2.5.6 Modeling Results

Storm events are classified by the amount of rainfall, in inches, that occurs over the duration of a storm. The amount of rainfall depends on how frequently the storm will statistically occur and how long the storm lasts. Based on many years of rainfall data collected, storms of varying strength have been established based on the duration and probability of that event occurring within any given year. In general, smaller storms occur more frequently than larger storms of equal duration. Hence, a 2-year, 24hr storm (having a 50% chance of happening in a given year) has less rainfall than a 10-year, 24hr storm (having a 10% chance of happening in a given year). Stormwater runoff (which is related to the strength of the storm) is surplus rainfall that does not soak into the ground. This surplus rainfall flows (or „runs off") from roof tops, parking lots and other impervious surfaces and is ultimately received by storm drainage systems, culverts and streams.

Modeling is a way to mathematically predict and spatially represent what will occur with a given rainfall event. There are two primary types of models that are used to achieve this goal; hydrologic and hydraulic:

- Hydrologic models take into account several factors; the particular rainfall event of interest, the physical nature of the land area where the rainfall occurs and how quickly the resulting stormwater runoff drains this given land area. Hydrologic models can describe both the quantity of stormwater runoff and resulting pollution, such as nutrients (nitrogen and phosphorus) and sediment that is transported by the runoff.

- Hydraulic models represent the effect the stormwater runoff from a particular rainfall event has on both man-made and natural systems. These models can both predict the ability for man-made culverts/channels to convey stormwater runoff and the spatial extent of potential flooding.

The table below shows three storm events and the rationale for being modeled:

Storm Event	Rationale for being Modeled
2-year, 24hr	Represents the amount of runoff that defines the shape of the receiving streams.
10-year, 24hr	Used to determine which road culverts will have adequate capacity to convey this storm without overtopping the road.
100-year, 24hr	Used to define the limits of flood inundation zones

The County is using a customized version of the Environmental Protection Agency‟s (EPA‟s) Spreadsheet Tool for the Estimation of Pollutant Loads (STEPL). This customized program (STEPL-FFX) was built in Microsoft (MS) Excel Visual Basic for Application (VBA). It provides a user-friendly interface to create a customized spreadsheet-based model in MS Excel. It employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs), including Low Impact Development (LID) practices for urban areas. It computes surface runoff; nutrient loads, including nitrogen, phosphorus and 5-day biological oxygen demand (BOD); and sediment delivery based on various land uses and management practices. The land uses considered are user-defined land uses from Fairfax County. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (from sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

Existing Conditions water-quality data from the STEPL-FFX is shown on Maps 2-21, 2-22 and 2-23. The color gradient map symbols for pollutant loadings are the same for both the Johnny Moore and Little Rocky Run watersheds. Therefore, for Total Nitrogen (TN), Total Phosphorous (TP) and Total Suspended Solids (TSS), the subwatersheds located in Little Rocky Run – Upper WMA are producing relatively high pollutant loadings. The water-quality analysis is driven by land use and the watershed is predominantly medium to high density residential and commercial. With more impervious areas and small or non-existent buffer areas, the results are consistent with expectations. The I-66 Transfer Station Complex is located in the headwaters of this WMA and is the only recognized VPDES point source in the Little Rocky Run watershed. This WMA has undergone the most significant development over the past 10 years, owing to medium/high density residential and commercial areas replacing open space and low density residential areas. The field reconnaissance revealed that this system is still responding to these recent changes.

Table 2-17 provides a summary of runoff peak values and pollutant loadings at the outlet of the WMA. The second table is normalized by contributing drainage area.

Table 2-17. Little Rocky Run - Upper Stormwater Peak Values and Pollutant Loadings

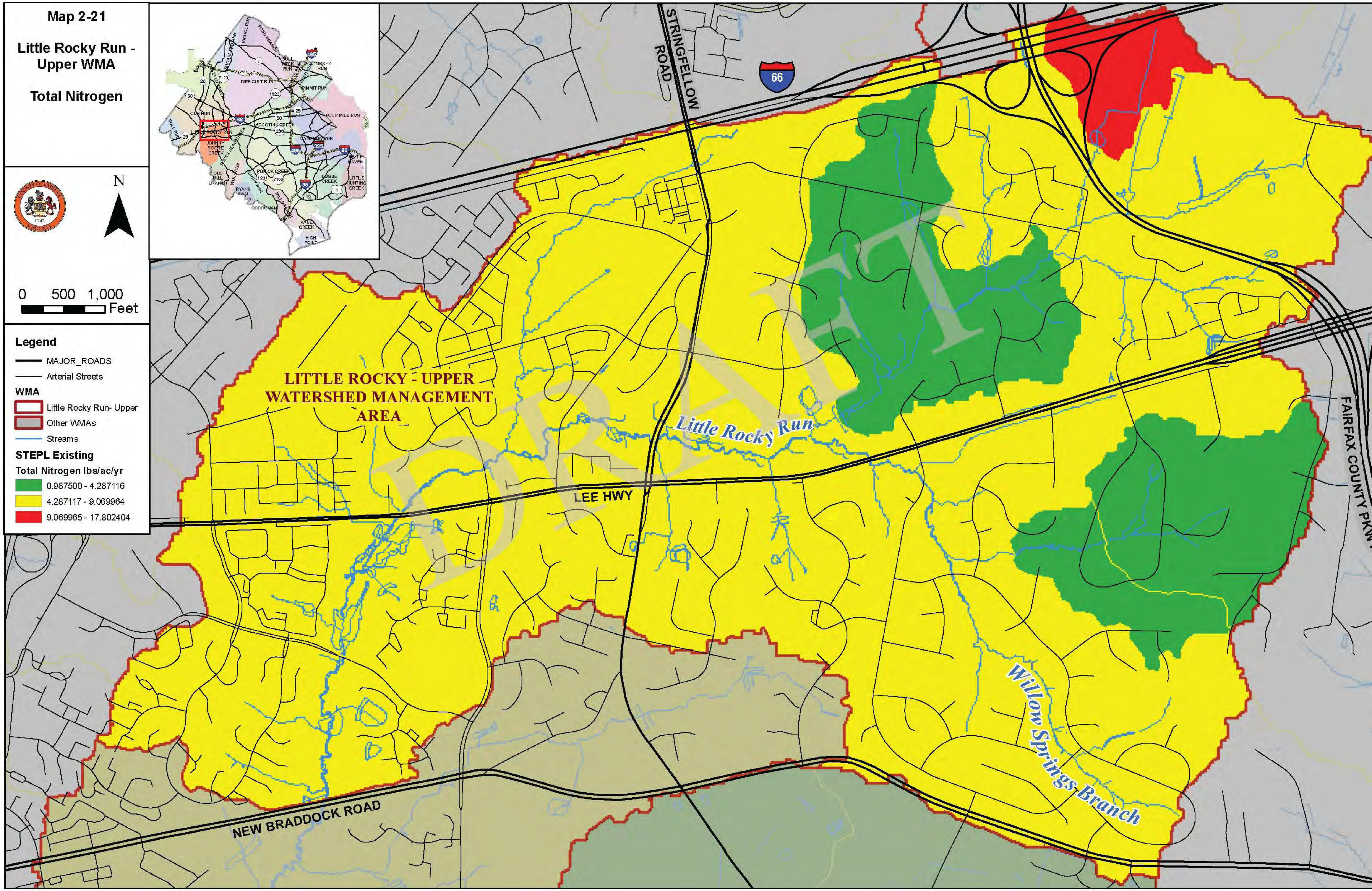
WMA	Stormwater Runoff Peak Values		Pollutant Loadings		
	2-yr storm (cfs)	10-yr storm (cfs)	TSS (tons/yr)	TN (lbs/yr)	TP (lbs/yr)
Little Rocky Run - Upper	515	1312	352.9	15196.7	2250.2

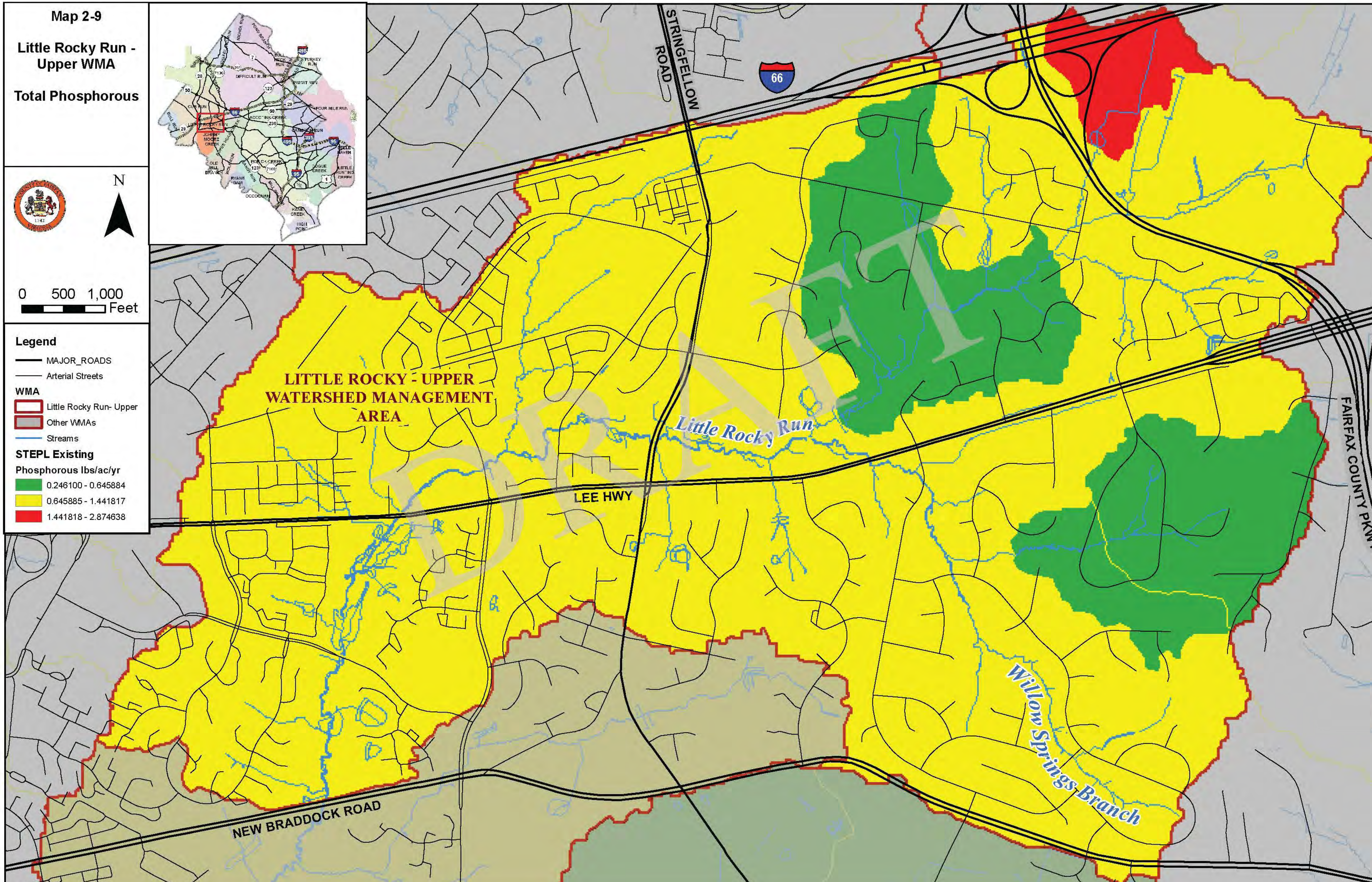
NORMALIZED BY DRAINAGE AREA

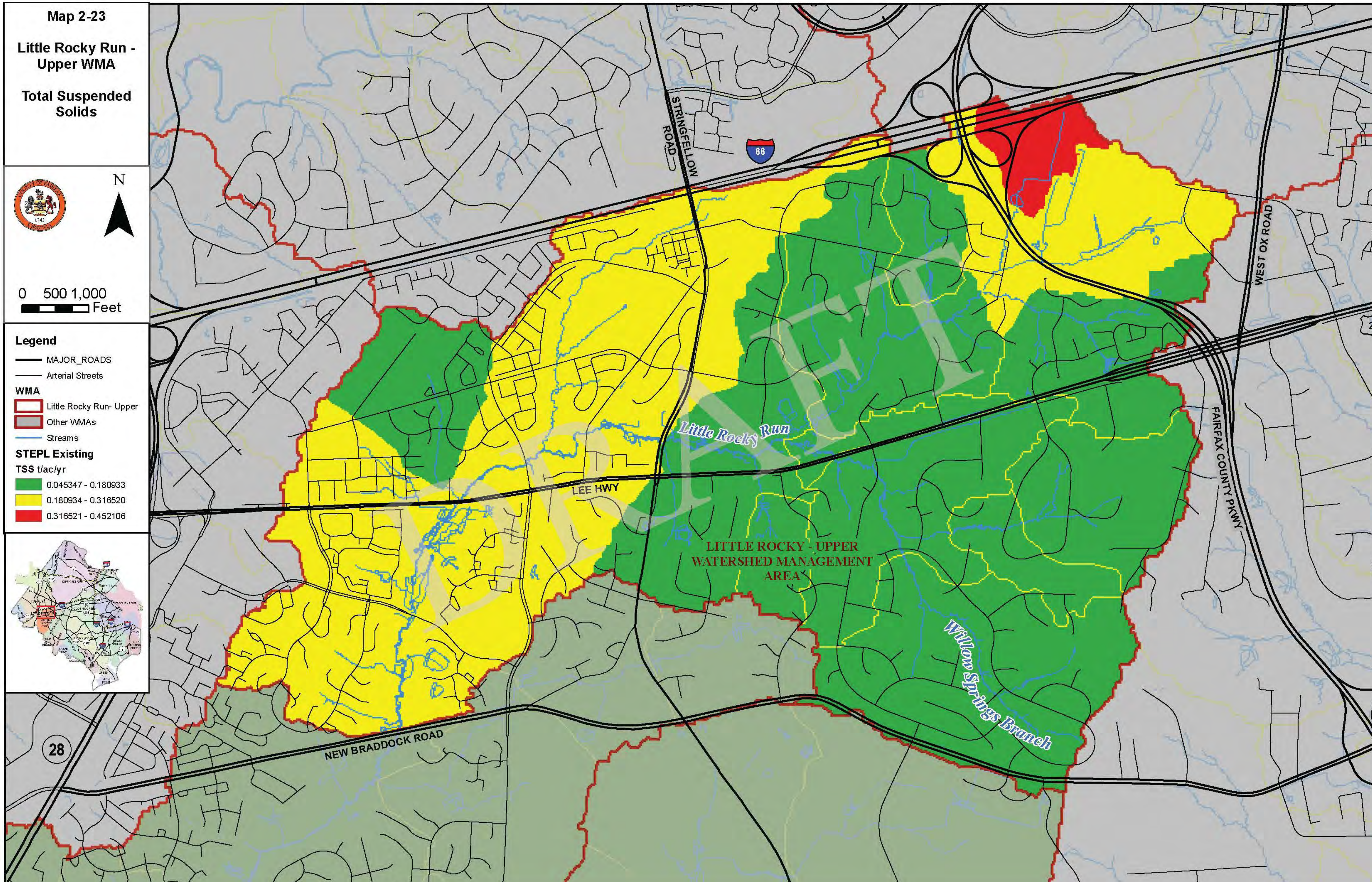
WMA	Stormwater Runoff Peak Values		Pollutant Loadings		
	2-yr storm (cfs/acre)	10-yr storm (cfs/acre)	TSS (tons/acre /yr)	TN (lbs/acre /yr)	TP (lbs/acre/ yr)
Little Rocky Run - Upper	0.233	0.594	0.160	6.871	1.017

The preliminary hydraulic model for Little Rocky Run - Upper was developed using United States Army Corps of Engineers (USACE) Hydrologic Engineering Centers River Analysis System (HEC-RAS) to compute water surface profiles. The preliminary model results were used to analyze the water surface elevation and flooding of inline structures.

The input data for the HEC-RAS model was extracted using HEC-GeoRAS. HEC-GeoRAS is a tool that processes the geospatial data within the County"s GIS, specifically as it pertains to physical features such as stream geometry and flowpath so that these features can be represented in the model. HEC-RAS models were developed for study


Map 2-21
Little Rocky Run - Upper WMA
Total Nitrogen
N
0 500 1,000
Feet
Legend
MAJOR_ROADS
Arterial Streets
WMA
Little Rocky Run- Upper
Other WMAs
Streams
STEPL Existing
Total Nitrogen lbs/ac/yr
0.987500 - 4.287116
4.287117 - 9.069964
9.069965 - 17.802404
STRINGFELLOW ROAD
66
LITTLE ROCKY - UPPER WATERSHED MANAGEMENT AREA
Little Rocky Run
LEE HWY
FAIRFAX COUNTY PKWY
Willow Springs Branch
NEW BRADDOCK ROAD
DRAFT


Map 2-9
Little Rocky Run - Upper WMA
Total Phosphorous
N
0 500 1,000 Feet
Legend
MAJOR_ROADS
Arterial Streets
WMA
Little Rocky Run- Upper
Other WMAs
Streams
STEPL Existing
Phosphorous lbs/ac/yr
0.246100 - 0.645884
0.645885 - 1.441817
1.441818 - 2.874638
LITTLE ROCKY - UPPER
WATERSHED MANAGEMENT
AREA
Little Rocky Run
Willow Springs Branch
STRINGFELLOW ROAD
66
LEE HWY
FAIRFAX COUNTY PKWY
NEW BRADDOCK ROAD
DRAFT



Map 2-23
Little Rocky Run - Upper WMA
Total Suspended Solids
N
0 500 1,000
Feet
Legend
MAJOR_ROADS
Arterial Streets
WMA
Little Rocky Run- Upper
Other WMAs
Streams
STEPL Existing
TSS t/ac/yr
0.045347 - 0.180933
0.180934 - 0.316520
0.316521 - 0.452106
STRINGFELLOW ROAD
66
WEST OX ROAD
29
FAIRFAX COUNTY PKWY
Little Rocky Run
LEE HWY
LITTLE ROCKY - UPPER WATERSHED MANAGEMENT AREA
Willow Springs Branch
NEW BRADDOCK ROAD
28
DRAFT

streams within Little Rocky Run using a naming convention unique for each reach. The study streams were defined as having a drainage area of at least 200 acres.

Bridge and Culvert crossings were coded according to available County or Virginia Department of Transportation (VDOT) engineering documents that depict the facility as it was actually built. Where not available, limited field reconnaissance was performed to obtain the crossing data. The crossing elevation data was determined relative to a point where the elevation could be estimated accurately from the County‟s topographic data.

Manning‟s „n" values, which represent surface roughness, were assigned to the channel and overbank portions of the studied streams based on field visits and aerial photographs.

The flow change locations were extracted from the EPA Storm Water Management Model (SWMM) developed to estimate preliminary stormwater runoff flow values. The 2-yr, 10-yr and 100-yr storm flows were determined at several locations in order to provide a detailed flow profile for the hydraulic model.. Map 2-24 provides a graphical representation of the SWMM results for the 10-year storm discharge.

The 2-year storm discharge is regarded as the channel-forming or dominant discharge for the purposes of this study. This discharge is the flow value that transports the majority of a stream‟s sediment load and therefore actively forms and maintains the channel. A comparison of stream dynamics and channel geometry for the 2-year discharge provides insight regarding the relative stability of the system and helps to identify areas in need of restoration.

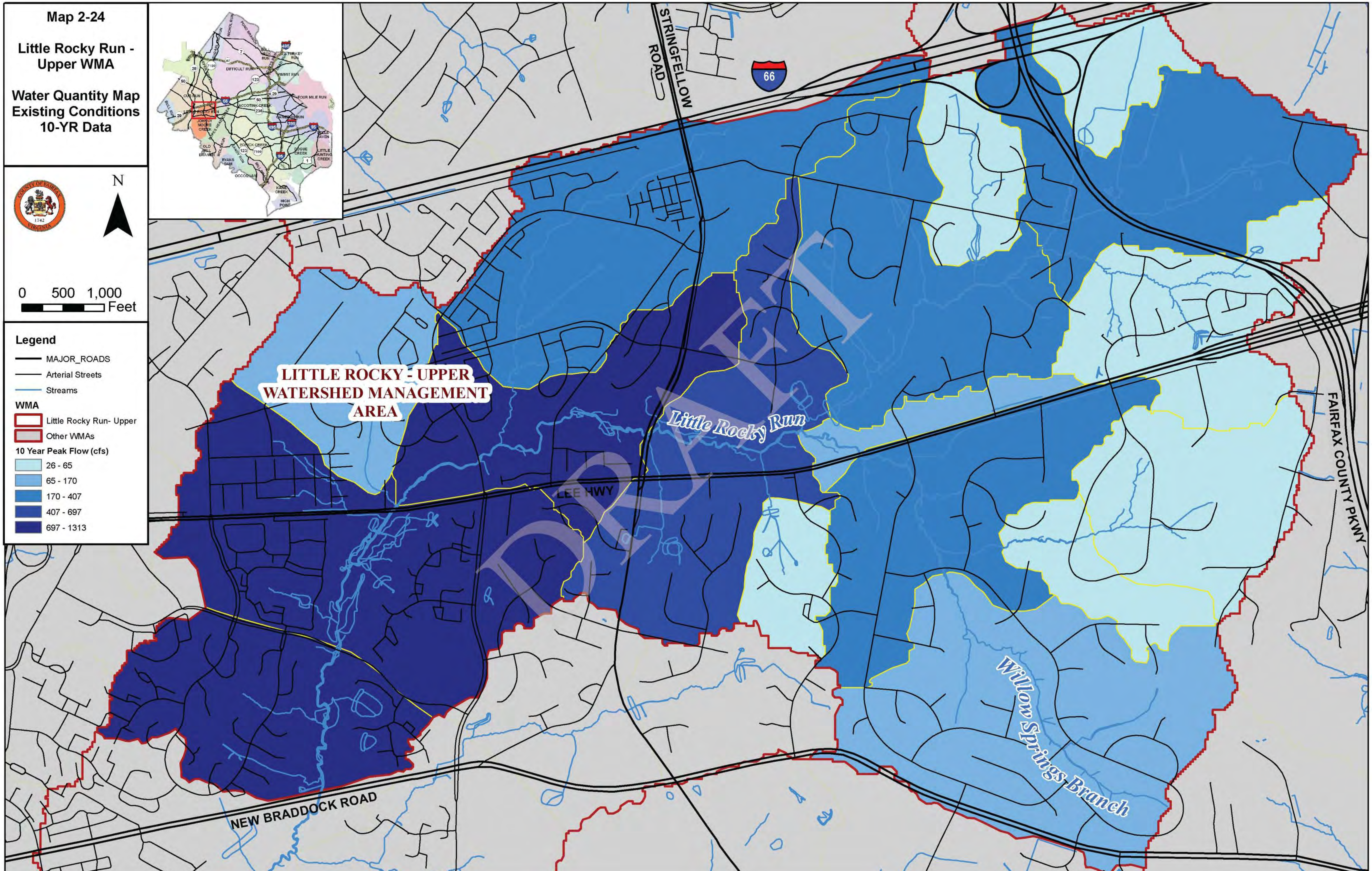
The 10-year storm discharge is being included to analyze the level of service of stream crossings. Occurring less frequently than the 2-year storm, the flood stage associated with this storm can result in more significant safety hazards to residents. All stream crossings (bridges and culverts) will be analyzed against this storm to see if they are performing at a level that safely passes this storm.

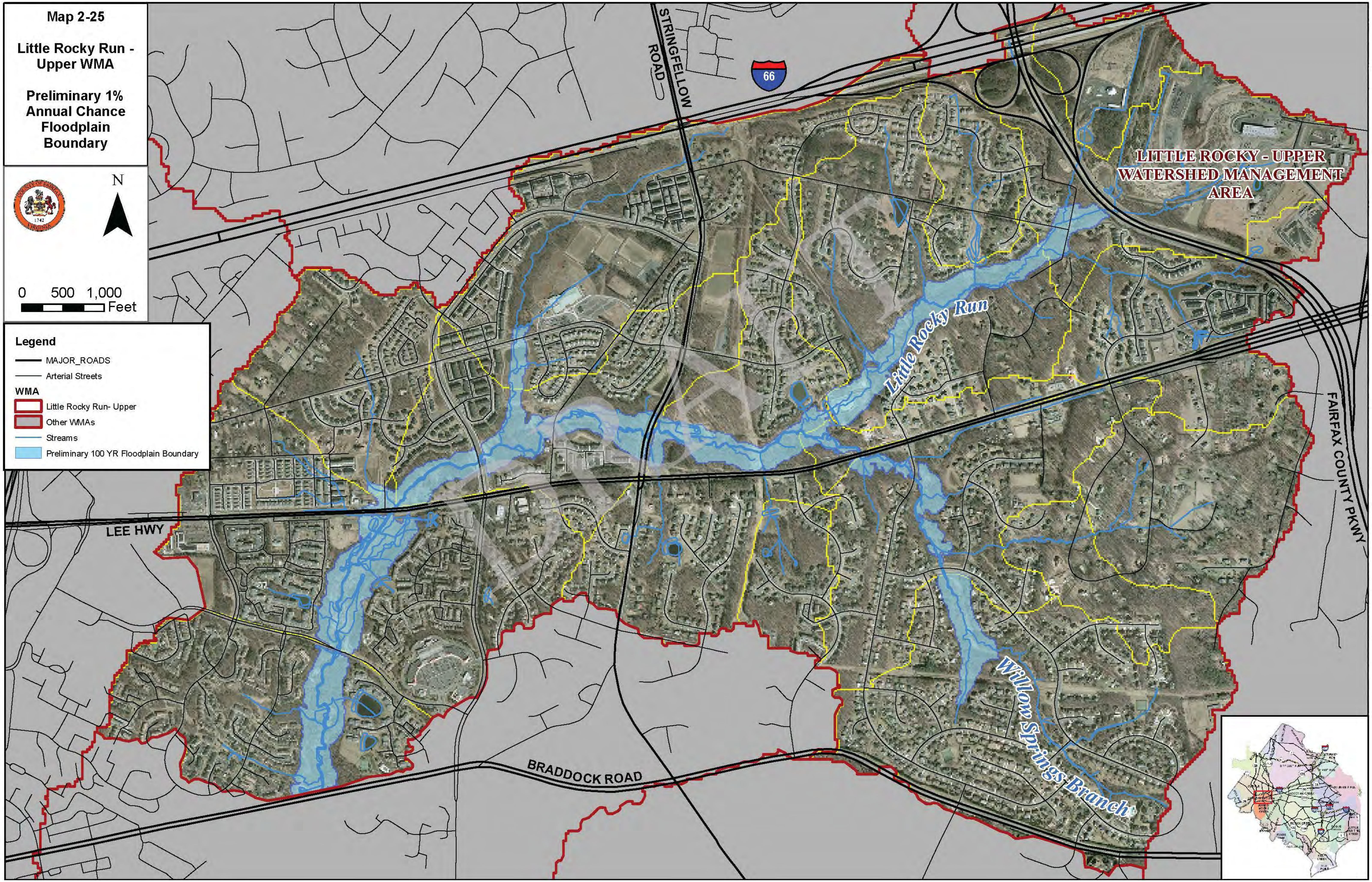
The 100-year storm discharge is used by the Federal Emergency Management Agency (FEMA) to map floodplain inundation zones and establish flood insurance rates. This provides a means to assess which properties are at risk to flooding and determine the appropriate insurance requirements for these at risk properties. The models developed to analyze the system for watershed planning have been built in compliance with FEMA standards in order to update the Flood Insurance Rate Maps for Fairfax County where appropriate.

In summary, the preliminary HEC-RAS model results indicate:

- 3 of 10 structures identified for analysis in the Little Rocky Run – Upper watershed do not have the capacity to pass the 10-year discharge.
- The 2-year discharge exceeds the channel banks in several locations
- There is very little if any evidence of flooding impacts to residential/commercial structures within the 100 year flood inundation zone.

The limit of the 100-year flood is graphically represented in Map 2-25.


Map 2-24
Little Rocky Run - Upper WMA
Water Quantity Map
Existing Conditions
10-YR Data
N
0 500 1,000
Feet
Legend
MAJOR_ROADS
Arterial Streets
Streams
WMA
Little Rocky Run- Upper
Other WMAs
10 Year Peak Flow (cfs)
26 - 65
65 - 170
170 - 407
407 - 697
697 - 1313
STRINGFELLOW ROAD
66
LITTLE ROCKY - UPPER WATERSHED MANAGEMENT AREA
Little Rocky Run
LEE HWY
DRAFT
FAIRFAX COUNTY PKWY
Willow Springs Branch
NEW BRADDOCK ROAD



Map 2-25
Little Rocky Run - Upper WMA
Preliminary 1% Annual Chance Floodplain Boundary
N
0 500 1,000 Feet
Legend
MAJOR_ROADS
Arterial Streets
WMA
Little Rocky Run- Upper
Other WMAs
Streams
Preliminary 100 YR Floodplain Boundary
STRINGFELLOW ROAD
66
LITTLE ROCKY - UPPER WATERSHED MANAGEMENT AREA
Little Rocky Run
LEE HWY
FAIRFAX COUNTY PKWY
Willow Springs Branch
BRADDOCK ROAD
DRAFT

2.5.7 Subwatershed Ranking

It should be noted that all designations of the preliminary ranking results are relative to the area studied for this report. In other words, a „low quality" designation does not necessarily indicate a poor quality subwatershed, only relative to the 51 other subwatersheds in the Little Rocky Run/Johnny Moore Creek watersheds.

Little Rocky Run - Upper contains the majority of „low quality" subwatersheds. This is best summarized on maps 2-33 (Objective Composite Score) and 2-34 (Source Composite Score). Maps 2-26 to 2-32 describe more specific objective criteria, which have been weighted to determine the objective composite score. Please refer to section 2.2 for a more detailed description of impact, source and programmatic indicators and how they are being used to characterize the subwatersheds.

Little Rocky Run - Upper contains all but one of the low quality subwatersheds shown on map 2-33. The objective composite scores are based on measures of environmental condition. Some indicators (Benthic and Fish Communities) were only sampled at a handful of sites, the results of which were applied for several subwatersheds (based on several factors). The rest were determined using the best available GIS data. A more detailed analysis of individual results will accompany any proposed plan controls for a subwatershed. At the time sampling was performed, a significant portion of the watershed was undergoing development, the impact of which is accurately reflected at the sampling sites. The remaining impact indicators are consistent with a nearly built-out watershed, namely that riparian, wetland and terrestrial forested habitat have been compromised, while pollutant loads are relatively high.

Little Rocky Run - Upper contains the highest percentage of medium/high density residential, commercial/industrial and impervious surfaces, as well as the only VPDES permitted point source. Therefore, its relatively low scores for source indicators, as shown on Map 2-34, appear reasonable. It contains all but two of the low quality subwatersheds.

The only consistent discrepancy from the overall trends described above in Little Rocky Run - Upper is subwatershed LR-WS-0005, which is a headwater subwatershed comprised of Low Density Residential land use, the majority of which is forested. This explains why it often stands out as a high quality subwatershed within the WMA.

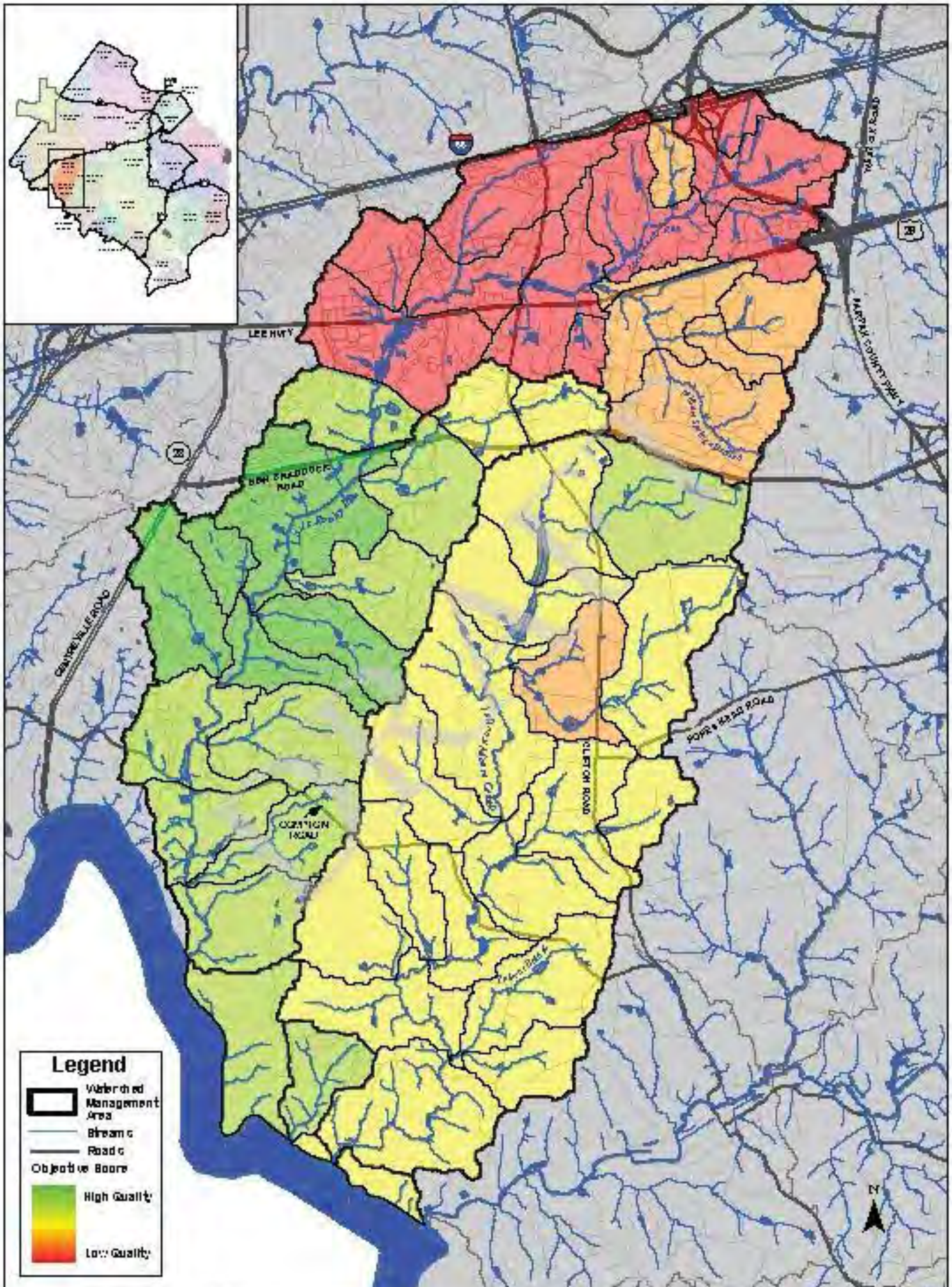
2.6 Subwatershed Characterization

The purpose of the subwatershed ranking approach is to provide a systematic means of compiling available water quality and natural resources information. Ranking subwatersheds based on watershed characterization and modeling results provides a tool for planners and managers to use as they consider which subwatersheds should undergo further study and/or set priorities. The ranking will be updated based on issues and problem areas identified during the introductory and issues scoping forum and advisory group meetings. The resultant data is then utilized to identify key issues and proceed with projects that will achieve the County‟s watershed management goals and objectives.

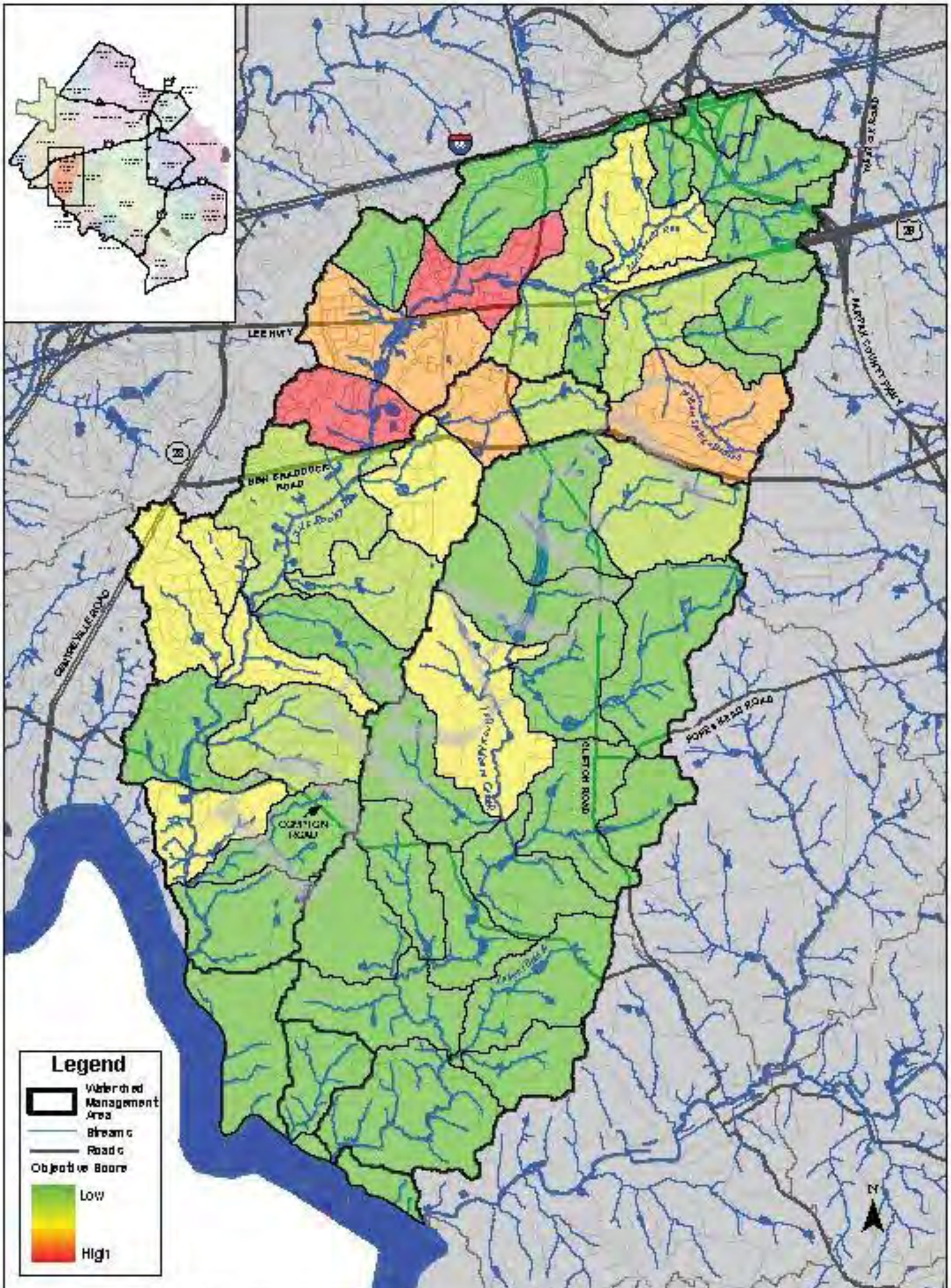
Three basic indicator categories as described in Section 2.3 are used to rank subwatershed conditions:

Indicator Type	Description
Watershed Impact	Diagnostic measures of environmental condition (e.g. water quality, habitat health, biotic integrity) which are linked to the County‟s goals and objectives
Programmatic	Reports the existence, location or benefits of stormwater management facilities or programs
Source	Quantifies the presence of stressors and/or pollutant sources

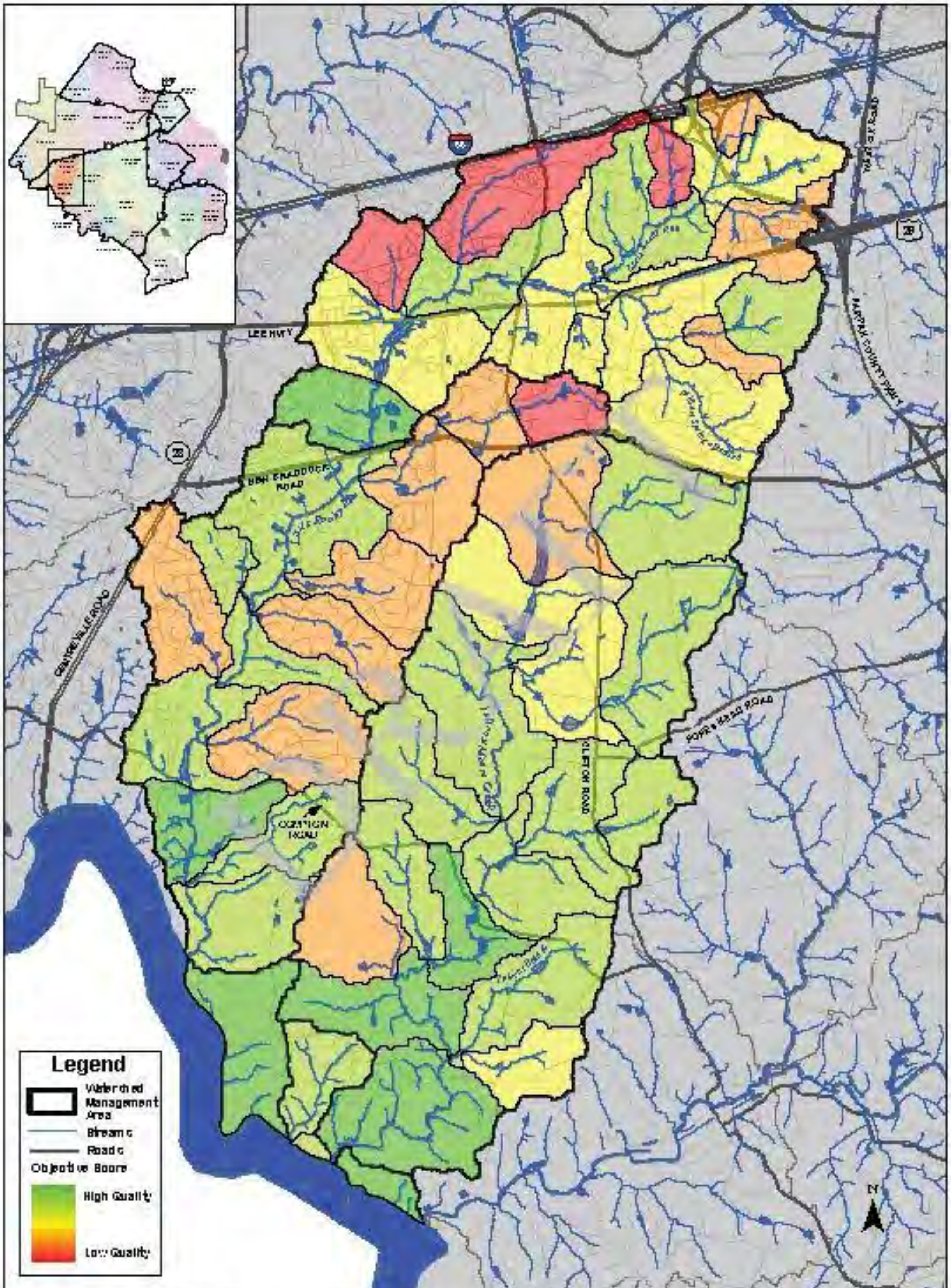
These scores are rolled up into composite scores which are used in the prioritization and subwatershed ranking process. The following sample maps (2-26 through 2-34) display preliminary results.



Map 2-26
Stormwater Runoff Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

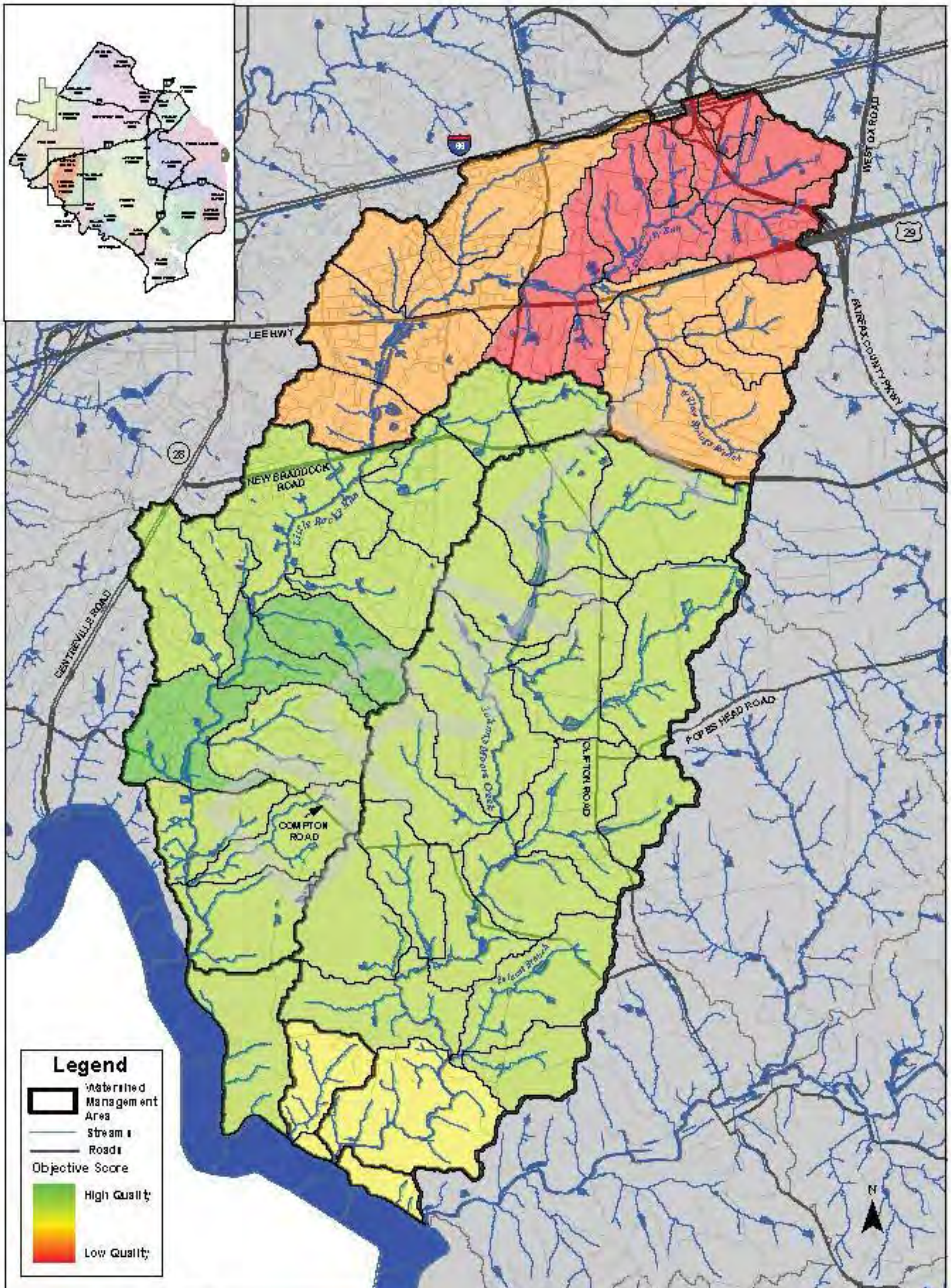


Map 2-27
Flood Hazards Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds



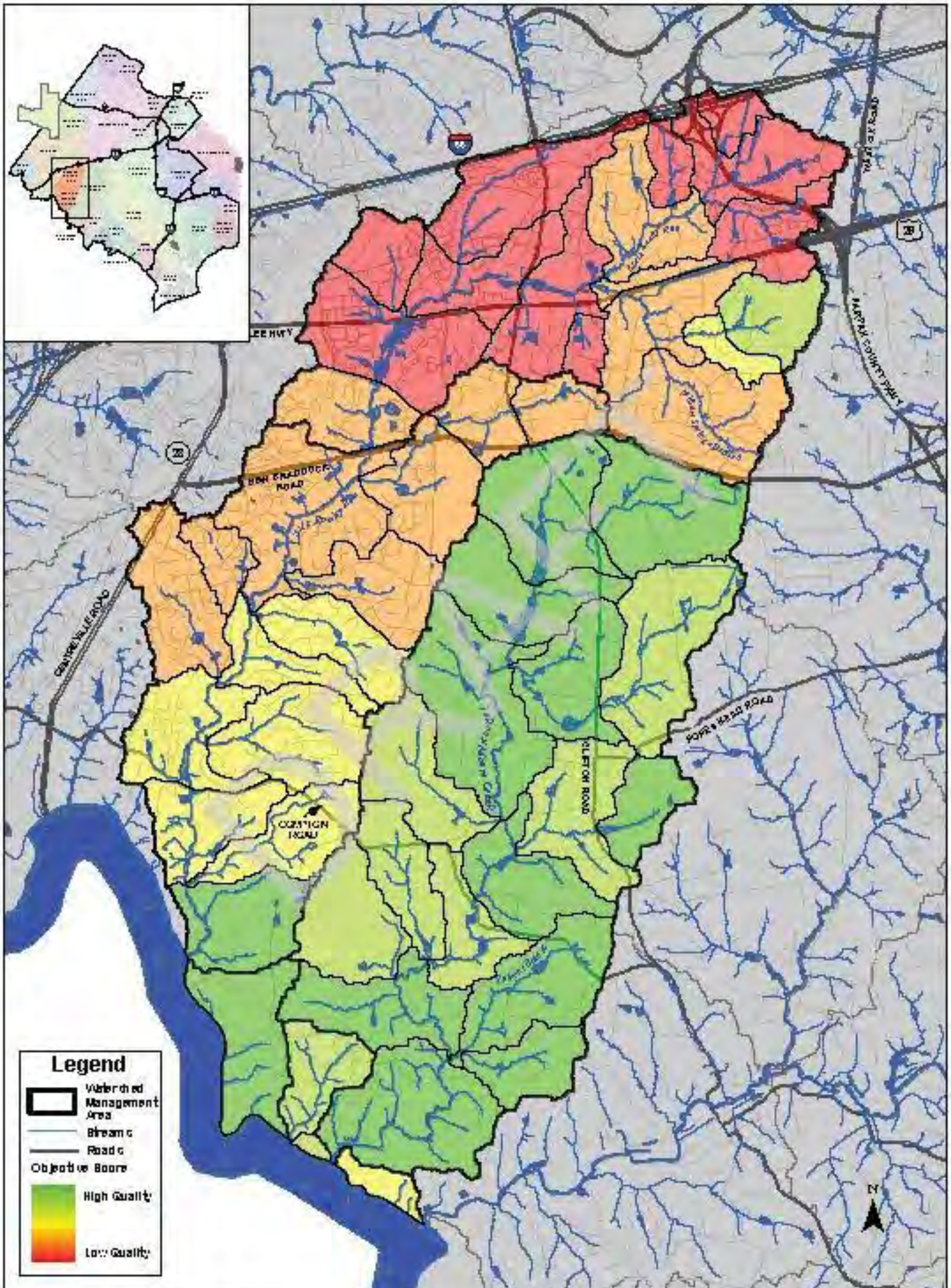
Map 2-28
Habitat Health Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

0 1500 3000 6000 9000 Feet



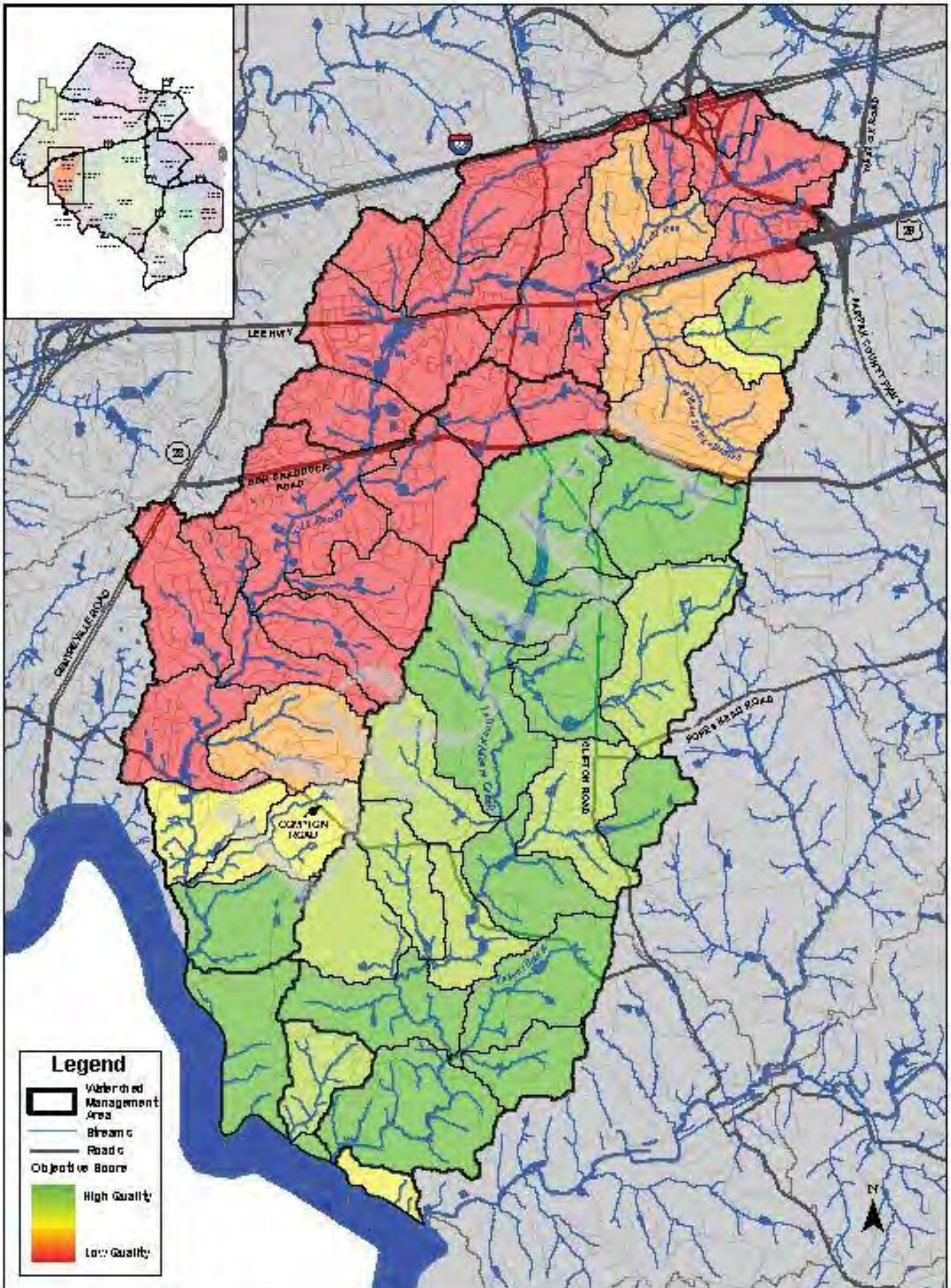
Map 2-29
Habitat Diversity Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

0 1500 3000 6000 9000 Feet

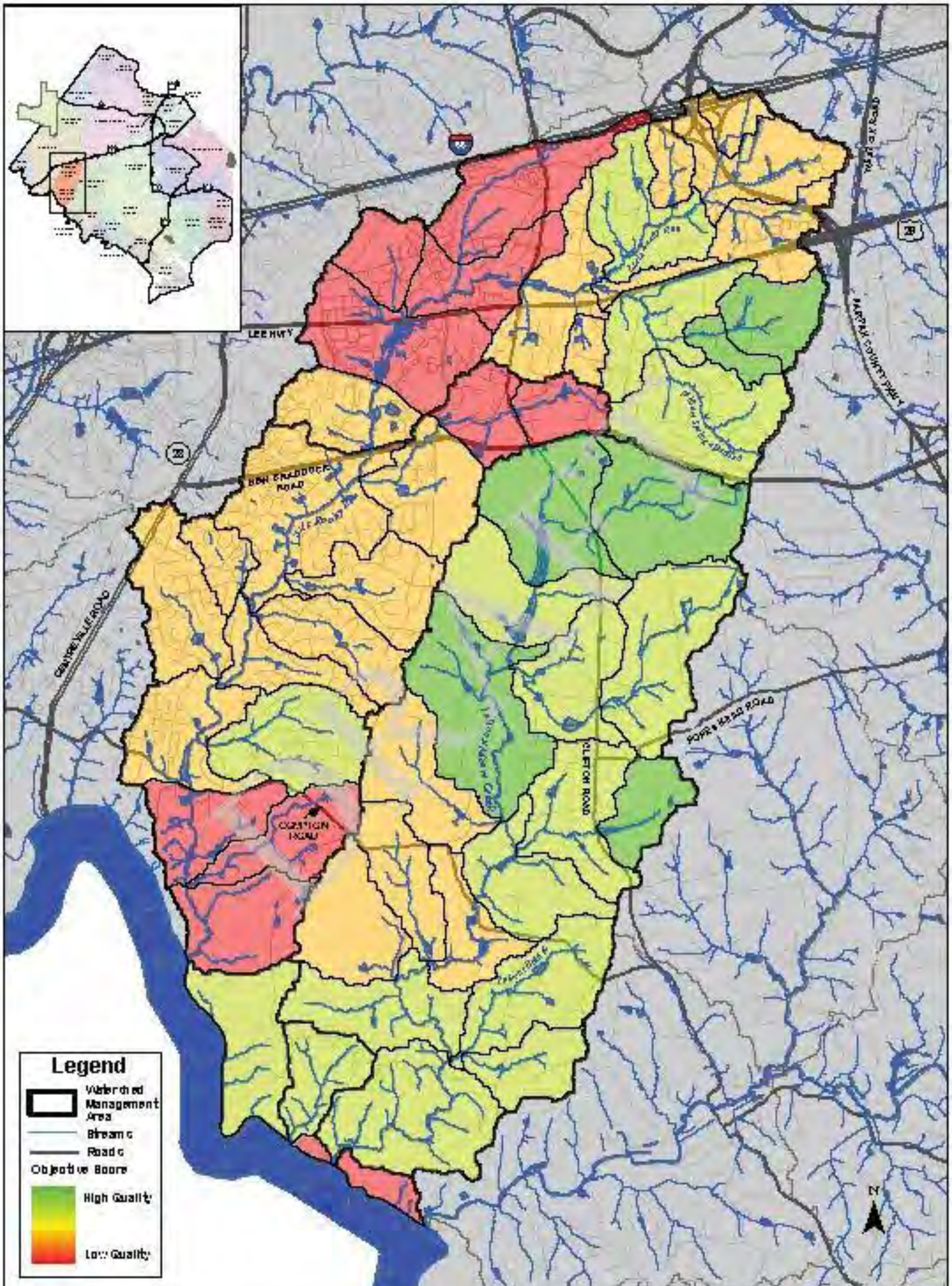


Map 2-30
Stream Water Quality Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

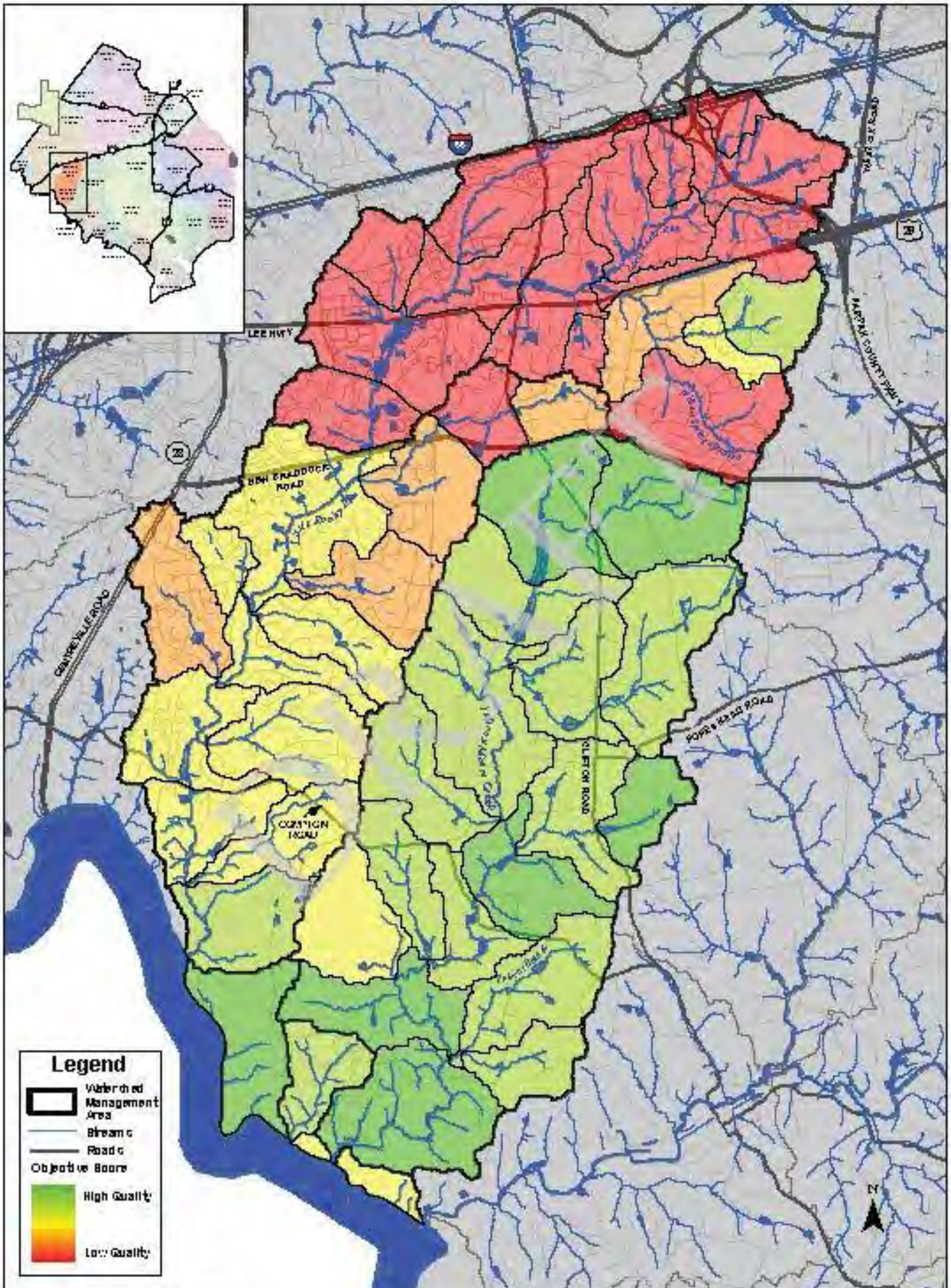
0 1500 3000 6000 9000 Feet



Map 2-31
Drinking Water Quality Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

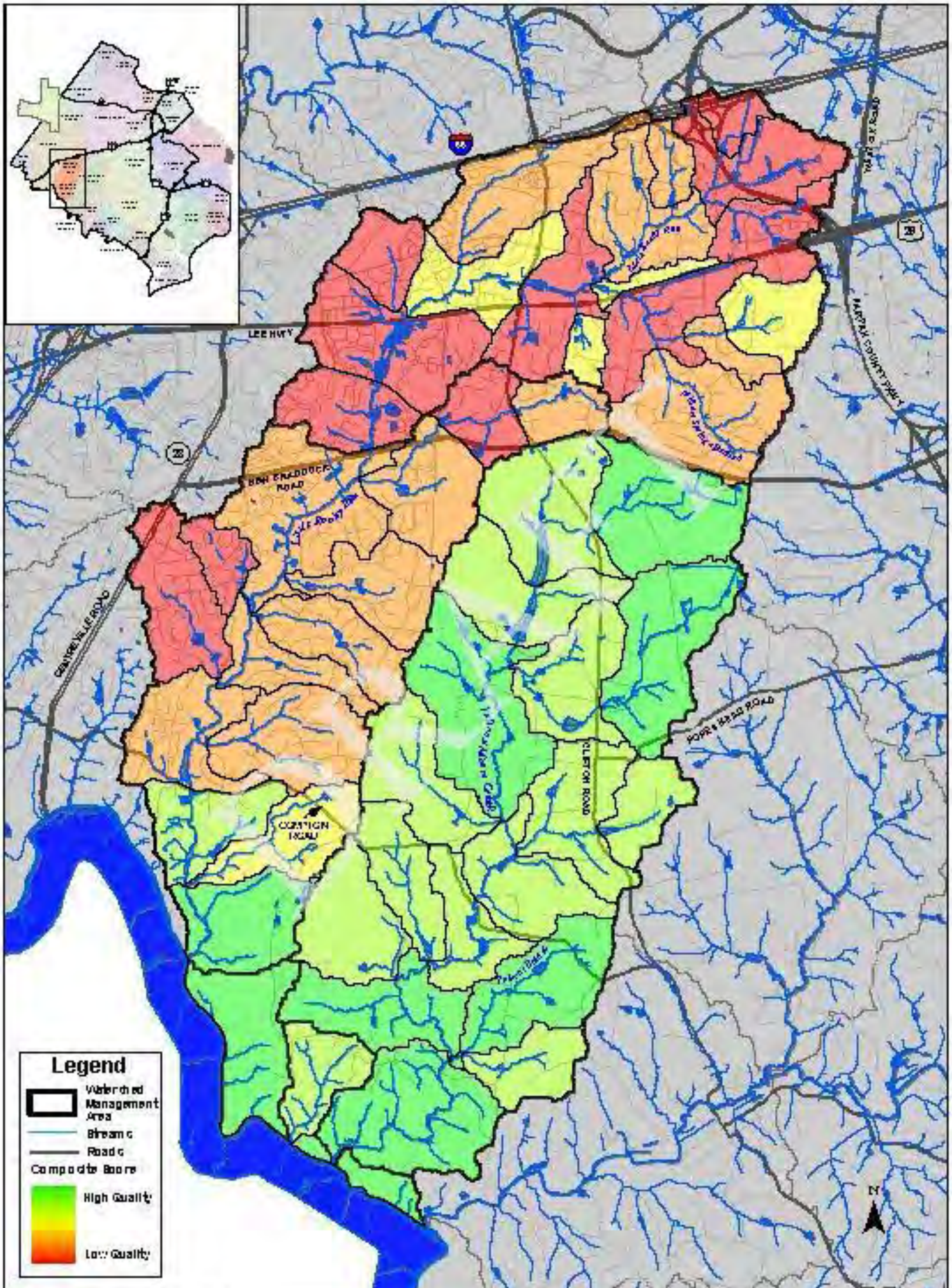


Map 2-32
Storage Capacity Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds



Map 2-33
Objective Composite Score
Little Rocky Run - Johnny Moore Creek Watersheds

0 1500 3000 6000 9000 Feet



Map 2-34
Source Composite Score
Little Rocky Run - Johnny Moore Creek Watersheds