

### **Section 3.3 Watershed Assessment and Inventory**

A watershed assessment protocol was prepared to support the development of the Rondout Creek Management Plan. The protocol was meant to provide the project team with a general baseline inventory of conditions throughout the stream corridor.

#### Stream Feature Inventory

In the initial stages of a watershed assessment and planning effort, it is necessary to gain a basic familiarity with the stream corridor and surrounding watershed. An inventory of stream features can reveal trends important to understanding the stream system. The stream feature inventory protocol provided an inventory of the following features:

- 1) Conditions that affect hydraulic function, particularly sediment transport function such as bedrock sills and banks, cultural and natural grade controls, berms, and rip-rap or other revetment, and inadequate riparian vegetation;
- 2) Potential sources of water quality impairment in the corridor, especially eroding banks, clay exposures, road runoff outfalls, dumps sites, and exposed septic leach fields or other hazards;
- 3) Locations of bank erosion monitoring sites to be monumented and surveyed for study of bank erosion rates;
- 4) Infrastructure, including road crossings, bridge abutments, culverts and outfalls, and utility lines or poles;
- 5) Other features such as tributary confluences, water intakes, springs, wells, diversions, and invasive species.

This stream feature inventory was also used to help define and prioritize further assessment, and scope the issues to be addressed in the management plan. Most of the data presented in the Management Unit Descriptions in Section 4 was derived from the stream feature inventory walkover conducted during the summers of 2008 and 2009. The Trimble GeoXH Global Positioning System (GPS) was used to map locations of features described above. Photographs and attribute data were also taken at each feature. Protocol used for attribute collection is detailed in Appendix D, Stream Management Data Dictionary Guide.

Following collection, all data was integrated into a common geodatabase using the Stream Analyst ArcGIS extension. The geodatabase is the common data storage and management framework for ArcGIS. It supports all the different types of data that can be used by ArcGIS such as; attribute tables, geographic features, and survey measurements.

Utilizing GPS coordinates, each feature was then linked to the management unit in which it was located creating an improved organizational structure and allowing for the reporting of stream feature statistics based on management unit. The first page of each of the Management Unit Descriptions in Section 4 presents the results of this data for each individual management unit. The following are summary statistics for the Rondout Creek Mainstem.

Table 1. Summary Statistics for all streams walked (Rondout Creek, Sundown Creek and Sugarloaf Brook) in Rondout watershed; this excludes state-owned land adjacent to streams. Data represents ~13.5 miles of stream walked in the summers of 2008 and 2009.

Stream Feature	Results
Bank Erosion	4,205 ft. or 3% of stream banks
Clay Exposures	420 ft. or 0.3% of stream banks
Berms	5,029 ft. or 3.5% of stream banks
Revetments	7,188 ft. or 5.1% of stream banks
Inadequate Vegetation	192 acres within 100 ft. buffer of stream
Knotweed Occurrences	3 stands covering 120 ft. <sup>2</sup>
Bridges	10
Culverts	4
Obstructions	38
Stream within 50 ft. of road	11,201 <sup>^</sup>
Houses within 100-year floodplain boundary	22

<sup>^</sup>This includes State-owned land.

#### High Watermark Verification of Bankfull Stage

The Rondout watershed received high water July 31, 2009 which resulted in a bankfull event (i.e. 1.5 year storm). During Stream Feature Inventory, the Program Team documented signs of high water in order to calibrate bankfull stage throughout the watershed.

#### Riparian Vegetation

Riparian vegetation mapping of a 300-foot stream corridor was conducted to identify the status of the vegetative community, and identify areas in need of enhancement. This protocol provided a characterization of the vegetative community (physiognomic) structure of riparian areas from remotely-sensed data. Characterizing riparian vegetation supported the assessment of the capacity of the riparian buffer to mitigate potentially deleterious water quality impacts from upland land uses. In addition, riparian classification defines the role of vegetation in the cohesiveness of stream bank soils and the integrity of the stream and riparian ecosystems. This analysis will lead to recommendations of where improvements to the riparian buffer may be most critical and/or effective, and locations of reference riparian vegetative communities within the watershed. The mapping also provided the area of impervious surfaces (e.g. roofs, driveways, roads) within the 300 foot buffer. Riparian vegetation maps are located in individual Management Unit descriptions. Planting recommendations and descriptions of the existing riparian community are presented in each management unit (Section 4).

#### Japanese Knotweed Mapping

As part of stream feature inventory, locations of Japanese knotweed (*Fallopia japonica*) along the streambank were identified. This invasive species has become a widespread problem in recent years, shading out other species and not providing adequate root structure to stabilize the soil in streambanks. The results may include rapid streambank erosion and decreased community richness. Japanese knotweed occurrences are discussed in each management unit (Section 4) and included on the riparian vegetation maps.

#### Historical Channel Alignments

A series of historical stream channel alignments was used to determine the frequency and magnitude of historical channel avulsions. ArcGIS 9.2 was used to georeference aerial photographs, when necessary, and then used to digitize each stream channel alignment. The alignment from each flight series was compared to locate areas of historic instability. This characterization was also one criteria used to divide the stream corridor into management units. Historic stream channel alignments from 1959, 1967, 1980, 2001 and 2009 aerial photographs can be viewed in management units which have displayed channel realignments during this time. The alignments are overlaid on 2001 aerial imagery. Where there was significant lateral shifting, these maps were included in the individual Management Unit descriptions in Section 4.

### Flood Frequency Analysis

Using USGS historic gage records, the Program Team conducted a flood frequency analysis to determine discharge that corresponds with different high flow events (e.g. 5-year flood, 10-year flood, 25-year flood, etc.). This information will help highway departments and other stream managers with appropriate sizing of bridges, culverts and other stream related activities.

### Management Unit Delineation

To describe the current conditions and recommendations for the stream corridor, the 10 miles of Rondout Creek and select tributaries were divided into eighteen management units based on the following criteria:

- 1) Valley Slope - A profile of the valley slope was created using United States Geologic Survey contour data. This profile was divided into segments based on common slope characteristics.
- 2) Valley Confinement - The width of the 100-year floodplain was measured perpendicular to the valley fall line at each of the cross-sections along the mainstream, and the ratio of the width to bankfull and floodprone width at each was determined. A graph of these ratios was generated and analyzed to identify segments exhibiting common valley confinement characteristics.
- 3) Historical Channel Alignment - Stream alignments were created from 1959, 1967, 1980, 2001 and 2009 aerial photographs (as described above). These alignments were overlaid to determine segments of historical stream instability.
- 4) Vertical and Lateral Controls - Bedrock channels and banks, revetments, bridges and berm locations were documented in the 2006 GPS walkover. Frequency of occurrence of these controls influenced management segment breaks.

The resulting 18 management units are described in Section 4 and depicted in Fig.

4.0.1. The data were then compiled by management unit to facilitate interpretation of conditions, trends and to make recommendations.

### Channel Morphology & Valley Topography

Summary statistics pertaining to the Rondout Creek's channel morphology and valley topography were derived in ArcGIS using the State of Vermont's Phase 1 Stream Geomorphic Assessment protocol (Table 2). One of the first steps in this process is the measurement of the *channel length* and *valley length*. Because valley length does not include the common meandering pattern of a stream, it is often a shorter measured distance than the stream channel length. In reaches where the stream channel does not meander, the valley length will be close to the channel length. The stream's meander, or *sinuosity*, is calculated by dividing the stream

channel length by the valley length. *Channel slope* is a calculation of the change in elevation over the length of the stream channel from the top of a management unit to the bottom. *Valley slope* is determined in the same manner, and is often steeper than channel slope due to its shorter length. *Valley width* calculations are an average of ten measurements throughout each of the management units. For each of these measurements, the total valley length of the management unit was divided by ten to provide a measurement interval (i.e. valley width in a 300 ft. long reach would be measured every 30 ft.). A random starting point of 1-10 feet from the beginning of a management unit was chosen, and valley width was measured ten times at the defined interval and averaged. By dividing valley width by the width of the channel, the *confinement* of the reach can be determined. The steepness of the valley walls on each stream bank, or *valley side slope*, are defined as the change in valley elevation from within the floodplain to the stream channel.

Table 2. Rondout Channel and Valley Summary Statistics

Mgmt Unit	Channel Length (ft)	Channel Slope (%)	Valley Length (ft)	Average Valley Width (ft)	Valley Side Slope % (LB)	Valley Side Slope % (RB)	Valley Slope(%)	Sinuosity
M1	1020.08	0.00	1010.24	896.19	26.7	31.7	0.00	1.01
M2	3581.76	0.46	3535.84	919.74	32.0	26.7	0.46	1.01
M3	2381.28	0.69	2335.36	801.66	30.0	15.0	0.70	1.02
M4	806.88	1.22	803.60	795.96	36.7	22.5	1.22	1.00
M5	1693.14	0.76	1695.76	836.47	27.5	33.3	0.75	1.00
M6	6566.89	0.85	6560.00	852.18	35.0	26.7	0.86	1.00
M7	2230.40	1.15	2187.76	908.00	30.0	25.0	1.17	1.02
M8	3817.92	1.04	3788.40	974.29	20.0	28.0	1.05	1.01
M9	2925.10	1.35	2902.80	621.10	30.0	36.0	1.36	1.01
M10	1912.24	0.84	1876.16	683.72	37.5	36.7	0.86	1.02
M11	3460.07	1.28	3352.16	603.59	36.5	36.1	1.32	1.03
M12	4510.00	1.31	4411.60	626.71	26.9	40.0	1.34	1.02
M13	899.05	0.91	842.96	739.12	40.0	25.0	0.97	1.07
M14	2985.13	1.96	2994.64	297.89	26.0	30.0	1.95	1.00
M15	4221.03	1.10	4172.16	166.07	30.0	23.3	1.11	1.01
M16	7885.12	1.61	7862.16	234.00	36.0	16.7	1.61	1.00
M17	1224.10	2.68	1105.36	346.40	30.0	22.9	2.97	1.11

The hydraulic geometry of the stream channel was calculated using regression equations relating drainage area to bankfull discharge, channel cross-sectional area, depth & width in the Catskill mountain streams specified by Miller & Davis (2003). The predictive variable in the hydraulic geometry equations, drainage area, was determined at the upstream end of each management unit break to create independent geometry calculations for each management unit. Miller & Davis (2003) indicate that reaches with a higher mean annual runoff (MAR) will generally fall above the regression line and that bankfull channel geometry is predicted more accurately by drainage area when locations are stratified into two classes by MAR. Data from USGS indicates that MAR within the Rondout drainage basin falls into the “high” MAR class. Therefore, hydraulic geometry for this management plan was calculated using both the Catskill mountain regional regression equation and the adjusted high MAR regression equation for the Rondout drainage basin.

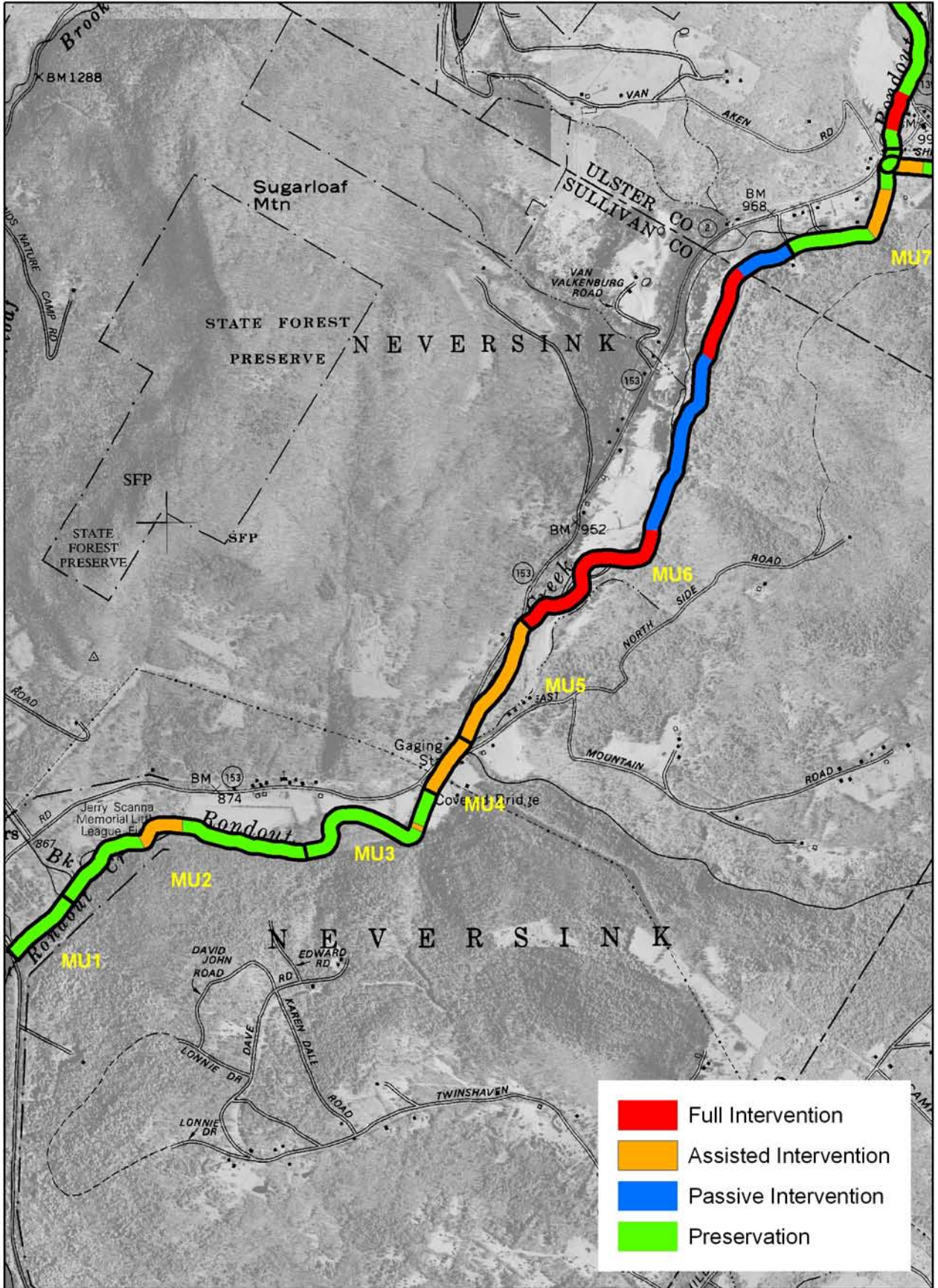
These values for width, depth and cross-sectional area can be used in post-flood emergency situations as rough guides to support rapid dimensioning of channels in stream work performed in post-flood, emergency situations where avulsions or other channel shifts require a temporary channel to be constructed. **They are not intended to substitute for reference reach data, sediment supply characterization and shear stress equations in stream restoration design in non-emergency situations.**

Table 3. Catskill & Rondout Creek Hydraulic Geometry

Mgmt Unit	Catskill Streams Region					Rondout Basin Stratified High MAR		
	DA (mi <sup>2</sup> )	Wbf (ft.)	Dbf (ft.)	Abf (ft <sup>2</sup> )	Qbf (ft <sup>3</sup> /s)	Wbf (ft.)	Dbf (ft.)	Abf (ft <sup>2</sup> )
M1	39.70	79.29	6.60	245.78	1548.86	96.13	3.60	347.40
M2	39.10	78.68	6.55	242.73	1528.48	95.53	3.58	343.61
M3	38.50	78.06	6.50	239.67	1508.05	94.93	3.57	339.80
M4	36.00	75.44	6.28	226.84	1422.49	92.35	3.49	323.77
M5	35.60	75.01	6.25	224.77	1408.72	91.93	3.48	321.17
M6	33.30	72.49	6.04	212.79	1329.20	89.45	3.41	306.10
M7	26.30	64.27	5.35	175.35	1082.50	81.20	3.17	258.27
M8	25.10	62.76	5.23	168.76	1039.40	79.66	3.12	249.73
M9	22.30	59.09	4.92	153.16	937.76	75.89	3.01	229.34
M10	22.00	58.68	4.89	151.47	926.77	75.47	3.00	227.11
M11	18.20	53.27	4.44	129.66	785.83	69.82	2.83	198.13
M12	17.40	52.06	4.34	124.97	755.69	68.55	2.79	191.82
M13	14.20	46.94	3.91	105.78	633.22	63.07	2.62	165.71
M14	13.40	45.57	3.79	100.87	602.07	61.58	2.57	158.93
M15	12.10	43.26	3.60	92.77	550.92	59.06	2.49	147.67
M16	9.30	37.83	3.15	74.77	438.17	53.02	2.30	122.18
M17	6.50	31.51	2.62	55.74	320.85	45.78	2.05	94.41

#### Reconnaissance Trips with Highway Departments

The Program Team accompanied the four highway departments with jurisdiction in the Rondout Creek watershed – Town of Neversink Highway Department, Town of Denning Highway Department, Ulster County Department of Public Works and Sullivan County Department of Public Works – to various locations of stream/road interactions. These site visits provided discrete points of concern along the Rondout Creek, Sundown Creek and Sugarloaf Brook of primary interest for the highway departments. Additionally, the Program Team gleaned valuable information about historic road impacts by the streams and “repeat offenders”. Section 5.2 provides details about these specific points of interest.



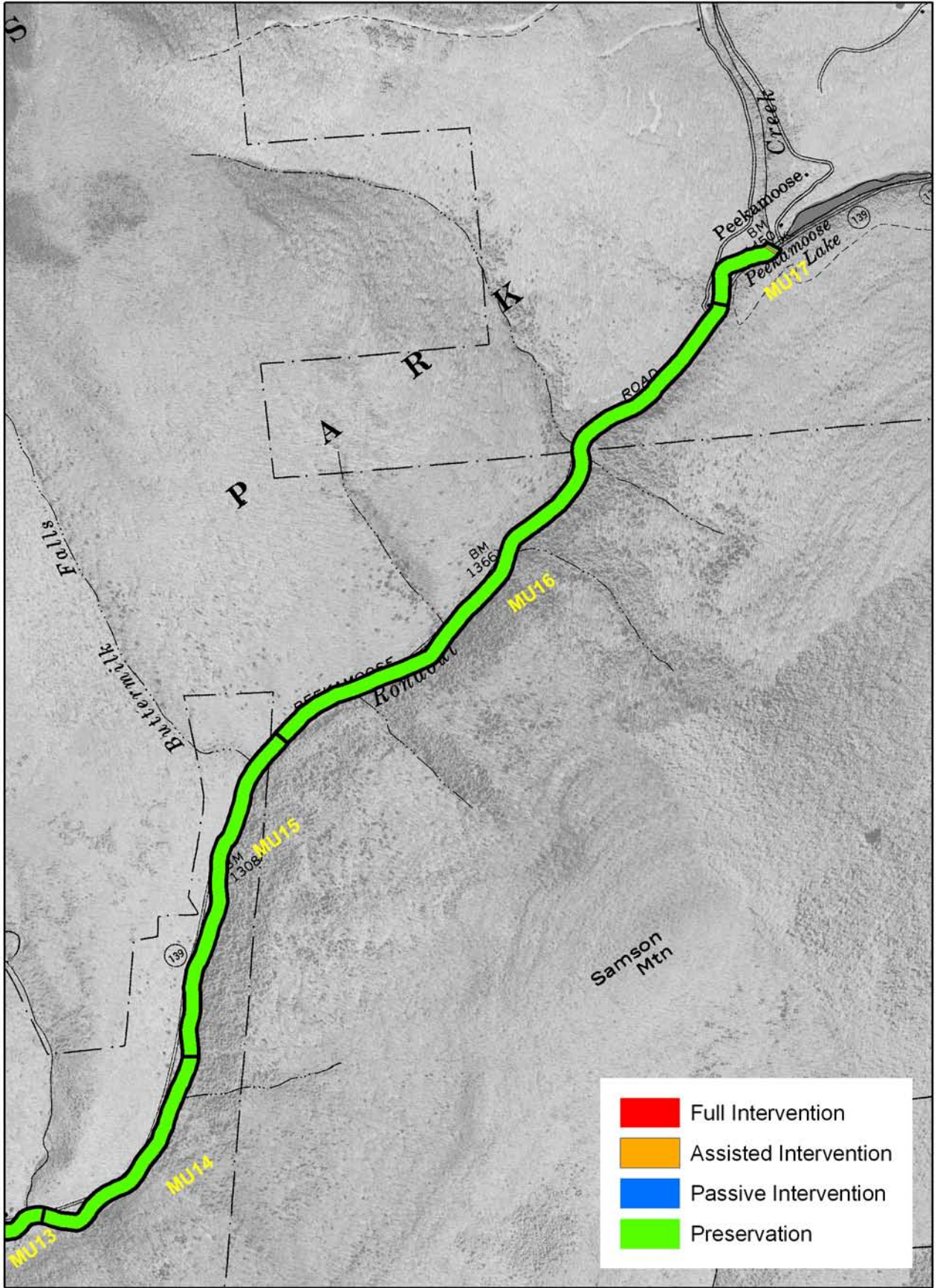
Management Units 8-13 (West Branch) & MU 18-20 (East Branch)

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- Full Intervention
- Assisted Intervention
- Passive Intervention
- Preservation