A. Chestnut Creek Management Unit 1

1. Summary Description

This section is intended to summarize the overall character and condition of Management Unit 1 (MU1). Subsequent sections will discuss specific issues (e.g., *riparian* land use and public infrastructure, *channel stability*, etc.) in greater detail.

This unit has two sections (see MU1 general map, Figure 1). The upstream section is approximately 450 linear feet (0.085 miles) in length, beginning at the *culvert* where the stream crosses Mutton Hill Road (Photo 1). This section was assessed using a field-based stream assessment method (Methodology used to accomplish goals, Volume I, Section I.E), and will be the focus of more detailed description below. The downstream section extends approximately 5,000 feet (0.947 miles) to the top of Management Unit 2, just downstream from the *confluence* of a small, unnamed *tributary*, where the stream moves from the largely forested setting that characterizes MU1 to the open grassy *wetland* characterizing MU2. The last few hundred feet of MU1 contain a large forested wetland (Photo 2).

Photo 1. View looking upstream toward culvert under Mutton Hill Road. Laid-up stone walls on both banks, small pump on right bank.

Photo 2. Looking upstream from MU2, trees and grassy flood-plain typical of this type of channel.

The downstream section of MU 1 was assessed using remotely sensed data sources (primarily aerial photographs). The *drainage areas* at the upstream and downstream ends of the upstream section of MU1 are 0.12 and 0.14 square miles, respectively. The drainage areas at the upstream and downstream ends of the downstream section are 0.14 and 0.84 square miles, respectively.

Land use along the stream corridor through both sections is predominantly forest along adjacent hillslopes, with some residential development. *Riparian* areas in the upstream section are maintained in generally well-vegetated, narrow residential woodland, including hemlock and birch (Photo 3). The downstream section is also primarily forested along the southern (right) bank. There is little impervious area in the stream corridor in this unit. Storm water runoff is conveyed

Photo 3. View looking upstream toward private foot bridge and waterfall from below XS-5. As seen here, riparian, or stream side vegetation plays an important role in the health of the stream and aquatic ecosystem.

predominantly as sheet flow through both cleared and forested areas, with culvert crossings at road locations.

An analysis of a series of historic aerial photographs covering the period 1974-2001 indicates that routine channel maintenance has not been widespread through MU1, except in the immediate vicinity of Route 55, Mutton Hill and Meyers roads (Aerial Photos 4, 5, 6, 7, 8, & 9). The stream crosses through culverts under two roads and runs along a private road behind the Crystal Falls Farm quarry.

The landowner carefully maintains the upstream section of MU1, primarily with hand-worked stone on one or both banks throughout most of this section (Photo 10).

Photo 10. View looking upstream from private foot bridge. Both banks are laid-up walls.

Photo 4. 1974 Aerial Photograph of the upstream section of MU1.

Photo 5. 1985 Aerial Photograph of the upstream section of MU1.

Photo 6. 2001 Aerial Photograph of the upstream section of MU1.

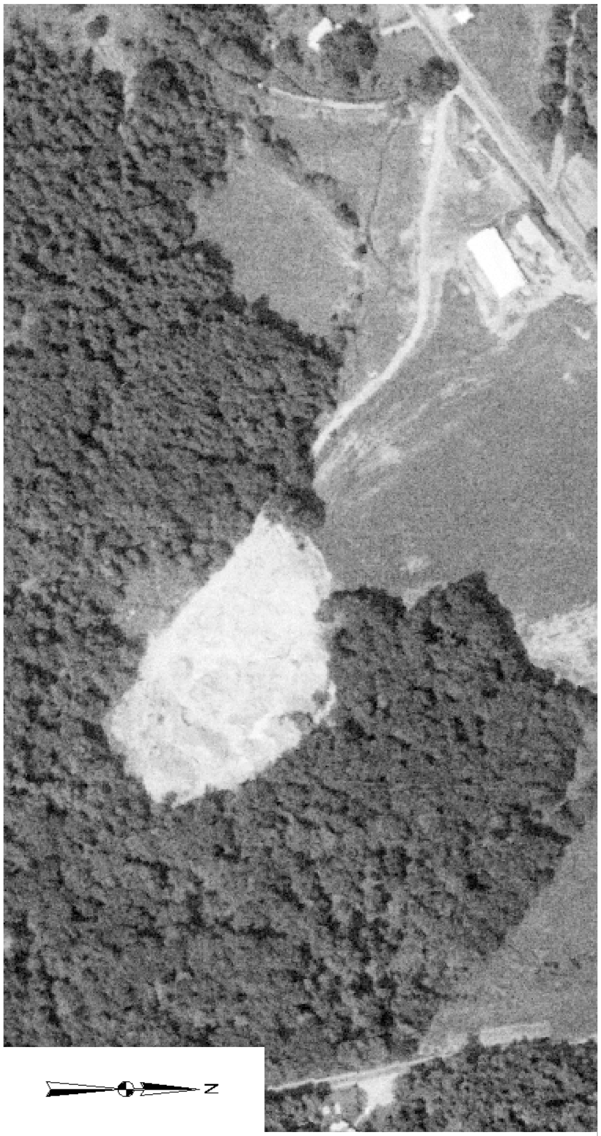

Photo 7. 1974 Aerial Photograph of the downstream section of MU1.

Photo 8. 1985 Aerial Photograph of the downstream section of MU1.

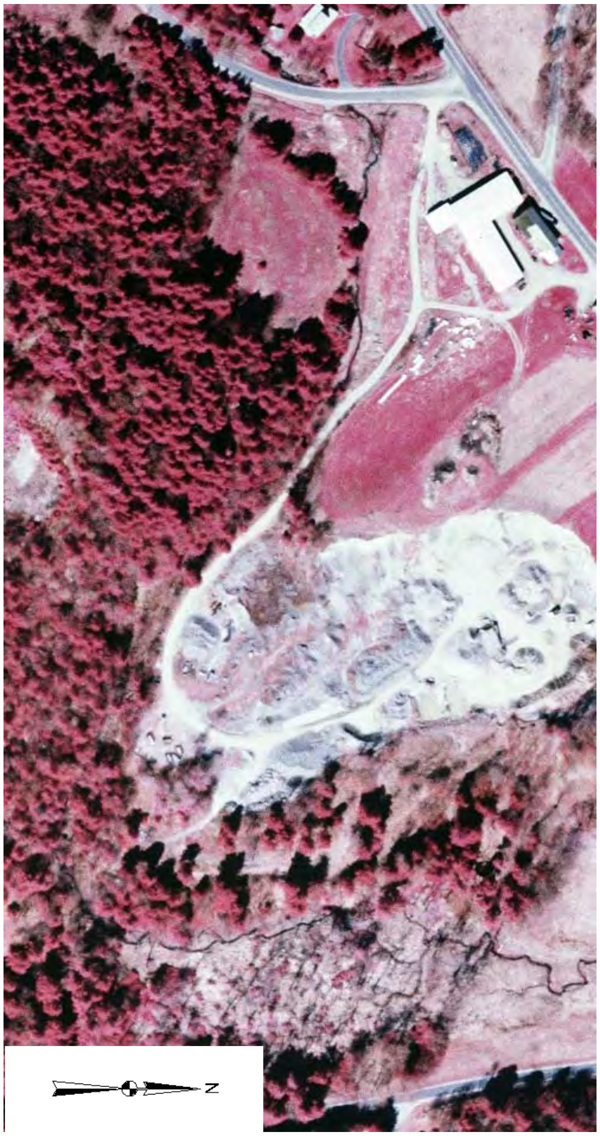

Photo 9. 2001 Aerial Photograph of the downstream section of MU1.

Much of the stonework is maintained with special attention to preserving riparian trees, adding to the stability of MU1, particularly in especially narrow sections near the top and in the vicinity of a private bridge crossing with a high, built step (Photo 11). These channel modifications have resulted in a somewhat confined channel with a low width/depth ratio (from 8 to 20 feet), but with very low *entrenchment* despite the steep slope (from 2% to nearly 8% slope in some sections) (Introduction to Stream Processes and Ecology, Volume I, Section III).

Photo 11. View looking upstream toward small step/ pool waterfall below private bridge.

Because of ongoing channel modifications and maintenance, the *stream types* in the upstream section are not typical of what would be expected in this setting under natural conditions, though the current configuration appears to be functioning well. The stream is very small in this *headwaters* location, with *bankfull* channel cross sectional area between 2.5 and 4.5 square feet (Photo 12). As such, the adjacent *floodplain* and riparian areas are not as susceptible to flood inundation problems, though may be more susceptible to ongoing stability problems due to the

Photo 12. View looking upstream toward XS-10 from XS-11.

typically "flashy" nature (rapid rise and fall of *stage* during floods) of headwaters areas and the steep slope in this section.

2. Riparian Land Use and Public Infrastructure

There are 22 parcels within the stream *corridor* along MU1 that include predominantly private residences and undeveloped areas. As noted above, development of the riparian corridor has historically been light, with some residential development and clearing of forested areas especially along the *left bank* throughout the downstream section, though fairly consistent riparian corridors are evident in the entire aerial photographic series.

Maintenance of public infrastructure is always a concern for local municipalities. The Chestnut Creek crosses under Mutton Hill and Myers Roads in MU1 and is conveyed by use of culverts (Photos 13 & 14).

There is one small unnamed tributary that enters the Chestnut above Myers Road through a small culvert under Route 55.

Photo 13. Tributary through culvert, Mutton Hill Rd.

Photo 14. Tributary through culvert under Meyers Rd.

No further information or assessment of these culverts was obtained.

Volume as well as water quality of runoff is a function of the size and characteristics of the land area each system drains. For example, land areas with a high percentage of *impervious surfaces* tend to generate considerably more runoff than areas that are predominantly forest or lawn. Size and land use characteristics of areas draining to identified outfalls (culverts), as well as potential for storm water retrofit opportunities were not evaluated as part of the initial assessment. However, a review of aerial photographs indicates MU1 has very little impervious surface presently, though the trend of expanding residential developments shown in the aerial photo series could continue, potentially adding impervious area to this unit depending on stormwater management strategies implemented in development designs.

3. History of Stream and Floodplain Work

As noted Chestnut Creek appears to have been managed at some time in the past in the vicinity of road crossings and expanding development. Channel work to remove *gravel* deposits and maintain flood conveyance has been routine in the past, commonly used throughout Chestnut Creek to maintain infrastructure. Development of the riparian corridor along Chestnut Creek has historically involved floodplain fill and/or the construction of flood *berms* to protect structures placed in these areas – the presence of this kind of development in MU 1 cannot be assessed from aerial photos, there were no berms in the upstream section. Filling floodplain areas to accommodate development on private as well as public land is still a common practice in the Chestnut Creek watershed.

General impacts of traditional approaches to stream management have been addressed in the Watershed Recommendations for Best Management Practices, Volume II, Section II.A of this plan. Specific impacts and management considerations in relation to the assessment of MU1 are included with this section of the plan.

4. Channel Stability and Sediment Supply

During the 2001 Stream Corridor Survey, MU1 was divided into 9 *reaches* on the basis of the Level II – Morphologic Description (Rosgen, 1996). The largest portion (47%) of this unit includes moderately entrenched channel types B and Ba (MU1 Stream Type & Cross Sections location map, Figure 2). With a low width to depth ratio (i.e., 11 – 16) and mature vegetation on the banks these types of channels tend to be very *stable* and are generally effective at moving *sediment* transported from upstream reaches. Although mature trees and shrubs provide lateral control along much of the management unit, channel maintenance activities in the upstream portion have left all of the reaches in this unit with moderate to low width to depth ratios making them more efficient at moving sediment (Photo 15), though not necessarily prone to severe *downcutting*, especially in reaches with coarser sediment in the lower reaches of the upstream section (Photo 16).

Highly entrenched reaches (i.e. F-types)

Photo 15. View looking upstream from XS-6 at narrow, well forested gravel and cobble bed stream.

Photo 16. View looking upstream toward XS-9 and large boulder in stream bed.

account for 9% of the total length. Because they lack a floddplain area (i.e., an area adjacent to the channel where floodwaters can spread out and reduce the energy against the streambed and banks), entrenched reaches experience considerable stress during storm flow and tend to be more susceptible to stability problems, particularly bank *erosion* and bed scour or *degradation*. In addition, these types of channels route storm flow quickly to downstream reaches where they can contribute to channel instability and flooding.

Morphological data collected along the reaches is summarized in Table 1 and illustrated in Figure 2. As can be discerned in the aerial photographs, the channel *planform*, or stream pattern, along this management unit is characterized by relatively low *sinuosity*, though shows a few truncated *meanders*. The greatest alteration in meander geometry appears to be associated with road locations, though does not appear to have changed appreciably since the 1970s. What

Table 1 - Summary of Morphological Data for Reaches along Management Unit 1 .

Reach	Length (ft)	Area (ft^2)	Width (ft)	Mean Depth (ft)	W/D	Ent.	Slope (ft/ft)	Stream Type
1	123	2.7-4.6	3.1-4.4	0.9-1.1	4	2.7-2.9	0.039	E4b
2	13	4.1	5.6	0.7	8	1.4	0.110	A3a+
3	31	4.3	7.5	0.6	13	1.5	0.021	B4
4	19	3.9	8.8	0.4	20	1.1	0.044	F4a
5	13	3.0	6.5	0.5	14	2.4	0.041	C4b
6	182	2.8-4.6	5.6-8.6	0.4-0.5	11-18	1.5-2.2	0.068	B4a
7	23	2.5	4.2	0.6	7	1.9	0.047	A3
8	26	3.9	6.9	0.6	12	3.3	0.071	E3a
9	20	3.0	7.1	0.4	17	1.3	0.030	F3b

alteration has occurred has likely been the result of minor channel adjustments to accommodate the roads, some development of properties along the stream corridor, and periodic channel maintenance at culverts and stream crossings.

The effects of the channel maintenance and natural adjustments are most evident between the 1974 and 2001 aerial photographs. Apparent from the imagery is slight alignment changes near the culvert at Myers Road and some shifting of the channel south away from the road constructed to serve the Crystal Falls Farm quarry just upstream from the large meander bend near the bottom of the unit. This change has been gradual judging by the aerial photo series, associated with increased usage of land and road in the quarry area. The smaller channel area near the top of MU1 can only be seen as the line of riparian trees, apparent in each of the four photos, and appears not to have changed appreciably in the last 30 years.

As pointed out in Introduction to Stream Processes and Ecology, Volume I, Section III, natural streams are composed of three distinct flows that include: a *baseflow* or low flow channel, which provides habitat for aquatic organisms; a *bankfull* channel, which is critical for maintaining sediment transport; and a floodplain, which effectively conveys flows greater than the bankfull discharge (i.e., 1 – 3-year peak flow).

Standard engineering practice includes designing channels to convey large storm flows (e.g., 25-, 50-, or even 100-year peak flows) without overtopping adjacent streambanks. While enlarging the channel to improve its ability to convey storm flows may seem logical, in fact this approach usually creates channels that have poor habitat, are ineffective at transporting sediment, and require constant maintenance. These engineered channels are generally designed to convey all flows (baseflow, bankfull flow, and flood flow) in a single channel that is relatively straight, very wide and trapezoidal in *cross-sectional area*, with a uniform profile.

In these altered channels, baseflow is usually very shallow or may actually flow beneath the *substrate* because it is spread out over such a large surface area. The uniform profile replaces the typical *riffle-pool* sequence with a continuous shallow riffle or run that provides no cover for fish to avoid predation or strong flushing currents. A very wide, shallow channel is less efficient at moving sediment under bankfull flow conditions. As a consequence, sediment (e.g., *sand, gravel, cobble*) tends to accumulate, developing lateral and/or mid-channel bars along these altered reaches. Ironically, the accumulation of sediment and the development of bars significantly reduce the channel's capacity to convey the large storm flows for which it was designed.

The 2001 Stream Assessment Survey conducted by SCSWCD did not contain enough detail in the downstream section to show large areas of *aggradation*, though some shifting in channel pattern is evident in the vicinity of the Myers Road culvert. The upstream section did not show any pattern of ongoing aggradation, though could be at higher risk for degradation due to low width to depth ratios and high bank height ratios.

Hand-stacked rock walls and *rip-rap* currently provide lateral control along the channel in the upstream section, and mature riparian vegetation provides lateral control throughout MU1. These lateral controls appear to have maintained the current channel planform through the last several decades, the notable exceptions being in locations near the stream crossing, where riparian coverage is inadequate, and the channel can therefore be seen in the aerial photographs.

Lateral control along the majority of the management unit in the downstream section is provided by mature trees and shrubs. Preliminary observations indicate that most of the channel along this management unit is laterally stable (i.e., bank erosion rates are low). Bank height to bankfull ratios along the upstream section of this unit ranged from an estimated 1.0 to nearly 2.0, confirming that a significant length of the channel is *incised*, even though entrenchment ratios show low entrenchment. Rosgen (2002) notes that bank to bankfull height ratio is a good measure of vertical stability, as well as an indicator of sediment supply potential. Because this upper section is well maintained, and there is a significant grade control at the private foot bridge within this section (Photo 9), any continued downcutting will not likely result in large-scale instability or increased sediment supply.

Debris jams and other channel obstructions can cause problems by deflecting storm flows into stream banks and trapping sediment, which initiates the development of gravel bars and reduces channel capacity. At the time of the Assessment Survey debris jams were not a significant problem along the reaches in this unit.

As part of the Assessment Survey *monumented cross-sections* were installed in a number of locations along Chestnut Creek to monitor stream bank erosion and streambed changes (e.g., aggradation) in specific reaches of concern. Due to the generally stable condition within the upstream section of this unit, no monitoring cross sections were installed. The downstream section was not assessed to the level of detail to determine site-specific erosion, and no monitoring will be done in this section.

Evaluating reaches along Chestnut Creek to determine whether they are contributing to sediment problems in the Chestnut Creek/Rondout Reservoir System was a component of the Assessment Survey. Preliminary results of the field work indicate that there are few actively eroding banks or mid-channel bars (as noted above) that could provide a source of sediment to downstream reaches. Where they accumulate, sediments can reduce channel capacity and contribute to localized channel stability problems, as may be the case in the vicinity of the Myers Road culvert.

Sediment eroded from the reaches along Chestnut Creek is generally coarse (i.e., sand, gravel and cobble). Unlike other watersheds where exposed *silt* or clay deposits are a water quality concern because they contribute very fine material to the suspended load, these coarser sediments tend to move as bed load and settle out quickly after storms. As a consequence, sediment eroded from the streambed and stream banks along this management unit does not appear to directly affect water quality within the Chestnut Creek/Rondout Reservoir System.

5. Riparian Vegetation

The riparian area along Management Unit 1 can be characterized as: reaches adjacent to developments or cleared areas with scattered trees and shrubs; reaches with small wooded buffers of mature trees, shrubs, and herbaceous plants; and reaches along steep hillslopes and/or terraces with mature forest. In riparian areas where small wooded buffers are present, their width varies from 75 feet to 2000 feet. Along developed properties, the riparian vegetation has been affected by clearing, routine maintenance, or other land use activities. Properties along the stream corridor with the lowest percent of riparian vegetation and buffer include primarily the left bank along most of the downstream section of the unit, though the right bank typically contains large expanses of wooded area. The notable exception to this is the section of stream downstream from the culvert at Myers Road where the aerial photographs indicate very little riparian vegetation, and no woody vegetation, along both sides of the stream. The upstream section contains well-wooded, though somewhat narrow, riparian areas along both banks.

The presence of two problem *invasive* exotic species, *multi-flora rose* and *Japanese Knotweed*, was not found in this management unit. These species have caused problems elsewhere in the Chestnut Creek, primarily leading to bank instability and crowding out native vegetation that has ecological as well as stability benefits.

Of perhaps future ecological significance is the presence of Hemlock Wooly Adelgid. This insect pest was noted on the underside of Hemlock needles in this headwaters section of the Chestnut Creek. Hemlock Wooly Adelgid causes approximately a 90% mortality rate within 5 years of infection. See the Riparian Vegetation Issues in Stream Management section for more information on sighting and dealing with Wooly Adelgids (Also see Riparian Vegetation Management Recommendations, Volume II, Section II. A.1).

6. Restoration and Management Recommendations

As presented previously, the Chestnut Creek Management Plan will be utilized to guide and facilitate stakeholders in their efforts to correct stream channel instability problems, restore and maintain natural floodplain functions, control runoff from developed areas to reduce pollutant loadings from channel and upland sources, restore and protect in-stream habitat, and reduce the need for future channel maintenance.

This section includes specific restoration and management recommendations for Management Unit 1 for the Chestnut Creek Watershed. The SCSWCD, NYCDEP, and other agencies and organizations will be working with the community to implement restoration and management strategies outlined in this Management Plan. Stream and upland area projects must be integrated to avoid potential conflicts in their respective objectives. Therefore, this section also includes comments and recommendations regarding integration of proposed strategies in upland areas, in particular floodplain management and storm water management practices.

Restoration and Management Recommendations Management Unit 1

1. Implement storm water management for properties with the highest percent impervious surface along the corridor including the quarry and any other significant impervious areas identified during the field reconnaissance recommended below. Storm water management facilities should be designed to provide water quality management for the first half-inch of runoff and quantity management that reduces the peak discharge runoff rate for the 1 – 3-year storm flows.

2. Evaluate the potential for reconstructing the channel and/or augmenting riparian vegetation along the historically active reach below the culvert at Myers Road. Evaluate the culvert at road crossing to determine the best method for reducing scour and improving sediment transport and conveyance of bankfull and flood flows, if this is determined to add to channel instability in this area. Install flow diverting structures (e.g., rock vanes, J-Hook vanes, etc.) at key points along the channel to reduce stress in the near bank region.

3. Stabilize banks and provide long-term lateral control by reestablishing bank vegetation composed of native trees, shrubs and grasses along the left bank in the downstream section.

4. Research the extent of Wooly Adelgid infestation, develop and implement a strategy for control.

5. Maintain or increase vegetative buffer in area of the quarry to control sediment runoff contribution to the stream.

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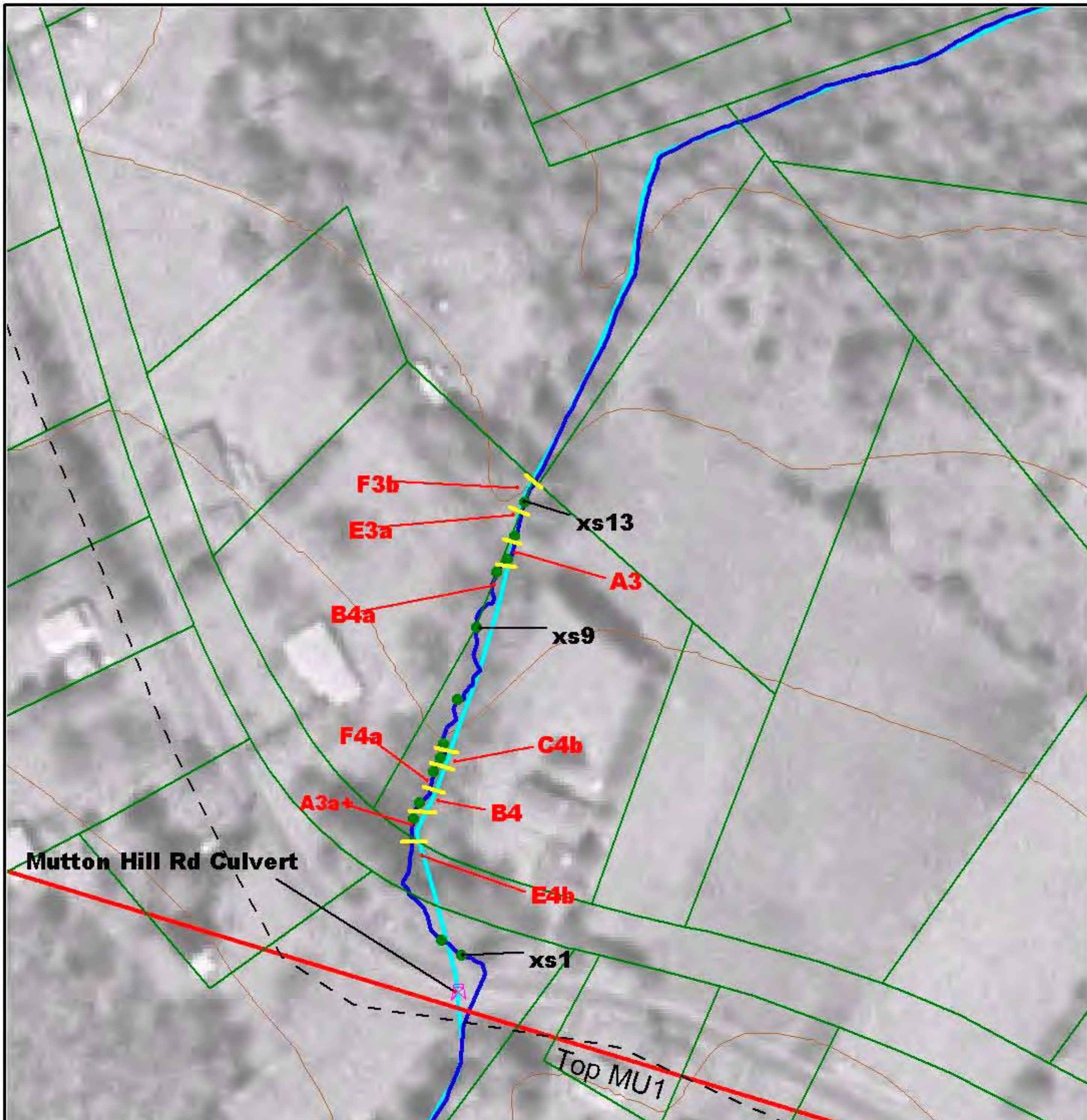
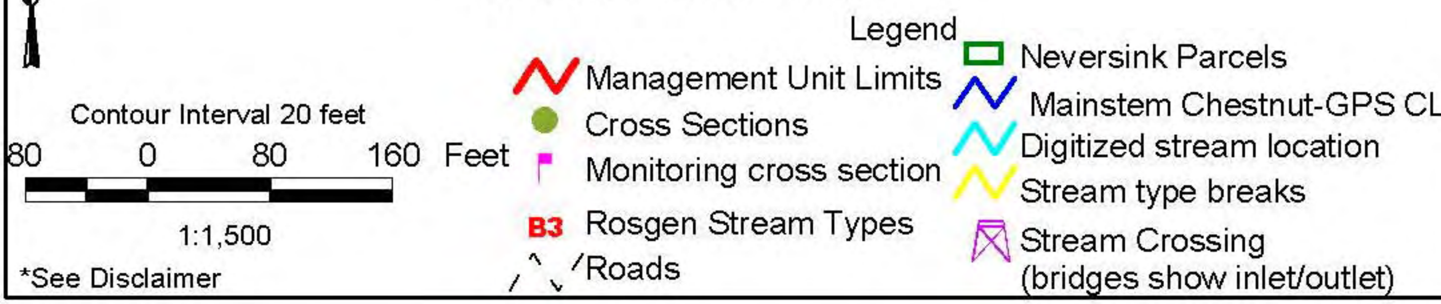


Figure 2. Chestnut Creek MU1 (upstream portion)
Stream Types & Cross Sections
Stream Assessment Survey 2001



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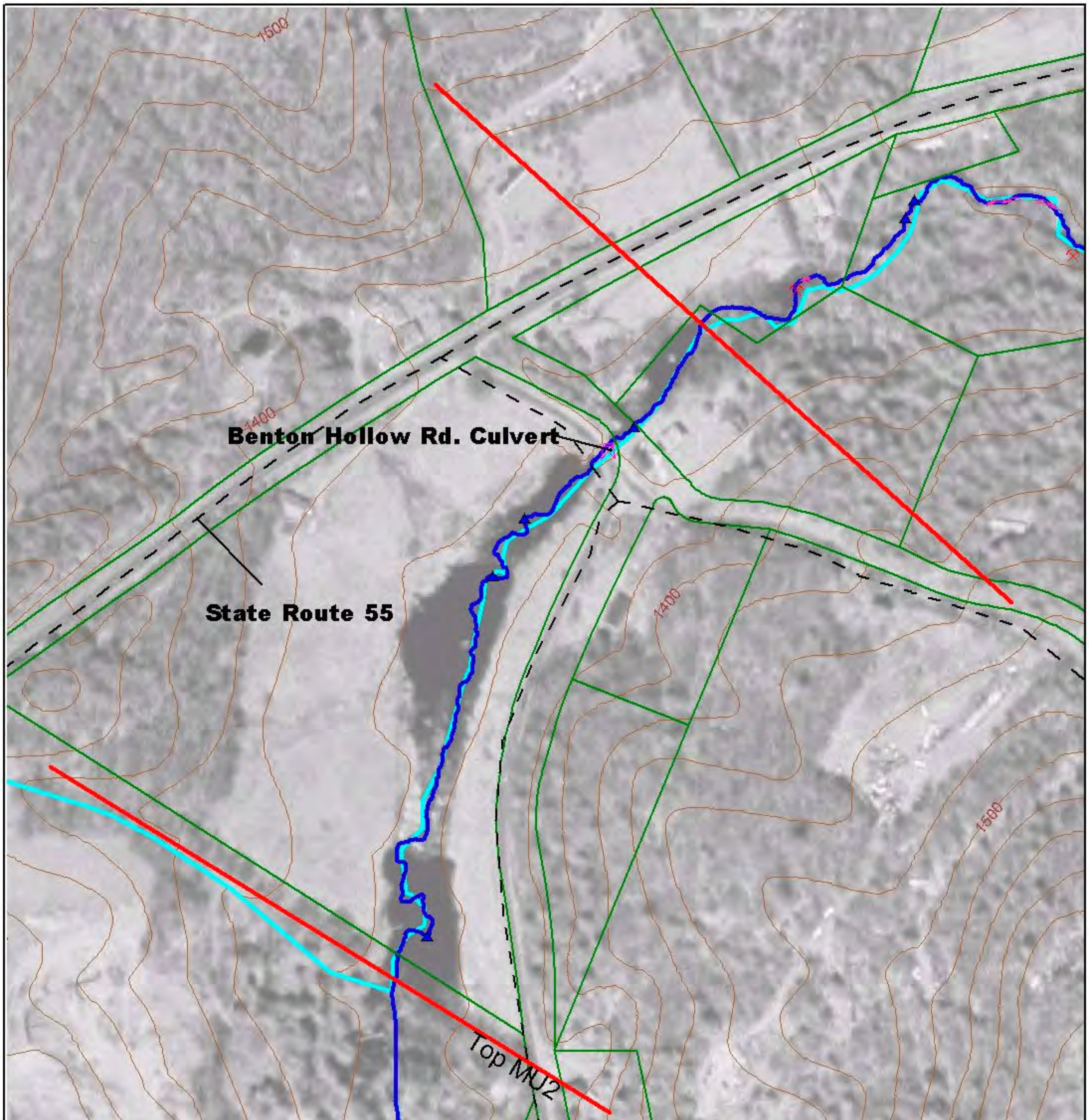

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Figure 1. Chestnut Creek Management Unit 2

Stream Assessment Survey 2001

Contour Interval 20 feet

100 0 100 200 300 400 Feet

Scale 1:3,000

*See Disclaimer

Legend

- Neversink Parcels
- Management Unit Limits
- Revetment
- Road
- Stream Crossing (bridges show inlet/outlet)
- Drainage culvert
- Digitized stream location
- Mainstem Chestnut-GPS CL
- Landfills
- Tributary confluence
- Bedrock
- Erosion
- Debris Jams or Dams
- Knotweed