Appendix A Native Vegetation

Appendix A: Native Vegetation

Several sources were used to determine vegetation species native to the Catskill Mountain region. The first list of species that is provided here, includes species recommendations for planting in different locations within the riparian buffer including, upland, bench and streamside plantings (Table A.1). This list provides information regarding the characteristics of each plant, these characteristics are described below. The second list of species is a more comprehensive list of species that are native to the Catskill Mountain region and the habitat types that species are commonly found in (Table A.2). The information on plant characteristics and wetland indicator status was obtained from the USDA plants database. Wetland indicator status was also determined using *the National List of Plant Species That Occur in Wetlands: 1988 New York.*

Northeast Indicator Category (NEWIS): The estimated probability of a species occurring in wetlands versus nonwetlands in the region. OBL, FACW, FAC, FACU, UPL.

Indicator Category Definitions

OBL: Obligate Wetland. Occur almost always (estimated probability >99% under natural conditions in wetlands.

FACW: Facultative Wetland. Usually occur in wetlands (estimated probability 67%-99%), but occasionally found in nonwetlands.

FAC: Facultative. Equally likely to occur in wetlands or nonwetlands (estimated probability 34%-66%).

FACU: Facultative Upland. Usually occur in nonwetlands (estimated probability 67%-99%), but occasionally found in wetlands (estimated probability 1%-33%).

UPL: Obligate Upland. Occur in wetlands in another region, but occur almost always (estimated probability >99%) under natural conditions in nonwetlands in the region specified. If a species does not occur in wetlands in any region, it is not on the National List.

A positive (+) or negative (-) sign was used with the Facultative Inidcator categories to more specifically define regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).

Habit: Habit symbols are combined to describe the life form of the species.

Symbol	Characteristic or Life Form
A	Annual
B	Biennial
C	Clubmoss

E	Emergent
@	Epiphytic
F	Forb
/	Floating
F3	Fern
G	Grass
GL	Grasslike
H	Partly woody
HS	Half shrub
H2	Horsetail
I	Introduced
N	Native
P	Perennial
+	Parasitic
P3	Pepperwort
Q	Quillwort
S	Shrub
-	Saprophytic
Z	Submerged
$	Succulent
T	Tree
V	Herbaceous vine
W	Waterfern
WV	Woody vine

Species Characteristics

Growth Rate: The growth rate relative to other plant species. Slow, Moderate, Rapid, Unknown

Coarse Textured Soils: Can this plant establish and grow in coarse textured soils?

Coarse Textured Soils: Can this plant establish and grow in fine textured soils?

Moisture Use: What are this plant's relative moisture requirements for growth?

Planting Density per Acre: The recommended minimum and maximum number of individuals to plant per acre.

Cuttings: Can the plant be propagated as cuttings?

Seedling Vigor: What is the relative vigor of the plant in seedling stage? Low, Medium, High, Unknown

Table A.1 Recommended species for planting in upland, bench and streamside locations within the riparian buffers of Catskill streams.

Species recommended for upland plantings

Scientific Name	Common Name	NEWIS	Growth Rate	Coarse Soils	Fine Soils	Moisture Use	Seedling Vigor	Cuttings
Trees								
Acer rubrum	Red maple	FAC	Rapid	Yes	Yes	High	Medium	No
Betula alleghaniensis	Yellow birch	FAC	Rapid	Yes	Yes	Medium	Medium	No
Betula papyrifera	Paper birch	FACU	Rapid	Yes	Yes	High	Medium	Yes
Betula populifolia	Gray birch	FAC	Rapid	Yes	Yes	Low	Medium	No
Carya ovata	Shagbark hickory	FACU	Rapid	Yes	No	Medium	High	No
Pinus resinosa	Red pine	FACU	Rapid	Yes	No	Low	High	No
Pinus rigida	Pitch pine	FACU	Rapid	Yes	No	Low	High	No
Populus grandidentata	Bigtooth aspen	FACU-	Rapid	Yes	No	High	Medium	No
Prunus pensylvanica	Pin cherry	FACU	Rapid	Yes	Yes	Medium	Low	Yes
Prunus serotina	Black cherry	FACU	Rapid	Yes	No	Medium	High	No
Ulmus rubra	Slippery or red elm	FAC	Rapid	Yes	Yes	High	High	No
Shrubs								
Cornus florida	Flowering Dogwood	FACU	Moderate	No	No	Low	Medium	No
Kalmia latifolia	Mountain laurel	FACU	Slow	Yes	No	Low	Low	Yes
Prunus virginiana	Choke cherry	FACU	Rapid	Yes	Yes	Medium	Medium	No
Vaccinium angustifolium	Lowbush blueberry	FACU	Moderate	Yes	Yes	Medium	Low	Yes

Species recommended for bench plantings.								
Scientific Name	**Common Name**	**NEWIS**	**Growth Rate**	**Coarse Soils**	**Fine Soils**	**Moisture Use**	**Seedling Vigor**	**Cuttings**
Trees								
Acer rubrum	Red maple	FAC	Rapid	Yes	Yes	High	Medium	No
Betula alleghaniensis	Yellow birch	FAC	Rapid	Yes	Yes	Medium	Medium	No
Betula populifolia	Gray birch	FAC	Rapid	Yes	Yes	Low	Medium	No
Fraxinus pennsylvanica	Green ash	FACW	Rapid	Yes	Yes	Medium	Medium	No
Populus balsamifera	Balsam Poplar	FACW	Rapid	Yes	Yes	High	Medium	Yes
Quercus bicolor	Swamp white oak	FACW+	Rapid	Yes	Yes	High	High	No
Ulmus americana	American elm	FACW-	Rapid	Yes	Yes	High	Medium	Yes
Ulmus rubra	Slippery or red elm	FAC	Rapid	Yes	Yes	High	High	No
Shrubs								
Alnus serrulata	Hazel alder	OBL	Rapid	Yes	Yes	High	Low	No
Alnus viridis ssp. *crispa*	Mountain alder	FAC	Moderate	No	No	High	Medium	No
Amelanchier arborea	Downy Service Berry	FAC-	Moderate	Yes		Medium	Low	Yes
Cornus amomum	Silky dogwood	FACW	Moderate	Yes	Yes	High	Medium	Yes
Rhododendron maximum	Great or white laurel rhododendron	FAC	Slow	Yes	No	Medium	Low	Yes
Vaccinium corymbosum	Highbush blueberry	FACW-	Moderate	Yes	Yes	Medium	Low	Yes
Sambuscus nigra canadensis	Common Edlerberry	FACW-	Rapid	No	No	Medium	High	No
Herbaceous								
Adiantum pedatum	Northern maidenhair	FAC-	Moderate	Yes	No	Medium	Low	No
Andropogon gerardii	Big Bluestem	FAC	Moderate	Yes	Yes	High	Low	No
Arisaema triphyllum	Jack-in-the-Pulpit	FACW-	Moderate	Yes	No	High	Low	No
Athyrium filix-femina	Common ladyfern	FAC	Moderate	No	No	Medium	Unknown	No
Helenium autumnale	common sneezeweed or Helen's Flower	FACW+	Rapid	Yes	Yes	Medium	High	No
Helianthus tuberosus	Jerusalem Artichoke	FAC	Rapid	Yes	No	Low	Medium	No
Osmunda cinnamomea	Cinnamon fern	FACW	Moderate	No	Yes	Medium	Medium	No

Species recommended for streamside plantings								
Scientific Name	**Common Name**	**NEWIS**	**Growth Rate**	**Coarse Soils**	**Fine Soils**	**Moisture Use**	**Seedling Vigor**	**Cuttings**
Willows								
Salix amygdaloides	Peach-leaved willow	FACW	Rapid	Yes	No	High	Low	Yes
Salix bebbiana	Beaked willow	FACW	Moderate	Yes	Yes	High	Unknown	Yes
Salix discolor	Pussy willow	FACW	Rapid	Yes	Yes	High	High	Yes
Salix eriocephala	Gall willow	FACW	Rapid	No	Yes	High	High	Yes
Salix nigra	Black willow	FACW+	Rapid	Yes	Yes	High	Low	Yes
Salix sericea	Silky willow	OBL	Rapid	Yes	Yes	High	Medium	Yes
Shrubs								
Alnus serrulata	Hazel alder	OBL	Rapid	Yes	Yes	High	Low	No
Cornus amomum	Silky dogwood	FACW	Moderate	Yes	Yes	High	Medium	Yes
Herbaceous								
Carex flaccosperma	Blue Wood Sedge	FAC	Slow	No	Yes	High	Low	No
Carex grayi	Gray's Sedge	FACW+	Slow	No	Yes	High	Low	No
Carex intumescens	Greater bladder sedge	FACW+	Moderate	No	Yes	High	Low	No
Carex lacustris	Hairy sedge	OBL	Rapid	No	Yes	High	Low	No
Carex stricta	Upright sedge	OBL	Moderate	Yes	Yes	Medium	Medium	No
Carex vulpinoidea	Fox Sedge	OBL	Moderate	No	Yes	Medium	Medium	No
Cinna arundinacea	Sweet Woodreed	FACW+	Moderate	Yes	Yes	Low	Medium	No
Elymus riparius	Riverbank wildrye	FACW	Moderate	Yes	Yes	High	High	No
Osmunda regalis	Royal fern	OBL	Moderate	Yes	Yes	High	Unknown	Yes
Peltandra virginica	Arrow arum	OBL	Slow	Yes	Yes	High	Medium	No
Symplocarpus foetidus	Skunk cabbage	OBL	Moderate	Yes	Yes	High	Medium	No

Table A.2 Tree, shrub and herbaceous species native to the Catskill Mountain region.

Common Name	**Scientific Name**	**Habitat Types**
Trees		
American beech FACU	*Fagus grandifolia*	Northern hardwoods forest; moist, well-drained, acidic soils, dominant; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; codominant; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; common associate; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; codominant tree
American elm FAC, FACW; NT	*Ulmus americana*	Successional northern hardwoods; AND Red maple-hardwood swamp; found throughout New York; codominant
Balsam fir FAC, FACW; NT	*Abies balsamea*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); dominant; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; almost entirely balsam fir; AND Spruce-fir rocky summit; exposed ledges and ridgetops; sparse woods; dominant; AND Pitch pine-oak-heath rocky summit; on warmer ridgetops; stunted oak and pine forest with dwarf shrub openings; dominant; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; AND Boreal coniferous forest; southern most portion
Balsam poplar FACU, FACW; NT	*Populus balsamifera*	Successional northern hardwoods; characteristic tree
Basswood FACU	*Tilia americana*	Northern hardwoods forest; moist, well-drained, acidic soils, not dominant; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; codominant
Bigtooth aspen FACU	*Populus grandidentata*	Successional northern hardwoods; characteristic tree
Bitternut hickory FACU, FAC	*Carya cordiformis*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; not dominant; AND Red maple-hardwood swamp; found throughout New York; low percent cover
Black ash FACW NT	*Fraxinus nigra*	Red maple-hardwood swamp; found throughout New York; codominant
Black birch FACU	*Betula lenta*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; codominant
Black cherry FACU	*Prunus serotina*	Northern hardwoods forest; moist, well-drained, acidic soils, not dominant; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; codominant; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; common associate; AND Successional northern hardwoods; characteristic tree
Black gum FAC	*Nyssa sylvatica*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; AND Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring tree; AND Red maple-hardwood swamp; found throughout New York; low percent cover
Black oak	*Quercus velutina*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; dominant; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; dominant
Butternut FACU	*Juglans cinerea*	Red maple-hardwood swamp; found throughout New York; low percent cover
Chestnut oak UPL, FACU	*Quercus prinus*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; dominant; AND Pitch pine-oak-heath rocky summit; on warmer ridgetops; stunted oak and pine forest with dwarf shrub openings; dominant; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; dominant
Choke cherry	*Prunus virginiana*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation

FACU, FAC		
Eastern hemlock FACU	*Tsuga canadensis*	Hemlock-hardwoods forest; 305-1006 meters; co-dominant with hardwood species; AND Spruce-fir rocky summit; exposed ledges and ridgetops; sparse woods; dominant; AND Pitch pine-oak-heath rocky summit; on warmer ridgetops; stunted oak and pine forest with dwarf shrub openings; dominant; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; common associate; AND Spruce-fir swamp; found in the Catskills ecozone; less frequently occurring tree; AND Hemlock-hardwood swamp; found throughout upstate New York; dominant
Eastern hop hornbeam FACU	*Ostrya virginiana*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; not dominant
Gray birch FAC NT	*Betula populifolia*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; AND Successional northern hardwoods; characteristic tree
Green ash FAC, FACW, NT	*Fraxinus pensylvanica*	Successional northern hardwoods; AND Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring tree; AND Red maple-hardwood swamp; found throughout New York; codominant
Ironwood	*Carpinus carolinianus*	Red maple-hardwood swamp; found throughout New York; low percent cover
Mountain ash FACU, FAC	*Sorbus americana*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); sub-canopy; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; almost entirely balsam fir; occassional individual; AND Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; characteristic tree; AND Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; less frequently occurring shrub
Mountain maple FACU	*Acer spicatum*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); sub-canopy; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; subcanopy tree
Mountain paper birch FACU	*Betula cordifolia*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); common associate; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; almost entirely balsam fir; small amounts of paper birch; AND Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; characteristic tree
Paper birch FACU	*Betula papyrifera*	Successional northern hardwoods; characteristic tree; AND Boreal coniferous forest; southern most portion
Pignut FACU	*Carya glabra*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; mixed in lower densities
Pin cherry FACU	*Prunus pensylvanica*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); sub-canopy; AND Successional northern hardwoods; characteristic tree
Pitch pine FACU	*Pinus rigida*	Pitch pine-oak-heath rocky summit; on warmer ridgetops; stunted oak and pine forest with dwarf shrub openings; dominant; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; dominant Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic species
Quaking aspen FACU, FAC, IT	*Populus tremuloides*	Successional northern hardwoods; characteristic tree
Red maple FAC, NT	*Acer rubrum*	Northern hardwoods forest; moist, well-drained, acidic soils, not dominant; AND Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; not dominant; AND Pitch pine-oak-heath rocky summit; on warmer ridgetops; stunted oak and pine forest with dwarf shrub openings; dominant; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; codominant; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; common associate; AND Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; codominant tree; AND

		Successional northern hardwoods; characteristic tree; AND Spruce-fir swamp; found in the Catskills ecozone; codominant tree; AND Hemlock-hardwood swamp; found throughout upstate New York; codominant; AND Red maple-hardwood swamp; found throughout New York; dominant
Red oak FACU	*Quercus rubra*	Northern hardwoods forest; moist, well-drained, acidic soils, not dominant; AND Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations (1); usually ridgetops, upper slopes (3)dominant; AND Pitch pine-oak-heath rocky summit; on warmer ridgetops; stunted oak and pine forest with dwarf shrub openings; dominant; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; codominant; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; dominant; AND Red pine rocky summit; cool, dry, rocky ridgetops and summits; POSSIBLY in the Catskills; codominant Spruce-fir rocky summit; exposed ledges and ridgetops; sparse woods with a shrub layer; dominant; AND Pitch pine-oak-heath rocky summit; on warmer ridgetops; stunted oak and pine forest with dwarf shrub openings; dominant; AND Red pine rocky summit; cool, dry, rocky ridgetops and summits; POSSIBLY in the Catskills; dominant
Red spruce FACU	*Picea rubens*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); dominant; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; almost entirely balsam fir; occassional individual; AND Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; characteristic tree Spruce-northern hardwood forest; occurs on lower mountain slopes; codominant tree; AND Spruce-fir swamp; found in the Catskills ecozone; dominant tree Boreal coniferous forest; southern most portion
Scarlet oak	*Quercus coccinea*	Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; dominant; AND Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic species
Scrub oak	*Quercus ilicifolia*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; dominant
Serviceberry FAC, FACU, NT	*Amelanchier arborea*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation
Shagbark hickory FACU	*Carya ovata*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; not dominant
Slippery or red elm FAC, NT	*Ulmus rubra*	Red maple-hardwood swamp; found throughout New York; codominant
Striped maple FACU	*Acer pensylvanicum*	Hemlock-hardwoods forest; 305-1006 meters; mid-story tree; AND Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); sub-canopy; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; subcanopy tree
Sugar maple UPL, FACU	*Acer saccharum*	Northern hardwoods forest; moist, well-drained, acidic soils, dominant; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; codominant; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; codominant tree
Swamp white oak FACW, OBL, NT	*Quercus bicolor*	Red maple-hardwood swamp; found throughout New York; codominant
Sweet pignut, Red hickory UPL, FACU	*Carya ovalis*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; mixed in lower densities
White ash FACU	*Fraxinus americana*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; not dominant; AND Successional northern hardwoods; AND Red maple-hardwood swamp; found throughout New York; codominant
White oak	*Quercus alba*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations (1); usually ridgetops, upper slopes (3)dominant; AND

FACU		Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; dominant
White pine FACU	*Pinus strobus*	Northern hardwoods forest; moist, well-drained, acidic soils, not dominant; AND Spruce-fir rocky summit; exposed ledges and ridgetops; sparse woods; dominant; AND Pitch pine-oak-heath rocky summit; on warmer ridgetops; stunted oak and pine forest with dwarf shrub openings; dominant; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; codominant; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; dominant; AND Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; AND Red pine rocky summit; cool, dry, rocky ridgetops and summits; POSSIBLY in the Catskills; codominant; AND Successional northern hardwoods; characteristic tree; AND Spruce-fir swamp; found in the Catskills ecozone; less frequently occurring tree; AND Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring tree; AND Red maple-hardwood swamp; found throughout New York; low percent cover
Yellow birch FACU, FAC, NT	*Betula alleghaniensis*	Northern hardwoods forest; moist, well-drained, acidic soils, dominant; AND Spruce-fir forest; higher elevation peaks (900-1200 meters); sub-canopy or (common associate Source 3); AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; codominant; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; codominant tree; AND Spruce-fir swamp; found in the Catskills ecozone; less frequently occurring tree; AND Hemlock-hardwood swamp; found throughout upstate New York; codominant; AND Red maple-hardwood swamp; found throughout New York; codominant

Shrubs

American fly honeysuckle FACU	*Lonicera canadensis*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); shrub layer; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic shrub
Beaked hazelnut UPL, FACU	*Corylus cornuta*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; subcanopy low shrub
Bearberry UPL, FACU	*Arctostaphylos uva-ursi*	Red pine rocky summit; cool, dry, rocky ridgetops and summits; POSSIBLY in the Catskills; characteristic shrub Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; less frequently occurring shrub
Canada yew FACU, FAC	*Taxus canadensis*	Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic shrub
Chokeberry Chokeberry, Black FAC, FACW, NS Chokeberry, Purple FACW, NS Chokeberry, Red FACW, NS	*Aronia* spp. ? Notes say dry *Aronia melanocarpa* *Aronia prunifolia* *Aronia arbutifolia*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation
Choke-cherry FACU, FAC	*Prunus virginiana*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; sub-canopy
Common elderberry FACW, UPL, NS	*Sambucus canadensis*	Red maple-hardwood swamp; found throughout New York; characteristic shrub
Common juniper	*Juniperus communis*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic shrub
Deerberry FACU	*Vaccinium stamineum*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation

Dwarf raspberry/blackberry FACW, FAC, NF	*Rubus pubescens*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); shrub layer
Flowering dogwood FACU	*Cornus florida*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; sub-canopy
Gray dogwood	*Cornus racemosa*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; subcanopy low shrub; AND Red maple-hardwood swamp; found throughout New York; characteristic shrub
Great rhododendron FAC, NT	*Rhododendron maximum*	Hemlock-hardwood swamp; found throughout upstate New York; characteristic shrub
Green alder	*Alnus viridis*	Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; almost entirely balsam fir; occassional individuals; AND Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; less frequently occurring shrub
Hazel/Brook alder OBL, FACW, NT	*Alnus serrulata*	Red maple-hardwood swamp; found throughout New York; characteristic shrub
Highbush blueberry FACW,NS	*Vaccinium corymbosum*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; AND Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; less frequently occurring shrub; AND Hemlock-hardwood swamp; found throughout upstate New York; characteristic shrub; AND Red maple-hardwood swamp; found throughout New York; characteristic shrub
Hobblebush FAC, NS	*Viburnum lantanoides*	Hemlock-hardwoods forest; 305-1006 meters; shrub layer; AND Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); shrub layer; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic shrub; AND Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring shrub
Huckleberry FACU	*Gaylussacia baccata*	Spruce-fir rocky summit; exposed ledges and ridgetops; sparse woods with a shrub layer; dominant; AND Pitch pine-oak-heath rocky summit; on warmer ridgetops; stunted oak and pine forest with dwarf shrub openings; dominant; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; shrub layer; AND Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic shrub
Labrador tea OBL, FACW, NS	*Ledum groenlandicum*	Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; almost entirely balsam fir; occassional individuals
Lowbush blueberry FACU	*Vaccinium angustifolium*	Spruce-fir rocky summit; exposed ledges and ridgetops; sparse woods with a shrub layer; dominant; AND Pitch pine-oak-heath rocky summit; on warmer ridgetops; stunted oak and pine forest with dwarf shrub openings; dominant; AND Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; subcanopy low shrub; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; shrub layer; AND Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic shrub; AND Red pine rocky summit; cool, dry, rocky ridgetops and summits; POSSIBLY in the Catskills; characteristic shrub
Maple-leaved viburnum UPL, FACU	*Viburnum acerifolium*	Hemlock-hardwoods forest; 305-1006 meters; shrub layer; AND Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; subcanopy low shrub
Mountain alder FAC, FACW, NS	*Alnus viridis* ssp. *crispa* *Alnus crispa*	Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring shrub
Mountain/Early azalea FAC, NS	*Rhododendron prinophyllum*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); shrub layer
Mountain holly, Catberry OBL, NS	*Nemopanthus mucronatus*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); shrub layer; AND Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; characteristic and dominant shrub; AND Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring shrub
Mountain laurel FACU	*Kalmia latifolia*	Spruce-fir rocky summit; exposed ledges and ridgetops; sparse woods with a shrub layer; dominant; AND Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation

Nannyberry FAC, FACU, NTS	*Viburnum lentago*	Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring shrub
Northern Arrowwood FACW, NS	*Viburnum recognitum*	Red maple-hardwood swamp; found throughout New York; characteristic shrub
Raspberries	*Rubus* spp.	Hemlock-hardwoods forest; 305-1006 meters; shrub layer
Red elderberry FACU	*Sambucus racemosa*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); shrub layer Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; subcanopy low shrub
Redosier dogwood	*Cornus sericea*	Red maple-hardwood swamp; found throughout New York; characteristic shrub
Scrub oak	*Quercus ilicifolia*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic shrub
Shadbush/ downy serviceberry FAC, FACU, NT	*Amelanchier arborea*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; sub-canopy
Sheep laurel FAC, NS	*Kalmia angustifolia*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation
Silky dogwood FACW, NS	*Cornus amomum*	Red maple-hardwood swamp; found throughout New York; characteristic shrub
Southern low blueberry	*Vaccinium pallidum*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; subcanopy low shrub; AND Appalachian oak-pine forest; mixed forest occurs on sandy soils, sandy ravines in pine barrens, or on slopes with well drained rocky soils; shrub layer; AND Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic shrub
Speckled alder FACW, FAC, OBL, NT	*Alnus incana* ssp. *rugosa*	Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring shrub Red maple-hardwood swamp; found throughout New York; characteristic shrub
Spicebush FACW	*Lindera benzoin*	Red maple-hardwood swamp; found throughout New York; characteristic shrub
Sweet fern	*Comptonia peregrina*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic shrub
Velvetleaf Blueberry FAC, FACU, FACW, NS	*Vaccinium myrtilloides*	Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; shrub layer; AND Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; less frequently occurring shrub
Wild raisin, Withe-rod FACW, NS	*Viburnum cassinoides*	Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; less frequently occurring shrub; AND Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring shrub; AND Red maple-hardwood swamp; found throughout New York; characteristic shrub
Winterberry FACW, OBL, NST	*Ilex verticillata*	Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; less frequently occurring shrub; AND Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring shrub Red maple-hardwood swamp; found throughout New York; characteristic shrub
Witch hazel FAC, FACU, NST	*Hamamelis virginiana*	Appalachian oak-hickory forest; dryer, warmer, south and west-facing slopes and lower elevations; sub-canopy

Herbaceous

Arrow arum OBL	*Peltandra virginica*	Red maple-hardwood swamp; found throughout New York; characteristic herb
Bellwort, Sessile-leaf FACU	*Uvularia sessilifolia*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant
Black cohosh	*Cimicifuga racemosa*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; groundlayer herb
Bluebeads FAC, FACU, PNF	*Clintonia borealis*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); characteristic herb; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; characteristic herb; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic groundlayer plant
Bracken fern	*Pteridium aquilinum*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation

FACU, FAC		
Bristly/Stiff clubmoss FAC, FACU PNC	*Lycopodium annotinum*	Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; characteristic herb
Bromelike sedge FACW, PNGL	*Carex bromoides*	Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring herb
Bunchberry FAC, FACU, NS	*Cornus canadensis*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); characteristic herb; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; characteristic herb; AND Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; characteristic herb; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic groundlayer plant; AND Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; characteristic herb
Canada mayflower (Wild Lily of the Valley) FAC, FACU, PNF	*Maianthemum canadense*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); characteristic herb; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; characteristic herb; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic groundlayer plant; AND Hemlock-hardwood swamp; found throughout upstate New York; characteristic herb
Christmas fern FACU, UPL, FAC	*Polystichum acrostichoides*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; characteristic herb; AND Hemlock-hardwood swamp; found throughout upstate New York; characteristic herb; AND Red maple-hardwood swamp; found throughout New York; dominant fern
Common (Tufted) hairgrass	*Deschampsia flexuosa*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic herb; AND Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; characteristic herb; AND Red pine rocky summit; cool, dry, rocky ridgetops and summits; POSSIBLY in the Catskills; characteristic herb
Common wood fern	*Dryopteris campyloptera*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic groundlayer plant
Common wood-sorrel	*Oxalis acetosella*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); characteristic herb; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; characteristic herb; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic groundlayer plant; AND Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; characteristic herb
Cow-wheat FACU	*Melampyrum lineare*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic herb
Creeping snowberry FACW, NS	*Gaultheria hispidula*	Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; characteristic herb
Crested wood fern FACW, OBL, PNEF3	*Dryopteris cristata*	Red maple-hardwood swamp; found throughout New York; herbaceous layer
Dewdrop, Robin-Run-Away Fac, FACU, FACW, PNF	*Dalibarda repens*	Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; characteristic herb
False nettle, Small spike FACW, OBL, PNF	*Boehmeria cylindrica*	Red maple-hardwood swamp; found throughout New York; characteristic herb
False Solomon's seal FACU	*Smilacina racemosa*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; groundlayer herb
Foamflower FAC, PNF	*Tiarella cordifolia*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant
Goldthread FACW, FAC, PNF	*Coptis trifolia*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); characteristic herb; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; characteristic herb; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic groundlayer plant; AND

		Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; characteristic herb; AND Hemlock-hardwood swamp; found throughout upstate New York; characteristic herb
Greater bladder sedge FACW, OBL, PNGL	*Carex intumescens*	Red maple-hardwood swamp; found throughout New York; characteristic herb
Hairy/Smooth Sheath sedge OBL, PNGL	*Carex lacustris*	Red maple-hardwood swamp; found throughout New York; characteristic herb
Harebell FACU, UPL, FAC	*Campanula rotundifolia*	Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; characteristic herb
Hepatica americana	*Hepatica americana*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; groundlayer herb
Indian cucumber-root	*Medeola virginiana*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic groundlayer plant
Jewelweed FACW, ANF	*Impatiens capensis*	Red maple-hardwood swamp; found throughout New York; characteristic herb
Large-leaf goldenrod	*Solidago macrophylla*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); characteristic herb; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; characteristic herb; AND Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; characteristic herb
Little bluestem FACU, PNG	*Schizachyrium scoparium*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation
Marsh fern	*Thelypteris palustris*	Red maple-hardwood swamp; found throughout New York; dominant fern
Marsh marigold OBL, PNF	*Caltha palustris*	Red maple-hardwood swamp; found throughout New York; characteristic herb
Mountain (Whorled) aster	*Aster acuminatus*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); characteristic herb; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; characteristic herb
Mountain goldenrod FACU	*Solidago spathulata* ssp. *randii*	Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; characteristic herb
Mountain sorrel, white woodsorrel FAC, UPL, PNF	*Oxalis montana*	Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring herb
Mountain wood fern	*Dryopteris campyloptera*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); characteristic herb; AND Mountain fir forest; 1100-1400 meters; cool upper slopes exposed to wind; characteristic herb; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant
Northern long sedge	*Carex folliculata*	Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; characteristic herb; AND Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring herb
Partridge berry FACU	*Mitchella repens*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant
Pennsylvania sedge	*Carex pensylvanica*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; groundlayer herb Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic herb; AND Red pine rocky summit; cool, dry, rocky ridgetops and summits; POSSIBLY in the Catskills; characteristic herb
Pink corydalis	*Corydalis sempervirens*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation
Poverty-grass	*Danthonia spicata*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic herb; AND Red pine rocky summit; cool, dry, rocky ridgetops and summits; POSSIBLY in the Catskills; characteristic herb
Purple trillium FACU, UPL	*Trillium erectum*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant
Rattlesnake root FACU	*Prenanthes alba*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; groundlayer herb

Round-leaf violet FAC, PNF	*Viola rotundifolia*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant
Royal fern OBL, PNF3	*Osmunda regalis*	Red maple-hardwood swamp; found throughout New York; dominant fern
Sensitive fern FACW, PNEF3	*Onoclea sensibilis*	Hemlock-hardwood swamp; found throughout upstate New York; characteristic herb Red maple-hardwood swamp; found throughout New York; dominant fern
Shining clubmoss FACW, FAC, PNC	*Lycopodium lucidulum*	Mountain Spruce-fir forest; higher elevation peaks (900-1200 meters); characteristic herb; AND Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic groundlayer plant
Skunk cabbage OBL, PNF	*Symplocarpus foetidus*	Red maple-hardwood swamp; found throughout New York; characteristic herb
Small ricegrass	*Oryzopsis pungens*	Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; characteristic herb
Spinulose wood fern	*Dryopteris carthusiana*	Red maple-hardwood swamp; found throughout New York; herbaceous layer
Star flower FAC, PNF	*Trientalis borealis*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant; AND Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; characteristic herb
Tall meadow rue FACW, PNF	*Thalictrum pubescens*	Red maple-hardwood swamp; found throughout New York; characteristic herb
Threeseeded sedge OBL, PNGL	*Carex trisperma*	Spruce-fir swamp; found in the Catskills ecozone; shrub layer often sparse; characteristic herb; AND Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring herb
Three-toothed cinquefoil	*Potentilla tridentata*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; characteristic herb; AND Spruce-fir rocky summit; occurs on cool, dry, rocky ridgetops and summits; patchy or sparse vegetation; characteristic herb
Trailing arbutus	*Epigaea repens*	Red pine rocky summit; cool, dry, rocky ridgetops and summits; POSSIBLY in the Catskills; characteristic herb
Twisted stalk, Rosy FAC, FACU, PF	*Streptopus roseus*	Hemlock-northern hardwood forest; occurs on middle to lower slopes of ravines; cool, mid-elevation slopes; groundlayer plant; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic groundlayer plant
Upright sedge OBL, PNEGL	*Carex stricta*	Red maple-hardwood swamp; found throughout New York; characteristic herb
White goldenrod	*Solidago bicolor*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; groundlayer herb
White hellebore FACW, FACU, OBL, PNF	*Veratrum viride*	Red maple-hardwood swamp; found throughout New York; characteristic herb
Wild Sarsaparilla FACU, FAC	*Aralia nudicaulis*	Appalachian oak-hickory forest; usually on ridgetops, upper slopes, or south and west facing slopes; groundlayer herb; AND Spruce-northern hardwood forest; occurs on lower mountain slopes; characteristic groundlayer plant; AND Hemlock-hardwood swamp; found throughout upstate New York; less frequently occurring herb
Wintergreen FACU	*Gaultheria procumbens*	Pitch pine-oak-heath rocky summit; occurs on warm, dry, rocky ridgetops and summits; sparse vegetation; AND Red pine rocky summit; cool, dry, rocky ridgetops and summits; POSSIBLY in the Catskills; characteristic herb

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Appendix B Riparian Corridor Assessment Protocol

Appendix B: Riparian Corridor Assessment Protocol

I. Objectives for Assessing the Riparian Corridor:

A. Identify and map the types of vegetative communities and non-vegetated surfaces that are within the riparian corridor of the stream.

B. Compare the results from the riparian vegetation mapping project with stream stability assessments (e.g. location of BEHIs) and stream typing. Look for correlations between stream type and riparian vegetation type. Is vegetation often poor where streams are having stability problems? Assess riparian vegetation in terms of channel stability and flood risks. These types of information will be discussed within the management plan.

C. Start a data library for potential future reference and stream management. In the future, we can compare these results with additional riparian assessments and see how the riparian corridor changes over time.

D. Use the vegetation mapping data to roughly assess nonpoint source pollution of the stream, based on the percent of impervious surfaces within the riparian corridor.

E. Identify areas of poor vegetation and potential planting sites where improvement of the riparian vegetation is likely to be both effective and successful.

F. Develop management recommendations that may be implemented by landowners, Towns or SCSWCD, to maintain, protect and improve/enhance (e.g. plantings) the riparian corridor.

II. Vegetation Mapping Project

A. Use ArcGIS 9.2 to map the riparian corridor vegetation types and non-vegetated surfaces.

B. Create a shapefile of the center of the stream channel. The line will be drawn over the approximate center of the stream using 2006 Ortho Pictometry at a scale of 1:1000. Or, if the stream alignment has been drawn, create a polygon of the stream by tracing the stream alignment.

C. If using the centerline of a stream, create one buffer shapefile at 350 feet from the center of the stream. If using a polygon of the stream create a 300ft. buffer. Add flood hazard zone data and extend buffer to include the 100-year floodplain where applicable.

D. Add the soils shapefiles (WOH and hydric) and wetland shapefiles (NWI and DEC maps) to aid in classifying wetland vegetative communities. The soils24woh shapefile will need to be joined with the comp INFO table to determine drainage characteristics of the soils. Identify the soils within the soils24woh shapefile that are poorly or very poorly drained. Those soils that are hydric, poorly drained or very poorly drained will usually support wetland vegetation.

E. Map the vegetation types and non-vegetated surfaces within the 350 ft. buffer. Create a shapefile by drawing polygons around areas of each classification type using 2006 Ortho Pictometry at a scale of at least 1:1000.

F. Designate vegetation types according to Level 1 and Level 2 classification categories, as determined by DEP and GCSWCD on January 7, 2005.

Level 1	Level 2	Code	Notes	WQ notes
Bare soil	Cobble	BSC		
	Construction Spoils	BSCS		
	Exposed Bank	BSEB		
	Gravel Mine	BSGM		
	Junkyard	BSJ		
	Landfill/dump	BSL		
	Roadcut cliff/slope	BSR		
	Bedrock	BSB		
Herbaceous Vegetation	Mowed Lawn	HML		
	Mowed Lawn w/ Trees	HMLT		
	Mowed Roadside	HMR		
	Pastureland	HP		
	Wet Meadow	HWM		
	Shallow Emergent Marsh	HSEM		
	Sparse Vegetation	HSV		
	Successional Old Field	HSOF		
	Cropland	HC	field, row	
Shrubland	Brushy Cleared Land	SBCL		
	Evergreen Shrubland	SE		
	Deciduous Shrubland	SD		
	Scrub/Shrub Wetland	SW		
Shrubland	Successional Shrubland	SS		
Deciduous Closed Tree Canopy	Closed Northern Hardwood	DCNH		
	Closed Floodplain Forest	DCFF		
	Closed Deciduous Forested Wetlands	DCFW		
	Closed Successional Northern Hardwood	DCSNH		
Deciduous Open Tree Canopy	Open Northern Hardwood	DONH		
	Open Floodplain Forest	DOFF		

Level 1	Level 2	Code	Notes	WQ notes
	Open Deciduous Forested Wetlands	DOFW		
	Open Successional Northern Hardwood	DOSNH		
Evergreen Closed Tree Canopy	Closed Hemlock Forest	ECH		
	Closed White Pine Forest	ECWP	Plantation	
	Closed Evergreen Forested Wetlands	ECFW		
Evergreen Open Tree Canopy	Open Hemlock Forest	EOH		
	Open White Pine Forest	EOWP		
	Open Evergreen Forested Wetlands	EOFW		
Mixed Closed Tree Canopy	Closed Hemlock-Northern Hardwood	MCHN		
	Closed Pine-Northern Hardwood	MCPN		
	Closed Spruce-Northern Hardwood	MCSN		
	Closed Mixed Forested Wetlands	MCFW		
Mixed Open Tree Canopy	Open Hemlock-Northern Hardwood	MOHN		
	Open Pine-Northern Hardwood	MOPN		
	Open Spruce-Northern Hardwood	MOSN		
	Open Mixed Forested Wetlands	MOFW		
Unpaved Road	Unpaved road	UR	gravel, dirt	
	Railroad	URR		
	Path	UP		
Impervious Surface	Paved	ISP		
	Other	ISO		
	Rooftop	ISR	Commercial, Residential	
Revetment	Riprap*	RRR	dumped, stacked	
	Concrete	RC		
Revetment	Other	RO	cribbing	
Water	Backwater Slough	WBS		
	Farm Pond/agricultural pond	WFPAg		
	Farm Pond/artifical pond	WFPA		
	Industrial Cooling Pond	WICP		
	Natural Pond	WNP		
	Reservoir/Artificial Impoundment	WR		
	Sewage Treatment Pond	WSTP		
	Tributary	WT		
	Beaver Impoundment	WBI		

Level 1	Level 2	Code	Notes	WQ notes
	Ephemeral Pond/Pool	WEP	vernal pool	
	Stream	WS		
	Stream/Drainage	WSD		
	Modifications:			
	Cobble/Herbaceous		reclass as sparse veg	
	C.R.E.P.		sep layer	
	Rural Structure Exterior		reclass as rooftop	
	*delete "erosion control roadside"			
	Commercial, Residential		reclass into appropriate Impervious Surface categories	

Standards for classifying vegetation (modified from the National Vegetation Classification Standard):

Non-Vegetated
Impervious Surfaces (0% Vegetative Cover) Roads, buildings, driveways
Unpaved Road (0% Vegetative Cover) Semi-impervious surfaces, roads, driveways, railroads, paths (dirt, gravel)

Open Tree Canopy
Evergreen Open Tree Canopy (25% - 60% cover, Evergreens contribute to > 75%, Crowns not touching)
Deciduous Open Tree Canopy (25% - 60% cover, Deciduous contributes to > 75%)
Mixed evergreen-deciduous Open Tree Canopy (25% - 75% of each type)

Closed Tree Canopy
Closed Evergreen Tree Canopy (Evergreen contributes to > 75% cover)
Closed Deciduous Tree Canopy (Deciduous Contributes to 75% Cover)
Closed Mixed Tree Canopy (25% - 75% each type)

Herbaceous and Shrub Vegetation
Herbaceous Vegetation (Herbaceous species dominant, > 25% of cover)
Deciduous Shrubland (Shrubs > 0.5 m tall, individual or clumps not overlapping, > 25% canopy cover with tree cover < 25%)

G. Field Checking. After reviewing photos in the office and picking out several different polygons with a variety of vegetation types, check the designation of these types on the map by going out into the field, locating the areas, and assessing if the assignment is correct.

H. Analyze the data created by the vegetation mapping project. Determine the acreage and percent cover of vegetation types and non-vegetated surfaces for the entire stream corridor and for individual management units. Use this information to make management recommendations and to help determine where the riparian corridor needs to be enhanced through potential planting programs. Note: Inadequate vegetation represents areas within the riparian buffer that may provide opportunities to improve the buffer with streamside plantings in order to promote a more mature vegetative community along the streambank and in the floodplain. To obtain the amount of inadequate vegetation combine the acreage of bare soil, herbaceous vegetation and revetment.

Appendix C Biodiversity of the Upper Schoharie Creek

Appendix C: Biodiversity of the Upper Schoharie Creek

Prepared by the NYSDEC Hudson River Estuary Program, February 2007

Predicted Terrestrial Vertebrate Species (source: Hudson River Valley GAP)

Terrestrial, vertebrate species that are predicted to occur within the watershed based upon presumed associations of species with habitats. See the HRV-Gap Analysis Project report to view predicted species distribution maps. *New York Natural Heritage Program Rarity Rank Definitions provided at the end of this document.*

Key: TNC Status: For State and Global Rank explanations see www.nynhp.org; Legal Status: FE = Federal Endangered, FT = Federal Threatened, SE = State Endangered, ST = State Threatened, G = Game species, SC = State Special Concern; NYNHP Species: Rare species tracked by the NY Natural Heritage Program; NYSDEC SGCN: Species of Greatest Conservation Need included in State Wildlife Plan; Hudsonia Regional: Hudson Valley regional status: R = regionally rare, Rm = regionally rare migrant, S = regionally scarce, D = declining, V = vulnerable

Mammals		**TNC Status**	**Legal Status**	**NYNHP Species**	**NYSDEC SGCN**	**Regional**	**Notes:** (This section lists mapping criteria for elevation and nearness to water identified in the HRV-GAP. For more information on habitat associations, see the HRV-GAP report and references below.)
Big Brown Bat	Eptesicus fuscus	G5					
Eastern Pipistrelle	Pipistrellus subflavus	G5, S3				R	
Eastern Red Bat	Lasiurus borealis	G5, S5B, SZN			X	R	
Eastern Small-Footed Myotis	Myotis leibii	G3, S2	SC	X	X		
Hoary Bat	Lasiurus cinereus	G5, S4B, SZN			X	R	
Indiana Myotis	Myotis sodalis	G2, S1	FE, SE	X	X		
Little Brown Myotis	Myotis lucifugus	G5					
Northern Long-eared Myotis	Myotis septentrionalis	G2G3					
Silver-haired Bat	Lasionycteris noctivagans	G5, S4B, SZN	SC		X	Rm	
Eastern Cottontail	Sylvilagus floridanus	G5					
Snowshoe Hare	Lepus americanus	G5					
Eastern Chipmunk	Tamias striatus	G5					
Woodchuck	Marmota monax	G5					
Eastern Gray Squirrel	Sciurus carolinensis	G5					Found in suitable habitats at elevations below 910 m (3000 ft)
Northern Flying Squirrel	Glaucomys sabrinus	G5					Found in suitable habitats at elevations above 180 m (600 ft)
Red Squirrel	Tamiasciurus hudsonicus	G5					
Southern Flying Squirrel	Glaucomys volans	G5					
Deer Mouse	Peromyscus maniculatus gracilis	G5					
Meadow Jumping Mouse	Zapus hudsonius	G5					
Woodland Jumping Mouse	Napaeozapus insignis	G5, S5				R	
White-footed Mouse	Peromyscus leucopus	G5					
Meadow Vole	Microtus pennsylvanicus	G5					

Rock Vole	Microtus chrotorrhinus	G5					Found in suitable habitats at elevations above 760 m (2500 ft)
Southern Red-backed Vole	Clethrionomys gapperi	G5					
Woodland Vole	Microtus pinetorum	G5					Found in suitable habitats at elevations below 610 m (2000 ft)
Long-tailed Shrew	Sorex dispar	G4, S4				R	Found in suitable habitats at elevations above 180 m (600 ft)
Masked Shrew	Sorex cinereus	G5					
Northern Short-tailed Shrew	Larina brevicauda	G5					
Pygmy Shrew	Sorex hoyi	G5					
Smoky Shrew	Sorex fumeus	G5					
Water shrew	Sorex palustris	G5					Found in suitable habitats within 90 m (300 ft) of streams or lakes at elevations between 180 m (600 ft) and 1320 m (4350 ft)
Hairy-tailed Mole	Parascalops breweri	G5					Found in suitable habitats at elevations below 910 m (3000 ft)
Eastern Mole	Scalopus aquaticus	G5					
Star-nosed Mole	Condylura cristata	G5					
American Beaver	Castor canadensis	G5					Found in suitable habitats within 90 m (300 ft) of streams and lakes
Common Muskrat	Ondatra zibethicus	G5					Found in suitable habitats within 90 m (300 ft) of streams and lakes and in all occurrences of Shrub Swamp, Salt Shrub, Emergent Marsh/Open Fen/Wet Meadow, Salt Marsh, and Fresh Water land cover types
Southern Bog Lemming	Synaptomys cooperi	G5, S4				R	Found in suitable habitats at elevations below 1320 m (4350 ft)
Porcupine	Erethizon dorsatum	G5, S5				R	
Coyote	Canis latrans	G5					
Red Fox	Vulpes vulpes	G5					Found in suitable habitats at elevations below 610 m (2000 ft)
Gray Fox	Urocyon cinereoargenteus	G5					Found in suitable habitats at elevations below 610 m (2000 ft)
Black Bear	Ursus americanus	G5, S5	G			S	
Common Raccoon	Procyon lotor	G5					
Fisher	Martes pennanti	G4G5, S4	G			S	
Short-tailed Weasel	Mustela erminea	G5					
Long-tailed Weasel	Mustela frenata	G5					Found in suitable habitats at elevations below 610 m (2000 ft)
Mink	Mustela vison	G5					Found in suitable habitats within 90 m (300 ft) of streams and lakes and in all occurrences of Shrub Swamp, Salt Shrub, Emergent Marsh/Open Fen/Wet Meadow, Salt Marsh, and Fresh Water land cover types
Striped Skunk	Mephitis mephitis	G5					Found in suitable habitats at elevations below 760 m (2500 ft)
Bobcat	Lynx rufus	G5, S4	G			V	
Eastern Cougar	Felis concolor cougar	G5TH, SX	FE, SE		X		Extirpated
White-tailed Deer	Odocoileus virginianus	G5					
Virginia Opossum	Didelphis virginiana	G5					Found in suitable habitats at elevations below 460 m (1500 ft)
River Otter	Lutra canadensis	G5, S5	G		X	S	Found in all land cover types within 90 m (300 ft) of water
Amphibians		**TNC Status**	**Legal Status**	**NYNHP Species**	**NYSDEC SGCN**	**Regional**	**Notes:** (This section lists mapping criteria for elevation and nearness to water identified in the HRV-GAP. For more information on habitat associations, see the HRV-GAP report and references below.)
Jefferson Salamander	Ambystoma jeffersonianum	G5, S4	SC		X		Found in suitable habitats at elevations below 760 m (2500 ft)

Jefferson Salamander Complex	Ambystoma jeffersonianum x laterale	G4, S3	SC		X		Found in suitable habitats at elevations below 760 m (2500 ft)
Spotted Salamander	Ambystoma maculatum	G5, S5				V	Found in suitable habitats at elevations below 610 m (2000 ft)
Eastern American Toad	Bufo americanus americanus	G5					Found in suitable habitats at elevations below 1400 m (4600 ft)
Northern Dusky Salamander	Desmognathus fuscus	G5, S5				D, V	Found in suitable habitats at elevations below 1400 m (4600 ft)
Allegheny Dusky Salamander	Desmognathus ochrophaeus	G5					
Northern Two-lined Salamander	Eurycea bislineata	G5					
Longtail Salamander	Eurycea longicauda longicauda	G5, S2S3	SC	X	X		Found in suitable habitats within 90 m (300 ft) of water
Northern Spring Salamander	Gyrinophilus porphyriticus porphyritcus	G5					Found in suitable habitats at elevations below 910 m (3000 ft)
Four-toed Salamander	Hemidactylium scutatum	G5			X		
Gray Treefrog	Hyla versicolor	G5					
Common Mudpuppy	Necturus maculosus	G5, S4			X		Found in suitable habitats at elevations below 1060 m (3500 ft); Lakes, rivers, and streams
Red-spotted Newt	Notophthalmus viridescens viridescens	G5					
Northern Redback Salamander	Plethodon cinereus cinereus	G5					
Northern Slimy Salamander	Plethodon glutinosus complex	G5					Found in suitable habitats at elevations below 550 m (1800 ft)
Northern Spring Peeper	Pseudacris crucifer crucifer	G5					Found in suitable habitats within 30 m (100 ft) of streams and lake/pond edges
Northern Red Salamander	Pseudotriton ruber ruber	G5, S3S4			X		
Bullfrog	Rana catesbeiana	G5					Found in suitable habitats at elevations below 1060 m (3500 ft)
Green Frog	Rana clamitans melanota	G5					Found in suitable habitats at elevations below 1060 m (3500 ft)
Pickerel Frog	Rana palustris	G5					Found in suitable habitats within 30 m (100 ft) of streams and lake/pond edges at elevations below 760 m (2500 ft)
Northern Leopard Frog	Rana pipiens	G5, S5	G			R	Found in suitable habitats at elevations below 760 m (2500 ft)
Wood Frog	Rana sylvatica	G5, S5	G			V	Found in suitable habitats at elevations below 1400 m (4600 ft)
Reptiles		**TNC Status**	**Legal Status**	**NYNHP Species**	**NYSDEC SGCN**	**Regional**	**Notes:** (This section lists mapping criteria for elevation and nearness to water identified in the HRV-GAP. For more information on habitat associations, see the HRV-GAP report and references below.)
Common Snapping Turtle	Chelydra serpentina serpentina	G5					Found in suitable habitats at elevations below 1060 (3500 ft)
Painted Turtle	Chrysemys picta	G5					Found in suitable habitats at elevations below 910 m (3000 ft); Slow moving stream
Wood Turtle	Clemmys insculpta	G4, S3	SC, G		X		Found in suitable habitats within 1610 m (1 mile) of streams and rivers at elevations below 1060 m (3500 ft)
Timber Rattlesnake	Crotalus horridus	G5, S3	ST		X		Found in suitable habitats at elevations between 30 m (100 ft) and 520 m (1700 ft)

Northern Ringneck Snake	Diadophis punctatus edwardsii	G5					Found in suitable habitats at elevations below 760 m (2500 ft)
Eastern Milk Snake	Lampropeltis triangulum triangulum						Found in suitable habitats at elevations below 610 m (2000 ft)
Smooth Greensnake	Opheodrys vernalis	G5, S4			X	D	Found in suitable habitats at elevations below 610 m (2000 ft)
Northern Redbelly Snake	Storeria occipitomaculata occipitomaculata	G5					Found in suitable habitats at elevations below 550 m (1800 ft)
Eastern Box Turtle	Terrapene c. carolina	G5, S3	SC		X		
Garter Snake	Thamnophis sirtalis	G5					Found in suitable habitats at elevations below 1400 m (4600 ft)

Observed Breeding Birds (source: 1980-1985 Breeding Bird Atlas)

Breeding bird species known or suspected to be breeding within the watershed. The species list is derived from reports of observed breeding bird activity within Breeding Bird Atlas Blocks that overlap the watershed. Parties using these data for environmental review purposes do so at their own risk.

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Birds		**TNC Status**	**Legal Status**	**NYNHP Species**	**NYSDEC SGCN**	**Other Ranking**	**# Blocks (35 total)**	**Notes:** (This section lists mapping criteria for elevation and nearness to water identified in the HRV-GAP. For more information on habitat associations, see the HRV-GAP report and references below.)
Alder Flycatcher	Empidonax alnorum	S5, G5					13	
American Black Duck	Anas rubripes	S4, G4	G		X	WL, PIF	3	
American Crow	Corvus brachyrhnchos	S5, G5					34	
American Goldfinch	Carduelis tristis	S5, G5					33	
American Kestrel	Falco sparverius	S5, G5					10	
American Redstart	Setophaga ruticilla	S5, G5					32	
American Robin	Turdus migratorius	S5, G5					34	
American Woodcock	Scolopax minor	S5,G5	G		X	WL, PIF	9	
Baltimore Oriole	Icterus galbula	S5, G5					29	
Bank Swallow	Riparia riparia	S5, G5					11	Found in suitable habitats within 500 m (1640 ft) of streams and rivers
Barn Swallow	Hirundo rustica	S5, G5					35	
Barred Owl	Strix varia	S5, G5					13	
Belted Kingfisher	Ceryle alcyon	S5, G5					22	Found in suitable habitats within 1000 m (3280 ft) of streams and rivers
Bicknell's Thrush	Catharus bicknelli	S2S3B, G4	SC	X	X	WL, PIF	5	
Black-and-white Warbler	Mniotilta varia	S5, G5					28	
Black-billed Cuckoo	Coccyzus erythropthalmus	S5, G5			X		2	
Blackburnian Warbler	Dendroica fusca	S5, G5					25	
Black-capped Chickadee	Poecile atricapillus	S5, G5					32	
Blackpoll Warbler	Dendroica striata	S3, G5					7	

Black-throated Blue Warbler	Dendroica caerulescens	NR, G5			X		23	
Black-throated Green Warbler	Dendroica virens	S5, G5					27	
Blue Jay	Cyanocitta cristata	S5, G5					34	
Blue-gray Gnatcatcher	Polioptila caerulea	S5, G5					5	
Blue-headed Vireo	Vireo solitarius	S5, G5					24	
Blue-winged Warbler	Vermivora pinus	S5, G5			X	WL, PIF	3	
Bobolink	Dolichonyx oryzivorus	S5, G5			X	PIF	15	
Broad-winged Hawk	Buteo platypterus	S5, G5					10	
Brown Creeper	Certhia Americana	S5, G5					13	
Brown Thrasher	Toxostoma rufum	S5, G5			X		21	
Brown-headed Cowbird	Molothrus ater	S5, G5					32	
Canada Goose	Branta Canadensis	S5, G5					1	Found in the Suburban/Residential land cover type when located within 90 m (300 ft) of water
Canada Warbler	Wilsonia Canadensis	S5, G5			X		13	
Cedar Waxwing	Bombycilla cedrorum	S5, G5					34	
Chestnut-sided Warbler	Dendroica pensylvanica	S5, G5					30	
Chimney Swift	Chaetura pelagica	S5, G5					19	
Chipping Sparrow	Spizella passerina	S5, G5					33	
Cliff Swallow	Petrochelidon pyrrhonota	S5, G5					22	
Common Grackle	Quiscalus quiscula	S5, G5					33	
Common Merganser	Mergus merganser	S5, G5					2	
Common Nighthawk	Chordeiles minor	S5, G5					1	
Common Raven	Corvus corax	S5, G5					2	
Common Snipe	Gallinago gallinago	S5,G5					1	
Common Yellowthroat	Geothlypis trichas	S5, G5					33	
Cooper's Hawk	Accipiter cooperii	S4, G5	SC		X		5	
Dark-eyed Junco	Junco hyemalis	S5, G5					29	
Downy Woodpecker	Picoides pubescens	S5, G5					30	
Eastern Bluebird	Sialia sialis	S5, G5					18	
Eastern Kingbird	Tyrannus tyrannus	S5, G5					32	
Eastern Meadowlark	Sturnella magna	S5, G5			X		14	
Eastern Phoebe	Sayornis phoebe	S5, G5					34	
Eastern Screech-Owl	Otus asio	S5, G5					2	
Eastern Towhee	Pipilo erythrophthalmus	S5, G5					27	
Eastern Wood-Pewee	Contopus virens	S5, G5					26	
European Starling	Sturnus vulgaris	SE, G5					34	
Evening Grosbeak	Coccothraustes vespertinus	S5, G5					1	
Field Sparrow	Spizella pusilla	S5, G5					31	
Golden-crowned Kinglet	Regulus satrapa	S5, G5					13	
Golden-winged Warbler	Vermivora chrysoptera	S4, G4	SC		X	WL, PIF	1	
Gray Catbird	Dumetella carolinensis	S5, G5					35	

Great Blue Heron	Ardea herodias	S5, G5		X			10	
Great Crested Flycatcher	Myiarchus crinitus	S5,G5					24	
Great Horned Owl	Bubo virginianus	S5, G5					12	
Green Heron	Butorides virescens	S5, G5					8	Found in suitable habitats at elevations below 610 m (2000 ft)
Green-winged Teal	Anas crecca	S3, G5					2	
Hairy Woodpecker	Picoides villosus	S5, G5					25	
Hermit Thrush	Catharus guttatus	S5, G5					28	
Hooded Merganser	Lophodytes cucullatus	S4, G5					1	
House Finch	Carpodacus mexicanus	SE, G5					19	
House Sparrow	Passer domesticus	SE, G5					29	
House Wren	Troglodytes aedon	S5, G5					32	
Indigo Bunting	Passerina cyanea	S5, G5					26	
Killdeer	Charadrius vociferous	S5, G5					17	
Least Flycatcher	Empidonax minimus	S5, G5					29	
Louisiana Waterthrush	Seiurus motacilla	NR, G5			X		18	Found in suitable habitats within 100 m (330 ft) of streams and rivers
Magnolia Warbler	Dendroica magnolia	S5, G5					23	
Mallard	Anas platyrhynchos	S5,G5					10	Found in the Suburban/Residential land cover type when located within 90 m (300 ft) of water
Mallard x Am. Black Duck Hybrid	Anas platyrhynchos x A. rubripes	NR					1	
Mourning Dove	Zenaida macroura	S5, G5					27	
Mourning Warbler	Oporornis Philadelphia	S5, G5					7	
Nashville Warbler	Vermivora ruficapilla	S5, G5					10	
Northern Bobwhite	Colinus virginianus	S4, G5	G		X		1	
Northern Cardinal	Cardinalis cardinalis	S5, G5					14	
Northern Flicker	Colaptes auratus	S5, G5					33	
Northern Goshawk	Accipiter gentiles	S4B, S3N, G4	SC		X		7	
Northern Mockingbird	Mimus polyglottos	S5, G5					5	
Northern Rough-winged Swallow	Stelgidopteryx serripennis	S5, G5					15	Found in suitable habitats within 500 m (1640 ft) of streams and rivers or near cliff faces with a slope gradient greater than 40%
Northern Waterthrush	Seiurus noveboracensis	S5, G5					7	
Olive-sided Flycatcher	Contopus cooperi	S5, G5			X	WL, PIF	3	
Ovenbird	Seiurus aurocapillus	S5, G5					29	
Pileated Woodpecker	Dryocopus pileatus	S5, G5					15	
Pine Siskin	Carduelis pinus	S5, G5					3	
Prairie Warbler	Dendroica discolor	S5, G5			X		12	
Purple Finch	Carpodacus purpureus	S5, G5					27	
Red Crossbill	Loxia curvirostra	S3, G5					2	
Red-breasted Nuthatch	Sitta Canadensis	S5, G5					19	
Red-eyed Vireo	Vireo olivaceus	S5, G5					33	
Red-headed Woodpecker	Melanerpes erythrocephalus	S4, G5	SC		X	WL, PIF	1	

Red-tailed Hawk	Buteo jamaicensis	S5, G5					17	
Red-winged Blackbird	Agelaius phoeniceus	S5, G5					34	
Ring-necked Pheasant	Phasianus colchicus	SE, G5					6	
Rock Dove	Columba livia	SE, G5					10	
Rose-breasted Grosbeak	Pheucticus ludovicianus	S5, G5					29	
Ruby-throated Hummingbird	Archilochus colubris	S5, G5					22	
Ruffed Grouse	Bonasa umbellus	NR, G5	G		X		20	
Savannah Sparrow	Passerculus sandwichensis	S5, G5					9	
Scarlet Tanager	Piranga olivacea	NR, G5			X		34	
Sharp-shinned Hawk	Accipiter striatus	S4, G5	SC		X		9	
Song Sparrow	Melospiza melodia	S5, G5					35	
Spotted Sandpiper	Actitis macularia	S5, G5					8	Found in suitable habitats within 90 m (300 ft) of streams or rivers.
Swainson's Thrush	Catharus ustulatus	S5, G5					7	
Swamp Sparrow	Melospiza Georgiana	S5, G5					13	
Tree Swallow	Tachycineta bicolor	S5, G5					32	
Tufted Titmouse	Baeolophus bicolor	S5, G5					3	
Turkey Vulture	Cathartes aura	S4, G5					26	
Veery	Catharus fuscescens	S5, G5					29	
Vesper Sparrow	Pooecetes gramineus	S5, G5	SC		X		3	
Warbling Vireo	Vireo gilvus	S5, G5					16	
Whip-poor-will	Caprimulgus vociferous	S4, G5	SC		X	PIF	2	
White-breasted Nuthatch	Sitta carolinensis	S5, G5					29	
White-throated Sparrow	Zonotrichia albicollis	S5, G5					29	
Wild Turkey	Meleagris gallopavo	S5, G5					18	
Willow Flycatcher	Empidonax traillii	S5, G5			X	WL, PIF	5	
Winter Wren	Troglodytes troglodytes	S5, G5					16	
Wood Duck	Aix sponsa	S5, G5					6	
Wood Thrush	Hylocichla mustelina	S5, G5			X	WL, PIF	30	
Worm-eating Warbler	Helmitheros vermivorus	S4, G5			X		1	
Yellow Warbler	Dendroica petechia	S5, G5					32	
Yellow-bellied Flycatcher	Empidonax flaviventris	S3, G5					4	
Yellow-bellied Sapsucker	Sphyrapicus varius	S5, G5					26	
Yellow-billed Cuckoo	Coccyzus americanus	S5, G5					4	
Yellow-rumped Warbler	Dendroica coronata	S5, G5					23	
Yellow-throated Vireo	Vireo flavifrons	S5, G5					15	Found in suitable habitats within 500 m (1640 ft) of streams or rivers

Observed Rare Species and Significant Ecological Communities (source: NY Natural Heritage Program)

Rare plant and animals species with known populations within the watershed and documented examples of rare and high quality ecosystems within the watershed. Information regarding the locations of rare species is considered sensitive. The distribution of information which identifies the locations of rare species or their habitats may lead to the collection or disturbance of the animals and plants at those locations.

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Rare Birds		**TNC Status**	**Legal Status**	**NYNHP Species**	**NYSDEC SGCN**	**Notes:** (this section contains habitat association and distribution status information reported by the NY Natural Heritage Program)
Bald eagle	Haliaeetus leucocephalus	S2S3B, S2N, G5	ST, FT	X	X	Schoharie reservoir
Bicknell's Thrush	Catharus bicknelli	S2S3B, G4	SC	X	X	Found in high altitude spruce-fir forest typically above 3500 feet
Rare Plants		**TNC Status**	**Legal Status**	**NYNHP Species**	**NYSDEC SGCN**	**Notes:** (this section contains habitat association and distribution status information reported by the NY Natural Heritage Program)
Blunt-lobe Grape Fern	Botrychium oneidense	S2S3, G4Q	SE	X		Historical occurrence
Climbing Fern	Lygodium palmatum	S1, G4	SE	X		Historical occurrence
Musk Root	Adoxa moschatellina	S1, G5	SE	X		
Rough Avens	Geum virginianum	S2, G5	SE	X		Historical occurrence
Whorled Mountain-mint	Pycnanthemum verticillatum var. verticillatum	S1S2, G5T5	ST	X		
Rare Invertebrates		**TNC Status**	**Legal Status**	**NYNHP Species**	**NYSDEC SGCN**	**Notes:** (this section contains habitat association and distribution status information reported by the NY Natural Heritage Program)
Appalachian Tiger Beetle	Cicindela ancocisconensis	S1, G3	U	X	X	Stream (cobble); Found on cobble bars
Natural Communities		**TNC Status**	**Legal Status**	**NYNHP**	**NYSDEC SGCN**	**Notes:** (this section contains habitat association and distribution status information reported by the NY Natural Heritage Program)
Hemlock-northern hardwood forest		S4, G4G5		X		Lowest elevations, adjacent to and forming a mosaic with beech-maple mesic forest, found in ravines
Beech-Maple Mesic Forest		S4, G4		X		Matrix forest at mid to high elevations ranging from 900 to 3720 feet
Spruce-Northern Hardwood Forest		S3S4, G3G4		X		Mid to high elevations, ridgelines at slightly lower elevations than highest
Mountain fir forest		S2, G3		X		Highest elevations
Mountain Spruce-Fir Forest		S2S3, G3		X		Highest elevations

New York Natural Heritage Program Rarity Rank Definitions

NY LEGAL STATUS - Animals:
Categories of Endangered and Threatened species are defined in New York State Environmental Conservation Law section 11-0535. Endangered, Threatened, and Special Concern species are listed in regulation 6NYCRR 182.5.

E - Endangered Species: any species which meet one of the following criteria:

- Any native species in imminent danger of extirpation or extinction in New York.
- Any species listed as endangered by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

T - Threatened Species: any species which meet one of the following criteria:

- Any native species likely to become an endangered species within the foreseeable future in NY.
- Any species listed as threatened by the U.S. Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

SC - Special Concern Species: those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. Unlike the first two categories, species of special concern receive no additional legal protection under Environmental Conservation Law section 11-0535 (Endangered and Threatened Species).
P - Protected Wildlife (defined in Environmental Conservation Law section 11-0103): wild game, protected wild birds, and endangered species of wildlife.
U - Unprotected (defined in Environmental Conservation Law section 11-0103): the species may be taken at any time without limit; however a license to take may be required.
G - Game (defined in Environmental Conservation Law section 11-0103): any of a variety of big game or small game species as stated in the Environmental Conservation Law; many normally have an open season for at least part of the year, and are protected at other times.
NY LEGAL STATUS - Plants:
The following categories are defined in regulation 6NYCRR part 193.3 and apply to NYS Environmental Conservation Law section 9- 1503.

E - Endangered Species: listed species are those with:

- 5 or fewer extant sites, or
- fewer than 1,000 individuals, or
- restricted to fewer than 4 U.S.G.S. 7 ½ minute topographical maps, or
- species listed as endangered by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.

T - Threatened: listed species are those with:

- 6 to fewer than 20 extant sites, or
- 1,000 to fewer than 3,000 individuals, or
- restricted to not less than 4 or more than 7 U.S.G.S. 7 and ½ minute topographical maps, or
- listed as threatened by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.

R - Rare: listed species have:

- 20 to 35 extant sites, or
- 3,000 to 5,000 individuals statewide.

V - Exploitably Vulnerable: listed species are likely to become threatened in the near future throughout all or a significant portion of their range within the state if causal factors continue unchecked.
U - Unprotected: no state status.
FEDERAL STATUS (PLANTS and ANIMALS):
The categories of federal status are defined by the United States Department of the Interior as part of the 1974 Endangered Species Act (see Code of Federal Regulations 50 CFR 17). The species listed under this law are enumerated in the Federal Register vol. 50, no. 188, pp. 39526 - 39527. The codes below without parentheses are those used in the Federal Register. The codes below in parentheses are created by Heritage to deal with species which have different listings in different parts of their range, and/or different listings for different subspecies or varieties.

(blank): No Federal Endangered Species Act status.
LE: The element is formally listed as endangered.
LT: The element is formally listed as threatened.
PE: The element is proposed as endangered.
PT: The element is proposed as threatened.
C: The element is a candidate for listing.
LE,LT: The species is formally listed as endangered in part of its range, and as threatened in the other part; or, one or more subspecies or varieties is listed as endangered, and the others are listed as threatened.
LT,PDL: Populations of the species in New York are formally listed as threatened, and proposed for delisting.
(LE): If the element is a full species, all subspecies or varieties are listed as endangered; if the element is a subspecies, the full species is listed as endangered.
LT,T(S/A): One or more subspecies or populations of the species is formally listed as threatened, and the others are treated as threatened because of similarity of appearance to the listed threatened subspecies or populations.
PS: Partial status: the species is listed in parts of its range and not in others; or, one or more subspecies or varieties is listed, while the others are not listed.
GLOBAL AND STATE RANKS (animals, plants, ecological communities and others):
Each element has a global and state rank as determined by the NY Natural Heritage Program. These ranks carry no legal weight. The global rank reflects the rarity of the element throughout the world and the state rank reflects the rarity within New York State. Infraspecific taxa are also assigned a taxon rank to reflect the infraspecific taxon's rank throughout the world. ? = Indicates a question exists about the rank. Range ranks, e.g. S1S2, indicate not enough information is available to distinguish between two ranks.

GLOBAL RANK:
G1: Critically imperiled globally because of extreme rarity (5 or fewer occurrences), or very few remaining acres, or miles of stream) or especially vulnerable to extinction because of some factor of its biology.
G2: Imperiled globally because of rarity (6 - 20 occurrences, or few remaining acres, or miles of stream) or very vulnerable to extinction throughout its range because of other factors.
G3: Either rare and local throughout its range (21 to 100 occurrences), or found locally (even abundantly at some of its locations) in a restricted range (e.g. a physiographic region), or vulnerable to extinction throughout its range because of other factors.
G4: Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
G5: Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
GH: Historically known, with the expectation that it might be rediscovered.
GX: Species believed to be extinct.
NYS RANK:
S1: Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State.

S2: Typically 6 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.
S3: Typically 21 to 100 occurrences, limited acreage, or miles of stream in New York State.
S4: Apparently secure in New York State.
S5: Demonstrably secure in New York State.
SH: Historically known from New York State, but not seen in the past 15 years.
SX: Apparently extirpated from New York State.
SZ: Present in New York State only as a transient migrant.
SxB and SxN, where Sx is one of the codes above, are used for migratory animals, and refer to the rarity within New York State of the breeding (B)populations and the non-breeding populations (N), respectively, of the species.

TAXON (T) RANK:
The T-ranks (T1 - T5) are defined the same way as the Global ranks (G1 - G5), but the T-rank refers only to the rarity of the subspecific taxon.

T1 through T5: See Global Rank definitions above.
Q: Indicates a question exists whether or not the taxon is a good taxonomic entity.

References:

Hudson River Valley - Gap Analysis Program (GAP)
Smith, C.R., S.D. DeGloria, M.E. Richmond, S.K. Gregory, M. Laba, S.D. Smith, J.L. Braden, W.P. Brown, and E.A. Hill. 2001. An Application of Gap Analysis Procedures to Facilitate Planning for Biodiversity Conservation in the Hudson River Valley, Final Report, Part I: Gap Analysis of the Hudson River Valley and Part 2: Atlas of Predicted Ranges for Terrestrial Vertebrates in the Hudson River Valley. New York Cooperative Fish and Wildlife Research Unit, Department of Natural Resources, Cornell University, Ithaca, N.Y

NY Natural Heritage Program
Online at: www.nynhp.org

NY Natural Heritage Program Conservation Guides
Online at: http://www.acris.nynhp.org/

Biodiversity Assessment Manual for the Hudson River Estuary Corridor
Kiviat, E. and G. Stevens. 2001. Biodiversity Assessment Manual for the Hudson River Estuary Corridor. Published by the NY State Department of Environmental Conservation with funding provided by the Hudson River Estuary Program. Hudsonia, Ltd., Bard College, Annandale, NY.

NYS Amphibian and Reptile Atlas
Online at: http://www.dec.state.ny.us/website/dfwmr/wildlife/herp/

NYS Breeding Bird Atlas
Online at: http://www.dec.state.ny.us/website/dfwmr/wildlife/bba/index.html

NYS Comprehensive Wildlife Conservation Strategy
Online at: http://www.dec.state.ny.us/website/dfwmr/swg/cwcsmainpg.html

NYS Threatened, Endangered & Special Concern Species List
Online at: http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/

Appendix D Shandaken SPDES Permit

APPENDIX D

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

State Pollutant Discharge Elimination System (SPDES)
DISCHARGE PERMIT
Special Conditions (Part 1)

Industrial Code:	**4941**	SPDES Number:	**NY- 026 8151**
Discharge Class (CL):	**01**	DEC Number:	**3-5150-00420/00001**
Toxic Class (TX):	**N**	Effective Date (EDP):	**9/1/2006**
Major Drainage Basin:	**13**	Expiration Date (ExDP):	**8/31/2011**
Sub Drainage Basin:	**07**	Modification Dates:	
Water Index Number:	**H-171**		
Compact Area:	**CAT**		

This SPDES permit is issued in compliance with Title 8 of Article 17 of the Environmental Conservation Law of New York State and in compliance with the Clean Water Act, as amended, (33 U.S.C. §1251 et.seq.)(hereinafter referred to as "the Act").

PERMITTEE NAME AND ADDRESS

Name: **New York City Department of Environmental Protection** Attention: **David Warne, Acting Deputy Commissioner**

Street: **465 Columbus Avenue**

City: **Valhalla** State: **NY** Zip Code: **10595**

is authorized to discharge from the facility described below:

FACILITY NAME AND ADDRESS

Name: **Shandaken Tunnel Outlet**

Location (C,T,V): **Shandaken (T)** County: **Ulster**

Facility Address: **7148 NYS Rte. 28**

City: **Allaben** State: **NY** Zip Code: **12480**

NYTM -E: 552.61 NYTM - N: 4 662.735

From Outfall No.: **001** at Latitude: **42 ° 06 ′ 53 ″** & Longitude: **74 ° 21 ′ 49 ″**

into receiving waters known as: **Esopus Creek** Class: **A (TS)**

and; (list other Outfalls, Receiving Waters & Water Classifications)

in accordance with the effluent limitations, monitoring requirements and other conditions set forth in Special Conditions (Part I) and General Conditions (Part II) of this permit.

DISCHARGE MONITORING REPORT (DMR) MAILING ADDRESS

Mailing Name: **New York City Department of Environmental Protection**

Street: **P.O. Box 358**

City: **Grahamsville** State: **NY** Zip Code: **12740**

Responsible Official or Agent: **Paul V. Rush, P.E.** Phone: **(845) 985-2275**

This permit and the authorization to discharge shall expire on midnight of the expiration date shown above and the permittee shall not discharge after the expiration date unless this permit has been renewed, or extended pursuant to law. To be authorized to discharge beyond the expiration date, the permittee shall apply for permit renewal not less than 180 days prior to the expiration date shown above.

DISTRIBUTION:

Bureau of Water Permits
Regional Water Engineers, Regions 3 and 4
USEPA Region II - Jeff Gratz
NYSDOH
Trout Unlimited
Greene County Soil and Water Conservation District

Permit Administrator: William R. Adriance	
Address: 625 Broadway Albany NY 12233-1750	
Signature:	Date: / /

PERMIT LIMITS, LEVELS AND MONITORING DEFINITIONS

OUTFALL	WASTEWATER TYPE	RECEIVING WATER	EFFECTIVE	EXPIRING
	This cell describes the type of wastewater authorized for discharge. Examples include process or sanitary wastewater, storm water, non-contact cooling water.	This cell lists classified waters of the state to which the listed outfall discharges.	The date this page starts in effect. (e.g. EDP or EDPM)	The date this page is no longer in effect. (e.g. ExDP)

PARAMETER	MINIMUM	MAXIMUM	UNITS	SAMPLE FREQ.	SAMPLE TYPE
e.g. pH, TRC, Temperature, D.O.	The minimum level that must be maintained at all instants in time.	The maximum level that may not be exceeded at any instant in time.	SU, ˚F, mg/l, etc.		

PARA-METER	EFFLUENT LIMIT	PRACTICAL QUANTITATION LIMIT (PQL)	ACTION LEVEL	UNITS	SAMPLE FREQUENCY	SAMPLE TYPE
	Limit types are defined below in Note 1. The effluent limit is developed based on the more stringent of technology-based standards, required under the Clean Water Act, or New York State water quality standards. The limit has been derived based on existing assumptions and rules. These assumptions include receiving water hardness, pH and temperature; rates of this and other discharges to the receiving stream; etc. If assumptions or rules change the limit may, after due process and modification of this permit, change.	For the purposes of compliance assessment, the analytical method specified in the permit shall be used to monitor the amount of the pollutant in the outfall to this level, provided that the laboratory analyst has complied with the specified quality assurance/quality control procedures in the relevant method. Monitoring results that are lower than this level must be reported, but shall not be used to determine compliance with the calculated limit. This PQL can be neither lowered nor raised without a modification of this permit.	Type I or Type II Action Levels are monitoring requirements, as defined in Note 2 on the following page, that trigger additional monitoring and permit review when exceeded.	This can include units of flow, pH, mass, Temperature, concentration. Examples include µg/l, lbs/d, etc.	Examples include Daily, 3/week, weekly, 2/month, monthly, quarterly, 2/yr and yearly.	Examples include grab, 24 hour composite and 3 grab samples collected over a 6 hour period.

Note 1: DAILY DISCHARGE: The discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for the purposes of sampling. For pollutants expressed in units of mass, the 'daily discharge' is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the 'daily discharge' is calculated as the average measurement of the pollutant over the day.

DAILY MAX.: The highest allowable daily discharge. DAILY MIN.: The lowest allowable daily discharge.

DAILY AVG or 30 DAY ARITHMETIC MEAN (30 day average): The highest allowable average of daily discharges over a calendar month, calculated as the sum of each of the daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

7 DAY ARITHMETIC MEAN (7 day average): The highest allowable average of daily discharges over a calendar week.

30 DAY GEOMETRIC MEAN: The highest allowable geometric mean of daily discharges over a calendar month, calculated as the antilog of the sum of the log of each of the daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

7 DAY GEOMETRIC MEAN: The highest allowable geometric mean of daily discharges over a calendar week.

RANGE: The minimum and maximum instantaneous measurements for the reporting period must remain between the two values shown.

Note 2: ACTION LEVELS:

Routine Action Level monitoring results, if not provided for on the Discharge Monitoring Report (DMR) form, shall be appended to the DMR for the period during which the sampling was conducted. The permittee is not authorized to discharge any of the listed parameters at levels which may cause or contribute to a violation of water quality standards.

Due to conflicting requirements between 6 NYCRR Parts 700-706 (Water Quality Regulations) and 6NYCRR Part 670 (Reservoir Release Regulations: Schoharie Reservoir - Shandaken Tunnel - Esopus Creek), Action Levels have been established for Turbidity and Temperature in the discharge from the Shandaken Tunnel. If levels higher than the Action Levels are detected, the permittee shall reduce the flow from the Shandaken Tunnel at the maximum allowable ramping rate until either the specified Action Level is met or the flow from the Tunnel (as measured at the portal) is at the minimum flow necessary to achieve a combined flow from the Tunnel and the Esopus Creek (as measured at the upstream monitoring location) of no less than 160 MGD in accordance with Footnotes 1 and 4 on Pages 4 through 6 of this Permit.

INTERIM PERMIT LIMITS, LEVELS AND MONITORING - TURBIDITY

OUTFALL No.	WASTEWATER TYPE	RECEIVING WATER	EFFECTIVE	EXPIRING
001	Public Water Supply	Esopus Creek	9/1/2006	Completion of Turbidity Reduction Schedule of Compliance items

PARAMETER	EFFLUENT LIMIT		ACTION LEVEL		UNITS	SAMPLE FREQUENCY	SAMPLE TYPE	FN
	Daily Avg.	Daily Max.	TYPE I	TYPE II				
Turbidity, upstream	Monitor	Monitor			NTU	Continuous	Recorder	1,2,3
Turbidity, portal	Monitor	Monitor			NTU	Continuous	Recorder	1,2,3
Turbidity, shutdown		100			NTU	Continuous	Recorder	2,3
Turbidity Increase, June-October			15		NTU	Daily	Calculated	1,2,3
Turbidity Increase, November-May			20		NTU	Daily	Calculated	1,2,3

FINAL PERMIT LIMITS, LEVELS AND MONITORING - TURBIDITY

OUTFALL No.	WASTEWATER TYPE	RECEIVING WATER	EFFECTIVE	EXPIRING
001	Public Water Supply	Esopus Creek	9/1/2006	8/31/2011

PARAMETER	EFFLUENT LIMIT		ACTION LEVEL		UNITS	SAMPLE FREQUENCY	SAMPLE TYPE	FN
	Daily Avg.	Daily Max.	TYPE I	TYPE II				
Turbidity, upstream	Monitor	Monitor			NTU	Continuous	Recorder	3
Turbidity, portal	Monitor	Monitor			NTU	Continuous	Recorder	1,2,3
Turbidity, Increase		15			NTU	Daily	Calculated	1,2,3
Turbidity, shutdown		100			NTU	Continuous	Recorder	2,3

FINAL PERMIT LIMITS, LEVELS AND MONITORING

OUTFALL No.	WASTEWATER TYPE	RECEIVING WATER	EFFECTIVE	EXPIRING
001	Public Water Supply	Esopus Creek	9/1/2006	8/31/2011

PARAMETER	EFFLUENT LIMIT			UNITS	SAMPLE FREQUENCY	SAMPLE TYPE	FN
	Daily Avg.	Daily Max.	Daily Min.				
Flow, June-October, Esopus Creek, downstream		300		MGD	Daily	Calculated	4
Flow, minimum, Esopus Creek, downstream			160	MGD	Daily	Calculated	4
Phosphorus, as P	Monitor	Monitor		kg/day	Weekly	Grab	
Phosphorus, as P, 12 month rolling average	8962			kg/yr	Monthly	Calculated	5
Solids, Settleable	Monitor	Monitor		ml/l	Weekly	Grab	
Solids, Total Suspended	Monitor	Monitor		mg/l	Weekly	Grab	
Temperature, May-September		70		deg F	Continuous	Recorder	1,2
Temperature, October-April	Monitor	Monitor		deg F	Continuous	Recorder	2
Cold Water Volume, Schoharie Reservoir		Monitor		cfs-days	Annual	Estimate	6

Footnotes: see pages 4 through 6 of this Permit

FOOTNOTES:

1.. During low stream flow conditions in the Esopus Creek, the quantity of water releases from the Schoharie Reservoir via the Shandaken Tunnel shall take precedence over the water quality aspects of this discharge. Whenever the discharge from the Shandaken Tunnel is being reduced in accordance with the maximum ramping rates, or the sum of the daily average flow measured at the Allaben monitoring station and the daily average discharge from the Shandaken Tunnel portal is less than 176 MGD (110% of the minimum stream flow limit), this discharge is exempt from the temperature and turbidity increase limits listed above. The permittee shall note the dates of such exemptions in a summary attachment to their monthly Discharge Monitoring Report.

2. Temperature and Turbidity Exemptions:

The discharge is exempt from the temperature and turbidity increase limits and action levels when:

A. NYCDEP, with concurrence from the Department, determines that additional resources are reasonably necessary for reservoir balancing, for refill of the Ashokan Reservoir, for proper water supply management, or in the case of drought watch, warnings or emergencies;

B. Any action in regard to the operation of the Shandaken Tunnel is directed by this Department, including those diversions provided for special recreational events on the Esopus Creek which have been approved by the Department;

C. The permittee takes an emergency action in regard to the operation of the Shandaken Tunnel in accordance with 6NYCRR Part 670.7;

D. NYCDEP, with concurrence from the Department, makes releases consistent with 6NYCRR Part 670 from the Shandaken Tunnel for the purpose of field monitoring or testing, research, protecting the fishery or other natural resources of the Esopus Creek, protecting the fishery or other natural resources of Schoharie reservoir or Ashokan reservoir;

E. Performing work that is required under the compliance schedules in this permit or otherwise approved by this Department, if such work directly causes a discharge in excess of those action levels or limits which is not reasonably preventable;

F. NYCDEP, with concurrence from the Department, makes releases to prevent spilling of the Schoharie Reservoir when the unfilled storage capacity of the Schoharie reservoir is less than five billion gallons and the unfilled storage capacity of Ashokan reservoir is more than five billion gallons.

The discharge is exempt from the Turbidity, Shutdown limit when:

G. NYCDEP, with concurrence from the Department, determines that additional resources are reasonably necessary in the case of drought watches, warnings or emergencies;

H. Any action in regard to the operation of the Shandaken Tunnel is directed by this Department, including those diversions provided for special recreational events on the Esopus Creek which have been approved by the Department;

I. The permittee takes an emergency action in regard to the operation of the Shandaken Tunnel in accordance with 6NYCRR Part 670.7;

J. NYCDEP, with concurrence from the Department, makes releases to prevent spilling of the Schoharie Reservoir when the unfilled storage capacity of the Schoharie reservoir is less than five billion gallons and the unfilled storage capacity of Ashokan reservoir is more than five billion gallons.

These exemptions shall be in effect until the drought watch, warning or emergency is lifted, or when the action, event, or release triggering the exemption has ceased. The permittee shall notify the Department in writing at the addresses listed on Page 14 of this Permit of the onset and expected duration (if known) of such events within 72 hours, and summarize these events on its monthly Discharge Monitoring Report. The permittee shall make all reasonable efforts to be in compliance with the subject permit limit during these events.

FOOTNOTES (continued):

3. Turbidity Monitoring:

A. The permittee shall conduct turbidity reduction measures in accordance with the Turbidity Reduction Schedule of Compliance on page 8 of this Permit. The permittee shall comply with the interim Turbidity Action Levels shown during this period. The permittee shall comply with the final Turbidity Effluent Limits at the conclusion of this period.

B. The permittee shall monitor the turbidity at the Esopus Creek upstream monitoring station as defined in the Schedule of Compliance. The daily measurement shall be determined by using the calculated daily average of the hourly turbidity measurements taken at the upstream monitoring location and subtracting this measurement from calculated daily average of the hourly turbidity measurements taken at Outfall 001. The resultant increase in turbidity shall not exceed the prescribed Action Levels or Limit for Turbidity Increase. This limit is established pursuant to 40 CFR Part 122.44(d)(1)(vi)(B) and based upon factors and circumstances unique to the Shandaken Tunnel, and as such does not define "substantial visible contrast" per 6NYCRR Part 703.2 and should not be construed to establish a statewide numeric limit for the parameters of Turbidity or Turbidity Increase.

C. The reported Daily Maximum Turbidity measurement shall be determined by calculating the average of the hourly turbidity measurements over the course of a 24 hour period. The Daily Maximum Turbidity reported on the Discharge Monitoring Report shall be the highest of the daily measurements taken during that month. The reported Daily Average Turbidity measurement shall be determined by taking the sum of the Daily Maximum Turbidity measurements for that month and dividing this sum by the number of days in which the discharge was sampled for that month.

D. The permittee is exempt from continuous turbidity monitoring whenever the continuous turbidity monitoring equipment is nonfunctional due to events beyond the permittee's control. During these periods, turbidity measurements shall be collected manually on a daily basis. The permittee is exempt from continuous turbidity monitoring whenever the Esopus Creek freezes or conditions at or near the monitoring location are unsafe due to natural occurrences (i.e., flood or storm conditions).

E. The permittee shall be exempt from the Turbidity Increase action levels and limits when the surface of the Esopus Creek is frozen upstream from the Shandaken Tunnel outlet. In cases where the upstream gage is not working but the creek is not frozen, turbidity measurements shall be collected manually on a daily basis.

F. At no time shall the turbidity of the discharge from the Shandaken Tunnel exceed 100 NTU. Should the turbidity of the discharge exceed 100 NTU, the permittee shall shut down the discharge from the Tunnel in accordance with the maximum allowable ramping rate.

4. The Flow limits shall regulate the discharge from the Tunnel as follows:

A. For the minimum stream flow limit, the permittee shall subtract the streamflow at the Allaben upstream monitoring station from the 160 MGD minimum stream flow limit. The discharge from the Shandaken Tunnel portal, in millions of gallons per day, shall be no less than the determined volumetric flow rate. The combined in stream flow shall not be less than 160 MGD as a daily mean. This minimum flow limit shall not apply when the Ashokan reservoir is spilling. Minimum flows deviating from these limits may be permitted in accordance with Part 670. Every effort should be made to assure that minimum combined flows do not drop below an instantaneous calculation of 100 MGD (+/- 10 MGD).

B. For the maximum flow limit, the permittee shall subtract the streamflow at the Allaben upstream monitoring station from the 300 MGD maximum stream flow limit. The discharge from the Shandaken Tunnel portal, in millions of gallons per day, shall be no greater than the determined volumetric flow rate. The combined in stream flow may be greater than 300 MGD as a daily mean, and the maximum flow limit shall not apply, when the unfilled storage capacity of the Schoharie reservoir is less than five billion gallons and the unfilled storage capacity of Ashokan reservoir is more than five billion gallons.

C. When weather or other circumstances beyond the control of the permittee make it impossible to measure the streamflow at the Allaben monitoring station, the permittee shall estimate the upstream flow in the Esopus Creek by calculating a prorated flow based on the calculated inflow to the Neversink Reservoir and a comparison of the relative drainage areas.

D. Whenever the flow at the Allaben monitoring station meets or exceeds 300 MGD, the permittee is exempt from the 300 MGD maximum stream flow limit.

E. The City is exempt from the minimum stream flow limit whenever any action in regard to the operation of the Shandaken Tunnel as directed by this Department would cause the City to violate this limit.

FOOTNOTES (continued):

4. F. The City is exempt from the maximum stream flow limit whenever the permittee takes an emergency action in regard to the operation of the Shandaken Tunnel in accordance with 6NYCRR Part 670.7.

5. The Phosphorus, as P, 12 month rolling average limit shall be calculated by adding the daily average Phosphorus loadings, in kg/day, for the subject month to the daily average Phosphorus loadings for each of the preceding eleven months. Compliance with this limit shall be recalculated each month.

6. The permittee shall estimate the volume of cold water within the Schoharie reservoir within 7 days of June 15 of each year, in CFS-days. This estimate shall be determined by developing a thermal profile from water temperature data collected at every one-half meter of water depth until the elevation where the 62 degF (16.7 degC) temperature is found, and every three (3) meters of water depth thereafter . The 62 degF (16.7 degC) temperature elevation should then be used to determine the volume of cold water available, by reference to a table of capacity versus reservoir elevation. The permittee shall then use that information to develop a Schoharie Reservoir Releases Plan for the period from July 1-September 15. The Releases Plan shall be developed with the goal of limiting the use of the cold water supply as much as possible while still maintaining an adequate supply of water for drinking purposes and coldwater habitat releases to Esopus Creek in accordance with the flow limits and requirements in Footnote 4. The Plan shall be developed consistent with good water supply and natural resource protection practices and shall be subject to the review, approval and revision by the Department. The thermal profile, storage data calculations, and Releases Plan shall be sent to DEC so that it is received by June 30 of each year. The permittee shall make all reasonable efforts to ensure that the Schoharie Reservoir is full on June 1 of each year and shall follow the Releases Plan as much as practicable. The permittee shall notify the Department's Releases Manager as soon as the permittee becomes aware of a need to deviate from the Releases Plan. The Department may, with consideration of water supply and habitat need, direct the permittee to halt its deviations from the Releases Plan at any time.

7. The exemptions listed in Footnotes 1-4 above shall be revisited upon completion of the Schedule of Compliance activities and reviewed with respect to need and applicability.

SCHEDULE OF COMPLIANCE - MONITORING AND REPORTING

a) The permittee shall comply with the following schedule.

Action Code	Outfall Number(s)	Compliance Action	Due Date
	N/A	**Upstream Monitoring Location:** The permittee shall construct an upstream monitoring station to measure upstream turbidity samples. The station shall be located such that the measurements are representative of the turbidity within the Esopus Creek as close as practical to, but prior to admixture with, the discharge of the Shandaken Tunnel.	1/1/2007
	N/A	**Progress Reports:** The City shall, consistent with 6 NYCRR § 750-1.14(b), submit detailed periodic progress reports on the status of all requirements set forth in this schedule of compliance.	6/1/2007 and at each 9 month interval thereafter
	001	**Annual Monitoring Data Summary:** The permittee shall submit an annual summary of Outfall 001 monitoring data, in electronic spreadsheet format, to the Bureau of Water Permits, 625 Broadway, Albany NY 12233-3505.	9/1/2007 and annually thereafter
	N/A	**Public Participation:** The permittee shall hold semiannual public meetings to discuss the progress of the turbidity reduction projects to be undertaken, gather public input on improvements in stream quality, and identify management efforts that may be undertaken by volunteers and other concerned groups and individuals.	3/1/2007 and every 6 months thereafter

The above compliance actions are one time requirements. The permittee shall comply with the above compliance actions to the Department's satisfaction once. When this permit is administratively renewed by NYSDEC letter entitled "SPDES NOTICE/RENEWAL APPLICATION/PERMIT", the permittee is not required to repeat the submission. The above due dates are independent from the effective date of the permit stated in the letter of "SPDES NOTICE/RENEWAL APPLICATION/PERMIT."

b) The permittee shall submit a written notice of compliance or non-compliance with each of the above schedule dates no later than 14 days following each elapsed date, unless conditions require more immediate notice as prescribed in 6 NYCRR Part 750-1.2(a) and 750-2. All such compliance or non-compliance notification shall be sent to the locations listed under the section of this permit entitled RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS. Each notice of non-compliance shall include the following information:

1. A short description of the non-compliance;
2. A description of any actions taken or proposed by the permittee to comply with the elapsed schedule requirements without further delay and to limit environmental impact associated with the non-compliance;
3. A description or any factors which tend to explain or mitigate the non-compliance; and
4. An estimate of the date the permittee will comply with the elapsed schedule requirement and an assessment of the probability that the permittee will meet the next scheduled requirement on time.

c) The permittee shall submit copies of any document required by the above schedule of compliance to NYSDEC Regional Water Engineer at the location listed under the section of this permit entitled RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS, **to the Bureau of Water Permits, 625 Broadway, Albany, N.Y. 12233-3505**, and the Greene County Soil and Water Conservation District, 907 County Office Building, Cairo NY 12413 unless otherwise specified in this permit or in writing by the Department.

SCHEDULE OF COMPLIANCE - TURBIDITY REDUCTION PROGRAM

The permittee shall develop a program to reduce the effects of storm water runoff and other activities on turbidity through land, storm water, and stream control initiatives within the Schoharie Reservoir Basin. The goal of this program shall be to reduce to the extent practical, the impacts of current and future development on turbidity within the basin.

a) The permittee shall comply with the following schedule.

Action Code	Outfall Number(s)	Compliance Action	Due Date
	NA	The Permittee shall develop a program, which may be administered by the Catskill Watershed Corp., consisting of the creation and funding of a Program Fund in the amount of $500,000. The fund will be distributed to municipalities within the Schoharie Watershed to fund generic environmental impact statements to address the environmental (in particular, turbidity) and infrastructure impacts from reasonably foreseeable future development. The purpose of these studies is to identify the impacts (i.e., environmental and infrastructure) from reasonably foreseeable future developments and the mitigation measures necessary to address such impacts. The funds will be allocated pursuant to one funding round and request for proposals. The funds shall be allocated based upon: (1) the quality of the proposal; (2) the applicant's demonstrated need; and (3) the area of the applicant municipality within the Schoharie watershed. Funds may be expended on planning only for areas within the Schoharie Watershed. Contracts for these projects shall be issued to municipalities within 15 months of the effective date of the permit.	12/1/2006
	NA	Submit an approvable turbidity reduction report evaluating the potential benefits of the heightened or more expansive implementation, within the Schoharie Reservoir basin, of program activities established under the 1997 New York City Watershed Memorandum of Agreement and the 2002 FAD. This report will include an evaluation of the potential benefits of increased or focused funding and implementation of whole farm, forestry, willing seller land acquisition, stream restoration, storm water retrofit, stream buffer and conservation easement programs. The report will include alternative proposals for a focused willing buyer-willing seller land acquisition and conservation easement program.	9/1/2007
	NA	Propose an implementation schedule, with specific milestones and goals, to implement the approved actions that were evaluated in the turbidity reduction report above.	1/1/2008
	NA	Commence implementation of heightened program activities in accordance with milestones and schedule approved by the Department.	9/1/2008

The above compliance actions are one time requirements. The permittee shall comply with the above compliance actions to the Department's satisfaction once. When this permit is administratively renewed by NYSDEC letter entitled "SPDES NOTICE/RENEWAL APPLICATION/PERMIT", the permittee is not required to repeat the submission. The above due dates are independent from the effective date of the permit stated in the letter of "SPDES NOTICE/RENEWAL APPLICATION/PERMIT."

b) The permittee shall submit a written notice of compliance or non-compliance with each of the above schedule dates no later than 14 days following each elapsed date, unless conditions require more immediate notice as prescribed in 6 NYCRR Part 750-1.2(a) and 750-2. All such compliance or non-compliance notification shall be sent to the locations listed under the section of this permit entitled RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS. Each notice of non-compliance shall include the following information:

1. A short description of the non-compliance;
2. A description of any actions taken or proposed by the permittee to comply with the elapsed schedule requirements without further delay and to limit environmental impact associated with the non-compliance;
3. A description or any factors which tend to explain or mitigate the non-compliance; and
4. An estimate of the date the permittee will comply with the elapsed schedule requirement and an assessment of the probability that the permittee will meet the next scheduled requirement on time.

c) The permittee shall submit copies of any document required by the above schedule of compliance to NYSDEC Regional Water Engineer

at the location listed under the section of this permit entitled RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS**, the Bureau of Water Permits, 625 Broadway, Albany, N.Y. 12233-3505**, and the Greene County Soil and Water Conservation District, 907 County Office Building, Cairo NY 12413, unless otherwise specified in this permit or in writing by the Department.

SCHEDULE OF COMPLIANCE - TURBIDITY REDUCTION MEASURES

A) The permittee shall develop a program consisting of structural and nonstructural measures to reduce the turbidity in the Shandaken Tunnel and maximize the volume of cold water available for discharge to the Esopus Creek. The goals of this program shall be to **protect the water supply, fishery, and recreational uses of the Esopus Creek through:**

1. Achieving consistent compliance with the turbidity limits listed on page 3 of this Permit; and

2. Providing adequate cold water volume to assure that the discharge from the Shandaken Tunnel does not exceed the water quality based effluent limit of 70 degF during the months of May through September.

The program shall include the following measures:

1. Structural Modifications:

The permittee shall identify and implement any short and long term structural measures which will achieve the above goals in accordance with the Schedule of Compliance below. These measures shall include, but are not limited to, a multi level intake structure, turbidity curtain and any alternatives identified and implemented in accordance with the **Comprehensive Analysis of Potential Alternatives at Schoharie Reservoir** that will be developed by the permittee and approved by the EPA in fulfillment of requirements contained in the November 2002 FAD. These measures shall also be reviewed and approved by the Department consistent with 6NYCRR § 750-1.2(a)(8).

2. Nonstructural Programs:

A. Filtration Avoidance Determination Schedule: The Permittee shall continue the Stream Management Program as detailed in Section 4.5 of the November 2002 FAD as approved by EPA. The DEP may continue contracts as previously developed to fulfill this requirement.

B. Stream Restoration Program: The Permittee shall continue a program to implement stream restoration programs to repair streams and streambanks that are in need of restoration based on identified addition of suspended sediment (and turbidity) to the Schoharie Reservoir. In addition to the stream restoration projects identified above under "A. Filtration Avoidance Determination Schedule", the Permittee shall repair a minimum of 5,000 linear feet of stream in the Schoharie Basin within seven years of the effective date of the permit. Plans for all stream repair shall be approved by the Department. The repair work shall include a minimum of two stream restoration projects. This work is above and beyond any requirement of the 2002 FAD.

C. Local Implementation Program: The Permittee shall provide at least $2 million in funding, for local implementation of stream management plan recommendations, as contained in the Stream Management Plans currently developed and in the process of being developed for the entire Schoharie Reservoir basin. The Permittee shall conduct projects and/or establish contract(s) with one or more local entities to implement this local program. The Permittee shall begin implementation within 36 months of either completion of the Stream Management Plans for the Schoharie Basin, or 9/1/2006, whichever is later. The Permittee, in consultation with the Project Advisory Committee for each Stream Management Plan and the appropriate county Soil and Water Conservation District(s), shall recommend projects to be implemented based on the goals of this program. The permittee's recommendations shall be subject to the Department's review and approval.

D. Other considerations and measures: The Permittee may identify and implement any other short or long term nonstructural measures not identified above that will assist in meeting the goals of this program. All measures to be considered shall be consistent, to the extent possible, with recommendations developed in the Stream Management Plans for tributaries of the Schoharie Reservoir.

Continued on following page

SCHEDULE OF COMPLIANCE - TURBIDITY REDUCTION MEASURES (continued)

The permittee shall comply with the following schedule.

Action Code	Outfall Number(s)	Compliance Action	Due Date
	001	Submit an approvable report detailing the short and long term structural modifications to be performed as outlined in Item 1. above. The report shall include an investigation of alternatives, projected turbidity reductions and increases in available cold water volume, and recommended actions to be taken along with a schedule for implementation.	3/1/2008
	001	Submit an approvable report detailing the actions to be taken with respect to each of the measures in Item 2. above, as well as any other avenues to be investigated that will achieve the goals of turbidity reduction and cold water storage within the Schoharie Reservoir. The report shall include an investigation of alternatives, projected turbidity reductions and increases in available cold water volume, and recommended actions to be taken along with a schedule for implementation.	3/1/2008
	001	Begin implementation of identified structural alternatives in Item 1. above as approved by the Department.	Effective Date of Approval +2 months
	001	Begin implementation of identified nonstructural alternatives in Item 2. above as approved by the Department.	Within 36 months of completion of Schoharie Basin SMP
	001	Complete implementation of identified structural alternatives and achieve compliance with final effluent turbidity requirements listed on page 4 of this Permit.	9/1/2013

The above compliance actions are one time requirements. The permittee shall comply with the above compliance actions to the Department's satisfaction once. When this permit is administratively renewed by NYSDEC letter entitled "SPDES NOTICE/RENEWAL APPLICATION/PERMIT", the permittee is not required to repeat the submission. The above due dates are independent from the effective date of the permit stated in the letter of "SPDES NOTICE/RENEWAL APPLICATION/PERMIT."

b) The permittee shall submit a written notice of compliance or non-compliance with each of the above schedule dates no later than 14 days following each elapsed date, unless conditions require more immediate notice as prescribed in 6 NYCRR Part 750-1.2(a) and 750-2. All such compliance or non-compliance notification shall be sent to the locations listed under the section of this permit entitled RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS. Each notice of non-compliance shall include the following information:

1. A short description of the non-compliance;
2. A description of any actions taken or proposed by the permittee to comply with the elapsed schedule requirements without further delay and to limit environmental impact associated with the non-compliance;
3. A description or any factors which tend to explain or mitigate the non-compliance; and
4. An estimate of the date the permittee will comply with the elapsed schedule requirement and an assessment of the probability that the permittee will meet the next scheduled requirement on time.

c) The permittee shall submit copies of any document required by the above schedule of compliance to NYSDEC Regional Water Engineer at the location listed under the section of this permit entitled RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS, **the Bureau of Water Permits, 625 Broadway, Albany, N.Y. 12233-3505**, and the Greene County Soil and Water Conservation District, 907 County Office Building, Cairo NY 12413, unless otherwise specified in this permit or in writing by the Department.

EDP: 9/1/2006

DISCHARGE NOTIFICATION REQUIREMENTS

(a) Except as provided in (c), (f) and (g) of these Discharge Notification Act requirements, the permittee shall install and maintain identification signs at all outfalls to surface waters listed in this permit. Such signs shall be installed before initiation of any discharge.

(b) Subsequent modifications to or renewal of this permit does not reset or revise the deadline set forth in (a) above, unless a new deadline is set explicitly by such permit modification or renewal.

(c) The Discharge Notification Requirements described herein do not apply to outfalls from which the discharge is composed exclusively of storm water, or discharges to ground water.

(d) The sign(s) shall be conspicuous, legible and in as close proximity to the point of discharge as is reasonably possible while ensuring the maximum visibility from the surface water and shore. The signs shall be installed in such a manner to pose minimal hazard to navigation, bathing or other water related activities. If the public has access to the water from the land in the vicinity of the outfall, an identical sign shall be posted to be visible from the direction approaching the surface water.

The signs shall have **minimum** dimensions of eighteen inches by twenty four inches (18" x 24") and shall have white letters on a green background and contain the following information:

N.Y.S. PERMITTED DISCHARGE POINT

SPDES PERMIT No.: NY_____

OUTFALL No. :____

For information about this permitted discharge contact:

Permittee Name: _____

Permittee Contact: _____

Permittee Phone: ( ) - ### - ####

OR:

NYSDEC Division of Water Regional Office Address :

NYSDEC Division of Water Regional Phone: ( ) - ### -####

(e) For each discharge required to have a sign in accordance with a), the permittee shall, concurrent with the installation of the sign, provide a repository of copies of the Discharge Monitoring Reports (DMRs), as required by the **RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS** page of this permit. This repository shall be open to the public, at a minimum, during normal daytime business hours. The repository may be at the business office repository of the permittee or at an off-premises location of its choice (such location shall be the village, town, city or county clerk's office, the local library or other location as approved by the Department). In accordance with the **RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS** page of your permit, each DMR shall be maintained on record for a period of three years.

(continued)

(f) If, upon November 1, 1997, the permittee has installed signs that include the information required by 17-0815-a(2)(a) of the ECL, but do not meet the specifications listed above, the permittee may continue to use the existing signs for a period of up to five years, after which the signs shall comply with the specifications listed above.

(g) All requirements of the Discharge Notification Act, including public repository requirements, are waived for any outfall meeting any of the following circumstances, provided Department notification is made in accordance with (h):

(i) such sign would be inconsistent with any other state or federal statute;

(ii) the Discharge Notification Requirements contained herein would require that such sign could only be located in an area that is damaged by ice or flooding due to a one-year storm or storms of less severity;

(iii) instances in which the outfall to the receiving water is located on private or government property which is restricted to the public through fencing, patrolling, or other control mechanisms. Property which is posted only, without additional control mechanisms, does not qualify for this provision;

(iv) instances where the outfall pipe or channel discharges to another outfall pipe or channel, before discharge to a receiving water; or

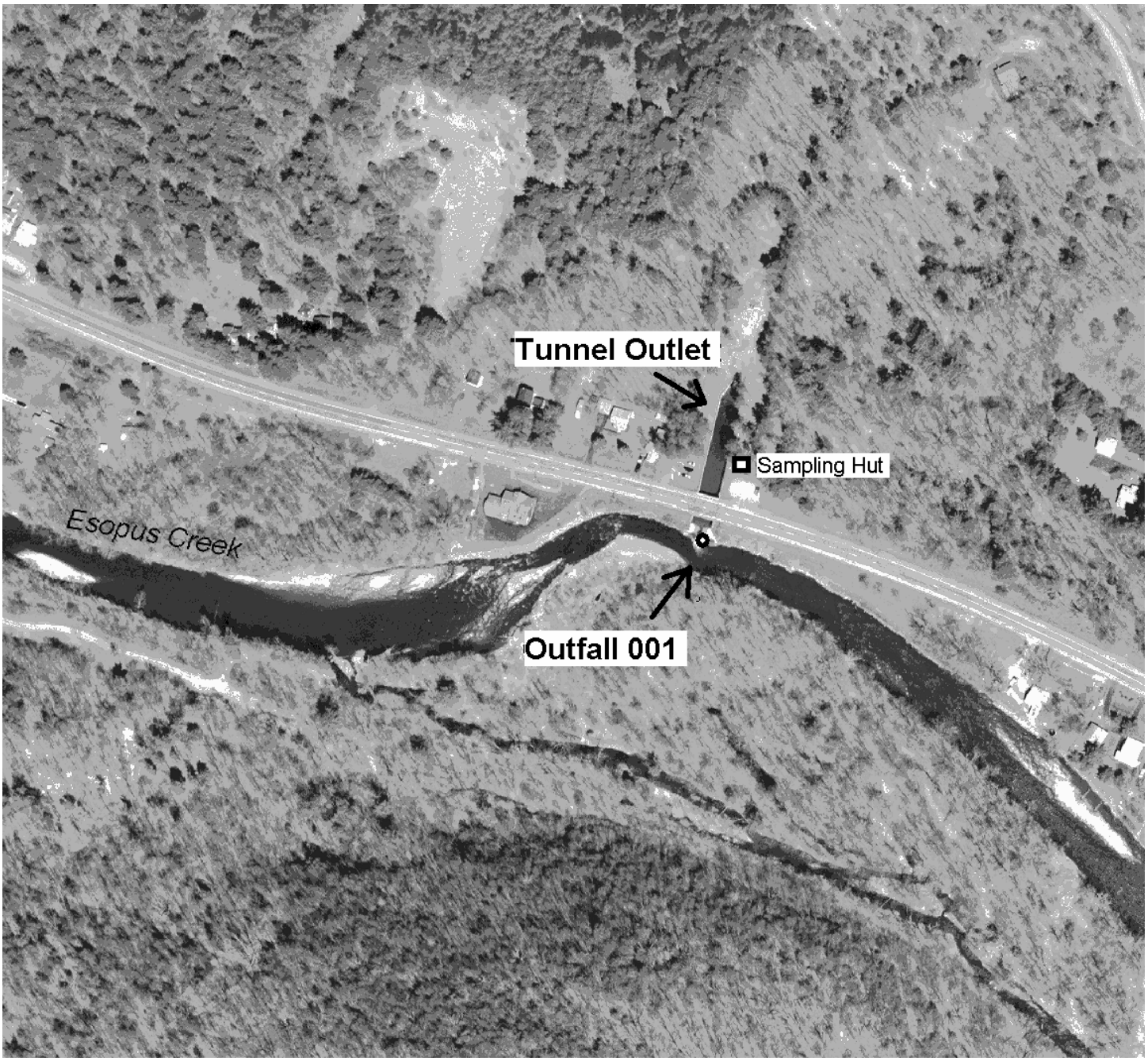
(v) instances in which the discharge from the outfall is located in the receiving water, two-hundred or more feet from the shoreline of the receiving water.

(h) If the permittee believes that any outfall which discharges wastewater from the permitted facility meets any of the waiver criteria listed in (g) above, notification (form enclosed) must be made to the Department's Bureau of Water Permits, Central Office, of such fact, and, provided there is no objection by the Department, a sign and DMR repository for the involved outfall(s) are not required. This notification must include the facility's name, address, telephone number, contact, permit number, outfall number(s), and reason why such outfall(s) is waived from the requirements of discharge notification. The Department may evaluate the applicability of a waiver at any time, and take appropriate measures to assure that the ECL and associated regulations are complied with.

(i) The permittee shall periodically inspect the outfall identification signs in order to ensure that they are maintained, are still visible and contain information that is current and factually correct.

MONITORING LOCATIONS

The permittee shall take samples and measurements, to comply with the monitoring requirements specified in this permit, at the location(s) specified below:



Sampling Point: At South Portal discharge point of tunnel prior to admixture with the Esopus Creek.

RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS

a) The permittee shall also refer to 6 NYCRR Part 750-1.2(a) and 750-2 for additional information concerning monitoring and reporting requirements and conditions.

b) The monitoring information required by this permit shall be summarized, signed and retained for a period of three years from the date of the sampling for subsequent inspection by the Department or its designated agent. **Also, monitoring information required by this permit shall be summarized and reported by submitting;**

[X] (if box is checked) completed and signed Discharge Monitoring Report (DMR) forms for each 1 month reporting period to the locations specified below. Blank forms are available at the Department's Albany office listed below. The first reporting period begins on the effective date of this permit and the reports will be due no later than the 28th day of the month following the end of each reporting period.

[X] (if box is checked) an annual report to the Regional Water Engineer at the address specified below. The annual report is due by February 1 and must summarize information for January to December of the previous year in a format acceptable to the Department.

[ ] (if box is checked) a monthly "Wastewater Facility Operation Report..." (form 92-15-7) to the:
[ ] Regional Water Engineer and/or [ ] County Health Department or Environmental Control Agency specified below

Send the **original** (top sheet) of each DMR page to:

Department of Environmental Conservation
Division of Water
Bureau of Watershed Compliance Programs
625 Broadway
Albany, New York 12233-3506

Phone: (518) 402-8177

Send an **additional copy** of each DMR page to:

Send the **first copy** (second sheet) of each DMR page to:

Department of Environmental Conservation
Regional Water Engineer
100 Hillside Avenue, Suite 1W
White Plains, NY 10603-2860

Phone: (914) 428-2505

c) Noncompliance with the provisions of this permit shall be reported to the Department as prescribed in 6 NYCRR Part 750-1.2(a) and 750-2.

d) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

e) If the permittee monitors any pollutant more frequently than required by the permit, using test procedures approved under 40 CFR Part 136 or as specified in this permit, the results of this monitoring shall be included in the calculations and recording of the data on the Discharge Monitoring Reports.

f) Calculation for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in this permit.

g) Unless otherwise specified, all information recorded on the Discharge Monitoring Report shall be based upon measurements and sampling carried out during the most recently completed reporting period.

h) Any laboratory test or sample analysis required by this permit for which the State Commissioner of Health issues certificates of approval pursuant to section five hundred two of the Public Health Law shall be conducted by a laboratory which has been issued a certificate of approval. Inquiries regarding laboratory certification should be sent to the Environmental Laboratory Accreditation Program, New York State Health Department Center for Laboratories and Research, Division of Environmental Sciences , The Nelson A. Rockefeller Empire State Plaza, Albany, New York 12201.

Appendix E Stream Management Data Dictionary Guide

Appendix E. Stream Management Data Dictionary Guide

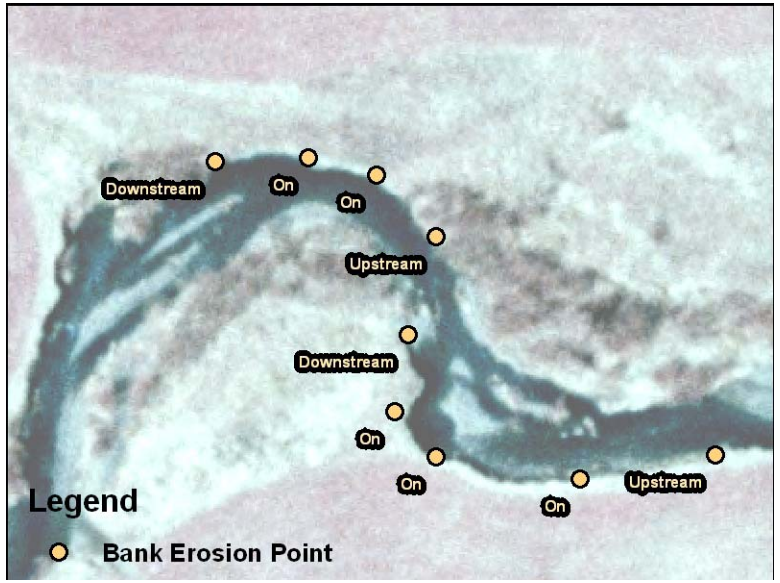
Updated 5/3/06
Based on 04/17/06 Data Dictionary

This guide serves as a reference for use with the NYC DEP Stream Management data dictionary and provides descriptions for each layer and many of the fields within the dictionary. The data dictionary is a critical component of the NYC DEP Stream Data Management Project which is an effort to improve stream related data collection , processing, analysis, storage and retrieval. The data dictionary was designed for use with Pathfinder Office database software and Trimble Geo XT data collectors and the ArcGIS extension developed by NYC DEP and PAR Government Technologies, Inc in cooperation with Greene County and Delaware County Soil and Water Conservation District.

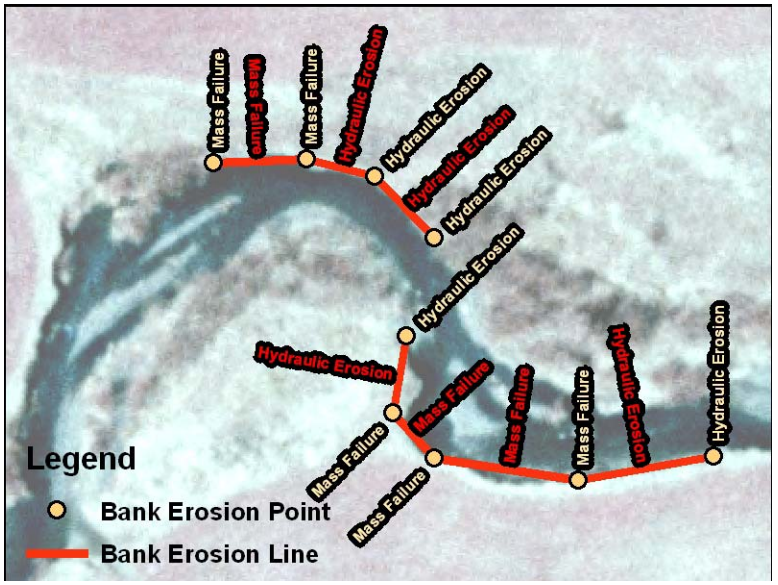
This guide has been created as part of an effort to improve the consistency of the stream related data collected by County and DEP Stream Management Programs. All post-processed files will be integrated into a common geodatabase. Changes in the names of features or attributes or the addition of features to the data dictionary will not be accepted by the geodatabase. Users are requested to submit any proposed changes to the dictionary with DEP Stream Management Program Data Manager and other County Stream Managers and not make changes on their own.

General Notes:

Collecting Points versus Lines: In many cases, linear features can be collected as points and later converted to lines after importation into a GIS. GPS'd point features typically have a greater accuracy than lines. Also, physical barriers, such a swift current, deep water, or a high bank often prevent the users from walking the line in the field. With this in mind, tools have been developed to convert field data collected as a series of points into lines. The point feature contains an attribute entitled "point" with the options of upstream, downstream and on. To collect a series of points to be later converted to a line feature, use the "upstream" point, then the "on" and then the "downstream" option of the point attribute. You can collect a series of "on" points if the feature is long or curved. Once processed, the length of the feature can be calculated using in ArcGIS.



The Stream Analyst extension contains a point to line conversion tool to aid with transferring attributes from points to a line. Although the point to line transfer tool will transfer attributes for a point, the user may need to resolve discrepancies between the attributes for two points. For instance if the upstream end of an eroding bank is the result of hydraulic erosion, but the bottom an example of mass failure, then it would be best to either choose one type in the field, or break the bank into two separate line segments. Consistency in field practices, such as starting and stopping features when attributes change can facilitate rapid data integration in the office. The collection of points using offsets is supported by Trimble and also greatly assists in the collection of points when the location cannot be easily occupied. See the GPS Survey Notes below for directions on taking offsets.



Photos and Descriptions:
All GPS Layers have a Description and a Photo field. The photo field is to be used to aide in the capture of photos in the field. Users should enter the photo number in this field. Where multiple photos are taken, a comma should be used to separate the photo numbers, ie. 001, 002,. The "Notes" field is available for additional comments or information to be used in further definition of the feature. (Examples)

In all references to left or right banks, the surveyor is assumed to be looking downstream.

GPS Surveying Notes:
Use of Offsets: GPS operator is advised to use an azimuth compass and tape or laser range finder to accurately record offsets when the surveyor is unable to occupy the feature location. Readings should be to the nearest 3 ft (yard) and degree. Care should be taken to accurately read the compass; minor errors in angle readings can result in significant position discrepancy.

Repeat function: Trimble Geoexplorer Models GeoXT are equipped with a repeat feature function which allows the surveyor to take consecutive shots of banks and the same feature type without having to re-enter the features attributes. This is especially useful with long eroding banks or other multiple point features which will later be converted to lines. If you are using the repeat function, be sure to update or clear the "Notes" field on any subsequent points.

Timely Data Download: Always download, post process and bring your field data into the geodatabase as quickly as possible. Typically you and your crew will retain familiarity with the data needed for efficient conversion for only about a week.

Know your Data Dictionary: This guide is only an introductory document. It is necessary to allow your crew a couple of days in the field to get familiar with the data dictionary before you can expect to improve your team's efficiency. Always check your field data in the geodatabase and perform tests of the various conversion tasks such as converting points to lines to get a clear understanding of proper field collection techniques.

Stream Management Data Dictionary Feature Index

Features

Bank Erosion (Point, Line)
Data Dictionary Layer(s): Bank_P, Bank_L
Use Notes: This feature is used to collect information on all eroding banks. Sources of fine suspended sediment, such as glacial lake clays beds can also be mapped with the Fine_Sed feature. If a failing bank contains such material both the Bank_P or Bank_L and Fine_Sed features should be used. Due to accuracy and accessibility issues it is preferable to collect this feature as a point in the field. It is also understood that the final database repository for this feature will be the associated line feature created in the office using a combination of heads-up digitizing and utilization of the point-to-line attribute transfer tool.

Attribute Fields	Description Options	Survey Notes
Point	Upstream, Downstream , Middle, On	This defines the location of a point on the eroding bank, ie. the upstream end, downstream end or a point on or along the bank (ie. the mid point, a vertex or a location where the bank character changes). For instance, changes in bank height can be captured using the "on" option, Middle should be used for short banks and the length must be noted under Length_Ft
Location	Left Bank, Right Bank, Across, In, Left Bed, Right Bed, on Center Bar	Is the eroding bank on the left bank or the right bank of the stream?
Height_Ft		This is the change in elevation from the toe of the bank (even if it is below the water surface) to the top of the unstable section. See the diagram under BEHI. This height is *not* the length of the exposure (slope distance).
Length_Ft		This is the length of the eroding bank and should only be used where the bank is very short (under 25 ft.) and where the surveyor expects to acquire only one point.
Fail_Gen	Hydraulic Erosion, Mass Failure, Surficial, Unknown, Multiple	See definitions below.
Fail_Spec	Fluvial Entrainment, Rotational Slip, Planar/Slab, Rills/Gullies, Shallow Sliding, Piping, Cantilever, Combination, Other	See definitions and diagram below.
Active	True, False, Unknown	Is there evidence of recent erosion? Indicators include bare

		soil, a lack of vegetation, tailings at the bottom of the bank or in the stream.
Stratified	True, False	Are there distinct layers of different sized material in the bank? Ie. A till layer over a clay layer.
Slope	Bank angle expressed in degrees	See illustration 2 under the BEHI feature
Material	Clay, Silt, Sand, Gravel, Cobbles, Bedrock, Mixed Till, Boulder	Dominant material in the bank (don't look at the bank toe). Additional notes can be included in the description field.
Vegetation	Barren, Grass/Sedge, Shrub, Tree, Roots/Woody, Shrub/Tree, Grass/Shrub, Grass/Tree	Is there vegetation on the bank, re-establishing on the bank, or roots in the bank?
WoodBuf_Ft		If there is a woody vegetation buffer above the point on the bank, how wide is it? Approximate measurement is recorded in feet.
Land_Class	Wetland, Forest, Agriculture, Parks/Recreation, Residential, Commercial, Transportation, Utility, Old Field	What is the predominant land use above the eroding bank within 2 bank full widths of the bank.
Undercut	True, False	Is the bank undercut
UndercutFt		Measure the depth of the undercut using a folding ruler. Record the measurements in feet and 10ths of foot, ie. 1.6 feet
Proposed	BEHI, Topo, Photo	Are additional surveys recommended?

Bank Erosion Glossary

General Erosion Types

Hydraulic Erosion – Material is removed or scoured by water flowing across the surface of a bank. Undercutting of banks is an example of hydraulic erosion

Mass Failure – The collapse and slumping of large chunks of bank material in single events. This would include all forms of failure shown in illustration 1 below.

Surficial – Loss of bank material caused by surface flows entering the channel from upland sources. Includes sheet, rill and gully erosion.

Specific Erosion Types

1. Fluvial Entrainment – The suspension and transport of bank materials by running water

2. Rotational Slip – See figure (e and f) in illustration 1

3. Planar/Slab – See figure (b and c) in illustration 1
4. Rills/Gullies – Erosion on the bank surface caused by water running off the exposed soil surface into small channels and then larger incised channels
5. Shallow Sliding – See figure (a) in illustration 1
6. Piping – A type of bank failure associated with ground water flow through coarse layers of material in a stream bank. The flow causes material within the layer or above the layer to erode into the stream
*7. Cantilev*er – See figures (g and h) in illustration 1Combination – enter the numeric code (1-7) for each type present in the notes field.
8. Other

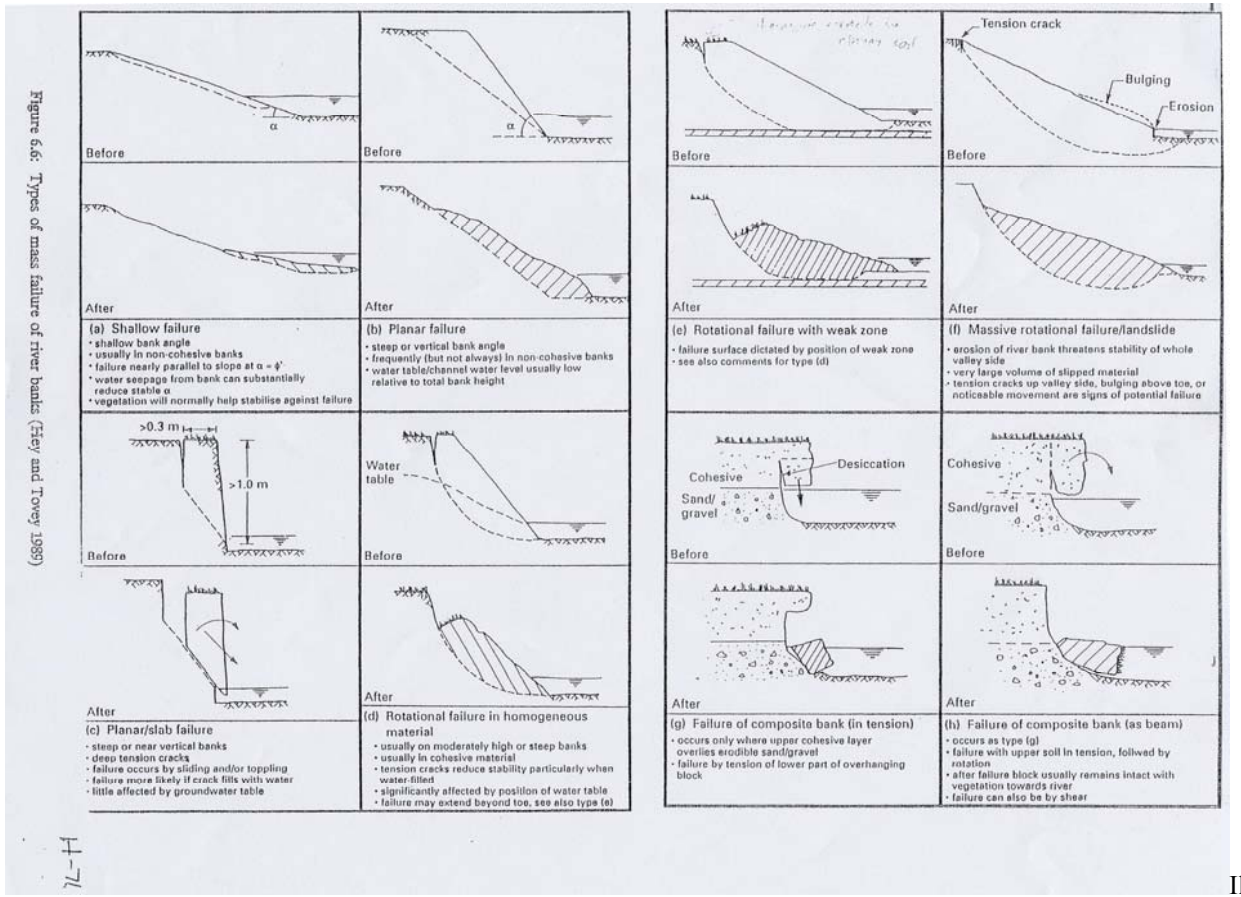


Illustration 1. Types of Mass Failure

BEHI (Point)
Data Dictionary Layer(s): BEHI
Use Notes: This layer is used identify the location and could be used to capture information gathered from a Bank Erosion Hazard Index survey. Sites where a future BEHI survey is recommended should be identified in the Bank Erosion feature. The BEHI survey protocol as described by D. Rosgen should be followed when taking measurements. While the data dictionary provides attributes to capture the entire set of BEHI variables, information from field forms, PocketRivermorph, or total station surveys can be integrated with the basic point information (id, data and location) within the geodatabase.

Attribute Fields	Description Options	Survey Note
BEHI_ID		Identification number
BEHI_Date		Date of BEHI survey, Month/Day/Year
Location	Left Bank, Right Bank	
BkFl_HtFt	Bankfull Height Ft	See illustration 2
Bk_Ht_Ft	Bank Height Ft	See illustration 2
RootDpthFt	Root Depth Ft	See illustration 2
pctRootDen	Root Density %	See illustration 2
Bank_Angle	degrees	See illustration 2
pctCover	Surface Protection	Percentage of surface covered by vegetation or other
BkankLngth	Bank Length Ft	Length of the eroding bank
BankMatrl		Size material
Bank_Strat		See glossary
Strat_Sev	1,2,3,4,5	One lowest, five highest

BEHI Glossary:
BEHI – Bank Erosion Hazard Index, as developed by D. Rosgen 1996, is a descriptor of bank condition and can be used to predict erosion potential.
Bankfull Height – For BEHI the bankfull height is the difference in elevation from the deepest point in the channel at the toe of the bank to the bankfull elevation (B in diagram 1)
Bank Height – Total height of the bank (A in illustration 2
Root Dpth Ft – Depth of roots from the top of the bank (C in illustration)
pctRootDen – Estimate of volume filled by roots
pctCover – Estimate of surface covered by vegetation
Bank Length – This can be estimated or taken from the bank erosion feature in the GIS

Reach Length – This can be acquired from the GIS
BankMatrl – Bedrock, Boulders, Cobble, Gravel, Sand, Silt/Clay
Bank_Strat - Presence, extent, sequence and position of stratification relative to bankful elevation
Strat_Sev – rating

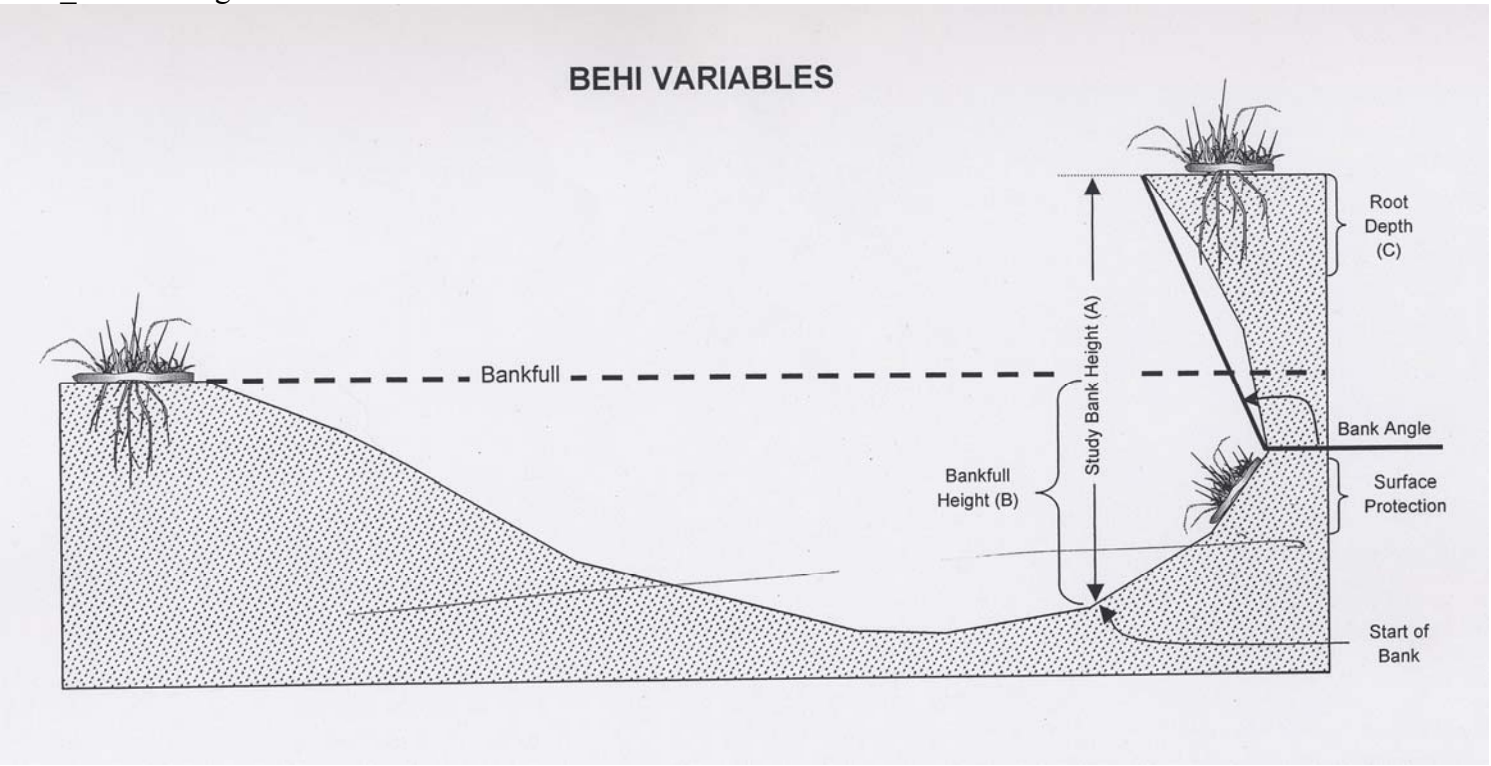


Illustration 2. BEHI Variables from Rosgen

Berm **(Point, Line)**
Data Dictionary Layer(s): Berm_P, Berm_L
Use Notes: Due to accuracy and accessibility issues it is preferable to collect this feature as a point in the field. It is also understood that the final database repository for this feature will be the associated line feature created in the office using a combination of heads-up digitizing and utilization of the point-to-line attribute transfer tool

Attribute Fields	Description Options	Survey Notes
Point	Upstream,Downstream, On	This defines the location of point on the eroding bank, ie. the upstream end, a point on the bank, or the downstream end. Changes in berm characteristics can be captured using the "on" option
Location	LB, RB	Is it on the left or the right bank?
Avg Ht_Ft	Average Height (ft.)	Height of the top of the berm above the surrounding floodplain. Height should be measured as the change in elevation, not slope distance.
Avg Wid_Ft	Average Width (ft.)	As measured at the base of the berm in feet.
Vegetation	None, Grass/Sedge, Shrub, Roots/Woody	Is there vegetation on the berm?
Activity	True, False	Is this an actively maintained berm?
Material	Boulder, Stone, Log, Concrete, Sheet Piling, Bedrock, Earthen, Other	From what you can detect, what is the principal material used to construct the berm?

Berm Glossary:
Berm – a manmade structure constructed to confine flood flows.

Best Management Practice (Point,Line)
Data Dictionary Layer(s): BMP_P, BMP_L
Use Notes: Due to accuracy and accessibility issues it is preferable to collect this feature as a point in the field. It is also understood that the final database repository for this feature will be the associated line feature created in the office using a combination of heads-up digitizing and utilization of the point-to-line attribute transfer tool

Attribute field	Description Options	Survey Notes
Point	Upstream, Downstream, On, Middle	
Location	Left Bank, Right Bank, Across, In, Thalweg	
BMP_Type	Vane, Cross Vane, Weir, Root Wad, Fascine, VRSS, Live Stakes, Live Crib, Joint Planting, Coconut Roll, Tree Seedling, Hydroseeded, Other	See definitions below
Material	Rock, Log , Plant, Other	
FunctCond	Good, Fair, Poor, Not Functional	Good – flows directed away from bank, no signs of bank stress, pool depth adequate but not excessive Fair – some bank or bed scour, flow may not be moving through the proper point on the structure, possibly some aggradation in the pool. Poor – significant bed or bank scour, aggradation, or flow is misdirected or beginning to move around the structure. Not Functional – structure is not redirecting flow away from the bank or protecting the bed, in fact excessive scour may be causing the channel to migrate.
StructCond	New, Good, Fair, Poor, Failed	New – the structure is new and has not experienced a bankfull event Good – the structure has experienced bankfull events and still appears much the same as when constructed. Fair – the structure has deteriorated and may be missing stones, may have gaps, settled or rotated materials, failed support plantings, may show evidence of the scour or aggradation. Poor – the structure is crumbling, slumping, covered with sediment,

		scoured out, show evidence of the significant likelihood that failure can be expected in the near future. Failed – the structure has been significantly damaged. Ie. it has been washed away, buried, or no longer flows
Length_Ft		Required when "middle" is selected on the point option

Vane – Rock or wood structures that protrude from either streambank but do not extend entirely across a channel. They deflect flows away from the bank, and dissipate energy in downstream scour pools created by water flowing over the vane.
Cross Vane – see Weir
Weir – Log, boulder, or quarrystone structures placed across the channel and keyed into the streambank to control grade, dissipate energy, create pool habitat, control bed erosion.
Root Wad – a tree root mass keyed into the bank with boulders or quarrystone to provide energy dissipation, and create habitat.
Fascine – Long bundles of woody branches partially buried to provide as a means of establishing rows of regeneration for bank and floodplain protection
VRSS – Vegetated Reinforces Slope Stabilization, a bioengineering practice which combines brush layering and geotextile materials to secure soil in layers on steep, high embankments
Live Cribbing – the use of vigorously sprouting woody materials stacked and backfilled to produce a living bank protection structure.
Live Staking – use of woody cuttings partially buried along a bank or floodplain for the purpose of establishing new trees or shrubs
Joint Planting – live staking or potted plant material planted in the cracks or interspaces of riprap or stacked rock walls for the purpose of providing long term bank stability and improved habitat.

Bridge **(Point)**
Data Dictionary Layer(s): **XBridge**
Use Notes:

Attribute Fields	Description Options	Survey Notes
Owner	Private, County, State, Town, Village	
Bridge_ID		Id number is commonly displayed on the abutment under the bridge deck
Road_Name		Name of road
SpanNormFt		Span from abutment to abutment
SpanEffect		Span that actually conveys the flow (see diagram)
Ht_Ft		Average height from bottom of deck to the stream bed
Funct	Conveying, Contributing	Does the bridge cross the main stem (conveying) or a tributary (contributing)
FunctCond	Good, Fair, Poor, Not Functioning	
StructCond	New, Good, Fair, Poor, Failed	
Piers		Number of Piers supporting the bridge
Encroch_Rt		Number of Ft. encroachment of the right abutment on the right floodplain
Encroch_Lf		Number of Ft. encroachment of the left abutment on the left bank

Bridge Glossary:
SpanEffect – the effective portion of the span (length of opening) of the bridge which discounts portions of the span where the direction of the flow conflicts or impeded by the abutments or piers of the bridge.

Control (Point, Line)
Data Dictionary Layer(s): Cntrl_P, Cntrl_L
Use Notes: Beaver dams are not considered grade control and are entered under the Obstruction feature. Stream BMPs constructed by DEP or partnering agencies should also be documented under BMP. Due to accuracy and accessibility issues it is preferable to collect this feature as a point in the field. It is also understood that the final database repository for this feature will be the associated line feature created in the office using a combination of heads-up digitizing and utilization of the point-to-line attribute transfer tool

Attribute Fields	Description Options	Survey Notes
Point	Upstream, Downstream, Middle, On	
Location	Across, Left Bed, Right Bed, Left Bank, Right Bank, All	If more than one type exists, ie. left bed and left bank, establish two separate points, one bed-grade control, a second as bank-planform control..
Ctrl_Type	Grade, Planform, Both	
Material	Boulder, Stone, Log, Concrete, Sheet Piling, Bedrock, Other	"Boulder" would pertain to a substantial natural control whereas "stone" refers to a man-made structure that acts as a control.
Func_Cond	Good, Fair, Poor, Not Functioning	Relevant for man-made structures (check dams, weirs, deflectors) Good – flows directed as intended by the structure Fair – some excessive bank or bed scour, flow may not be moving through the proper point on the structure, possibly some aggradation in the pool. Poor – significant bed or bank scour, aggradation, or flow is misdirected or beginning to move around the structure. Not Functioning – structure is not controlling the flow. The channel is beginning to migrate or headcut.
Struc_Cond	New, Good, Fair, Poor, Failed	Relevant for man-made structures (check dams, weirs, deflectors) New – the structure is new and has not experienced a bankfull event Good – the structure has experienced bankfull events and still appears much the same as when constructed. Fair – the structure has deteriorated and may be missing stones, may have gaps, settled or rotated materials, failed support plantings, may show evidence of the scour or aggradation. Poor – the structure is crumbling,

Length_Ft.		For use only with point “middle” option where the length of the control is less than 25 ft long

Grade Control Glossary:

Crossing (Point)
Data Dictionary Layer(s): Crossing
Use Notes: The point should be taken in the thalweg.

Attribute field	Description Options	Survey Notes
CrossType	Agricultural, Forestry, Recreational, Other	This feature is use to locate fords along the stream

Culvert **(Point)**

Data Dictionary Layer(s): XCulvert

Use Notes: Use this feature to locate and describe structures of passing stream flow and stormflow in natural channels and swales. Streams and tributaries that must pass the flow under a road or pathway. Use " piped outfall" to locate and describe structures for point source contribution or stormflow from developed areas to the system (contributions from parking areas, roadway ditches, barnyards, homes or businesses)

Attribute field	Description Options	Survey Notes
Owner	Private, County, State, Town, Village, Unknown	
Road_Name		
Culv_Type	Round, Pipe Arch, Box	
Material	Corrugated Metal, Smooth Steel, Plastic, Concrete, Other	
Funct	Conveying, Contributing	Is the pipe for water entering from a tributary or does the culvert convey the stream (ie. A road is passing over the stream)
FunctCond	Good, Fair, Poor, Not Functioning	Good – flows received and directed as intended by the structure Fair – some excessive bank or bed scour, flow may not be moving through the proper point on the structure, possibly some aggradation above or degradation below. Poor – significant bed or bank scour above or below, aggradation above or below, or flow is misdirected or beginning to move around or under the structure. Possibly undersized, constrains fish migration Not Functioning – structure is not controlling the flow. The channel is routed around the culvert
StructCond	New, Good, Fair, Poor, Failed	New – the structure is new and may not have experienced a flood event Good – the structure has experienced bankfull events and still appears much the same as when constructed. Fair – the culvert has deteriorated and may be corroded, slightly crushed, erosion of headwall or may show evidence of the scour or aggradation. Poor – the structure is crumbling or collapsing etc. Failed – blown out, crushed, collapsed
Rise_Ft		Height of the Culvert pipe (inside diameter measured to the 10^{th} foot)
Span_Ft		Width of the culvert pipe

Depositional Feature(Point)
Data Dictionary Layer(s): Dep_Feat
Use Notes: Use this feature to locate bars. Locate the approximate center of the bar and estimate its length, width.and principal particle size. Use the sed_sample feature to locate the position of bar samples. Use notes to further describe the types of materials present.

Attribute field	Description Options	Survey Notes
Point	Upstream, Downstream, Middle, On	
Location	Left Bed, Right Bed, Center, Thalweg, All	This defines the location of bar with respect to the channel. "All" represents across the entire channel.
Dep_Type	Transverse Bar, Point Bar, Center Bar, Side Bar, Delta Bar, Full Channel, Other	See definitions and illustration below
Material	Clay, Silt, Sand, Gravel, Cobble, Boulder, Stratified, Bi-Modal	
Vegetated	Grass/Sedge, Woody, Grass/Shrub, None	
Length_Ft	Feet	Length of the bar in feet
Width_Ft	Feet	Width of the bar in feet

Depositional Feature Glossary:
Transverse Bar- (Diagonal Bar) figure B5
Point Bar – Figure B1
Center Bar – (Mid Channel Bar) figure B3
Side Bar – figure B4

Delta Bar – figure B8
Full Channel Bar – a depositional feature that crosses the entire channel perpendicular to flow where the flow is not directed toward a particular bank.
Bi-Model – a distribution of material size classes that consists principally of two classes.

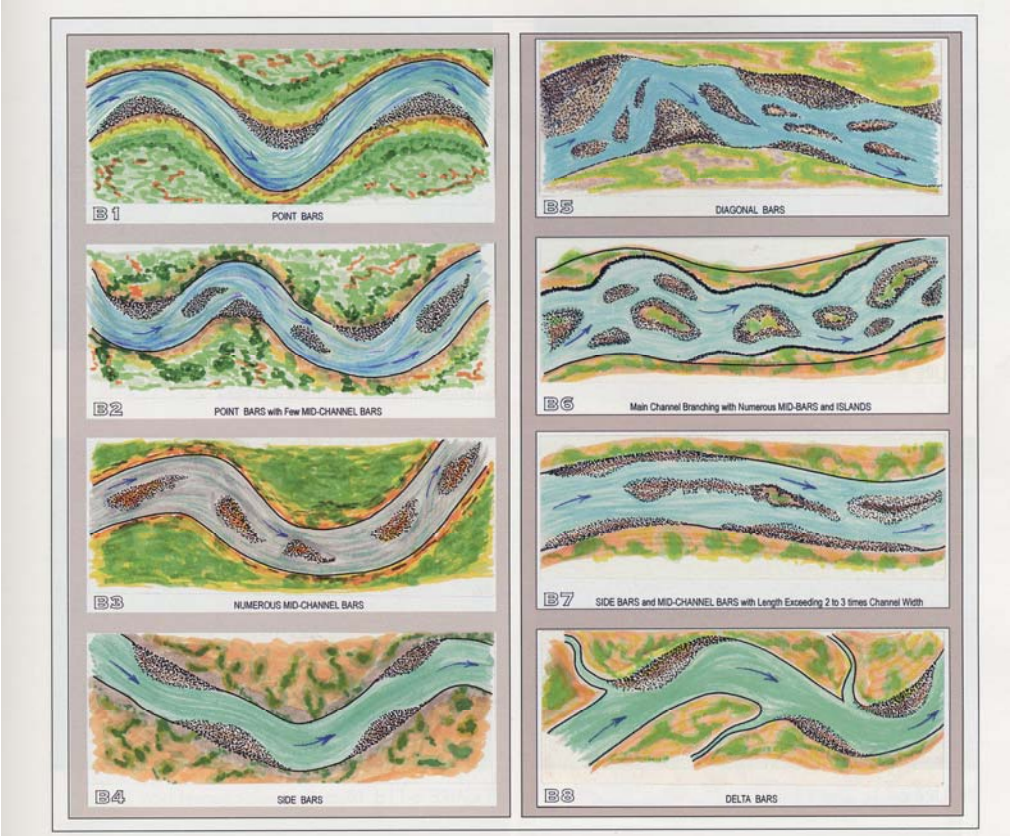


FIGURE 6-10. Illustrations of various depositional features as modified from Galay et al. (1973).

Dump **(Point)**
Data Dictionary Layer(s): **Dump**
Use Notes:

Attribute field	Description Options	Survey Notes
Location	Floodplain Left, Floodplain Right, In, Other	This defines the location of the dump. Floodplain left, Floodplain right or in the channel
Material	Yard Waste, Wood, Glass, Metal, Mixed, C&D	What is the principle material contained in the dump? Metal includes appliances and vehicles or parts.
Hazardous	True, False	Could the release of the material pose a threat to humans or wildlife or the environment in general?
Active	True, False	Has material been added to the dump within the past few years?
Fld_Hazard	True, False	Could this material be mobilized during a flood?

Dump Glossary:
C&D – Construction debris
Yard Waste – lawn and garden clippings, leaf piles, and piles of cut branches
Metal – including appliances, car frames or parts, unidentifiable pieces of metal
Wood – scrap or discarded wood or wooden objects such as boards or furniture

Fine Sediment Source (Point)
Data Dictionary Layer(s): Fine_Sed
Use Notes: This feature should be collected where the assessment team encounters clay or other fine sediment exposures along a stream bank or as part of the stream bed. Observations of exposed clay that might indicate local geologic instability away from the channel, but that might influence the stream and its waters can also be located using this feature. This feature is collected in addition to Bank Erosion (Bank_Er) and BEHI

Attribute field	Description Options	Survey Notes
Point	Upstream, Downstream, Middle, On	This defines the location of point on the exposure, ie. the upstream end, a point on the exposure, or the downstream end. Changes in exposure characteristics can be captured using the "on" option
Location	LB,RB,In Channel, Both, All	LB – left bank, RB – right bank. Both signifies both bed and bank exposures. If there is a left and a right bank exposure, collect two separate points.
Geol_Type	Lacustrine Clay, Glacial Till, Mixed, Alluvial, Other, Uncertain	
Source	Bed, Bank, Both, Other	
Length_Ft	Feet	Length of exposure along bank
Width_Ft	Feet	Width of exposure across bed
Height_Ft	Feet	Height of exposure on bank

Fine Sediment Glossary:
Lacustrine Clay – Refering to clay beds deposited at the bottom of glacial lakes. These clays typically are dense red clays that contain little gravel or cobble, and are easily suspended in water.
Glacial Till –Glacial drift composed of an unconsolidated, heterogeneous mixture of clay, sand, gravel, cobbles, and boulders
Mixed – A clay exposure that includes both lacustrine clay beds and glacial till deposits with a high clay component.
Alluvial – a sediment source that has previously been moved by water

Floodplain Indicator (Point)
Data Dictionary Layer(s): Fld_Ind
Use Notes:

Attribute field	Description Options	Survey Notes
Ind_Type	HWM, Bankfull, Terrace, Other	HWM - High water marks. For HWM indicate the date of the event in the notes field. Bankfull indicator, Terrace slope break
Location	RB, LB	
Elev_Ft		Datum for the elevation should be recorded in the notes field…ie, recent survey, height above ?
ID		Should be used for bankfull indicator or HWM flags are numbered
TerraceDst		Distance of base of terrace from top of streambank
TerraceHt		Height of top of terrace from base of terrace

Floodplain Indicator Glossary:
High Water Mark – an indicator of the maximum stage of a recent flood event as typically evidenced by a band of accumulated debris (grasses, leaves, twigs, or other light material).
Bankfull – used to indicate the location where bankfull indicators are readily identifiable or bankfull flags have been placed
Terrace – used to indicate the base of terraces especially where recent channel degradation processes have created a series of terraces.

Gage (Point)
Data Dictionary Layer(s): Gage
Use Notes: For Continuous gages, the GPS point for the gage should be taken at the stream where the inlet pipe enters the water. Staff plate and crest stage gages are GPSed at the location of the measuring device.
Fields

Attribute field	Description Options	Survey Notes
Location	Left Bank, Right Bank, In	
Gage_ID		USGS gage eight digit ID
Gage_Type	Staff Plate, Continuous, Crest Stage, Unknown	See glossary
Active	True, False	

Land Cover (Point)
Data Dictionary Layer(s): LandCovP
Use Notes: To be used for field veritication of supervised land cover classification. Users are refered to riparian land cover mapping protocol and classification schema developed by NYC DEP SMP and GCSWCD, DCSWCD. The relationship of level I classes to level II classes are

Attribute field	Level I Class	Level II Class
	Bare Soil"	Cobble Construction Spoils Exposed Bank Gravel Mine Junkyard Landfill/dump Roadcut, cliff/slope Bedrock
	Herbaceous	Mowed Lawn Mowed Lawn w/ Trees Mowed Roadside Pastureland Wet Meadow Shallow Emrgnt Marsh Sparse Vegetation Success Old Field Cropland
	Shrubland	Brushy Cleared Land Evrgrn Shrubland Shrub/Shrub Wetland Success Shrubland

Land Cover	**(Point) continued**	
	Decid Clsd Tr Canopy	Clsd N Hrd Clsd Floodplain Frst Clsd Decid Frst Wet Clsd Success N Hrd
	Decid Opn Tr Canopy	Opn N Hrd Opn Floodplain Frst Opn Decid Frst Wet Opn Success N Hrd
	Evrgrn Clsd Tr Canopy	Clsd Hem FrstClsd Clsd White Pine Frst Clsd Evrgrn Frst Wet
	Evrgrn Opn Tr Canopy	Opn Hem Frst Opn White Pine Frst Opn Evrgrn Frst Wet
	Mixed Clsd Tr Canopy	Clsd Hem-N Hrd Clsd Pine-N Hrd Clsd Sprc-N Hrd Clsd Mixed Frst Wet
	Mixed Opn Tr Canopy	Opn Hem-N Hrd Opn Pine-N Hrd Opn Sprc-N Hrd Opn Mixed Frst Wet
	Unpaved Road	Unpaved road Railroad Path
	Impervious Surface	Paved Other Rooftop
	Revetment	Riprap Concrete Other

Land Cover (Point) continued

	Water	Backwater Slough Farm Pnd/Ag Pnd Farm Pnd/ArtfclPnd Ind Cooling Pnd Natural Pnd Reservoir/Artfcl Sewage Treatment Pnd Tributary Beaver Impoundment Ephemeral Pnd/Pool
Location	Left Bank, Right Bank	

Land Cover Glossary:
Ag-Agricultural
Artfcl – Artifical
Clsd-Closed
Decid-Deciduous
Evrgrn-Evergreen
Frst-Forest
Hem-Hemlock
Hrd-Hardwood
N-Northern
Pnd-Pond
Sprc-Spruce
Success-Successional
Wet-Wetland

Large Woody Debris (Point
Data Dictionary Layer(s): LWD_P

Use Notes: This feature is used to capture piles of large woody debris on the floodplain that are not a significant obstacle to flows. Woody debris that is and obstacle should be captured under the Obstacle feature.

Attribute field	Description Options	Survey Notes
Point	Upstream, On, Downstream	Is this the upstream limit, a point along the reach, or the downstream limit
Location	Right Bank, Left Bank	

Monitoring Site (Point, Line)
Data Dictionary Layer(s): MntrSite
Use Notes: For use by assessment or research survey teams to delineate the extent of known or proposed monitoring locations. Due to accuracy and accessibility issues it is preferable to collect this feature as a point in the field. It is also understood that the final database repository for this feature will be the associated line feature created in the office using a combination of heads-up digitizing and utilization of the point-to-line attribute transfer tool

Attribute field	Description Options	Survey Notes
Point	Upstream, On, Downstream	Is this the upstream limit, a point along the reach, or the downstream limit
Location	Right Bank, Left Bank, Thalweg	
TypeMntr	Geomorphic Survey, Fisheries Survey, Macroinvert Survey, Sed transport survey, BEHI, Water Quality, Vegetation, Biota, Habitat	
SurveyType	Treatment, Control, Reference	
Status	Existing, Proposed	
Name/Id		Text field for identifying an existing site's name or id, ie. Broadstreet Hollow Reference reach…

Monitoring Point (Point)

Data Dictionary Layer(s): MntrPnt
Use Notes: For use by research or monitoring survey teams to identify location of specific instruments

Attribute field	Description Options	Survey Notes
Location	Right Bank, Left Bank, Left Bed, Right Bed, Thalweg	
InstType	Scour chain, bank pin, other	
Feature	Riffle, run, pool, glide	
Status	Existing, Proposed	
Id		Text field for identifying an existing site's name or id, ie. Broadstreet Hollow Reference reach…

Montgomery and Buffington Classification (Point)
Data Dictionary Layer(s): ClassM_B
Use Notes: For use by assessment survey teams to identify the location of stream feature types based on Montgomery and Buffington's Classification system. (See reference)

Attribute field	Description Options	Survey Notes
Location	Right Bank, Left Bank, In	
MB_Type	Colluvial, Bedrock, Cascade, Step-Pool, Pool-Riffle, Dune–Ripple, Regime, Braided	

Montgomery and Buffington Classification Glossary,

Management Practice (Point)
Data Dictionary Layer(s): MgtPract
Use Notes: Used to indicated general location of where stream management practices have been implemented

Fields

Attribute field	Description Options	Survey Notes
Point	Upstream, Downstream, On, Middle	
Location	Left Bank, Right Bank, Across, In, N/A	
TypePract	Channel Restoration, Bank Stabilization, Aquatic Habitat Str, Clay Removal, LWD Management, Berm Removal, Flood Control, Rip Veg Restoration, Invasive Sp Mgmt, Infrastruct.Setback, Stormwater Mgmt, Land Acquisition, Other	See definitions below

Miscellaneous (Point, Line, Area)
Data Dictionary Layer(s): Misc_P, Misc_L, Misc_A
Use Notes: Used for non specific features or features unaddressed by other data dictionary features
Fields

Attribute field	Description Options	Survey Notes
Point	Upstream, Downstream, On, Middle	
Location	Left Bank, Right Bank, Across, In, N/A	
Notes		
Photo		

Obstruction (Point)
Data Dictionary Layer(s): Obstruct
Use Notes: For multiple effects enter the principle effects in the notes field.

Attribute field	Description Options	Survey Notes
Location	LB,RB,Across,In	Across – the obstruction blocks the entire channel In – the obstruction may be only partially blocking the channel
Obstr_Type	Log, Tree, Woody Debris, Trash, Beaver Dam, Other, Multiple	Log – cut or broken off tree stem Tree – a whole or mostly whole tree that is fallen into the waterway. Its roots may or may not be still embedded in the bank Woody debris – a consolidation of woody material Trash – mixed debris from human sources

EffectUpt	Erosion, Deposition, Backwater, Scour, Reroute, Grade Control, Multiple, None	
EffectDown	Erosion, Deposition, Backwater, Scour, Reroute, Grade Control, Multiple, None	
Impact	Site, Reach, None, Unknown	
LengthFt		

Photo Point (Point)
Data Dictionary Layer(s): Photo_P,
Use Notes: Used for non specific photo points features or photo points of features unaddressed by other data dictionary features.

Attribute field	Description Options	Survey Notes
Location	Left Bank, Right Bank, Across, In, N/A	
Notes		
Sub_locate	Left Bank, Right Bank, In, Across	The subject is located on the leftbank, right bank, in stream or streaches across the stream
Photodirct	Upstream, Downstream, Across, N/A	Direction of the photo relative to the stream flow
Azimuth	Azimuth degrees (360)	Azimuth direction of the subject from the point where the photo is taken
Photo		

Piped Outfall (Point)
Data Dictionary Layer(s): PipedOut
Use Notes:

Attribute field	Description Options	Survey Notes
Size	2",4", 6", 8", 10" 12", 15", 18", 21", 24", 30", 36", 42", 48", 54", 60", 66", 72", 84", 96", 102", 108", other	Pipe diameter in inches
Location	LB, RB	Does the outfall enter from the left or right bank?
Material	Corrugated Metal, Smooth Steel, Plastic, Concrete, Other	What is the material of the pipe
Flow	Perennial, Ephemeral, Intermittent, Unknown	Is the flow year round (perennial) or seasonal/regulated (ephemeral)?
OutProtect	Good, Fair, Poor, Absent, Not Functional	Good – manmade structure or natural land form adequate for conveying flow without significant scour. Fair – structure provides some protection but scour is occurring. Poor – structure provides little protection and scour threatens water quality, bank stability or the pipe. Maintenance needed. Absent – no natural or man-made protection present and it is badly needed.
Outfall_Ft		Change in elevation between the bottom of the pipe and the water surface?
Headwall	True, False	Is there a headwall at the outlet of the pipe?
Owner	Private, Municipal, Undetermined	

Revetment (Point, Line)
Data Dictionary Layer(s): Revet_P, Revet_L
Use Notes: When using points to map revetment along a bank, survey both a start and end point. If the Revet_Type changes mid-way along a protected bank, survey a point at the end the initial feature, then use the repeat function to start a new feature with the new Revet_Type selected. Due to accuracy and accessibility issues it is preferable to collect this feature as a point in the field. It is also understood that the final database repository for this feature will be the associated line feature created in the office using a combination of heads-up digitizing and utilization of the point-to-line attribute transfer tool

Attribute field	Description Options	Survey Notes
Point	Upstream, Downstream, On, Middle	This defines the location of point on the revetment, ie. the upstream end, downstream end or a point on or along the revetment (ie. the mid point, or a vertex).
Location	LB, RB	Is the revetment on the left bank or the right bank of the stream.
Revet_Type	Gabion Basket, Rip-Rap, Sheet Piling, Log Cribbing, Stacked Rock, Sloped Stone, Concrete/Poured, Concrete/Slab, Bio-Engineering, Other	
HeightFt		Height in feet
Func_Cond	Good, Fair, Poor, Not Functioning	Good – flows are not disturbing the bank Fair – some bank scour Poor – significant bank scour Not Functioning – structure is not protecting the bank or the stream alignment/elevation has changed and abandoned or buried the revetment.
Struc_Cond	New, Good, Fair, Poor, Failed	New – the structure is new and has not experienced a bankfull event Good – the structure has experienced bankfull events and still appears much the same as when constructed. Fair – the structure has deteriorated and may be missing stones, may have gaps, settled or rotated materials, failed support plantings, may show evidence of the scour or aggradation.

		Poor – the structure is crumbling, slumping, covered with sediment, scoured out, show evidence of the significant likelihood that failure can be expected in the near future. Failed – the structure has been significantly damaged. Ie. it has been washed away, buried, or no longer protects the bank.
BankKeyed	True, False, Unknown	Is the revetment tied back into the bank?
ScourProt	True, False, Unknown	Is the toe protected from scour?

Riparian Vegetation (Point, Line)
Data Dictionary Layer(s): RipVeg_P, RipVeg_L
Use Notes: This feature provides information on the location of existing or proposed conservation plantings, invasive plant communities and the location of possible sources of planting material. Also see Land Cover (LandCov_P) for a point feature for documenting land cover in association with riparian corridor land cover/vegetation mapping. Due to accuracy and accessibility issues it is preferable to collect this feature as a point in the field. It is also understood that the final database repository for this feature will be the associated line feature created in the office using a combination of heads-up digitizing and utilization of the point-to-line attribute transfer tool

Attribute field	Description Options	Survey Notes
Point	Upstream, Downstream, On, Middle	This defines the extent of the vegetation on the bank, ie. the upstream end, downstream end or a point on or along the community (ie. the mid point, a vertex or a location along the community boundary).
Location	LB, RB	Is the vegetation being described located on the left bank or the right bank of the stream?
Plant_Site	Existing, Proposed, NA	Has the vegetation at this location been planted as part of a conservation effort. Could it be a site that would support additional vegetation as part of an effort to protect property, or improve habitat or water quality
Material	Willow, Sedge, , Other	Willow, Sedge and Alder can be noted where there is a possible source of planting material

Invasive	Alder, Knotweed, Multiflora Rose, Barberry, Loosestrife	Knotweed, Multiflora Rose, Barberry and Loosestrife should be mapped as individual points for small colonies or as a series of points to be joined as a line to represent a continuous community
Mow_Crop	True, False	Is the site mowed or cropped to the edge of the stream or nearly so? (ie. buffer is nearly absent due to practice)
Bank_length		For use with invasive feature. For small colonies that are best collected as points, provide an estimate of the colony width or the length of bank covered by the colony. If the colony occupies more than 100 ft of bank, collect the feature as a series of points that will be connected in the office. Can also be used to estimate bank lengths effected by mowing or cropping

Riparian Vegetation Glossary:

Road **(Point, Line)**
Data Dictionary Layer(s): Road_P, Road_L
Use Notes: This feature should be captured where a road or trail either crosses the stream or may impact the stream and its floodplain. Due to accuracy and accessibility issues it is preferable to collect this feature as a point in the field. It is also understood that the final database repository for this feature will be the associated line feature created in the office using a combination of heads-up digitizing and utilization of the point-to-line attribute transfer tool

Attribute Fields	Description options	Survey Notes
Location	Left bank, Right bank	
Position	Centerline, Edge, Ditch, Guiderail	Feature of the road that is being captured
Material	Paved, Gravel, Vegetation, Dirt, Other	
Road_Use	Auto, RR, Trail, Recreation Vehicles, Ag Use, Forestry, Other	Principle use
Owner	State, County, Town, Private, Federal	
Road_Name		Fill in the name

Road Glossary:
RR – working or abandoned railroad right of way – not including a rail trail. For rail trail see trail.
Trail – a path or improved route including a rail trail typically not used by motorized recreational vehicles
Recreational vehicle – trails used by recreational vehicles…atvs, snowmobiles, etc.
Ag. Use – farm road or tracks traveled by heavy equipment
Forestry – logging trails or roads including those that have not been used recently

Rosgen Level 1 Classification (Point)
Data Dictionary Layer(s): RosgenL1
Use Notes: This feature is captured in the field when the surveyor encounters what is believed to be a change in the Rosgen Classification Stream Type. **The point should be taken in the thalweg**, **preferably at a feature break.** This can be used to verify office based classification or add additional breaks at the time of a walkover.

Attribute Fields	Description options	Survey Notes
ClassAbove	Aa+-G,Undetermined	What is the likely classification of the upstream reach?
ClassBelow	Aa-G,Undetermined	What is the likely classification of the reach below this point?
Reference	True,False	Is this possibly a reference reach (at first glance, does it have indicators that suggest it might be stable?)

Rosgen Level 1 Class Glossary:

Sediment Sample Location (Point)
Data Dictionary Layer(s): SedSample
Use Notes: This feature is captured at the location of sediment samples such as a bar sample or pebble count

Attribute Fields	Description options	Survey Notes
Samp_Type	Bulk, Pebble	
Sample_Locat	Bed, Bar, Bank, Other	
Number		Id number
D84_Est		This is estimated
D50_Est		This is estimated

Stream Feature **(Point, Line)**
Data Dictionary Layer(s): **SFeat_P, SFeat_L**
Use Notes: This feature can be used to create stream alignments and define the breaks in features along the stream. **The point should be taken in the thalweg**, **preferably at a feature break.** Due to accuracy and accessibility issues it is preferable to collect this feature as a point in the field. It is also understood that the final database repository for this feature will be the associated line feature created in the office using a combination of heads-up digitizing and utilization of the point-to-line attribute transfer tool

Attribute field	Description Options	Survey Notes
Point	Upstream, Downstream, On, Middle	This defines the location of point on the stream feature, ie. the upstream start, downstream end or a point on or along the stream feature (ie. the mid point, or a vertex).
Location	Thalweg, Right, Left, On Center Bar	Is the location where the point is being taken. Normally this should be "Thalweg", but in the case of a divergence or convergence it might "On Center Bar".
Feat_Type	Riffle, Run, Pool, Glide, Step, Step Pool Sequence, Scour, Headcut, Cascade, Divergence, Convergence, Other	Taken at the top of the feature. See Stream Feature Glossary
Reference	True, False	Could this be a reference reach? This is only to indicate where a future reference reach survey might be undertaken.
Channel	Main, Secondary, Other	Is the point you are taking located on the main channel or a secondary channel?
SC_Type	Flood Chute, Avulsion, Backwater Area, Other, Side Channel	Secondary Channel Type. This attribute is used in combination with the Channel attribute. It provides more detail about the type of secondary channel.
Change_Ft		Elevation change between the top and bottom of a feature. Especially used for headcut
LengthFt		Required only if using middle under location
Flow	Perennial, Intermittent, Subsurface, Unknown	Is the channel flowing? Can be used to capture areas of subsurface flow

Stream Feature Glossary:

Riffle – The steeper section of a stream between two pools where the thalweg crosses from one side of the stream to the other. Water depth is shallower than pools, velocities are greater, and bed material size is greater than the pool material.

Run - the transition from the riffle to the pool typified by an increase in slope at the head of the run and by a reduction in velocity and an increase in depth at the end of the run. This runs are not differentiated from riffles and pools, then they should be included as part of the riffle. The run is the steepest section of the stream.

Pool – the deeper section of the stream typically located at meander bends where material sizes are smaller and velocities are lower. Bed slope through the pool are at first negative (downward) and then positive the bed rises upto the glide and then returns to a negative slope at the head of the riffle. The water surface through the pool is nearly flat.

Glide – the outlet of a pool where the stream bed slopes up out of the pool and crests before returning to the downward slope in the riffle. The limits of this feature are difficult to properly identify and should be confirmed by an experienced team member. In general, it is the location where water appears to be pouring out of the pool and into the riffle. There may be a break in slope between the pool and the beginning of the glide and then another break between the end of the glide and the beginning of the pool. If glides are not differentiated from pools and riffles, then they should be included as part of the pool.

Step – a single short drop between pools

Step Pool Sequence – a feature of high gradient streams where riffles are absent and water flows over a series short drops or "steps" interspaced with pools.

Headcut – a significant drop in elevation along the channel profile that appears to be migrating upstream. Below the feature there may be evidence of channel bottom scour, an entrenched condition, or bank exposure beginning immediately below the drop. There also may be evidence of the formation of a terrace below the headcut.

Cascade –

Divergence – location where a secondary channel splits off from the main channel

Convergence – location where a secondary channel rejoins the main channel or another secondary channel.

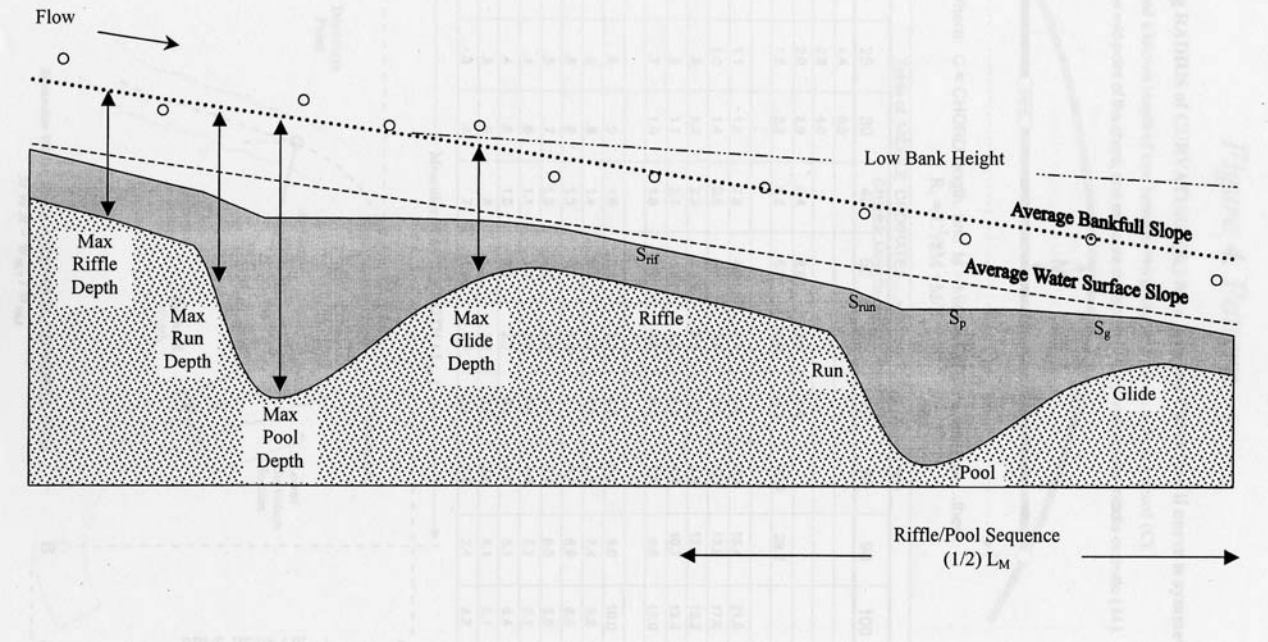
Flood Chute -

Avulsion -

Backwater Area –

Side Channel –

Figure 3. Longitudinal Profile



Survey Control (Point)
Data Dictionary Layer(s): SurvCont
Use Notes: For use in capturing the general location of all survey control. The Cont_Type attribute "Xsection" should be used to identify the location of cross section bank pins. . If a cross section has a vertex –in the case of a bifurcated channel -, an additional point with the same attribute information should be taken at the vertex . This is not for establishing specific coordinates for high level professional survey, but could be used to identify the approximate location of high level survey control benchmarks. For cross sections, the points will be used to establish a cross section line in the geodatabase using the point to line conversion tool. Use the notes field to record the appearance of the marker (ie. 2" capped rebar with orange flagging.)

Attribute field	Description Options	Survey Notes
Cont_Type	USGS Marker, DOT Marker, County Marker, BEHI, Erosion, Survey Station, Xsection, DEC Marker, Profile, Topo, Other	Erosion includes bank pins and scour chains. Xsection includes the bank pin or other permanent monuments demarcating the cross section.
Location	LB, RB	
Elevation		Elevation as recorded on the marker or assumed from the survey
XS_Type	Reference, Classification, Monitoring, Other	Purpose of the cross section
ID		

Tributary (Point)
Data Dictionary Layer(s): Trib
Use Notes:
Fields

Attribute field	Description Options	Survey Notes
Location	LB, RB	Does the tributary enter on the left or right bank?
Trib_Type	River, Stream, Spring Seep, Other	
Flow	Perennial, Ephemeral, Intermittent, Unknown	
Name		If unnamed tributary is significant, enter "unknown"

Utility **(Point)**
Data Dictionary Layer(s): **Utility**
Use Notes:

Attribute field	Description Options	Survey Notes
Util_Type	Pole, Well, Phone, Sewer, Water, Cable, Gas, Hydrant, Multiple	
Util_ID		If the pole has a id number
Owner	Public, Private, Unknown	
Orient	Parallel, Perpendicular	Does the utility line run approximately parallel or across (perpendicular to the stream

Utility Glossary:

Subject Index

Appendix F Fish & Macroinvertebrate Survey Reports

Appendix F: Fish and Macroinvertebrate Survey Reports

Fish Distribution and Water Quality of the Manor Kill, Schoharie County, NY

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Abstract: A survey of the Manor Kill, Schoharie County, NY was conducted to determine the distribution of the fish and water quality parameters of the stream. To meet this goal, 15 sites were sampled in the Manor Kill, and the Bear Kill, which is a major tributary of the Manor Kill. Data collected indicated that all water quality parameters except for alkalinity, and hardness were within optimal levels. The fish sampling showed that there is a stable trout population as well as a stable forage base for the trout.

Introduction

This survey of the Manor Kill, Schoharie County, NY was conducted at the request of the Town of Conesville. The Manor Kill flows into the Schoharie Reservoir. This makes the Manor Kill a high interest stream to not only Schoharie County but also the City of New York. The goal of the sponsor is to determine the fish distribution, and water quality of the Manor Kill.

Historically, the Manor Kill was stocked with brown trout (*Salmo trutta*) and brook trout (*Salvilinus fontinalus*) by the New York State Department of Environmental Conservation. New York State stopped stocking this water over 30 years ago.

Materials & Methods

Manor Kill is located in southern Schoharie County and runs through the town of Conesville along County Route 990V (Figure 1). The survey was conducted on three different dates. The water quality data was collected on 6 April 2008. The fish were sampled on two different dates. The first fish survey was on 27 April 2008, and the second was conducted on 15 September 2008.

The first part of the survey was the water quality data collection. In order to collect the water quality data, three pieces of equipment were used. The YSI water analyzer was used to collect Dissolved Oxygen, pH, Conductivity, Salinity, Temperature, and Total Dissolved Solids. In order to collect turbidity a turbidometer was used. Alkalinity and hardness was determined

using a HACH Test kit. Finally, in order to test the Phosphorus levels in the stream, a total phosphorus lab test was conducted.

Fish sampling was conducted using a Halltech 2000 backpack electrofishing unit. Each site was sampled for 1000 seconds. The fish collected were indentified. The trout, along with the largest and smallest of all other species were measured.

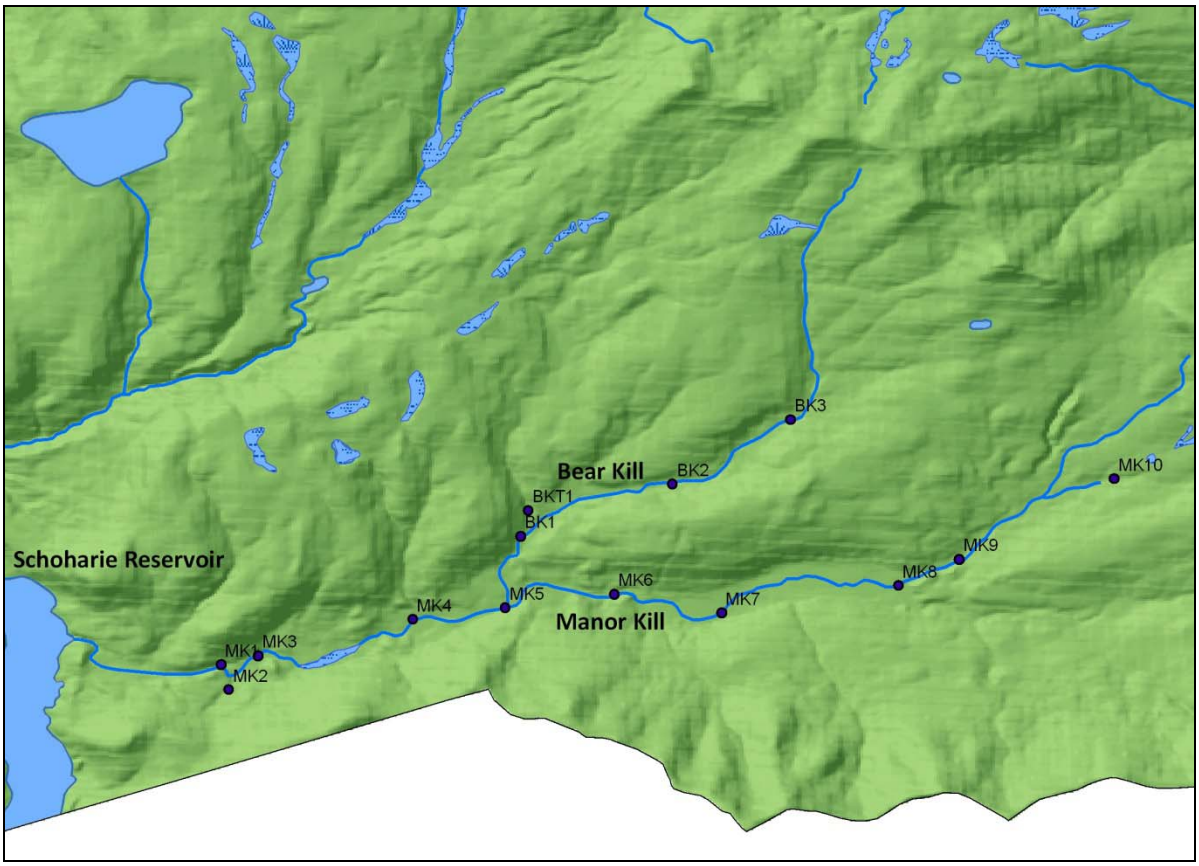

Figure 1: Map of sample sites on the Manor Kill, and Bear Kill Schoharie County, NY

Results

All water quality parameters except for alkalinity, and hardness were within normal levels (Table 1). Optimal levels of hardness, and alkalinity are between 100 and 400 mg/L. Alkalinity at all sites was 17.1mg/L, and Hardness levels at all sites were 51.3mg/L (Table 1).

Table 1: Water Quality data for Manor Kill, Schoharie County, 4/6/08

site	Temperature(°C)	pH	D.O. (mg/L)	TDS(g/L)	Cond(µs/cm)	Salinity	Alk(mg/L)	Hard(mg/L)	Turbidity (NTU)	Phosphorus(mg/L)
1	2.9	7.3	13.1	0.017	16	0.01	17.1	51.3	3.5	Below detectable limits
2	3.4	6.9	13.2	0.012	11	0.01	17.1	51.3	3.5	Below detectable limits
3	3.4	6.8	13.2	0.017	15	0.01	17.1	68.4	4.2	Below detectable limits
4	3.4	6.9	13.1	0.017	15	0.01	17.1	85.5	3.4	Below detectable limits
5	3.9	7.3	12.1	0.32	26	0.01	17.1	34.2	5.0	Below detectable limits
6	4.1	6.7	12.8	0.015	14	0.01	17.1	68.4	6.0	Below detectable limits
7	4.1	6.8	12.9	0.014	13	0.01	17.1	51.3	2.3	Below detectable limits
8	3.6	6.8	13.2	0.013	12	0.01	17.1	68.4	2.5	Below detectable limits
9	3.9	6.7	12.9	0.014	13	0.01	17.1	34.2	1.4	Below detectable limits
10	4.1	6.5	13.0	0.012	11	0.01	17.1	34.2	2.0	Below detectable limits
BK1	4.8	6.6	12.4	0.014	13	0.01	17.1	34.2	2.4	Below detectable limits
BK2	4.7	6.6	13.0	0.012	12	0.01	17.1	34.2	3.1	Below detectable limits
BK3	4.3	6.5	12.6	0.012	11	0.01	17.1	51.3	2.3	Below detectable limits
BKT1	3.3	6.7	13.5	0.015	14	0.01	17.1	34.2	2.6	Below detectable limits
Optimal	> 0	6.5-8.5	> 5	> 0	100-400	0	100-400	100-400	<10	0

Fish were found at all sites except for site 2 in the spring. During the summer data collection access to site 1 on Bear Kill, and the Bear Kill tributary could not be obtained. Site 2 and Site 10 were dry during the summer as well. Good numbers of both predators and prey were found at all other sites (Tables 2, 3).

Table 2: Fish Captured using backpack electrofisher on Manor Kill, Schoharie County, NY 4/27/08

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	BK 1	BK 2	BK 3	BKT 1	Totals
Fathead Minnow	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
White Sucker	4	0	1	2	0	5	1	1	0	0	0	0	0	0	14
Common Shiner	7	0	0	3	0	4	0	0	0	0	0	0	0	0	14
Longnose Dace	12	0	23	23	8	2	0	0	0	0	0	0	0	0	68
Blacknose Dace	96	0	104	110	4	91	80	3	1	1	4	5	10	0	509
Creek Chub	0	0	0	0	1	0	2	1	0	4	0	0	0	0	8
Slimy Sculpin	0	0	0	17	15	3	1	32	62	0	3	46	11	11	201
Brown Trout	0	0	1	0	1	2	0	3	7	0	4	7	2	1	28
Brook Trout	0	0	1	0	0	2	1	2	10	10	0	5	8	1	40
Totals	119	0	130	155	29	109	85	42	80	15	11	63	32	13	764

Table 3: Fish Captured using Backpack electrofisher on Manor Kill, Schoharie County, NY 9/15/08

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	BK 1	BK 2	BK 3	BKT 1	Totals
Brown Bullhead	0		0	0	0	0	0	0	1			0	0		1
Bluegill	0		0	0	0	0	0	0	0			4	8		12
White Sucker	1	DRY	6	2	0	3	36	1	0	DRY	No Access	0	0	No Access	49
Common Shiner	15		12	10	13	41	92	3	0			0	0		186
Longnose Dace	15		30	27	19	2	0	0	0			0	0		93
Blacknose Dace	142		104	176	137	261	80	49	6			53	45		1053
Creek Chub	14		2	5	3	8	115	10	0			0	0		157
Slimy Sculpin	0		0	0	12	6	1	16	79			70	18		202
Brown Trout	0		2	2	1	10	4	9	10			21	5		64
Brook Trout	0		2	0	0	1	2	5	8			35	72		125
Totals	187	0	158	222	185	332	330	93	104	0	0	183	148	0	1942

The trout that were captured ranged in size from 61mm to 414mm. Most of the trout caught were less than 200mm (Fig. 2,3)

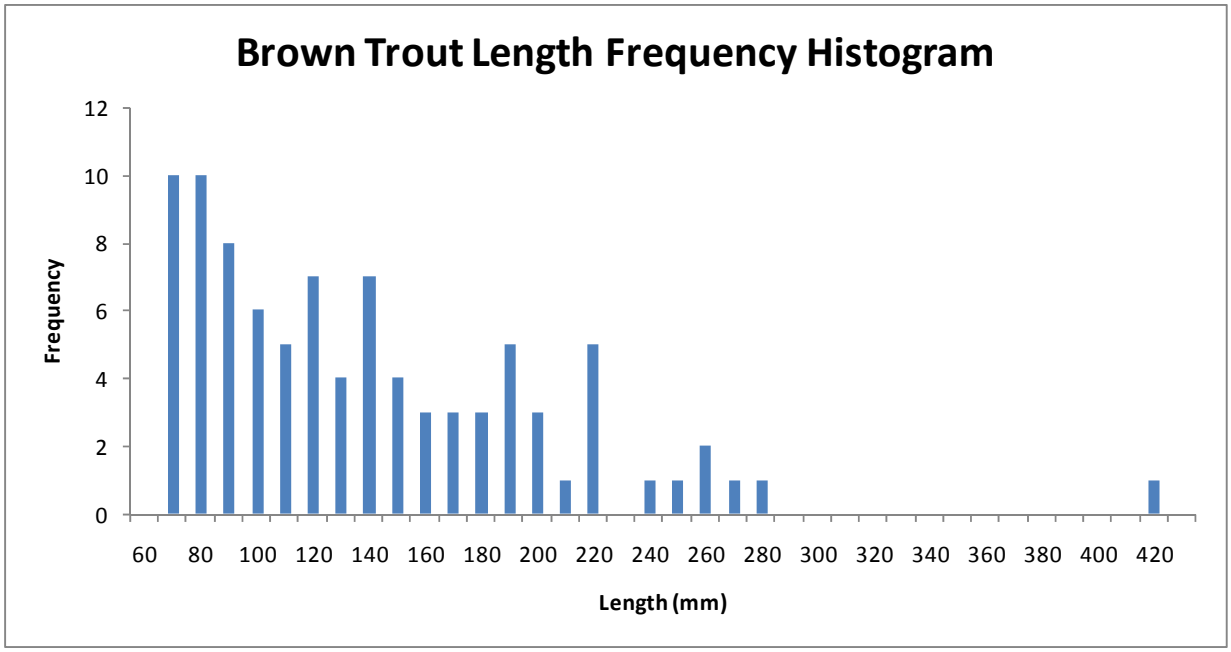

Fig. 2: Brown trout length frequency histogram from Manor Kill, Schoharie County, NY

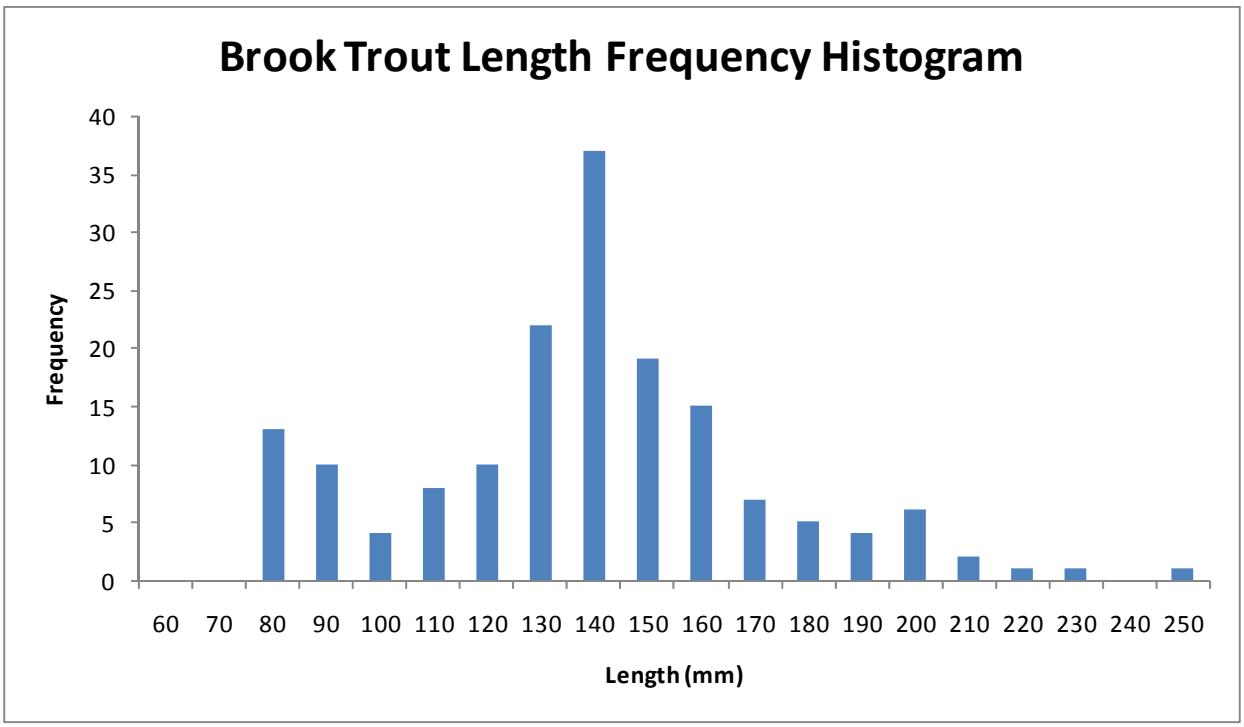

Fig. 3: Brook trout length frequency histogram from Manor Kill, Schoharie County, NY

Conclusions

The findings of this study show that there are no major chemical or physical water parameters that would limit the presence of the fish species. The alkalinity and hardness were below optimal range, but this is expected with the high volumes of runoff due to snow melt in the spring.

The distribution of fish is common for small order streams such as the Manor Kill. There is more diversity in the middle stream section. The upper section is dominated by cold water species such as trout and sculpins. The lower stream reaches are dominated by cool water species like minnows. The only fish that did not fit this model are a Fathead Minnow (*Pimephaies promelas),* a Brown Bullhead (*Ameiurus nebulosus*), and a small number of Bluegill (*Lepomis macrochirus*). All of these fish are warmwater species that were most likely introduced by sport fisherman.

Acknowledgements

We would like to thank Kevin Poole for his help in transportation, sampling, and his GIS imagery. The land owners for letting us have access to the stream. SUNY Cobleskill provided the equipment used. SUNY Cobleskill students who helped us sample. Town of Conesville who was the sponsor of this project.

Macroinvertebrate Survey of the Manor Kill, Conesville, NY: Summer 2008

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Abstract: This study was conducted to determine a baseline of water quality assessment within the Manor Kill watershed. Macroinvertebrate indices along with water quality and physical parameters were used to assess biological impairments within the watershed. The results show a relatively stable watershed with an exception of the stream reach between Sites 5 and 7. The higher water temperatures (>20°C) along with the change in water quality impaction from slightly too moderately impacted has indicated there is reason to focus efforts on this stretch of stream. Further research should be conducted to determine practical applications for stream riparian zone restoration

Introduction

The Manor Kill watershed is an important resource to the Town of Conesville, NY and the City of New York. It provides drinking water, an agriculture water supply, and supports fishing activities along its length. In recent years, the need to address water quality has become increasingly important.

However, little research has been done on the Manor Kill watershed. The NYS DEC has conducted studies in the past, but they have been limited. There has never been such a comprehensive study of this magnitude.

This study was conducted to determine a baseline of water quality assessment using multiple indices. These included water quality parameters, physical parameters, and macroinvertebrate indices.

Materials and Methods

The Manor Kill is located in southern Schoharie County, New York State, in the foothills of the Catskill Mountains. This 2nd order stream empties into Schoharie Reservoir in the town of West Conesville. It mainly runs east to west with the Bear Kill tributary flowing in from the north. The stream can be reached from Rte. 30 by turning left on to State Route 990v.

The survey sites were selected based on a downstream/upstream water quality assessment for every major tributary located on the Manor Kill. These selections were based on the NYS DEC Stream Biomonitoring Unit's standard operating procedures for "Biological Impairment Criteria" (Bode et. al. 2002). Sites 8 and 10, on the Manor Kill and Bear Kill respectively, were the upper most sites that did not include a second site due to drought conditions. The following is a map of site locations within the Manor Kill watershed (Figure 1) along with Table 1 indicating GPS coordinates of the survey sites.

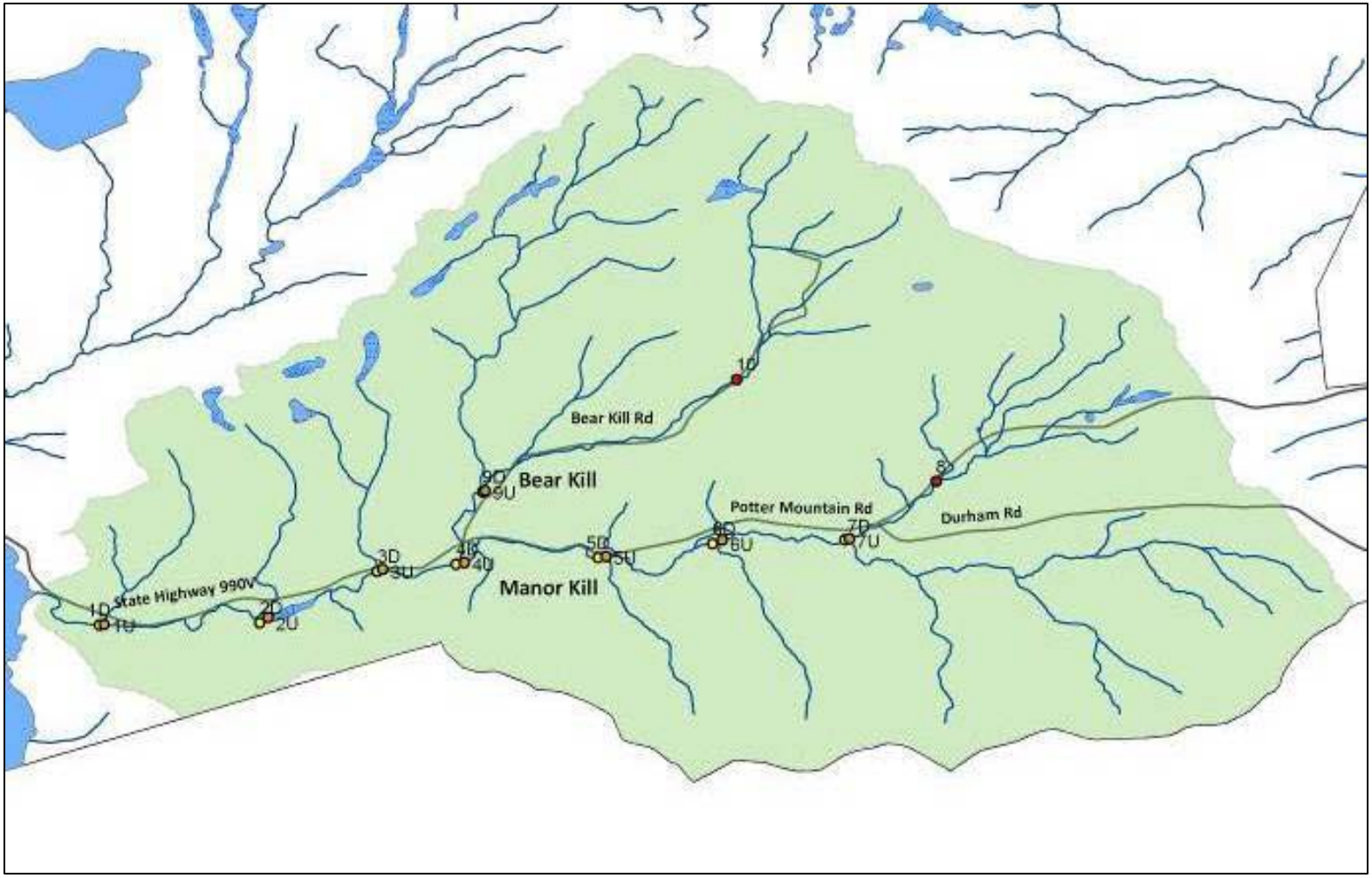

Figure 1*: Map of the macroinvertebrate survey sites within the Manor Kill watershed: Summer 2008*

Table 1: GPS coordinates of the macroinvertebrate survey sites within the Manor Kill watershed: Summer 2008

Site	Water	Latitude	Longitude
1D	Manor Kill	42.376222	-74.423717
1U	Manor Kill	42.376292	-74.423017
2D	Manor Kill	42.376502	-74.402715
2U	Manor Kill	42.377237	-74.401700
3D	Manor Kill	42.383222	-74.387383
3U	Manor Kill	42.383502	-74.386683
4D	Manor Kill	42.384167	-74.377093
4U	Manor Kill	42.384378	-74.376007
5D	Manor Kill	42.384973	-74.358541
5U	Manor Kill	42.385148	-74.357526
6D	Manor Kill	42.386828	-74.343594
6U	Manor Kill	42.387318	-74.342369
7D	Manor Kill	42.387283	-74.326338
7U	Manor Kill	42.387493	-74.325778
8	Manor Kill	42.394983	-74.314437
9D	Bear Kill	42.393618	-74.373662
9U	Bear Kill	42.393758	-74.373312
10	Bear Kill	42.408320	-74.340444

The sampling was done in the summer of 2008 on July 8th and 9th. The weather was partly cloudy with air temperatures ranging from low 80's to low 90's °F. The stream discharge conditions during the survey were below normal. It had not rained for weeks prior to the survey.

Initially, basic water quality parameters were taken at each site using an YSI 556 water analyzer which included temperature, conductivity, dissolved oxygen, and pH. Next, a standardized kick net (800 x 900µm) was used to sample macroinvertebrates within riffles for a length of five meters. The kick netter stood upstream of the net, kicking the substrate while moving downstream the length of the site for five minutes (Bode 2004). This was repeated at the upstream and downstream site of each tributary. Once these samples were collected, they were preserved in ethyl alcohol to be sorted back at the lab to their lowest taxa possible using a taxonomic key (Merritt et. al. 2008). Each taxa were then weighted using digital scale. Furthermore, physical parameters were taken at each site which included stream width, depth, velocity, embeddness, canopy cover, and substrate type.

Results

Table 2: Water quality parameters taken at each survey site within the Manor Kill watershed: Summer 2008.

Date	Time (mil)	Site	Velocity (ft/sec)	Temp (°C)	D.O. (mg/L)	pH	Conductivity (µs/cm)
07/08/08	9:25	1D	1.5	19.5	6.5	8.2	59
07/08/08	9:30	1U	3.5	19.4	5.8	7.8	58
07/08/08	10:30	2D	4.0	20.1	4.7	7.5	53
07/08/08	10:45	2U	4.0	20.5	5.6	7.3	54
07/08/08	11:25	3D	2.5	21.5	6.4	7.9	51
07/08/08	11:40	3U	4.0	21.3	5.1	8.1	50
07/08/08	12:40	4D	3.0	19.9	5.9	7.5	45
07/08/08	12:55	4U	2.5	20.6	6.9	7.7	49
07/08/08	13:20	5D	1.5	22.5	6.1	7.4	44
07/08/08	13:40	5U	1.0	22.1	6.3	7.2	41
07/09/08	9:20	6D	2.0	15.7	7.1	6.3	33
07/09/08	9:40	6U	2.0	15.5	6.2	6.7	30
07/08/08	14:15	7D	0.3	15.3	6.9	7.1	50
07/08/08	14:30	7U	1.0	16.4	7.3	6.9	49
07/09/08	10:35	8	2.0	13.3	7.1	7.8	32
07/09/08	11:50	9D	1.5	17.2	5.7	7.2	37
07/09/08	12:05	9U	2.0	18.8	5.6	7.6	39
07/09/08	12:40	10	1.0	17.3	5.4	7.5	32

For the most part, water quality remained relatively constant throughout the Manor Kill watershed (Table 2). However, the water temperature hovered around the stress threshold (20°C) for trout species in the lower half of the watershed, particularly at Site 5. Furthermore, the conductivity was low throughout the watershed, indicating low nutrient levels. All other water quality parameters were within optimal range.

Table 3: Physical parameters taken at each survey site within the Manor Kill watershed: Summer 2008.

Site	Stream Width (m)	Stream Depth (mm)	Embeddedness (%)	Canopy (%)	Substrate Type
1D	11.2	160	10	20	Rock
1U	7.7	170	10	30	Rock
2D	3.5	160	40	10	Rubble/Gravel
2U	3.3	140	10	0	Rubble
3D	4.6	130	10	30	Rock/Rubble
3U	3.8	230	30	30	Rubble
4D	6.7	120	10	10	Rock
4U	2.9	110	20	50	Rock/Rubble
5D	4.5	60	35	0	Gravel
5U	3.4	190	40	0	Rubble/Gravel
6D	2.5	100	25	0	Gravel
6U	2.3	80	20	0	Gravel
7D	1.5	40	40	40	Rock/Rubble
7U	4.0	70	20	50	Rock/Rubble
8	3.7	85	15	80	Rock
9D	4.8	70	10	60	Rubble
9U	2.3	70	30	30	Rubble
10	2.7	60	10	95	Rock

The embeddedness (measure of how deeply rocks are buried in the stream substrate) was, for the most part, higher around Sites 5-7 (Table 3). The substrate at these sites was typically of a gravel consistency. Furthermore, the canopy was completely absent from Sites 5 and 6. These physical parameters show below optimal characteristics for this reach of the watershed.

Table 4: Macroinvertebrate indices for the Manor Kill watershed: Summer 2008.

Site	Species Richness	EPT Richness	EPT Index (% by Weight)	Hilsenhoff Biotic Index	Percent Model Affinity
1D	18	10	38	4.11	63
1U	20	11	54	4.75	75
2D	15	7	39	4.48	61
2U	11	8	52	3.42	60
3D	18	10	50	2.99	70
3U	18	10	92	3.07	50
4D	12	6	16	4.60	78
4U	17	10	83	3.81	56
5D	11	5	61	2.95	61
5U	14	7	31	5.74	42
6D	8	6	24	4.96	48
6U	7	5	71	4.08	39
7D	4	2	98	4.00	15
7U	13	10	52	2.28	67
8	12	9	66	1.74	62
9D	15	11	56	3.96	56
9U	11	8	99	2.47	61
10	11	9	98	3.26	57

The water quality indices calculated above (Table 4), were based from NYS DEC Stream Biomonitoring Unit's Biological Assessment Profile (Bode et. al. 2002). These are common macroinvertebrate community indices used to indicate water quality impact statuses. Furthermore, the EPT Index calculated by taxa weight (Appendix I), was included to show that all sites had high abundances of EPT organisms. EPT represents orders of Ephemeroptera, Plecoptera, and Trichoptera which typically indicates healthier water quality conditions.

Table 5: Macroinvertebrate water quality impact scores for the Manor Kill: Summer 2008.

Site	WQ Scores	WQ Impact
1D	7.1	Slightly Impacted
1U	7.2	Slightly Impacted
2D	6.0	Slightly Impacted
2U	5.9	Slightly Impacted
3D	7.4	Slightly Impacted
3U	6.7	Slightly Impacted
4D	5.9	Slightly Impacted
4U	6.6	Slightly Impacted
5D	5.7	Slightly Impacted
5U	4.9	Moderately Impacted
6D	4.7	Moderately Impacted
6U	4.4	Moderately Impacted
7D	3.2	Moderately Impacted
7U	7.0	Slightly Impacted
8	6.5	Slightly Impacted
9D	6.4	Slightly Impacted
9U	6.3	Slightly Impacted
10	5.8	Slightly Impacted

The results of the water quality scores indicate that most of the Manor Kill watershed had slightly impacted water quality. However, Sites 5-7 indicates that there was moderately impacted water quality at this reach of the watershed.

Discussion

This survey was conducted to determine a baseline for water quality within Manor Kill watershed. The results are significant showing a relatively stable watershed with an exception of the stream reach between Sites 5 and 7.

The higher water temperatures (>20°C) along with the change in water quality impaction from slightly too moderately impacted has indicated there is reason to focus efforts on this stretch of stream. Also, the macroinvertebrate species richness and EPT richness drops significantly. The lack of canopy corresponding with a poor riparian zone increases the chance of more sedimentary input into the stream which is shown by an increase of gravel substrate and embeddedness.

The Manor Kill between Sites 5 and 7 shows the most altered conditions relating to stream side activities. This stretch consists of farm fields extending into the riparian zones and a rock quarry just upstream. These conditions could contribute to the degraded water quality conditions found along this stretch during the study.

Further research should be conducted to determine practical applications for stream riparian zone restoration. The continued degradation along this stretch on the Manor Kill could lead to more complicated remedies in the future.

Appendix I

Table 6: Macroinvertebrate taxa found at each survey site on the Manor Kill: Summer 2008.

Site	Order	Suborder	Family	Subfamily	Genus	Species	Count	Weight (gm)
1D	Coleoptera		Psephenidae		Psephenus		24	0.09
1D	Coleoptera		Elmidae				13	0.02
1D	Diptera		Tipulidae		Hexatoma		17	2.00
1D	Diptera		Tipulidae		Antocha		1	0.01
1D	Diptera		Tipulidae				7	0.01
1D	Diptera		Chironomidae				18	0.02
1D	Diptera		Chironomidae				3	0.01
1D	Ephemeroptera		Leptohyphidae				4	0.02
1D	Ephemeroptera		Oligoneuriidae				5	0.03
1D	Ephemeroptera		Neoephemeridae				2	0.01
1D	Ephemeroptera		Baetidae				1	0.02
1D	Ephemeroptera		Baetidae				2	0.01
1D	Megaloptera		Corydalidae		Nigronia		1	0.02
1D	Plecoptera		Leuctridae				2	0.01
1D	Plecoptera		Perlidae		Claasenia		11	0.85
1D	Trichoptera		Hydropsychidae		Hydropsyche		6	0.08
1D	Trichoptera		Polycentropodidae		Nyctiophylax		3	0.28
1D	Trichoptera		Polycentropodidae		Neuroclpsis		3	0.01
1U	Coleoptera		Psephenidae		Dicranopsclaphus		2	0.01
1U	Coleoptera		Elmidae				7	0.01
1U	Coleoptera		Scirtidae				1	0.01
1U	Decapoda		Cambaridae	Cambarinae	Orconectes	rusticus	1	0.24
1U	Diptera	Brachycera	Cyclorrhaphous				6	0.01
1U	Diptera	Brachycera	Orthorrhaphous				7	0.01
1U	Diptera		Chironomidae				11	0.01
1U	Ephemeroptera		Potamanthidae		Anthopotamus		2	0.01
1U	Ephemeroptera		Baetiscidae				4	0.01
1U	Ephemeroptera		Leptohyphidae				3	0.03
1U	Ephemeroptera		Baetidae				5	0.02
1U	Ephemeroptera		Ameletidae		Ameletus		1	0.01
1U	Ephemeroptera		Leptophlepiidae		Traverella		1	0.01
1U	Megloptera		Corydalidae		Corydalus	Latreille	1	0.08
1U	Odonota	Anisoptera	Libellulidae		Erythemis		1	0.07
1U	Plecoptera		Pteronarcyidae		Pteronarcella	badia	1	0.05
1U	Plecoptera		Perlidae				1	0.01
1U	Trichoptera		Hydroptilidae		Hydroptilla		4	0.02
1U	Trichoptera		Phryganeidae				3	0.02
1U	Trichoptera		Polycentropodidae				3	0.01

Site	Order	Suborder	Family	Subfamily	Genus	Species	Count	Weight (gm)
2D	Coleoptera		Eluichadidae		Stenocolus		2	0.02
2D	Coleoptera		Ptilodactylidae		Anchytarsas		2	0.01
2D	Coleoptera		Elmidae				17	0.01
2D	Diptera		Tipuldidae		Hexatoma		11	2.49
2D	Diptera	Nematocera	Blephariceridea		Blepharicera	Marcquart	3	0.37
2D	Diptera	Nomatocera	Chironomidae	Pentoneurini			12	0.02
2D	Ephemeroptera		Baetidae				12	0.07
2D	Ephemeroptera		Baetisidae		Baetisca		1	0.01
2D	Ephemeroptera		Potamanthidae		Anthopotomas		1	0.03
2D	Megaloptera		Corydalidae		Chauliodes	Latreille	2	0.17
2D	Odonata		Coenagrionidae		Amphiagrion		5	0.30
2D	Plecoptera		Perlidae		Claassenio		3	0.15
2D	Trichoptera		Polycentropodidae		Neureclipsis		17	0.39
2D	Trichoptera		Limnephilidae				6	0.66
2D	Trichoptera		Brachycentridae				1	0.08
2U	Coleoptera		Psephenidae		Psephenus		2	0.03
2U	Coleoptera		Elmidae				12	0.01
2U	Diptera		Tipulidae		Hexatoma		7	2.30
2U	Ephemeroptera		Baetidae				8	0.11
2U	Ephemeroptera		Leptohyphidae				24	1.09
2U	Ephemeroptera		Heptageniidae				1	0.03
2U	Plecoptera		Perlidae		Claassenia		6	0.04
2U	Plecoptera		Perlidae		Perlesta		1	0.01
2U	Trichoptera		Polycentropodidae		Nyctiophylax		1	0.10
2U	Trichoptera		Polycentropodidae		Neuroeclipsis		4	0.05
2U	Trichoptera		Hydropsychidae		Hydropsyche		47	1.09
3D	Coleoptera		Psephenidae		Psephenus		1	0.01
3D	Coleoptera		Elmidae				3	0.02
3D	Decapoda		Cambaridae	Cambarinae	Orconectes	rusticus	1	6.03
3D	Ephemeroptera		Polymitarcyidae		Ephoron		3	1.71
3D	Ephemeroptera		Baetidae				7	0.03
3D	Ephemeroptera		Leptohyhidae				17	0.04
3D	Diptera		Tipulidae		Hexatoma		1	0.07
3D	Diptera		Chironomidae				6	0.07
3D	Diptera		Tipulidae		Antocha		3	0.23
3D	Megaloptera		Corydatidae		Nigroriia		1	0.26
3D	Odonata	Anisoptera	Gomphidae		Stylogompnus		2	0.21
3D	Plecoptera		Perlidae		Claassenia		13	0.75
3D	Plecoptera		Pteronarcyidae		Pteronarcys		3	0.57
3D	Plecoptera		Chloroperlidae				3	0.03
3D	Trichoptera		Hydropsychidae		Hydropsyche		11	0.21
3D	Trichoptera		Polycentripodidae		Neureclipsis		3	0.03
3D	Trichoptera		Limnephilidae				1	0.87
3D	Trichoptera		Limnephilidae				3	0.93

Site	Order	Suborder	Family	Subfamily	Genus	Species	Count	Weight (gm)
3U	Coleoptera		Psephenidae		Psephenus		3	0.02
3U	Coleoptera		Elmidae				1	0.01
3U	Decapoda		Cambaridae	Cambarinae	Orconectes	rusticus	1	0.03
3U	Diptera		Tipulidae		Hexatoma		16	0.04
3U	Diptera		Chironomidae				4	0.06
3U	Diptera		Tipulidae		Antocha		2	0.19
3U	Ephemeroptera		Polymitarcyidae		Ephoron		1	1.62
3U	Ephemeroptera		Baetidae				3	0.02
3U	Ephemeroptera		Leptohyhidae				12	0.02
3U	Odonata	Anisoptera	Gomphidae		Stylogomphus		2	0.21
3U	Odonata	Anisoptera	Gomphidae		Lanthus		6	0.03
3U	Plecoptera		Perlidae		Claassenia		9	0.67
3U	Plecoptera		Pteronarcyidae		Pteronarcys		3	0.97
3U	Plecoptera		Chloroperlidae				1	0.02
3U	Trichoptera		Hydropsychidae		Hydropsyche		21	0.54
3U	Trichoptera		Polycentripodidae		Neureclipsis		5	0.05
3U	Trichoptera		Limnephilidae				3	1.12
3U	Trichoptera		Limnephilidae				2	0.29
4D	Coleoptera		Elaichadidae		Stenocolas		4	0.02
4D	Coleoptera		Elmidae				3	0.01
4D	Coleoptera		Scirtidae				4	0.02
4D	Diptera		Tipulidae		Hexatoma		6	1.25
4D	Diptera	Nematocera	Chironomidae	Pentanearini			31	0.03
4D	Ephemeroptera		Baetidae				17	0.08
4D	Ephemeroptera		Potomanthidae		Anthopotama		2	0.02
4D	Ephemeroptera		Leptohyhidae				1	0.01
4D	Megaloptera		Corydalidae		Chauliodes	Lateille	2	0.04
4D	Plecoptera		Perlidae		Classenia		4	0.03
4D	Trichoptera		Polycentropodidae		Neuroclipsis		2	0.03
4D	Trichoptera		Hydropsychidae				4	0.05
4U	Coleoptera		Psephenidae		Psephenus		5	0.04
4U	Coleoptera		Scirtidae				2	0.02
4U	Diptera		Chironomidae				2	0.01
4U	Diptera		Tipulidae		Hexatoma		4	0.37
4U	Diptera		Tipulidae		Antocha		1	0.01
4U	Ephemeroptera		Baetidae				3	0.01
4U	Ephemeroptera		Oligoneuridae				4	0.03
4U	Ephemeroptera		Leptohyphidae				13	0.11
4U	Ephemeroptera		Heptageniidae				1	0.01
4U	Megaloptera		Corydalidae		Nigronia		3	0.06
4U	Megaloptera		Corydatidae		Nigronia		1	0.04
4U	Plecoptera		Perlidae		Classesnia		9	0.91
4U	Tricoptera		Polycentropodidae		Neureclipsis		19	0.14
4U	Tricoptera		Glossosomatidae				1	0.08
4U	Tricoptera		Hydropsychidae		Hydropsyche		23	0.56
4U	Tricoptera		Polycentropodidae		Nytiophylax		3	0.23
4U	Tricoptera		Limnephilidae				2	0.03

Site	Order	Suborder	Family	Subfamily	Genus	Species	Count	Weight (gm)
5D	Coleoptera		Psephenidae		Psephenus		1	0.01
5D	Coleoptera		Elmidae				1	0.01
5D	Diptera		Tipulidae		Hexatoma		8	0.37
5D	Diptera		Chironomidae				4	0.01
5D	Diptera		Tipulidae		Antocha		27	0.04
5D	Ephemeroptera		Leptohyphidae				22	0.28
5D	Ephemeroptera		Baetidae				3	0.02
5D	Odonata	Anisoptera	Gomphidae				2	0.24
5D	Plecoptera		Perlidae		Claassenia		3	0.09
5D	Plecoptera		Leuctridae				1	0.01
5D	Tricoptera		Hydropsychidea		Hydropsyche		14	0.05
5U	Decapoda		Cambaridae	Cambarinae	Orconectes		2	0.42
5U	Diptera		Tipulidae		Hexatoma		2	0.25
5U	Diptera	Nematocera	Chironomidae	Pentaneurini			63	0.10
5U	Ephemeroptera		Euthyplociidae		Euthyplecia	Hecuba	1	0.05
5U	Ephemeroptera		Polymitarcyidae		Ephoron		1	0.01
5U	Ephemeroptera		Potamanthidae		Anthopotamus		1	0.02
5U	Ephemeroptera		Baetidae				4	0.02
5U	Ephemeroptera		Leptohyphidae				1	0.03
5U	Megaloptera		Corrdalidae		Chaaliodes	Latreille	1	0.02
5U	Odonata		Coenagrionidae		Chromagrion		1	0.12
5U	Odonata		Coenagrionidae		Telebasis		1	0.03
5U	Odonata		Coenagrionidae		Enallagmo		1	0.02
5U	Plecoptera		Perlidae		Classenia		1	0.01
5U	Trichoptera		Polycentropodidae		Neureclipsis		1	0.01
6D	Diptera		Tipulidae		Hexatoma		10	0.88
6D	Diptera		Chironomidae	Pentaneurini			73	0.07
6D	Ephemeroptera		Baetidae				7	0.04
6D	Ephemeroptera		Ephomerellidae		Attenella		3	0.02
6D	Plecoptera		Perlidae		Aceroneuria		1	0.15
6D	Plecoptera		Leuctridae		Perlomyia		7	0.01
6D	Trichoptera		Hydropsychidea		Hydropsyche		1	0.01
6D	Trichoptera		Polycentropodidae				2	0.07
6U	Diptera	Nematocera	Chironemidae	Pentaneurini			38	0.04
6U	Diptera		Tipulidae		Hexatoma		1	0.01
6U	Ephemeroptera		Leptophlebiidae				4	0.03
6U	Ephemeroptera		Baetidae				1	0.03
6U	Ephemeroptera		Baetiscidae		Baetisca		1	0.02
6U	Plecoptera		Leuctridae		Perlomyia		16	0.03
6U	Trichoptera		Polycentropodidae				1	0.01
7D	Diptera	Nematocera	Tipulidae		Hexatoma		2	0.34
7D	Diptera		Chironomidae	Pentaneurini			2	0.01
7D	Ephemeroptera		Leptohyphidae				1	0.02
7D	Tricoptera		Limnephilidae				107	22.41

Site	Order	Suborder	Family	Subfamily	Genus	Species	Count	Weight (gm)
7U	Coleoptera		Elmidae				1	0.01
7U	Diptera		Tipulidae		Hexatoma		11	1.03
7U	Diptera		Chironomidae				1	0.01
7U	Ephemeroptera		Baetidae				8	0.03
7U	Ephemeroptera		Leptohyphidae				28	0.21
7U	Ephemeroptera		Neoephemeridae				1	0.01
7U	Ephemeroptera		Heptageniidae				1	0.01
7U	Plecoptera		Perlidae		Claassenia		10	0.43
7U	Plecoptera		Pteronareyidae		Pteronarcys		2	0.22
7U	Plecoptera		Leuctridae				14	0.03
7U	Tricoptera		Hydropsychidae		Hydropsyche		7	0.13
7U	Tricoptera		Piolycentropodidae		Neureclipsis		4	0.02
7U	Tricoptera		Phryganeidae				2	0.06
8	Coleoptera		Elmidae				3	0.01
8	Diptera		Tipulidae				4	0.86
8	Diptera		Tipulidae				1	0.01
8	Ephemeroptera		Ephemerellidae				25	0.09
8	Ephemeroptera		Baetidae				9	0.04
8	Ephemeroptera		Leptophlebiidae				1	0.01
8	Plecoptera		Pteronerctidae		Pteronarcys		7	0.82
8	Plecoptera		Perlidae		Claassenia		15	0.50
8	Plecoptera		Leuctridae				10	0.01
8	Plecoptera		Perlodidae				7	0.02
8	Tricoptera		Hydropsychidae		Hydropsyche		5	0.10
8	Tricoptera		Limnephilidae				3	0.14
9D	Coleoptera		Eulichadidae		Stenocolas		2	0.01
9D	Coleoptera		Elmidae				1	0.05
9D	Diptera		Tipulidae		Hexatoma		5	1.11
9D	Diptera		Chironomidae				7	0.01
9D	Ephemeroptera		Ephemerellidae		Attenella		13	0.10
9D	Ephemeroptera		Leptophelbiidae				2	0.01
9D	Ephemeroptera		Baetidae				1	0.01
9D	Plecoptera		Perlidae				8	0.42
9D	Plecoptera		Pteronarcyidae		Pteronarcys		2	0.37
9D	Tricoptera		Polycentropodidae		Nyctiophylax		2	0.19
9D	Tricoptera		Hydropsychidae		Hydropsyche		1	0.02
9D	Tricoptera		Polycentropodidae		Neureclipsis		21	0.04
9D	Tricoptera		Leuctridae		Perlomyia		1	0.03
9D	Tricoptera		Polycentropodidae		Cyrennclus		6	0.21
9D	Tricoptera		Limnephilidae				3	0.13

Site	Order	Suborder	Family	Subfamily	Genus	Species	Count	Weight (gm)
9U	Diptera		Tipulidae				2	0.01
9U	Diptera		Chironomidae				3	0.01
9U	Ephemeroptera		Baetidae				4	0.03
9U	Ephemeroptera		Ephemerellidae				61	0.65
9U	Ephemeroptera		Leptophlebiidae				2	0.01
9U	Ephemeroptera		Ephemerellidae		Attenella		7	0.09
9U	Megaloptera		Corydatidae		Nigronia		1	0.06
9U	Plecoptera		Perlidae		Claassenia		4	0.20
9U	Plecoptera		Leuctridae				3	0.02
9U	Tricoptera		Polycentropodidae		Neuroclipsis		22	0.05
9U	Tricoptera		Hydropsychidae		Hydropsyche		7	0.24
10	Coleoptera		Scirtidae				1	0.01
10	Coleoptera		Eulichadidae		Stenocolus		1	0.01
10	Ephemeroptera		Ephemerellidae		Attenella		3	0.01
10	Ephemeroptera		Ephemerellidae				31	0.21
10	Ephemeroptera		Leptophlebiidae				5	0.07
10	Plecoptera		Perlidae				6	0.14
10	Plecoptera		Leuctridae				1	0.01
10	Tricoptera		Polycentropodidae		Cyrenellus		3	0.07
10	Tricoptera		Polycentropodidae		Neureclipsis		23	0.17
10	Tricoptera		Leuctridae		Perlomyia		4	0.04
10	Tricoptera		Polycentropodidae		Cyrennclus		11	0.11

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