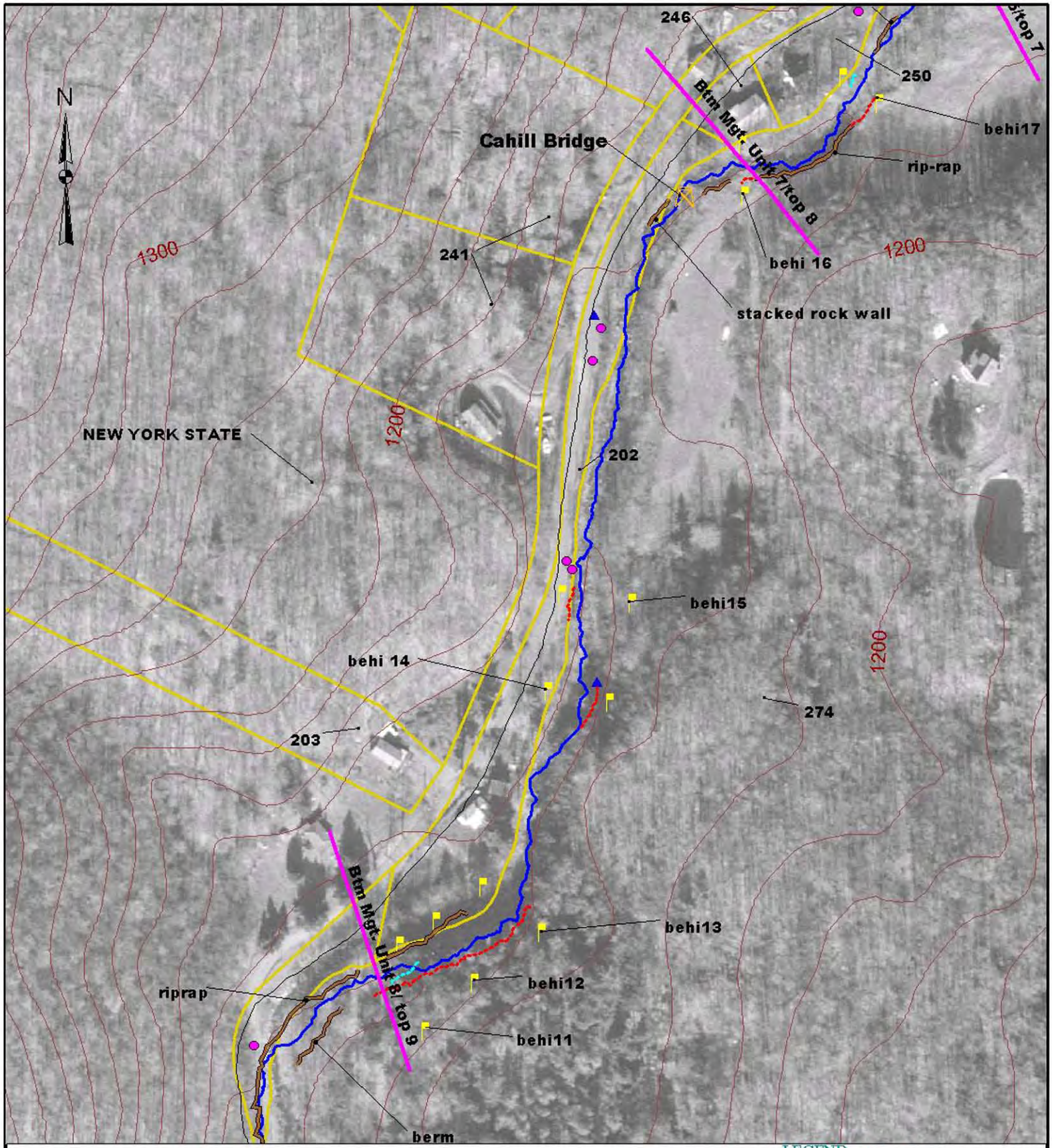

GIS Parcel, Contour and Wetland coverages are edited and provided by NYC DEP, 2000, UTM NAD 27, Zone 18 North, meters. Aerial Photography provided by UCSWCD & NYC DEP November 2001. All other coverages were developed using GPS in the UTM, Zone 18 North projection, NAD CON (Conus), datum. GPS data collected 2001, by UCSWCD & NYC DEP SMP.

Note: G.I.S. data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey. Parcel coverages are based on Ulster County Real Property tax maps 2000 and may not reflect actual surveyed property boundaries.

Broadstreet Hollow Management Unit 8

Contour Interval 20 feet

50 0 50 100 150 200 Feet

Scale 1:2,400

LEGEND

- 247 Street Address/911 code
- Greene parcels
- Ulster parcels
- Land fills
- Managment units
- Stream Center (Thalweg)
- Culvert
- Wetland
- Clay exposure
- Revetment
- Eroding bank
- Tributary
- Behi pin
- Bridge
- Broadstreet Hollow Road
- Knotweed

Broadstreet Hollow Management Unit 8

General Description:
This Management Unit (MU) is 1,630 feet long, entirely to the east of Broadstreet Hollow Road[1]. MU8 is divided into two sections; the upstream section (Photo 1) and the downstream section (Photo 2).

Photo 1. Looking upstream, road at left, in the upstream section of MU8.

Upstream Section Description:
The upstream section of MU8 (approximately 838 feet long) is in relatively good condition (*stable*), even though it runs less than 50 feet from the road and contains two short eroding banks.

The structural shape, or *morphology*, of the stream (i.e., slope, width and depth) changes frequently in this section, creating even smaller sections, or *reaches*, that have a discrete character, or *stream type*[5]. The valley in MU8 is particularly narrow in the upstream section. Stable stream types typically associated with this type of valley are relatively narrow and steep, with small waterfalls ("steps"), and stream banks formed into low benches, or *discontinuous floodplains*, that help slow and absorb floodwaters. MU8 seems to retain some of these discontinuous floodplains on the banks near the road, increasing the stability of this section. The fact that the stream shifts rapidly between types over such a short distance, however, and contains artificially narrow valley sections without functioning floodplain benches, suggests potential impact from *road fill*, which further constricts the narrow valley and causes the stream to become *entrenched*.

Photo 2. Looking upstream toward the largest eroding bank on Broadstreet Hollow, in the downstream section of MU8.

Downstream Section Description:

Two large eroding banks, both on the *left bank* (looking downstream) and away from the road, dominate the 790-foot downstream section of MU8. There is one structure at 202 Broadstreet Hollow Road which is between the road and the stream, on the right bank overlooking the stream. The structure is on a terrace, well above the active floodplain, so is at lower risk of flood damage in all but the most extreme flood events.

The valley in the downstream section of MU8 is somewhat wider compared to the upper section, with the road well away from the stream. The one reach of unstable stream type in this section is associated with the largest eroding stream bank documented in the entire Broadstreet Hollow, on the left bank (looking downstream) near the bottom of MU8, just upstream from where the road and the stream come back together. A long *berm* (a narrow mound of earth along the stream) along the right bank has caused the stream to become entrenched, and may increase flood stage (height) impinging on the opposite bank, increasing bank erosion and instability and perhaps exacerbating flooding damages in downstream areas.

I. Flooding and Erosion Threats

A. Roads, Infrastructure and Private Property

There are seven properties (land parcels) associated with MU8. Two of these parcels contain or are bounded by the stream; the other five have property within approximately 150 feet of the stream[1&2].

Stream assessment survey data for 2001 show the centerline of Broadstreet Hollow Road ranges from 25 to 95 feet from the stream (measured from the *thalweg*, or the deepest part of the stream). Broadstreet Hollow Road itself does not cross the stream in this unit, hence there are no county or town bridges in MU8. There is one private bridge off the main road, at the upstream end of the upstream section. (Photo 3).

Photo 3. Private bridge near the top of the upstream section of MU8, looking downstream.

MU8 Culverts

All three culverts found in MU8 during the 2001 stream assessment survey 2001 are in the upstream section, where the road is close to the stream (Photos 4, 5 and 6).

Two had flowing water in them at the time of the survey, during the lowest yearly flow, or *summer base-flow*, condition. This indicates some groundwater supply and shows the stream is spring fed year round, despite drought conditions during 2001.

Photo 4. Upstream-most (top) culvert on the right bank, MU8.

Photo 5. Middle culvert, right bank, MU8.

Photo 6. Bottom culvert, right bank, MU8.

The top culvert provides a road crossing for a small tributary.

Middle and bottom culverts in MU8 provide a road crossing for roadside ditch drainage.

Culvert inlets were not surveyed as part of the stream assessment, so culvert inlet condition is unknown. Culvert outlets are generally in good condition; with no apparent immediate threat to stream bank or road fill stability. Culverts in this section currently enter the stream at a low angle, with ample vegetation, reducing negative impacts to stream stability in this reach.

Culvert function under flooding conditions was not documented, but no problems on the stream outlet side were observed (i.e., there appears to be no active erosion from heavy flow, or excessive debris blocking the culverts).

B. History of Stream Work

Approximately 250 feet, or 8%, of the stream bank in MU8 has been altered by human intervention, in three individual sections[2]. All three sections are in the upper reach of MU8.

The upper reach of MU8 includes approximately 50 feet of rip-rap upstream of the private bridge on the left bank (Photo 7). This rip-rap is located on the inside of a stream bend.

Photo 7. Boulder rip-rap, left bank, above private bridge at the top of MU8.

Photo 8. Stacked rock wall, right bank below bridge, MU8.

Approximately 50 feet of stacked rock wall stabilize the stream bank and road fill on the downstream side of the private bridge, on the right bank (Photo 8). Narrow bridges often require bank stabilization, or *revetment*, on the banks both up- and downstream from the bridge, due to increased erosion potential caused by stream constriction at high flow. These areas often require repeated maintenance and repair, which could be reduced by increasing bridge span, improving flood conveyance through the bridge opening, and extending the useful life of the bridge.

There is a new length of stacked rock wall stabilizing the right bank at *monitoring cross section* 15 (Photos 9 and 10) installed by the Town of Shandaken Highway Department in 2002. By using a stacked rock wall, they were able to preserve existing riparian vegetation (note small trees at left, with stones behind them), and as a result, only a minimum of disturbance was made to the stream bed in this area (note boulders and cobbles in the same configuration before and after the work). Augmenting stacked rock walls with *bioengineering*, or re-vegetation, would improve stability and enhance riparian functions in these areas.

Photo 9. Eroding bank at monitoring cross-section 15, MU8, summer, 2001.

Photo 10. Stacked rock wall at monitoring cross section 15, MU8, 2002.

Photo 11. Earthen berm viewed from floodplain (at left), stream is on the other side, at right.

The downstream half of MU8 contains approximately 150 feet of low earthen berm of unknown age (primarily cobble material), along the right bank (looking downstream, see photos 11 & 12). The berm appears to have been constructed to prevent inundation of the floodplain lawn area behind it. This berm is fully vegetated, with some large trees.

Photo 12. Earthen berm viewed from stream (at right), floodplain is on the other side, at left.

Unfortunately, berms like these prevent floodwaters from flowing over the stream's floodplain, cutting off an important function of these flat areas. Floodplains function to reduce flood velocity, increase absorption of floodwaters, encourage deposition of silts and clay sediments (keeping them from being washed further downstream) and decrease flood stage, or height, in downstream areas. Because the majority of Broadstreet Hollow stream floodplains consist of small, low, discontinuous floodplain benches, larger areas such as this floodplain are influential to the overall flooding capacity of the stream. This berm should be removed or restructured to allow greater access of the stream to the floodplain[3].

C. Exposed banks

Stream assessment conducted in 2001 revealed approximately 440 feet (13%) of eroding stream bank in MU8, in four sections (Photos 13-18, and Photo 9). All four sections have been monumented for future monitoring (locations designated as "monitoring cross-sections") to determine erosion rates and priority for potential restoration [3].

Photo 13. Eroding left bank at high terrace, monitoring cross-section 11, MU8.

Monitoring cross sections 11-13 have been set up to monitor a single 200+ foot-long bank, in the lower half of the downstream section, approximately. This bank contains a substantial exposure of a glacial *ice contact deposit* characterized by a poorly consolidated matrix of silty sand supporting *gravel* to *boulder*-sized rocks.

Photo 14. Eroding left bank at high terrace, monitoring cross-section 12, MU8.

On the older, downstream portion of the bank *glacial lake clay* is exposed as slumped material as well as *in-situ* (in place) layered clay in the stream bed. The presence of the clay is likely the primary factor contributing to the destabilized bank. The bank is largely un-vegetated on its face, though supports a forested *wetland* on the terrace above. The base of the bank has been partially protected by downed trees, placed there by volunteers from Trout Unlimited in 1999.

Photo 15. Eroding left bank at high terrace, monitoring cross-section 13, MU8.

This eroding bank represents the greatest potential for ongoing stream instability in MU8. This bank received the highest bank erodibility hazard index (BEHI) ranking out of the 28 BEHI sites monitored as part of stream assessments conducted in 2001[3&4]. The stream bank is very high (approximately 25 feet), the angle of the bank is steep, the material is poorly consolidated, there is very little vegetation to hold bank materials in place. The stream is entrenched in this area, partially due to the presence of the low flood-control berm on the opposite bank (Photos 11 and 12). Additionally, the berm may be increasing flood risk by raising flood stage and increasing stream velocity and erosion at the toe of the opposite bank. This situation could also increase erosion downstream as flood waters are concentrated and accelerated through this reach.

The eroding bank represented by BEHI monitoring cross sections 11, 12 and 13 would benefit from a full-scale stream stability restoration project (one that uses natural stability restoration principles and design) to prevent further erosion of unstable bank materials, and reduce the potential hazard from increased velocity and excessive amounts of *large organic debris*[8] (i.e., tree trunks and branches). Restoration of this bank should include removal or reconfiguration of the berm on the opposite bank.

BEHI monitoring cross sections 14, 15 and 16 correspond to small eroding banks in the upstream half of MU8, none of which are associated with glacial lake clay exposures. As previously noted, the Town of Shandaken Highway Department has stabilized the eroding bank at BEHI 15 with a stacked rock wall (see Photos 9 & 10).

Photo 16. Eroding left bank at wooded area, at monitoring cross-section 14, MU 8.

Photo 17. Eroding left bank at mowed field, monitoring cross-section 16, MU8.

II. Water Quality

A. Sediment

Multiple eroding banks in MU8, especially in the downstream section (monitoring cross-sections 11-13, Photos 13-18), may cause increased turbidity in this reach from fine sediment (silt and clay) coming from stream bank and bed material. In particular, the glacial lake clay exposure at the base of the largest eroding bank at the downstream end of MU8 presents the greatest potential impact to water quality, especially during high stream flow events (Photo 18).

Photo 18. Close-up view of clay exposure at base of eroding high terrace, monitoring cross-section 11, MU8.

This area is at greater risk due to the lack of riparian vegetation, and increased flood stage due to stream entrenchment caused by the berm on the right bank. Vegetation would help reduce bank erosion at the toe and intercept runoff, although vegetation alone will not be adequate to stabilize this bank.

An additional source of suspended sediment to the Broadstreet Hollow in MU8 is road and road ditch runoff. These sources may be reduced through seeding of road ditches with native grasses and forbes, and may be addressed along the stream and road together as part of an integrated stormwater management effort.

B. Landfills/Dumping Sites

Stream assessment conducted in 2001 did not reveal any current *dumping sites* in or near the stream in MU8 that could contribute to water quality impairment.

C. Other Water Quality Issues

Investigation of other possible sources of contamination was not part of the stream assessment conducted in 2001. However, no evidence was found for *nutrient* or *pathogen* contamination in the stream (i.e., odors or discolored water).

The length of the Broadstreet Hollow Road along MU8 is surfaced with oil and crushed stone. Any runoff of water from the road and culverts that may contain salts or other pollutants was not specifically investigated, but lack of riparian vegetation in the two stacked rock wall areas and along the road in some locations (Photo 19) could reduce the capacity of stream banks to intercept or slow the input of contaminants to the stream in runoff, especially in the upstream section of MU8 where the road is in close proximity to the stream[5]. Potential impacts from water heating due to stream flow or runoff in contact

with non- or under-vegetated rip-rap and stacked rock walls could be mitigated by re-vegetating or "inter-planting" bare rock areas[3].

Photo 19. Right bank, under-vegetated riparian area near road, just upstream of the top culvert, MU8.

III. Stream Ecology

A. Aquatic habitat and populations

No specific aquatic habitat or population monitoring was conducted in MU8 as part of the ream assessment conducted in 2001. However, data collected since 1998 in the Management Units both upstream and downstream of MU8 show that the Broadstreet Hollow stream supports self-sustaining populations of all three common trout species (rainbow, brook and brown), as well as a healthy and diverse community of aquatic insects[6]. The impact that stream bed and bank instability in MU8 has on these aquatic organisms or their communities is unknown.

B. Riparian vegetation

Stream assessment conducted in 2001 did not investigate specific streamside (riparian) plant species or density, other than to note areas of insufficient or stressed vegetation that could affect stream stability, flooding or erosion threats, water quality or aquatic habitat for trout species. Based on these general, qualitative observations, riparian vegetation in MU8 appears fairly healthy, excepting in the sections containing rip-rap or stacked rock walls, and most notably excepting in the actively eroding areas described above[3]. Eroding and hardened sections of MU8 have insufficient riparian vegetation to either protect banks from further erosion or improve stream habitat[7]. Under-vegetated areas in the vicinity of stacked rock walls, rip-rap and road fill sections in this reach should be vegetated with a mixture of native riparian species to improve shade, cover and water temperature conditions for aquatic habitat[9], as well as to improve bank stability and reduce the need for bank stabilization work that could cause stream ecosystem disturbances[3].

No *Japanese Knotweed* [7], a non-native, *invasive* plant was noted in this reach at the time of the assessment survey.

[1] Broadstreet Hollow Management Unit 8 Map
[2] Volume II Appendix 3.1.5 Management Unit 8 Workbook.
[3] Volume II Section 2.2 Watershed Management Recommendations
[4] Volume II Section 2.2.1-Monitoring Cross Section and Summary Tables
[5] Volume I Sections 3.2.1&2 Stream Processes, Morphology and Classification
[6] Volume I Section 3.5 Fisheries and Wildlife
[7] Volume I Sections 3.4 & Volume II 2.2.2 Riparian Vegetation Issues and Recommendations
[8] Volume II 2.0 Stream Stability Restoration Projects, Techniques and Contact Information & Appendices
[9] Volume I Sections 3.4 & Volume II 2.2.2 Riparian Vegetation Issues and Recommendations
[10] Section 3.2.4.2 Broadstreet Hollow Geology