of Black Mountain Stormwater Master Plan

0 100 200 Feet

1 in = 200 ft

N W E S





Black Mountain Avenue Outfall System	
ROADWAY	LEVEL OF SERVICE
Terry Estate Dr at Black Mtn Ave	50-YR
Black Mountain Ave at Terry Estate Dr	50-YR
Vance Ave at Black Mtn Ave	25-YR
Railroad Tracks at Black Mtn Ave	50-YR
S. Dougherty St at Black Mtn Ave	50-YR
S. Dougherty St Bend	50-YR
West State St (US 70)	25-YR
N. Dougherty St at West State St	50-YR

NC 9 Outfall System	
ROADWAY	LEVEL OF SERVICE
Terry Estate Dr west of NC 9	50-YR
Terry Estate Dr at NC 9	50-YR
Vance Ave at NC 9	50-YR
Vance Ave west of NC 9	50-YR

Bridge Street / Terry Estate Outfall System	
ROADWAY	LEVEL OF SERVICE
3 Terry Estate Dr Crossings near Bridge St	25-YR
2 Terry Estate Dr Crossings east of Bridge St	25-YR
Vance Ave at Bridge St	50-YR
Vance Ave near Spring St	50-YR

Legend

Stormwater Pipe Level of Service
- <2-YR
- 2-YR
- 10-YR
- 25-YR
- 50-YR
- Proposed Pipe Abandonment
- Non-Modeled Swannanoa NC9 HWY Culvert
- Non-Modeled Pipe*

Stormwater Structures
- Existing Structure
- Proposed Structure
- Proposed Structure Abandonment
- Proposed Channel Improvements
- Existing Open Channel
- Swannanoa River
- Norfolk Southern Railway

*Evidence of pipe in the field; survey/inventory data not sufficient enough to model

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Figure 5-3: Proposed Conditions Level of Service
DOWNTOWN (SOUTH) DRAINAGE SYSTEM
Town of Black Mountain Stormwater Master Plan

0 100 200 Feet
1 in = 200 ft

N W E S

5.2. Tomahawk Branch Watershed

5.2.1 Primary System

Improvements along Tomahawk Branch focused on the Laurel Circle Drive culvert. Based on observed field conditions, the culvert is in a low spot in the roadway, making it difficult to significantly increase the culvert size due to cover limitations. With upstream and downstream floodplain benching along the golf course for additional storage area and replacing the existing arch pipes with a triple barrel 5' x 9' RCBC, the Town may achieve a 10-yr LOS at this location. Proposed projects and proposed LOS are shown in Figures 5-5 and 5-5. Recommended infrastructure improvements are noted below in Table 5.2.

TABLE 5.2: TOMAHAWK PRIMARY SYSTEM - EXISTING CONDITIONS LEVEL OF SERVICE

ROADWAY CROSSING	PROPOSED PIPE	EXISTING SYSTEM LEVEL OF SERVICE	PROPOSED SYSTEM LEVEL OF SERVICE
Laurel Circle Dr (north of Lake Tomahawk)	Triple RCBC	< 2-YR	10-YR
Cragmont Rd (south of Lake Tomahawk)	NA	50-YR	50-YR
W. State St (US 70)	NA	50-YR	50-YR
Swannanoa Ave (south of Cragmont Rd)	48" RCP	2-YR	25-YR

5.2.2 Secondary System

The Town is currently completing projects to improve the stormwater drainage system on Tomahawk Ave at Fairway Dr. This includes upsizing the existing culvert that drains from the right-of-way on Tomahawk Ave to the golf course from a 15" to 24" culvert, establishing swales along both sides of Tomahawk Ave and along the west side of the golf course pathway, and routing the stormwater to a new bioretention facility on the golf course.

Secondary system improvements located within the Tomahawk Lake watershed should be coordinated with the Town's maintenance plan and infrastructure criticality improvements. It is also recommended that the Town conduct additional, detailed evaluation of the stormwater systems draining to Lake Tomahawk as well as evaluating the lake itself for additional storage capacity. Key stormwater conveyance crossings that are both under capacity and have been designated as high-risk infrastructure (as determined by the criticality analysis) are noted in Table 5.3 below.

TABLE 5.3: TOMAHAWK SECONDARY SYSTEM RECOMMENDED IMPROVEMENT AREAS

ROADWAY CROSSING	EXISTING LEVEL OF SERVICE	CRITICALITY ASSESSMENT
Rhododendron Ave (south of Tenth St)	10-YR	Medium-High
Rhododendron Ave (near Eighth St)	2-YR	Medium-High
Rhododendron Ave (Laurel Circle Dr to Lake)	< 2-YR	Medium / High
S. Laurel Circle (near Circle Dr)	2-YR	High
Tomahawk Ave (just north of Fairway Dr)	2-YR	Medium-High
Hiawassee Ave (north of Tudor Way)	< 2-YR	Medium-High
S. Oconeechee Ave (downstream of noted Hiawassee Ave crossing)	< 2-YR	Medium-High
Hickory St / Tomahawk Ave to Lake	2-YR	Medium-High / High

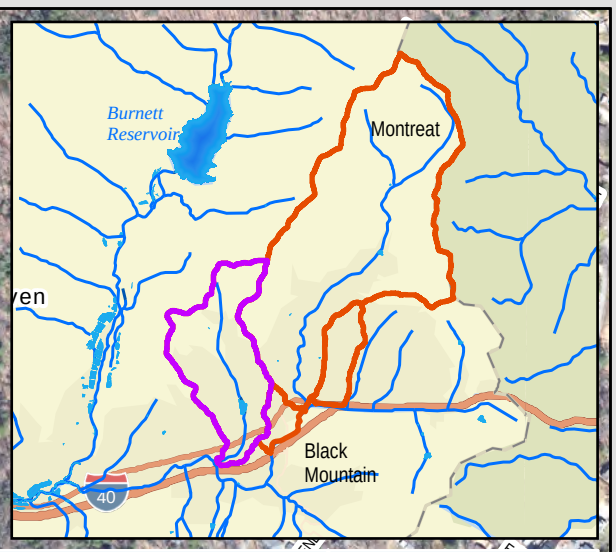


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Figure 5-4: Proposed Stormwater Improvement Projects
TOMAHAWK BRANCH PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 100 200
Feet
1 in = 200 ft

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CULVERT CROSSING	LEVEL OF SERVICE
W State St (Hwy 70)	50-YR
Cragmont Rd.	50-YR
Laurel Circle Dr.	10-YR
9th St Bridge	25-YR
Hiawassee Ave Bridge	25-YR
Chapel Rd.	25-YR
Golf Course Bridge	2-YR
North Fork Rd. Bridge	50-YR
Private Dr.	50-YR
Walker Cove Rd.	50-YR
Hiawassee Ave (South of Ross Dr.)	50-YR
Swannanoa Ave	25-YR
E College St.	50-YR
Cragmont Rd. (Secondary Crossing)	25-YR

Legend

Stormwater Pipe Level of Service

- <2-YR
- 2-YR
- 10-YR
- 25-YR
- 50-YR
- Modeled Open Channel
- Non-Modeled Open Channel
- Non-Modeled Pipe*
- Bridge Location

Stormwater Structures

- Pipe End
- Inlet
- Assumed Underground Junction Box
- Manhole
- Unsurveyed Structure
- Tomahawk Branch
- Tomahawk Lake

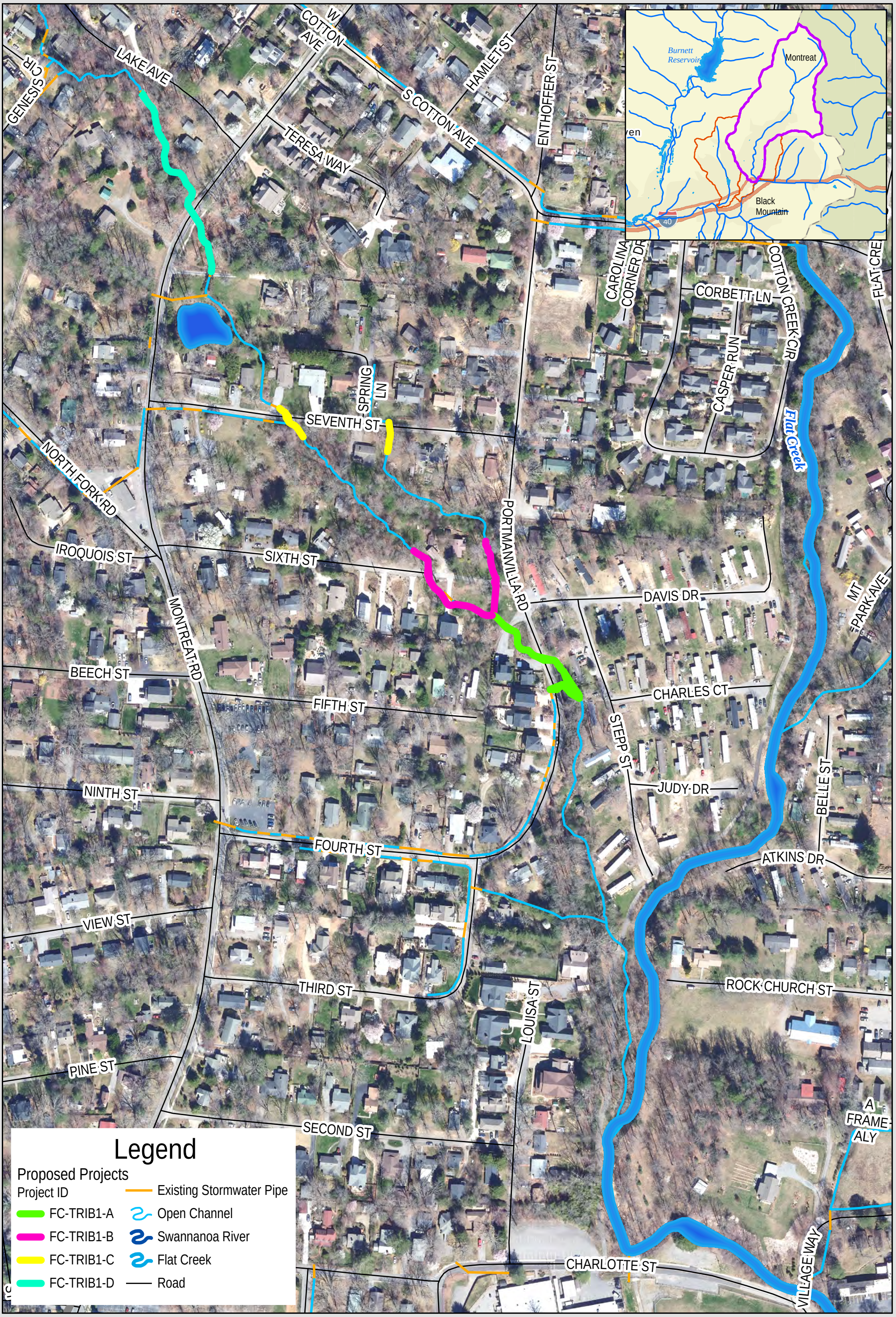
*Evidence of pipe in the field; survey/inventory data not sufficient enough to model

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Figure 5-5: Proposed Conditions Level of Service
TOMAHAWK BRANCH PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 250 500 Feet
1 in = 500 ft

N
W E
S



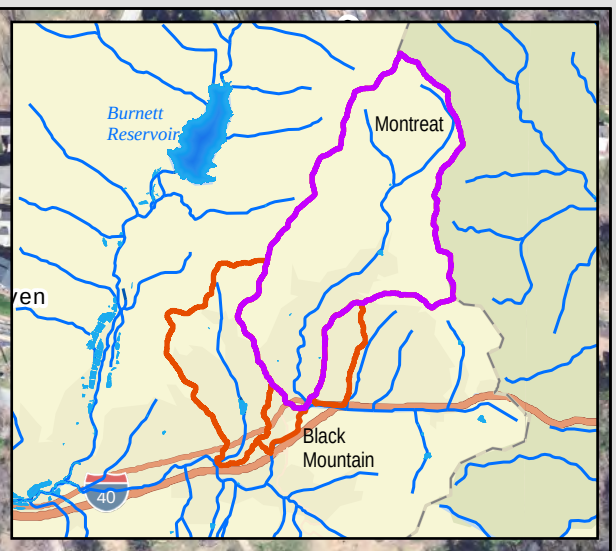
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Figure 5-6: Proposed Stormwater Improvement Projects
FLAT CREEK TRIBUTARY 1 PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 100 200 Feet

1 in = 200 ft

N
W E
S



CUVLERT CROSSING	LEVEL OF SERVICE
US 70 (Triple 11'x10' RCBC)	50-YR
Flat Creek Tributary 1 Culverts	
Private Driveway	25-YR
Portmanvilla Rd (15" CMP)	50-YR
Portmanvilla Rd (30" CMP)	25-YR
Private Driveway	10-YR
6th Street (15" CMP) near Portmanvilla Rd	50-YR
6th Street (42" CMP)	50-YR
7th Street near Portmanvilla Rd (15" CPP)	50-YR
7th Street (Triple 24" CMP)	25-YR
Montreat Rd (24" CMP)	50-YR

Legend

Stormwater Pipe Level of Service

- <2-YR
- 2-YR
- 10-YR
- 25-YR
- 50-YR
- Modeled Open Channel
- Non-Modeled Open Channel
- Non-Modeled Pipe*

Stormwater Structures

- Pipe End
- Inlet
- Assumed Underground Junction Box
- Manhole
- Unsurveyed Structure
- Swannanoa River
- Flat Creek
- Bridge Location

Evidence of pipe in the field; survey/inventory data not sufficient enough to model

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Figure 5-7: Proposed Conditions Level of Service
FLAT CREEK TRIBUTARY 1 PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 125 250 Feet
1 in = 250 ft

5.3. Flat Creek Watershed

Proposed improvements focused on the known flooding concerns located along Flat Creek Tributary 1 from Portmanvilla Rd upstream to Montreat Rd. Except for the NC DOT large RCBC culvert at US 70, the primary stream crossings along Flat Creek within the Town are bridges. As previously noted, these were modeled using FEMA data. Bridge improvements were not included as part of the SWMP.

Proposed improvements along Flat Creek Tributary 1 are shown in Figure 5-6 and the proposed level of service is provided in Figure 5-7. The proposed LOS for key roadway crossings is noted in Table 5.4.

TABLE 5.4: FLAT CREEK PRIMARY SYSTEM - PROPOSED LEVEL OF SERVICE

ROADWAY CROSSING	PROPOSED PIPE	EXISTING SYSTEM LEVEL OF SERVICE	PROPOSED SYSTEM LEVEL OF SERVICE
Montreat Rd (NC 9)	42" RCP	2-YR	50-YR
Seventh St	Triple 22.5" x 36.25" Arch (30" Eq)	2-YR	25-YR
Seventh St (west of Portmanvilla Rd)	22.5" x 36.25" Arch (30" Eq)	< 2-YR	50-YR
Sixth St	Twin 26.63" x 43.75" Arch (36" Eq)	10-YR	50-YR
Sixth St (west of Portmanvilla Rd)	Twin 22.5" x 36.25" Arch (30" Eq)	< 2-YR	50-YR
Portmanvilla Rd (existing 30" CMP)	Twin 31.31" x 51.13" Arch (42" Eq)	2-YR	50-YR
Portmanvilla Rd (existing 15" CMP)	Twin 22.5" x 36.25" Arch (30" Eq)	< 2-YR	50-YR
US 70 (E. State St)	NA	50-YR	50-YR

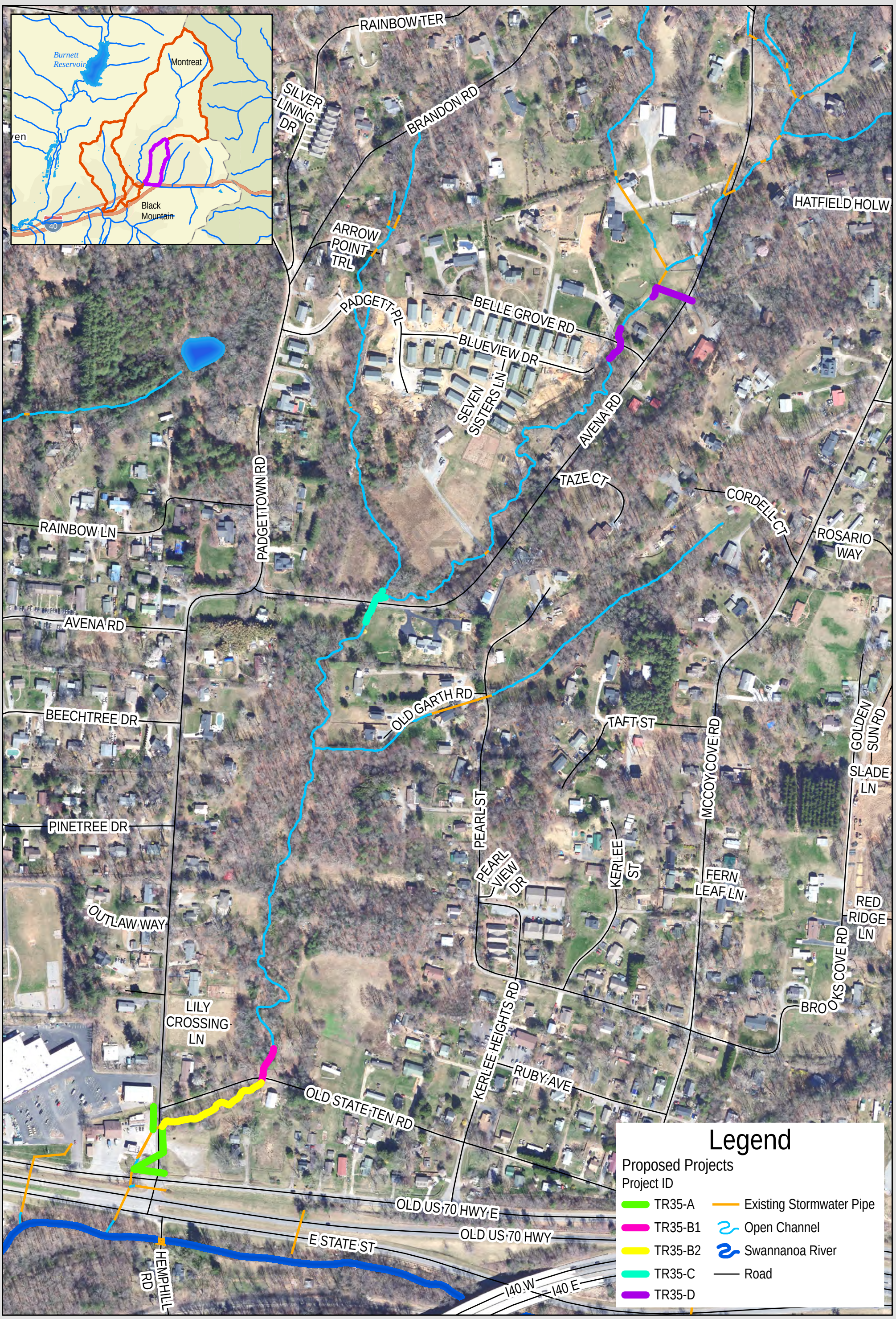
5.4. Tributary 35 / Avena Road Watershed

Tributary 35 of the Swannanoa River is located on the eastern edge of the Town. Historical flooding has been noted along Old State 10 Rd and Padegettown Rd. New development is underway near Bellgrove Rd and Avena Rd in the upper part of the watershed. The primary system consists of open channel and culverts. Infrastructure improvements focused on providing the Town's desired level of service along main roadways, allowing for emergency vehicle access.

Proposed projects are shown in Figure 5-8 and the resulting proposed LOS is provided in Figure 5-9. Proposed LOS for the primary system crossings are also noted below in Table 5.5. It should be noted that the existing conditions around Padgettown Road and Old US 70 East limit the amount of flood reduction achievable in this area.

TABLE 5.5: TRIBUTARY 35 PRIMARY SYSTEM - PROPOSED LEVEL OF SERVICE

ROADWAY CROSSING	PROPOSED PIPE	EXISTING SYSTEM LEVEL OF SERVICE	PROPOSED SYSTEM LEVEL OF SERVICE
Avena Rd (near Bellgrove Rd)	30" RCP	2-YR	50-YR
Bellgrove Rd	Twin 48" RCP	2-YR	50-YR
Avena Rd	Twin 48" RCP	10-YR	25-YR
Old State 10 Rd	Twin 4' x 6' RCBC	2-YR	25-YR
Padgettown Rd (north of Old US 70 E) New Bypass System	Twin 60" RCP	< 2-YR	10-YR
Old US 70 East	6' x 10' RCBC	25-YR	25-YR
US 70 (E. State St)	6' x 7' RCBC	50-YR	50-YR

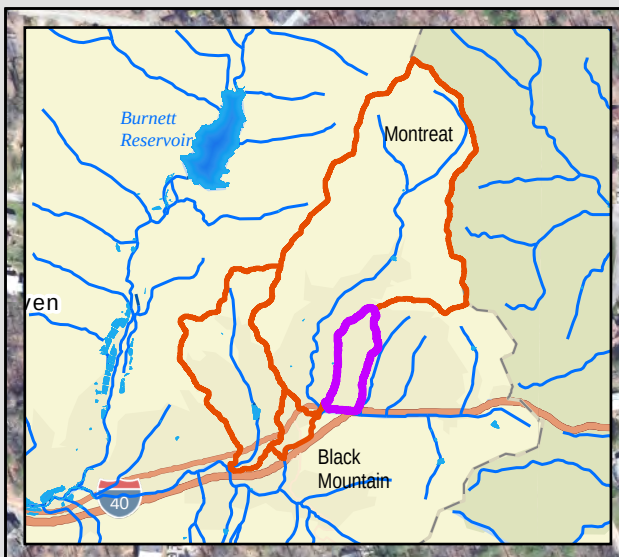


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Figure 5-8: Proposed Stormwater Improvement Projects
AVENA ROAD/TRIBUTARY 35 PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 150 300 Feet
1 in = 300 ft

N W E S





CULVERT CROSSING	LEVEL OF SERVICE
US-70 (6'x7' RCBC)	100-YR
Old US-70 (6' x10' RCBC)	50-YR
Padgettown Rd (15" CMP)	50-YR
Parking Lot (Twin 36" CMP)	10-YR
Parking Lot (12" CMP)	100-YR
Padgettown Rd (Twin 36" CMP)	10-YR
Unimproved property	10-YR
Padgettown Rd (24" CMP)	25-YR
Old State Ten Rd (Twin 36" CPP)	25-YR
Avena Rd (48" CMP)	25-YR
Padgett Place (Twin 36" CPP)	100-YR
Belle Grove Rd (Twin 36" CMP)	50-YR
Avena Rd (24" CMP+18" CMP)	50-YR
Avena Rd (48" CMP)	100-YR

Legend

Stormwater Pipe Level of Service

- <2-YR
- 2-YR
- 10-YR
- 25-YR
- 50-YR
- Modeled Open Channel
- Non-Modeled Open Channel
- Non-Modeled Pipe*

Stormwater Structures

- Pipe End
- Inlet
- Assumed Underground Junction Box
- Manhole
- Unsurveyed Structure
- Swannanoa River

*Evidence of pipe in the field; survey/inventory data not sufficient enough to model

LOS results at US-70 include the use of the depression area between Old US-70 and US70 as a storage area.

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Figure 5-9: Proposed Conditions Level of Service
AVENA ROAD/TRIBUTARY 35 PRIMARY SYSTEM
Town of Black Mountain Stormwater Master Plan

0 150 300 Feet
1 in = 300 ft

N W E S

5.5. Intense Storm Analysis

As noted in Section 3.5, the 2-yr and 5-yr, 6-hr storm events were modeled to simulate high-intensity rainfall events for the purpose of developing projects more resilient to climate change. These storm events were also modeled with the proposed stormwater improvement projects for each watershed. The modeling results indicate that the proposed capital projects would provide carrying capacity to prevent roadway overtopping during an intense storm event.

6. ANTICIPATED PERMITTING

The proposed improvements described in Sections 5 and 7 may require local, State, and/or Federal permits or approvals prior to the onset of construction. Based on the types of projects identified within the Town, permits or approvals may be required for any of the following reasons:

- Stream, riparian buffer, and/or wetland impacts;
- FEMA floodway and floodplain impacts;
- Land disturbance; and
- Potable water and sewer line adjustments.

The permitting matrix in Table 6-1 shows the different types of permits that are anticipated for each of the proposed projects. Riparian buffer requirements may apply to projects located within fifty (50) feet of a streambank. Coordination with the North Carolina Department of Environmental Quality (NCDEQ) is recommended to determine if buffer impacts are exempt or allowable with mitigation.

The types of 404/401 permits are described below and may vary based on the length of stream impacts and/or acreage of wetland impacts. Wetlands will need to be delineated to determine the acreage of impacts. Permit requirements for a given project may change based on the final design and any changes to the existing regulations. The appropriate permitting agencies should be contacted during the design process to determine if permits will be required.

6.1. NCDEQ Division of Water Resources 401 Water Quality Certification and USACE 404

Proposed improvements must adhere to the requirements set forth in Section 401 and 404 of the Clean Water Act. Required permitting can range from activities that are pre-authorized to those requiring pre-construction notification (PCN) for a Nationwide Permit (NWP) to those requiring an Individual Permit (IP). Individual permits may be required for projects with stream impacts greater than 300 feet and wetland impacts greater than 0.5 acres. It is anticipated that NWP #3 (Maintenance) and NWP #13 (Bank Stabilization) may be required to support the projects that include work within channels that are claimed jurisdictional by the US Army Corps of Engineers (USACE). More detailed explanations of the types of 404 permits are provided below.

NWP#3 – Maintenance

This permit authorizes the repair, replacement, or rehabilitation of any previously permitted or currently serviceable structure. A PCN is not required for minor deviations in the structure's configuration or filled area that occur because of changes in materials, construction techniques, or safety standards necessary to make repair or replacement, provided environmental impacts are minimal. A PCN to the USACE is required if a significant amount of sediment is excavated/filled within the channel. The NCDEQ Division of Water Resources (DWR) does not typically require a PCN for NWP #3 but usually receives one as a courtesy. A general water quality certification (WQC) is conditionally authorized under a NWP #3. If an activity does not meet the general WQC conditions, an individual WQC from DWR will be required.

Other provisions imposed by the State of North Carolina require that culvert inverts must be buried a minimum of 1-foot below the streambed for culverts greater than or equal to 48 inches in diameter to allow low flow passage of water and aquatic life. Culverts less than 48 inches in diameter should be buried to a depth of 20% or greater of the culvert's diameter.

NWP #13 – Bank Stabilization

This permit authorizes the reshaping of channel banks or bank stabilization activities that are necessary for erosion prevention. The placement of material is prohibited in any special aquatic site in a manner that may impede surface water flow into or out of a wetland area, or in a manner that will be eroded during normal or high flows. The activity must be part of a single and complete project and cannot exceed one cubic yard per running foot placed below the high-water mark line. If stabilization activities exceed 500 linear feet, then a PCN is required for both the USACE and DWR. DWR must also be notified and should fill be placed within the streambed. A WQC is conditionally authorized under a NWP #13. If an activity does not meet the general WQC conditions, an individual WQC from DWR will be required.

NWP #27 – Stream and Wetland Restoration Activities

This permit authorizes stream enhancement, stream restoration, and channel relocation for restoration purposes that provide gains in aquatic functions. Stream channelization and the conversion of streams to other aquatic uses such as impoundments or waterfowl habitat are not authorized. A PCN to the USACE is required for any restoration activities occurring on private or public lands. DWR requires a PCN if impacts are proposed for greater than 500 feet of stream bank or if in-stream structures are used.

Impacts proposed to the streams may need evaluation under the State Environmental Policy Act (SEPA). An Environmental Assessment (EA) is required under SEPA if greater than 500 linear feet of perennial stream is disturbed, and stream restoration or enhancement is not performed. Channel disturbances are defined as activities that remove or degrade stream uses such as channelization, culvert placement, riprap, and other hard structures. A list of some other conditions that should be followed under regulations provided by the USACE and DWR include the following:

- Soil erosion and sediment controls must be used and maintained in effective operating conditions during construction, and all exposed soil and fills should be stabilized at the earliest possible date.
- No activity is authorized under any NWP that is likely to jeopardize the existence of a threatened or endangered species, or which will destroy or adversely modify the habitat of such species.
- No activity is authorized that may affect historic properties listed or eligible for listing in the National Register of Historic Places.
- More than one NWP used for a single and complete project is prohibited.
- Impacts to the waters of the US should be avoided and minimized to the greatest extent practicable.
- Mitigation in all its forms will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.
- Hardening techniques should be avoided and minimized to the greatest practicable extent.

6.2. Individual Permits

Individual permits are required when stream or wetland impacts do not meet the conditions of a nationwide permit. Permit applications may be reviewed by multiple agencies including but not limited to USACE, DWR, EPA, State Historic Preservation Office (SHPO), North Carolina Wildlife Resources Commission (NCWRC), and United States Fish and Wildlife Service (USFWS). The application is also made available for public review. There is no defined timeline for review of the application for an IP; therefore, the permitting process for an IP is typically significantly longer than the review time for a NWP. Typically, 404 and 401 Individual Permits are applied for jointly and their review is concurrent. There are no anticipated individual permit requirements for proposed projects as part of the Town's Proposed Capital Improvement Plan.

6.3. Federal Emergency Management Agency (FEMA)

Streams with a drainage area greater than one (1) square mile are typically modelled and mapped by FEMA for flood insurance purposes. The 100-year floodway and floodplain have been mapped for the watersheds included in the Town's SWMP (Tomahawk Branch, Flat Creek, Tributary 35 of the Swannanoa River, and the Swannanoa River). Any proposed projects that will include grading within a FEMA defined floodway will require a Conditional Letter of Map Revision (CLOMR) submitted to FEMA for pre-approval purposes and a Letter of Map Revision (LOMR) upon completion of construction.

6.4. Erosion and Sedimentation Control

The NCDEQ Division of Energy, Mineral, and Land Resources (DEMLR) is another agency that requires notification before proposed activities are constructed. DEMLR requires that an erosion and sedimentation control plan be submitted to the for approval before the start of construction for any disturbance greater than one (1) acre.

TABLE 6.1: ANTICIPATED PERMITTING MATRIX FOR PROPOSED PROJECTS

PROPOSED STORMWATER IMPROVEMENT PROJECT		FEMA	NCDEQ /NPDES	404/401 (NWP)	404/401 (IP)	NC DOT	Railroad
DOWNTOWN SYSTEM							
DT-SA-A	Sutton Ave	x		x		x	x
DT-SA-B	Broadway St			x		x	
DT-SA-C	Cherry St					x	
DT-SA-D1	Police Station/Post Office Phase I	x		x			
DT-SA-D2	Police Station/Post Office Phase II					x	
DT-SA-E	West St / Honeycutt St					x	
DT-SA-F	Montreat Rd / Midland Ave					x	
DT-SA-G	S. Ridgeway Ave	x		x			
DT-BMR-A	Black Mountain Ave Phase I			x			
DT-BMR-B	Black Mountain Ave Phase II						x
DT-TE-A	Terry Estate Dr Phase I	x		x			
DT-TE-B	Terry Estate Dr Phase II						
DT-NC9-A	NC 9	x		x		x	
TOMAHAWK BRANCH PRIMARY SYSTEM							
TB-A1	Laurel Circle	x		x			
TB-A2	Golf Course Floodplain Benching	x		x			
TB-B	Swannanoa Ave	x		x			
FLAT CREEK TRIBUTARY 1 PRIMARY SYSTEM							
FC-TRIB1-A	Portmanvilla Rd	x		x			
FC-TRIB1-B	6th St	x		x			
FC-TRIB1-C	7th St	x		x			
FC-TRIB1-D	Montreat Rd	x		x		x	
TRIBUTARY 35 / AVENA ROAD PRIMARY SYSTEM							
TR35-A	Padgettown Rd	x		x		x	
TR35-B1	Old State 10 Rd	x		x			
TR35-B2	Tributary 35 Floodplain Benching	x		x			
TR35-C	Avena Rd	x		x		x	
TR35-D	Bellgrove Rd / Avena Rd			x		x	

7. PRIORITIZATION AND RECOMMENDATIONS

Infrastructure capital projects are proposed in areas where historic flooding has been reported, where infrastructure has been determined to be high risk, and in general where the desired level of service for stormwater conveyance is not provided.

7.1. Infrastructure Project Prioritization

After completing the assessments and modeling documented in this Report, conceptual solutions were developed to address stormwater quantity and protecting and restoring natural stream corridors where possible. The recommended solutions begin with projects that reduce flooding, which was identified as a priority for the Town.

The initial conceptual analysis of each proposed project was evaluated through a prioritization process based on utility conflicts, level of street flooding, property ownership, effect of improvements, and cost effectiveness. A summary of the prioritization criteria used in the initial evaluation is noted below and documented in Table 7.1.

1. **Utility Conflicts**: The number and type of sanitary sewer conflicts and/or stream crossings within the proposed project footprint.
2. **Street Flooding:** Improvements to help meet the LOS across major and minor public streets.
3. **Public or Private Land:** Location of the proposed project and whether it is situated on Town, NCDOT, or privately-owned land.
4. **Effect of Improvements**: Flood reduction risk to a property by 0.5’ or greater and the number of properties experiencing the flood reduction risk.
5. **Cost Effectiveness**: Ratio of total project cost to project benefits.

Bonus points were awarded for projects that may be eligible for grant funding and stormwater systems with medium-high and high criticality scores.

TABLE 7.1. INFRASTRUCTURE PRIORITIZATION CRITERIA

CATEGORY	RATING	DESCRIPTION
Utility Conflicts	3	Minimal Utility Conflicts
	2	Stream Crossing, Water Main Conflict, and/or Minor Sewer Conflict
	1	Potential Re-Alignment of Sewer
Street Flooding	4	Improvements Help Meet LOS for Principal Arterial and Major Collector
	3	Improvements Help Meet LOS for Minor Arterial and Other Public Streets
	2	Project Improves Los for Public Roads at Primary System Crossings, but Desired Los Not Met
	1	LOS Improved for Secondary Systems, but Desired Los Not Met
Publicly Or Privately-Owned Land	4	Town
	3	County
	2	Public and Private
	1	NCDOT
	1	1 Private Landowner
	0	2+ Private Landowners
Effects Of Improvements*	4	Reduces Flood Risk > 5 Properties
	3	Reduces Flood Risk At 2-5 Properties and Potential Structural Flooding
	2	Reduces Flood Risk At 2-5 Properties
	1	Reduces Flood Risk < 2 Properties
Cost Effectiveness	4	Cost/Benefit Ratio < $20,000
	3	Cost/Benefit Ratio: $20,000 - $30,000
	2	Cost/Benefit Ratio: $30,001 - $40,000
	1	Cost/Benefit Ratio: $40,001 - $50,000
	0	Cost/Benefit Ratio > $50,000
Grant Bonus Points	1	Project May Be Eligible for 1 Grant
	2	Project May Be Eligible for 2 Grants
	3	Project May Be Eligible for 3 or More Grants
Criticality Bonus Points	1	Project Aligns with Infrastructure in the Medium Category
	2	Project Aligns with Infrastructure in the Medium-High and High Categories

**Flood risk defined as reduction of 0.5' or greater*

Weighting factors for infrastructure improvement projects placed emphasis on the primary goal of reducing street flooding. The weighting factors, which standardize the final project scores on a 100-point scale, are shown in Table 7.2.

TABLE 7.2. INFRASTRUCTURE WEIGHTING FACTORS

CRITERIA	WEIGHTING FACTOR
Utility Conflicts	4
Street Flooding	8
Publicly Or Privately-Owned Land	4
Effect Of Improvements	5
Cost Effectiveness	5

7.2. Planning Level Cost Estimates

The opinions on project costs have been prepared to assist Town staff in making planning level decisions and prioritizing improvements. The costs presented herein are not final design cost estimates. The preliminary project cost estimates were developed using recent bid tabulations from other communities within North Carolina. They include easement acquisitions, environmental permitting, surveying, engineering, legal, and administrative costs.

The cost estimates are planning-level costs based on current information. Costs are subject to change based on local factors, materials, delivery, construction, and other influences. A detailed breakdown of estimated capital and project costs per proposed stormwater improvement project is in Appendix E.

7.3. Project Recommendations

The recommended projects are focused on improving the Town's stormwater conveyance system. System upgrades to replace aging infrastructure, improve carrying capacity, and reduce flooding are presented herein. The Town should continue to promote nature-based solutions and green infrastructure in redevelopment and future development projects to reduce stormwater runoff.

Table 7-3, on the next page shows the total prioritization score of each proposed stormwater capital improvement project. Opinions of total project cost are also provided in Table 7-3. The planning costs presented are based on the infrastructure necessary to meet the Town's 50-year desired level of service where feasible.

Projects were also evaluated based on the prioritization criteria noted in Section 7.1. As noted in Table 7-3, there are several instances where a phase II or upstream project has a higher priority score. However, the downstream project should be constructed first to provide the capacity for implementing stormwater improvements upstream.

The Town should re-visit the prioritization lists annually to determine if the priorities should change. Project sheets and detailed cost estimates for each proposed project are provided in Appendix E.

TABLE 7.3. PROPOSED CIP PLANNING COST AND PRIORITIZATION SUMMARY

PROPOSED STORMWATER IMPROVEMENT PROJECT		PROJECT PLANNING LEVEL OPINION OF COST	PRIORITIZATION SCORE
DOWNTOWN SYSTEM			
DT-SA-A	Sutton Ave	$ 2,250,000	88
DT-SA-B1	Broadway St Phase I	$ 2,029,000	83
DT-SA-B2	Broadway St Phase II	$ 1,292,000	88
DT-SA-C1	Cherry St Phase I	$ 1,510,000	75
DT-SA-C2	Cherry St Phase II	$ 1,021,000	88
DT-SA-D1	Police Station/Post Office Phase I	$ 4,303,000	71
DT-SA-D2	Police Station/Post Office Phase II	$ 1,932,000	87
DT-SA-D3	Police Station/Post Office Phase III	$ 923,000	81
DT-SA-E1	West St to Montreat Rd	$ 1,228,000	76
DT-SA-E2	Montreat Rd at Laurel Circle Dr	$ 797,000	49
DT-SA-F	Midland Ave	$ 1,121,000	82
DT-SA-G	S. Ridgeway Ave	$ 827,000	76
DT-BMA-A	Black Mountain Ave Phase I	$ 1,880,000	82
DT-BMA-B	Black Mountain Ave Phase II	$ 1,308,000	88
DT-TE-A	Terry Estate Dr Phase I	$ 1,963,000	61
DT-TE-B	Terry Estate Dr Phase II	$ 1,380,000	78
DT-NC9-A	NC 9	$ 1,335,000	68
TOMAHAWK BRANCH PRIMARY SYSTEM			
TB-A1	Laurel Circle Culvert Replacement	$ 760,000	58
TB-A2	Golf Course Floodplain Benching	$ 690,000	53
TB-B	Swannanoa Ave Culvert	$ 430,000	77
FLAT CREEK PRIMARY SYSTEM			
FC-TRIB1-A	Portmanvilla Rd	$ 900,000	87
FC-TRIB1-B	6th St	$ 633,000	78
FC-TRIB1-C	7th St	$ 405,000	87
FC-TRIB1-D	Montreat Rd	$ 546,000	88
TRIBUTARY 35 PRIMARY SYSTEM			
TR35-A	Padgettown Rd	$ 1,422,000	62
TR35-B1	Old State 10 Rd	$ 608,000	77
TR35-B2	Tributary 35 Floodplain Benching	$ 425,000	66
TR35-C	Avena Rd	$ 438,000	85
TR35-D	Bellgrove Rd / Avena Rd	$ 824,000	83

8. FUNDING OPPORTUNITIES

There have been substantial changes in the North Carolina stormwater funding landscape over the last five (5) years that have enabled new capital investment in stormwater infrastructure by communities large and small. Available funding, and thus competitiveness for each grant or loan program changes year-to-year as priorities fluctuate at the state and federal level. Keeping up to date on these changes and leveraging one funding source to gain access to another are both crucial elements to developing a successful funding strategy for a given project.

As the Town navigates the current and future opportunities, the key will be to evaluate each funding program, the selection criteria, application deadlines, and funding timelines to estimate compatibility with the Town's project goals and timeline.

Multiple federal and state agencies provide funding opportunities for municipalities and organizations to implement watershed management projects. As the Town of Black Mountain explores opportunities to fully fund or partially fund this Capital Improvement Plan, additional investigation will be needed to determine complete project eligibility and competitiveness for each funding program identified.

The financial resource summary provided below is informational and are current grant programs available at the time this SWMP was prepared. A summary of key points for each one is provided in Table 10.1.

8.1. Clean Water State Revolving Fund (CWSRF)

Administered through the NCDEQ Division of Water Infrastructure, the Clean Water State Revolving Fund (CWSRF) program funds construction projects related to wastewater treatment, wastewater collection, reclaimed water, stormwater control measures (SCMs), stream restoration, and energy efficient projects. These projects may be funded by low-interest loans or Principal Forgiveness (PF) and any local government can apply for this funding. Additional information can be found here: CWSRF | NCDEQ

8.2. Water Resources Development Grant – State and Local Projects

Through the NCDEQ Division of Water Resources, the Water Resources Development Grant (WRDG) provided funding to local governments to support technical assistance (planning, engineering, and design) and implementation of water-related projects. The seven eligible projects include: general navigation, recreational navigation, water management, stream restoration, water-based recreation, the NRCS Environmental Quality Incentives Program (EQIP) (stream restoration), and feasibility/engineering studies. Relevant to the Town of Black Mountain, the non-navigation/coastal projects are referred to as State and Local Projects (S&L) and will fund up to a 50% cost-share. The maximum award for constructions projects is $200,000 and the maximum award for feasibility/engineering studies is $50,000. The applicant must be a local government entity. Further information on can be found here: WRDG | NCDEQ-DWR

TABLE 8.1. FUNDING OPPORTUNITIES

FUNDING AGENCY	PROGRAM	POTENTIAL PROJECT TYPES	TENTATIVE APPLICATION DEADLINE
NCDEQ-DWI	Clean Water State Revolving Fund (CWSRF)	Stormwater SCMs, Stream Restoration	March/April & Sept. 2025 Cycles
NCDEQ-DWR	Water Resources Development Grant (WRDG)	Stormwater SCMs, Watershed Planning, Engineering Study, Stream/Wetland/Floodplain Restoration, Bank Stabilization, Dam Removal, Trails/River Access, Land Acquisition, NRCS EQIP Projects	June 30, 2025 & Dec. 31, 2025
NCDEQ-DWR	205(j) WQ Management Planning Grant*	Water Quality Planning, Stormwater Infrastructure Mapping, Stormwater SCMs, Watershed Assessment	Sept 19, 2025
GOLDEN LEAF FOUNDATION	Flood Mitigation Grant	Stormwater Management, Engineering/ Planning, Stormwater System Mapping, Flood Mitigation	Oct. 24. 2024 Dec. 26, 2024 Feb. 20, 2025
NCLWF	NC Land and Water Fund Grants	Stream/Wetland Restoration, Land Acquisition, Innovative Stormwater Management, Planning	March 1, 2025
NCDOJ	Environmental Enhancement Grant (EEG)	Stormwater Management, Stream/Wetland Restoration, Planning, Land Acquisition, Research	LOI: March 1, 2025 Due: April 4, 2025
USDA - NRCS	Emergency Watershed Protection (EWP)	Stream Debris Removal, Stream/Erosion Stabilization, Repair Stormwater Infrastructure/Flood Management Structures, Conservation Practices, Purchase EWP Buyouts	Submit Application With 60 Days of Declared Disaster
NCDA&CS	Streamflow Rehabilitation Assistance Program (StRAP)	Stream Debris Removal, Stream Stabilization, Stream Restoration, Repair to Impoundment Structures	Spring 2025
FEMA	Building Resilient Infrastructure and Communities (BRIC)**	Mitigate Impacts to Infrastructure due to Natural Hazards, Flood Control, Stormwater Infrastructure, Stream Stabilization/Restoration, Capability and Capacity Building Projects	LOI: TBD Sub-App: TBD Final App: TBD
FEMA	Hazard Mitigation Grant Program (HMGP)	Disaster Specific Funding to Support Recovery and Mitigation Efforts	Based On Date of Declared Disaster
FEMA	Flood Mitigation Assistance (FMA)	Floodplain Property Buyouts due to Repetitive Loss, Individual and Localized Flood Reduction Projects, Capability and Capacity Building Projects	LOI: Dec 20, 2024 Sub-App: TBD Final App: TBD

**Grant applicant must be a Council of Government*

***Projects outside of a declared disaster area compete at the national level.*

8.3. Golden Leaf Flood Mitigation Grant

As an annual appropriation from the North Carolina General Assembly, the Golden LEAF Foundation administers the Flood Mitigation Program (FMP) grant that awards funding for flood mitigation projects to local units of government. The program will fund construction of improvements to or the addition of new publicly owned stormwater infrastructure, including natural drainage ways, streams, green infrastructure stormwater control measures (SCMs), flood controls, and grey infrastructure. Improvements must mitigate flooding impacts for the future. Funds can also be used to cover planning or engineering studies related to flood mitigation solutions. The maximum grant award request is $2M, although most projects do not exceed $1M. Applications are reviewed twice a year. There is no financial match requirement. Learn more about the program here: FMP | Golden LEAF

8.4. North Carolina Water and Land Fund

Funded through the NC General Assembly, the North Carolina Water and Land Fund (NCWLF) (formerly known as the Clean Water Management Trust Fund) funds projects focused on conservation, ecological restoration, and water quality improvements throughout the state. Grants are available for Acquisition, Restoration, Innovative Stormwater, and Planning activities. Most appropriate for the Town to consider, the Restoration grant funds stream restoration and stabilization, wetland restoration and creation, dam removal and fish-passage culvert replacement, and other projects that improve surface water quality, including stormwater green infrastructure facilities and removal of infrastructure from floodplains.

Local units of government and non-profit organizations are eligible to apply. While the max funding request is not capped, recent awards have generally ranged from $150,000 to $900,000. The availability of funding varies year to year based on General Assembly priorities. No cost-share is required, however matching funds is a major component of project scoring. For stream projects, NCLWF requires a conservation easement to be established to protect a 50’ wide vegetated riparian buffer on both sides of the stream (100’ in total). To learn more about the Restoration grant program or any of the other NCLWF programs visit this website: NCLWF

8.5. Environmental Enhancement Grant (EEG)

Resulting from a legal settlement between the NC Attorney General and Smithfield Foods, the Environmental Enhancement Grant (EEG) was established to support projects that improve North Carolina’s air, water, and quality. Non-profit, academic, and governmental entities are eligible to apply, and awards generally range from $5,000 to $500,000. Eligible projects include land acquisition, remediation, restoration, planning, education, research, and construction activities. Projects that provide benefits to underserved or overburdened communities and address environmental justice issues. A financial match is not required but is advantageous. More information on scoring criteria and the application process can be found here: EEG | NCDOJ

8.6. Emergency Watershed Protection

The Emergency Watershed Protection (EWP) Program provides emergency federal recovery assistance to communities impacted by natural disasters. The program is administered through the USDA and NRCS and offers technical and financial assistance. In the absence of a federal or state disaster declaration, the NRSC State Conservationist can declare a local watershed emergency to open access to the EWP program.

Eligible projects include stream debris removal, stream bank and land erosion stabilization, repair or replacement of drainage facilities, repair of flood control structures, repair some conservation practices, and purchase EWP Buyouts. Projects must provide protection from future flooding, reduce threats to life and property, and restore hydraulic capacity to the natural environment. The program applicant/sponsor must be a local governmental entity and there is a 25% cost-share required. More detail about the program can be found here: EWP | USDA

8.7. Streamflow Rehabilitation Assistance Program

Under the North Carolina Department of Agriculture and Consumer Services (NCDA&CS), the Streamflow Rehabilitation Assistance Program (StRAP) funds projects that reduce flooding, improve streams through bank stabilization, stream debris removal, and stream restoration activities, and protect or improve drainage infrastructure (e.g., principal spillway, emergency spillway, and impoundment maintenance). Local governmental entities and non-profit organizations are eligible to apply, and awards can range from <$100,000 to $1M. More information can be found here: StRAP | NCDACS

8.8. Federal Emergency Management Agency (FEMA)

The Federal Emergency Management Agency (FEMA) provides multiple avenues for financial assistance, some of which are managed by the NC Department of Public Safety Division of Emergency Management. Additional information on these programs can be found at these links: Hazard Mitigation Assistance Grants | FEMA.gov and North Carolina Department of Public Safety's Division of Emergency Management.

Building Resilient Infrastructure and Communities (BRIC)

FEMA has several hazard mitigation programs that are particularly well-suited for stormwater projects. The newest of these programs is a retooling of the former Pre-Disaster Mitigation Program (PDM), known as the Building Resilient Infrastructure and Communities (BRIC) grant program. It represents a significant shift in the way FEMA conducts pre-disaster mitigation funding. It is a standard Stafford Act program with a 25% local match required. Applications are accepted in the fall of each year through the state emergency management agency, which is NCDPS. This program focuses on projects that have multi-layer benefits for the community and those that employ nature-based solutions. These can include flood control, water, sewer, or infrastructure construction projects or plans and studies to help develop future projects called Capability & Capacity Building (C&CB) proposals. The request amount is capped at $50M.

Eligible project types include shovel-ready (construction) projects, phased projects, and C&CB projects (planning and design). C&CB planning projects will be selected at the state level and awarded sooner than construction projects that will be scored and compete at the national level. It is important to note that applications are conducted through NCDPS, and that FEMA requires a minimum Benefit Cost Analysis (BCA) score for all non-planning projects. Currently, the BRIC program has not received funding, but it could be a source if the program is reinstated. More information can be found here: BRIC | NCDPS.

FEMA Hazard Mitigation Grant (HMGP)

FEMA's Hazard Mitigation Grant Program (HMGP) also funds stormwater projects that are designed to reduce flooding impacts. It is different from the BRIC and HMA programs in that it is not pre-disaster funding. HMGP funds are made available to areas that were covered under a federal disaster declaration. The need for the project submitted does not have to be a result of the disaster but must align with the

area's FEMA-approved Hazard Mitigation Plan. Pre-applications are normally due to NCDPS within 6 months after the declaration. Read further about the program here: HMGP | NCDPS

Flood Mitigation Assistance (Floodplain Buyouts)

Another program under the FEMA mitigation umbrella is the Flood Mitigation Assistance (FMA) grant program. The focus of this program is to fund projects that reduce or eliminate repetitive flood damage to buildings or structures insured by the National Flood Insurance Program (NFIP). The primary purpose of the FMA is to support individual floodplain property buyouts in NFIP communities. The program can also fund C&CB activities and localized flood rick reduction projects. As with the BRIC program, FEMA prioritizes projects that integrate nature-based solutions. Applications for this program follow the same process and general timeframe as BRIC program. Learn more about this program here: BRIC | NCDPS

9. REFERENCES

1. NOAA National Climate Data for Hurricane Helene: Daily Summaries Station Details: ASHEVILLE, NC US, GHCND:USW00013872 | Climate Data Online (CDO) | National Climatic Data Center (NCDC)
2. Town of Black Mountain Stormwater Master Plan Update (2022), Wildlands Engineering.
3. FEMA Models downloaded from the North Carolina Flood Risk Information System (FRIS): NCEM FRIS
4. NOAA National Weather Service ATLAS 14: https://hdsc.nws.noaa.gov/pfds/
5. Urban Hydrology for Small Watersheds, United States Department of Agriculture, Natural Resources Conservation Service, Conservation Engineering Division, Technical Release 55, June 1986.
6. USACE HEC-HMS Land Cover Curve Numbers: Curve Numbers | HEC-HMS | USACE
7. Environmental Protection Agency: Storm Water Management Model (SWMM) | US EPA
8. References for Anticipated Permits and Funding Opportunities are provided within Sections 6 and 8, respectively.