Ecological Inventory of land adjacent to the Concord River

in Lowell, Massachusetts

December 2002

completed for the

Lowell Parks and Conservation Trust

By the

Mass Audubon Ecological Extension Service

Mass Audubon
Protecting the Nature of Massachusetts

Table of Contents

Acknowledgements

The authors would like to thank Jane Calvin, Executive Director, and Steve Conant, President of the Board of the Lowell Parks and Conservation Trust for detailed information and extensive support throughout the project. We would also like to thank the owners of lands abutting the Concord River in the study area, for access permission.

Collins, Jeffrey, Simon Perkins, Joan Milam. 2002. *Ecological inventory of land adjacent to the Concord River in Lowell, Massachusetts*. Massachusetts Audubon Society, Lincoln, MA.

Introduction

The focus area for this study is the Concord River and directly adjacent land between Lawrence Street and the river's confluence with the Merrimack River (Figure 1). The land is heavily influence by past human land use – the vegetated river bank is a narrow strip between the water and developed land; much of the river bank soil is fill; several unused concrete structures stand on the banks; and much of the river itself is channelized by stone and concrete retaining walls. And yet, here among some of most densely settled and urbanized census blocks in the state, natural processes continue to function, and are on display for all who come looking.

- Spring floods scour the river channel and leave pliant river birches standing in water two feet deep;
- Migrating songbirds gorge on silver maple seeds to fuel their flight north;
- Red-tailed hawks glide above, kestrels perch on power lines, dragonflies glide in the meadows, and great blue herons stalk in the shallows, all looking for a meal;
- Anadramous fish swim upstream hoping to spawn;
- Bumble bees visit wildflowers for a meal and offer pollination in return;
- River water recedes by late fall, exposing bedrock and shallow mudflats which become wet meadow islands;

A walk along the Concord River in Lowell offers all of these observations and more for the attentive visitor. In addition, the shape of the land allows one to find low points near the river where the city nearly disappears. Those searching for a bit of an escape can find it at the river's edge, under the cover of silver maple, beech, and witch hazel, standing only feet from a tumbling white water rapid.

The study area is an urban site, no doubt, and it does display natural and cultural patterns reflecting heavy human presence. Many of the plant species are not native to North America and many – tree-of-heaven, black swallowwort, garlic mustard – are known invasive species. These plants aggressively outcompete many of our native species leading to overall decreased plant diversity. Litter, informal trails, fire-pits, temporary shelters, and dumping are all human use concerns which will need to be addressed by a long term stewardship plan.

The report is divided into a descriptive Natural History section and a narrative section which describes the visitor's impressions walking along the length of the study area, on the east side of the river, from north to south. This section attempts to capture some of the spirit of the place which may be missing from the long species lists. Further interpretation of this report and others will be very helpful for most visitors.

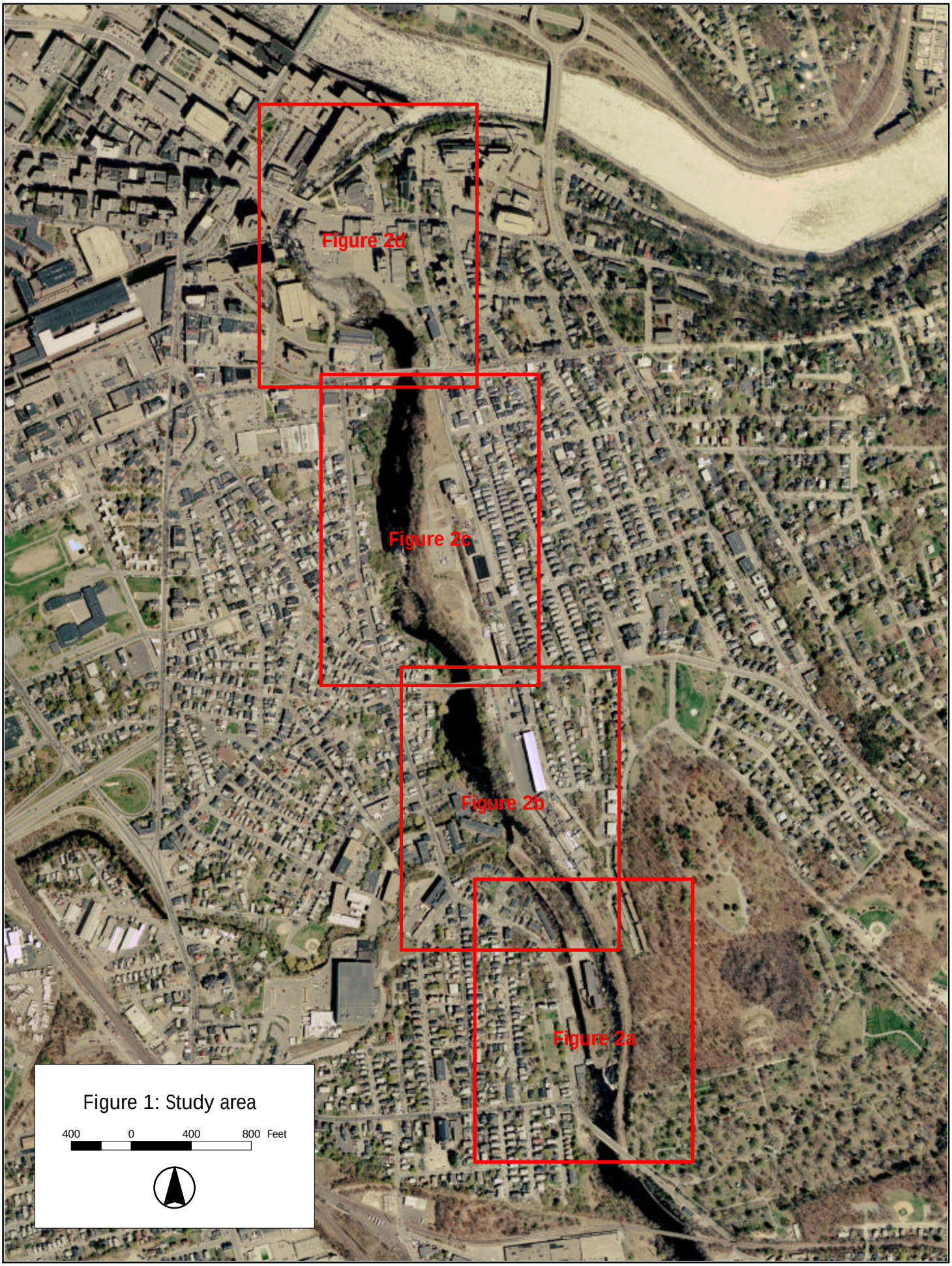
Figure 2d
Figure 2c
Figure 2b
Figure 2a
Figure 1: Study area
400 0 400 800 Feet

Natural Inventory

Bedrock

The study area is underlain by two types of bedrock: metamorphic rocks of the Nashoba Formation[1] to the south and igneous rock of the Andover Granite[2] to the north. These rocks were formed roughly 400 million years ago at a time of continental collision when a section of Africa was plunged underneath the edge of North America. Deep off-shore sediment deposits which had lithified to siltstone and sandstone were metamorphosed under tremendous heat and pressure into schist and gneiss. The original marine sediments would have included some amount of calcium carbonate from crustacean shells; weathered out of the bedrock into the soil today, calcium carbonate buffers against soil acidity and contributes to favorable growing conditions for plants.

At this time of continental collision, other sedimentary rocks were pushed deep toward the Earth's mantle. They eventually melted and bubbled back upward into overlying layers where they cooled and solidified before reaching the surface. Slow cooling leads to the formation of large-crystal granite which we find today, exposed by the erosion of millennia.

Surficial Geology and Soils

Twenty thousand years ago, Lowell lay underneath a sheet of ice several hundred feet thick. The Earth was nearing the end of a long cooling period, and the last North American continental ice sheet, the Laurentian Glacier, was slowly melting away. When the region's southernmost ice was in the vicinity of Lowell, water wanting to drain to the north was dammed up behind the glacier and formed a large lake. Meltwater streamed off of the ice into the lake and dumped its suspended sediment forming a large delta and a sandy lake bottom. When the glacier melted away further, the northern outlet for lake was opened, and the water drained away leaving an exposed sandy plain.

This extensive outwash feature, the remnants of glacial Lake Shawsheen-Merrimack, is the background of whatever native soil exists within the study area. It is clear, however, that extensive modification and shaping of the land has taken place along the river. As a result, it is difficult to classify the soil. Generally, the soil appears to be sandy and well-drained except right at the river's edge. It is steep in most sections, and other than at bedrock outcrops, does not appear to be stony. Soil below high water, especially on the small river birch terraces, reflects more recent depositional processes, and is closer to a silty loam with moderate drainage.

Flora

The plants found along the Concord River are a combination of native and non-native species which do not fit any natural community type as they are described in the *Draft*

---

[1] "sillimanite schist and gneiss, partly sulfidic amphibolite, biotite gneiss, calc-silicate gneiss, and marble." Zen et al. (1983)

[2] "light- to medium-gray, foliated medium- to coarse-grained muscovite-biotite granite [with] pegmatite masses common." Zen et al. (1983)

Classification of the Natural Communities of Massachusetts (Swain & Kearsley, 2000). The many non-native and weedy species reflect historic landuse, the influence of adjacent land uses, and the generally urbanized landscape setting. However variety in soil conditions, seasonal flooding, and aspect lead to distinct cover types. This variety creates several micro-habitats and allows the visitor to experience several different micro-communities along the river.

For the plant survey, the study area was divided into zones defined by street crossings or other landmarks (Figure 2a-d). Each zone was visited several times from Spring to late Summer in 2002. Zone descriptions include a plant species list and information on the canopy tree species as well as their height and percent canopy closure; shrub species and percent cover; and ground species. For this survey a woody plant over 3 meters is defined as a tree, woody plants from ½ meter to 3 meters are classed as shrubs, and herbaceous plants and others under ½ meter are classed as groundcover. Plants are listed in alphabetical order by common name. Scientific names are indexed in Appendix A.

Zone 1— East side of the river, Lawrence Street to Bradford Industries gate.

This zone is defined largely by the powerlines that run overhead and the vegetation management required by the power company. Except for a narrow band alongside the river, vegetation is kept low. The absence of a canopy creates sunny conditions at the ground level which lead to a diverse array of herbaceous species.

Plant cover in this zone is stratified into four sections perpendicular to river:

- a thin band of trees to 15 meters tall grows on the low slope within 5 meters of the river's edge;
- a steep bank stretching another 10 meters from the river's edge with a variety of shrubs to 3 meters tall growing over thick poison ivy and vines;
- a grassy, 2-meter wide service road, and;
- a second, 10 meter-wide, predominantly shrubby section reaching to taller trees on the adjacent cemetery property.

The common trees along the river bank are silver maple and American elm with a few large black willows right at the water's edge and the other species listed below mixed in among them on the river bank. These riverside trees reach to 20 meters and range from sparse at the southern end to close-growing at the north. Since the band of trees is so narrow, it is difficult to speak of canopy cover as in a forest. Pussy willow and a few apples are found atop the river bank.

Trees:

American elm	musclewood	silver maple
apples	Norway maple	speckled alder
black cherry	pin cherry	tree-of-heaven
black willow	pussy willow	trembling aspen
box elder	red maple	white ash
flowering dogwood	red oak	white pine
gray birch	river birch	

Figure 2a: Study area

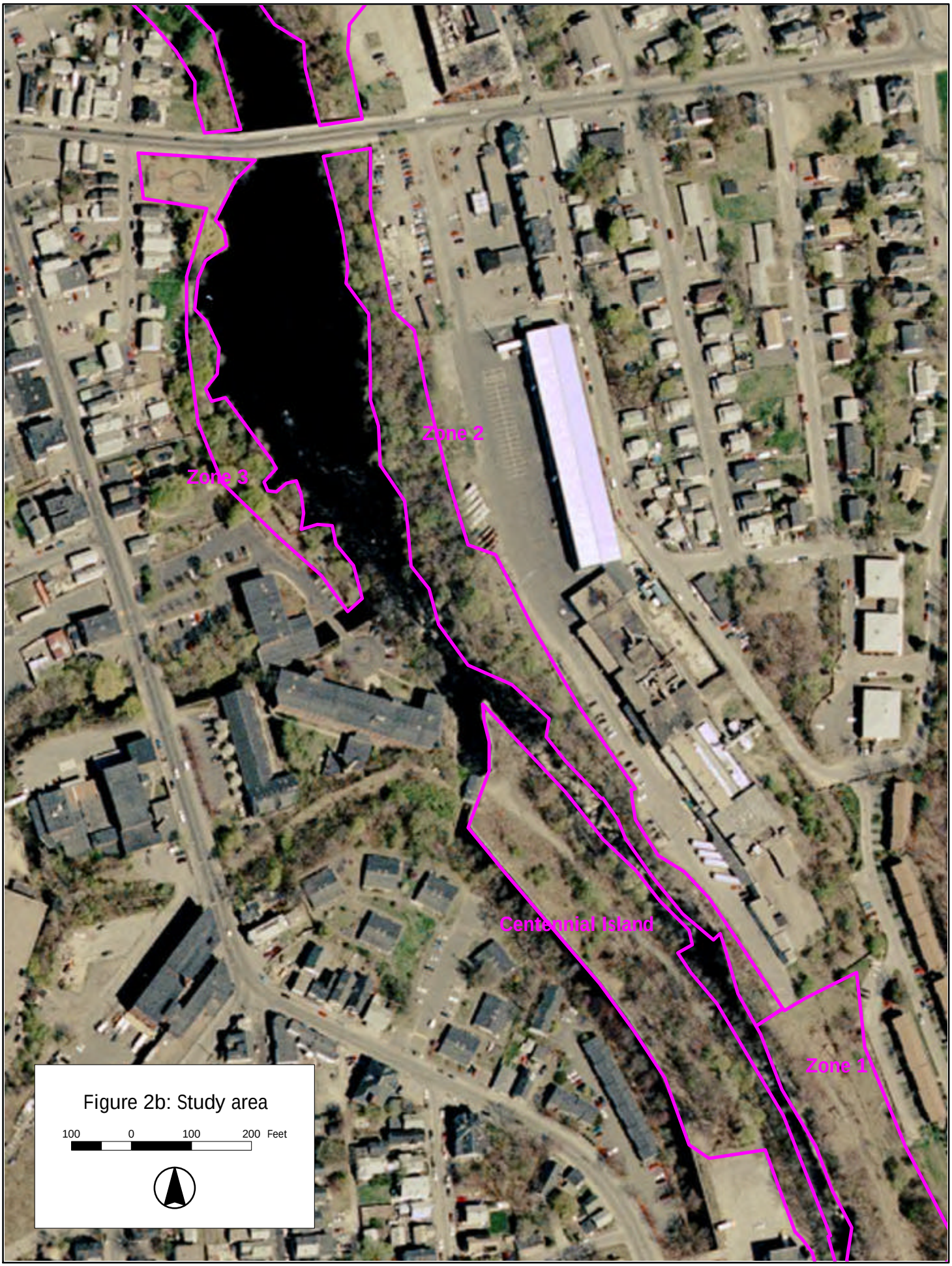

Figure 2b: Study area

Figure 2c: Study area

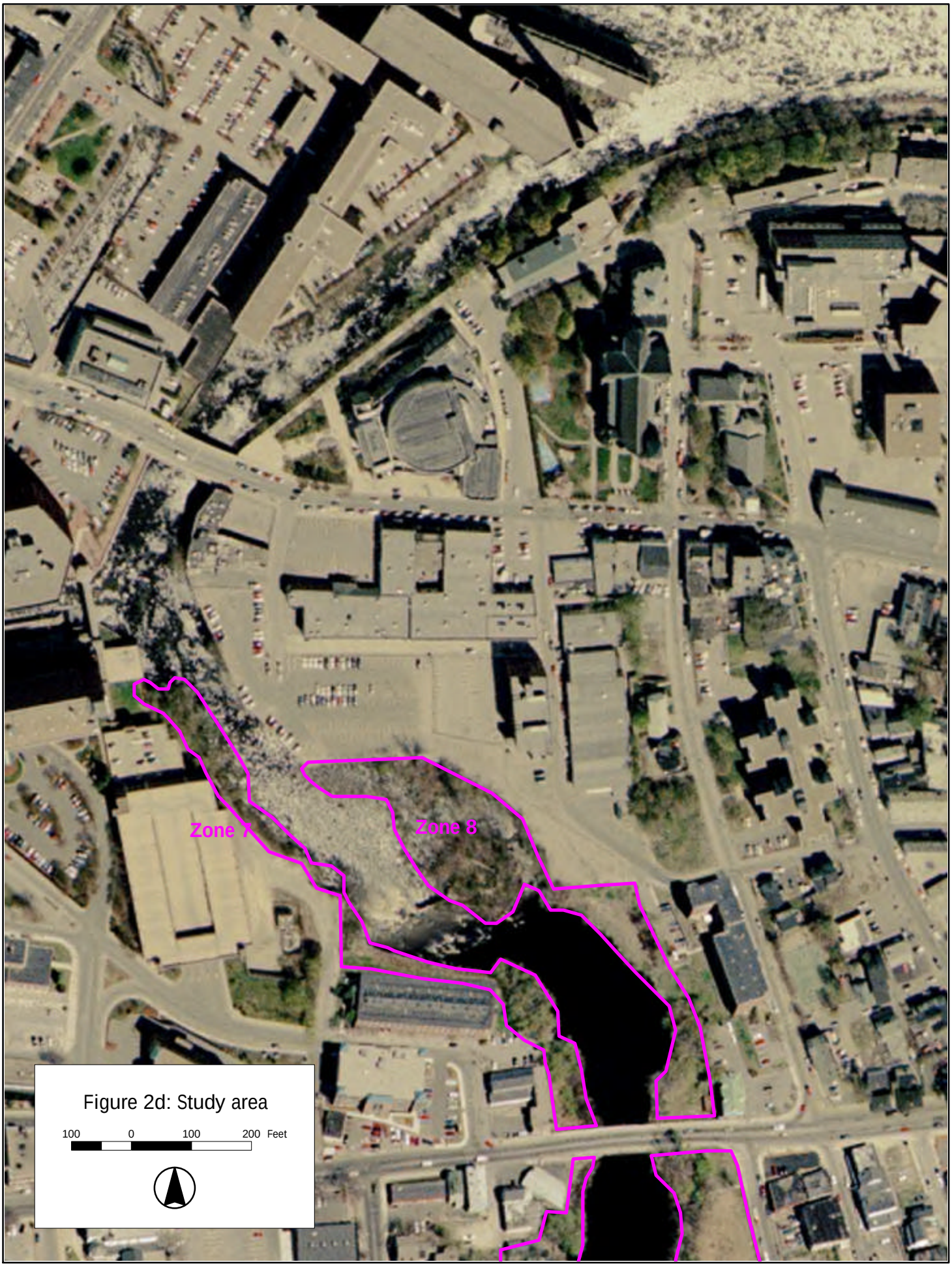

Figure 2d: Study area

Shrubs grow all along this section, benefiting from the relatively open canopy along the river and the complete absence of a canopy under the powerlines. Many of the shrub species – flowering dogwood, multiflora rose, lilac, honeysuckle, elderberry – provide attractive flowers throughout the summer and fruit in the fall. Flowers and fruit are an aesthetically pleasing addition to the human visitor, and provide important food sources for birds and invertebrates. The thickety growth in some sections may also provide nesting habitat for birds.

Shrubs:

alternate-leaved dogwood	greenbrier	raspberry
arrowwood	Japanese barberry	smooth sumac
bayberry	lilac	sweetfern
common buckthorn	lowbush blueberry	tatarian honeysuckle
common elderberry	multiflora rose	witch hazel
gray dogwood		

Diversity of grasses and forbs (non-grass herbaceous species) in this section makes it an interesting place to visit throughout the summer. The visitor is bound to find something new in flower each week. As with the shrubs, many of these species are non-native. Poison ivy is particularly thick in areas alongside the service road and near the riverside. Visitors should be warned of its presence and reminded of its appearance.

Groundcover:

asparagus	hoary alyssum	pigweed
barren brome grass	horsetails	poison ivy
black swallow-wort	Japanese knotweed	pokeweed
blue toadflax	late goldenrod	purple loosestrife
bracted plantain	lily of the valley	quackgrass
Canada goldenrod	little bluestem	rabbit's foot clover
chickory	marsh rose mallow	red clover
common evening primrose	meadowsweet	sheep fescue
common St. Johnswort	milkweed	spotted knapweed
cow vetch	mouse ear	tall blue lettuce
curly dock	mullein	touch me not
dandelion	ohio spiderwort	tower mustard
deertongue	orchard grass	Virginia creeper
dewberry	oriental bittersweet	white clover
false solomon's seal	oxeye daisy	wild carrot
field pennycress	panic grass	wild garlic
grape	pathrush	wild peppergrass
hairy vetch	Pennsylvania sedge	wood sorrel
hawkweed	phragmites	yarrow
hay-scented fern		

Zone 2 – East side of river, from Bradford Industries gate to Rogers Street.

This section, dominated by the steep bank between industrial properties and the riverside, ranges in width from very narrow sections at the southern end to a wider stretch at the north.

The very southern end of Zone 2, directly adjacent to Zone 1, features a narrow strip of large trees including white ash and silver maple. The narrow canopy reaches out over the river, merging with the canopy from Centennial Island. Gray squirrels were observed crossing the river in the tree-tops. The shrub layer here is a dense thicket including multiflora rose, gray dogwood, common buckthorn, japanese barberry, garden current, and plenty of poison ivy.

Passing a section where the bank narrows to only 20 feet and trees are replaced by a dense thicket of vines heavily littered with trash from the adjacent loading dock, the canopy returns, though a bit shorter, at a bedrock ledge standing over the river. Hophornbeam and solomon's seal are found here atop the bedrock which enriches the soil. Norway maple is dominant in understory and garlic mustard on ground.

From here north the bank, still steep, widens to 100 feet. The slope is quite littered in sections, and abandoned concrete structures are found throughout. The canopy reaches 60 feet and a number of stout silver maples and river birches root right at the water's edge. Norway maple remains common in the understory throughout.

Moving north past the lower rapid and toward the Rogers Street bridge, the vegetation increasingly reflects adjacent land use, with a higher percentage of non-natives including Japanese knotweed and celandine, although the silver maples remain large.

Trees:

American basswood	hophornbeam	tree of heaven
American elm	Norway maple	white ash
black cherry	river birch	white mulberry
box elder	silver maple	

Shrubs:

common buckthorn	Japanese barberry	poison ivy
garden current	maple-leaved viburnum	Tartarian honeysuckle
gray dogwood	multiflora rose	

Groundcover:

blueflag iris	garlic mustard	raspberry
celandine	ground ivy	solomon's seal
common chickweed	jack-in-the-pulpit	touch-me-not
common wintercress	Japanese knotweed	Virginia creeper
dewberry	oriental bittersweet	wild geranium
dogbane	poison ivy	

Centennial Island

The center of the island is not vegetated, covered as it is by a semi-abandoned building and its parking lot. The north end is dominated by Norway maple with an open understory as a result of recent understory clearing. The very northern tip of the island is cleared for land associated with the hydropower facility there. A narrow meadow runs down the northwest side of the island. The south end is a thicket of young aspen and birch on the east side and one acre of grassy meadow on west side. A few wetland associated plants grow alongside the channel on the island's west side.

Trees:

American beech	cottonwood	silver maple
American elm	Norway maple	sycamore-maple
big tooth aspen	pussy willow	trembling aspen
black cherry	red maple	white ash
black oak	red oak	white mulberry
box elder	river birch	

Shrubs:

common buckthorn	Japanese barberry	oriental bittersweet
common elderberry	multiflora rose	smooth sumac
honeysuckle		

Groundcover:

alfalfa	curled dock	mullein
Aster sp.	daisy fleabane	orchard grass
Barren brome grass	deertongue	pokeweed
bedstraw	Deptford pink	purple loosestrife
bittersweet nightshade	fescue	rabbit foot clover
black medick	forget-me-not	ragweed poison ivy
black swallowwort	garlic mustard	red clover
blue stem goldenrod	grape	red raspberry
bull thistle	great wood sorrel	riverbank grape
bush clover	horsetail	rough fruited cinquefoil
cat briar	jack-in-the-pulpit	sensitive fern
celandine poppy	joe-pye weed	Solidago sp.
common arrowhead	Kentucky bluegrass	solomon's seal
common blue violet	knawel	spotted touch-me-not
common chickweed	lady fern	tower mustard
common dandelion	lady's thumb	Virginia creeper
common evening primrose	late goldenrod	white clover
common hawkweed	lily of the valley	winter cress
common milkweed	mother wort	yarrow
common St. Johnswort	mouse ear chickweed	yellow iris
cow vetch	mugwort	

Zone 3

This is a section on the west side of the river from Centennial Island north to Rogers Street. A narrow strip of vegetation lies along riverbank with common riverside trees over low herbaceous cover. At the very north is Jollene Dubner Park which includes several horticultural plants.

Trees:

American elm	horse-chestnut	tree of heaven
apple	Norway maple	white pine
black cherry	silver maple	weeping willow
boxelder	sycamore maple	

Shrubs:

multiflora rose	forsythia	lilac

Groundcover:

alsike clover	English plantain	purple loosestrife
asters	ground ivy	Ragweed
common evening primrose	japanese knotweed	river grape
dandelion	poison ivy	Tulips

Zone 4

A narrow strip north of Rogers Street on west side of river. This section is difficult to access; data was collected from the Rogers Street bridge and from the east side of the river. Black oaks dominate in the 15 meter tall canopy, with American beech and red maple underneath; silver maple and river birch grow right near the water. The shrub layer is quite open with some low blueberry and grasses on the ground.

Trees:

American elm	boxelder	silver maple
beech	red maple	sycamore maple
black oaks	river birch	white pine

Groundcover:

grape	Japanese knotweed	pea
ground ivy	Oriental bittersweet	wintercress

Zone 5

The east side of the river from Rogers Street to Andover Street. This stretch includes some of the most attractive wooded areas to be found right near the river and sizeable meadows along Perry Street.

The bank at the very southern end is very steep. As with the northern end of Zone 2, this area is thick with non-native plants: Japanese knotweed grows in thick patches atop the bank, oriental bittersweet tangles in the trees, Japanese barberry and multiflora rose are the common shrubs, and garlic mustard is thick in the ground layer. Box elder, black oak, silver maple, cottonwood, scarlet oak, gray birch, and Norway maple are here, with several white ash, and a number of sycamore maples. Some individuals are the largest of their species found within the study area.

Atop the bank is a strip of tree-of-heaven, black locust, trembling and bigtooth aspen, gray birch, and boxelder with an understory of non-native shrubs. Beyond this to the east is a wide section of open land which serves as storage area, access road, electric utility equipment, and illegal dump. Areas that are not trampled resemble a grassy meadow, and many of the herbaceous species listed for this section occur here.

Moving north the river narrows and enters a small rapid. At this point the vegetation changes drastically. Black willows are found at the top of the rapid, with black gum; then the oaks, tree-of-heaven, and Norway maple are replaced by a small stand of more

northerly species such as American beech, witch hazel, musclewood, and common elderberry.

From the falls to Andover Street, the upper bank resembles the oak/maple mix found elsewhere. The lower bank, however, is more gently sloped here than elsewhere creating small floodplain stands of river birch and grassy mudflats at low water.

Trees:

American beech	choke cherry	sycamore maple
American elm	cottonwood	tree of heaven
black cherry	gray birch	trembling aspen
black gum	Norway maple	white ash
black locust	red maple	white birch
black oak	scarlet oak	white mulberry
black willow	silver maple	white oak
box elder		

Shrubs:

arrowwood	forsythia	musclewood
bell's honeysuckle	hawthorn	red-osier dogwood
chokecherry	highbush blueberry	speckled alder
common buckthorn	Japanese barberry	winged euonymus
common elderberry	lowbush blueberry	witch hazel
common juniper	multiflora rose	

Groundcover:

Alfalfa	early goldenrod	ragweed
Aster sp.	field scabious	red clover
Barren brome grass	garlic mustard	red raspberry
bedstraw	hawkweed	rough-fruited cinquefoil
black swallowwort	japanese knotweed	round headed bush clover
bladder campion	Kentucky bluegrass	sensitive fern
blue toadflax	knawel	sheep sorrel
bracken	late goldenrod	smartweed
butter and eggs	little bluestem	spurge
canada goldenrod	Marsh rose mallow	swamp dewberry
clearweed	milkweed	touch me not
cleavers	Mouse-ear chickweed	venus's looking glass
common arrowhead	mugwort	virginia creeper
common dandelion	mullein	white clover
common hawkweed	orchard grass	whorled loosestrife
common St. Johnswort	Oregon grape	wild madder
cow vetch	oriental bittersweet	wood sorrel
crinkled hairgrass	Poison ivy	yarrow
cuckooflower	Purple loosestrife	yellow clover
Deptford pink	quackgrass	yellow goatsbeard
dewberry		

Zones 6 & 7

As with Zone 4, these narrow sections were difficult to access. They appear to host many of the same species listed above. Zone 6 has a small bit of bank extending up from the river, and was the location of a black-crowned night heron siting from across the river. Zone 7 consists primarily of river birches and silver maples tightly hugging the low bank below parking lots.

Zone 8

The northeast end of study area, between Andover Street and East Merrimack. Includes a small island which was not accessible. The island and flooded banks at the base of retaining walls are dominated by river birch, with many of the other riverside species – silver maple and boxelder in particular – also present. The most notable feature here is a small, open meadow south of the parking lots. The plant diversity is high here, and it is a good area to see damselflies.

Trees:

american elm	Norway maple	tree-of-heaven
apple	river birch	white mulberry
boxelder	silver maple	

Shrubs:

common buckthorn	autumn olive

Groundcover:

asiatic dayflower	common dandelion	oriental bittersweet
awnless brome	common evening primrose	*Panicum virgatum*
barren brome grass	garlic mustard	poison ivy
black nightshade	ground ivy	purple loosestrife
black swallowwort	grove meadow grass	quack grass
bladder campion	heart leaved umbrella-wort	reed canary grass
bull thistle	hedge bindweed	soft rush
Canada bluegrass	Japanese knotweed	sweetfern
Carex cristata	Kentucky bluegrass	tall St. Johnswort
Carex sp.	lady's thumb	spotted touch-me-not
catbriar	larger blue flag	wild carrot
celandine	late goldenrod	wild madder
common arrowhead	mugwort	yellow iris

Wildlife

Birds

The following species have been observed within the study area.

Double-crested Cormorant	Eastern Phoebe	Northern Parula
Great Blue Heron	Eastern Kingbird	Yellow Warbler
Black-crowned Night Heron	Warbling Vireo	Yellow-rumped Warbler
Turkey Vulture	Blue Jay	Palm Warbler
Canada Goose	American Crow	Common Yellowthroat
Mallard	Tree Swallow	Song Sparrow
Wood Duck	Northern Rough-winged Swallow	White-throated Sparrow
Red-tailed Hawk	Barn Swallow	Northern Cardinal
American Kestrel	Black-capped Chickadee	Rose-breasted Grosbeak
Ring-billed Gull	Tufted Titmouse	Red-winged Blackbird
Herring Gull	White-breasted Nuthatch	Common Grackle
Rock Dove	Carolina Wren	Brown-headed Cowbird
Mourning Dove	Hermit Thrush	Baltimore Oriole
Chimney Swift	American Robin	House Finch
Belted Kingfisher	Gray Catbird	American Goldfinch
Red-bellied Woodpecker	Northern Mockingbird	House Sparrow
Downy Woodpecker	European Starling	Chipping Sparrow
Northern Flicker	Cedar Waxwing	Dark-eyed Junco

Based on habitat, the following species are likely to be found within the study area at various times of year.

Green Heron	Ruby-throated Hummingbird	Nashville Warbler
American Black Duck	Red-bellied Woodpecker	Chestnut-sided Warbler
Osprey	Hairy Woodpecker	Magnolia Warbler
Bald Eagle	Willow Flycatcher	Black-throated Green Warbler
Sharp-shinned Hawk	Great Crested Flycatcher	Blackpoll Warbler
Cooper's Hawk	Red-eyed Vireo	Black-and-white Warbler
Broad-winged Hawk	Bank Swallow	American Redstart
Merlin	Brown Creeper	Ovenbird
Killdeer	House Wren	Northern Waterthrush
Solitary Sandpiper	Golden-crowned Kinglet	Scarlet Tanager
Spotted Sandpiper	Ruby-crowned Kinglet	American Tree Sparrow
Great Black-backed Gull	Blue-gray Gnatcatcher	Savannah Sparrow
Great Horned Owl	Wood Thrush	Rose-breasted Grosbeak
Common Nighthawk		

Invertebrates

Dragonflies and damselflies were censused on June 13th and 24th, 2002. These invertebrates are mobile, visible, and susceptible to field identification, making them an attractive group for inventory; and their diversity can be an indicator of overall

invertebrate diversity. Most specimens were collected with nets and identified in the field, although several were collected for further identification in the lab. In addition, exuvia, or the shed exoskeleton of the nymph form, were collected and identified. Individuals are identified to species in some cases, and to family or genus in others. Notes on other invertebrates collected are included.

13 June 2002 – cloudy, previous evening was very cold.

One adult damselfly and one exuvia were observed at the southern end of Centennial Island.

Coenagrionidae
    Eastern Forktail (*Ischnura verticalis*) female, (1)
Cordullidae

The following specimens were collected from two sweeps with an aquatic net beside Centennial Island, below some small riffles with a substrate of medium size cobbles and coarse sand.

Isopoda
    Caecidotea communis (1)
Amphipoda
    Crangonyx sp., juvenile (1)
    Gammarus sp. (6)
Hyalella azteca (3)
Mollusca
    Physidae (3)
Trichoptera
    Hydropsyche sp. (1)
Diptera
    Simuliidae (3)
Unionoida (1)

24 June 2002 – Sunny, warm in low 80's with a moderate breeze.

Zone 1 and Centennial Island.
    Coenagrionidae
        Blue-fronted Dancer (*Argia apicalis*) (2 collected)
        Powdered Dancer (*Argia moesta*) (1 collected)
    Aeshnidae
        Aeshnidae sp?
        Common Green darner (*Anax junius*)
    Libellulidae
        Eastern Pondhawk (*Erythemis simplicicollis*)

Wet Meadow in Zone 8.
    Coenagrionidae
        Blue-fronted Dancer (*Argia apicalis*) (1 collected)
        Powdered Dancer (*Argia moesta*) (1 collected)
        Stream Bluet (*Enallagma exsulans*)
        Orange Bluet (*Enallagma signatum*)
        Fragile Forktail (*Ischnura posita*)
        Eastern Forktail (*Ischnura verticalis*)

The site in Lowell with the greatest odonate diversity and density was the wet meadow site, likely due to the presence of streamside vegetation. The *Argia* species are well

suited to this section of river as the nymphs seek refuge under stones and bottom debris. The two *Enallagma* species are considered mainly stream species, found in sheltered spots with standing aquatic plants such as *Sparganium*, *Sagittaria*, or *Iris* – of which the latter two were found at the wet meadow site. The *Ischnura* species are generally associated with slow streams.

The area does not display tremendous odonate diversity, possibly due to low water quality and river bank alteration. Aquatic nymphs of dragonflies and damselflies require emergent vegetation for climbing out of the water to emerge as adults.

Other Animals

Other animals sighted within the study area include a woodchuck under the powerlines and with a den in the river bank, gray squirrels, and cats (without collars, possibly feral). Tracks of deer and raccoon have been found in mud underneath powerlines, and beaver sign, some apparently recent, is found throughout the river, especially on Centennial Island. A painted turtle was found in the river on March 23rd, apparently stunned by the cold. A garter snake was noted in the large meadow section in Zone 5.

Visitor Experience

The following notes recall highlights of the visitor's experience, walking north to south from Lawrence Street on the east side of the river.

Immediately after leaving Lawrence Street, the visitor is on a narrow dirt access road among dense vegetation on both sides (Figure 3). Poison ivy limits exploration off the trail, and much of the luxuriant growth is from the leaves of non-native species such as black swallow-wort, but if one can mentally subtract the power lines overhead, the abundant blooming shrubs and wildflowers create the sensation of walking in a small meadow.

Figure 3: Vegetation under the power line.

The section is framed on the east by the cemetery retaining wall and the west side opens onto the river. Warblers venturing out from the cemetery flit among the riverside trees in the Spring, and mallards and black ducks dabble in the slow water all Summer. Only 100 yards from the trailhead, a riverbank retaining wall allows the visitor to stand right over the river, roughly 10 feet above the water level for a fine view of the wooden dam, the falls below the dam, and the south end of Centennial Island (Figure 4).

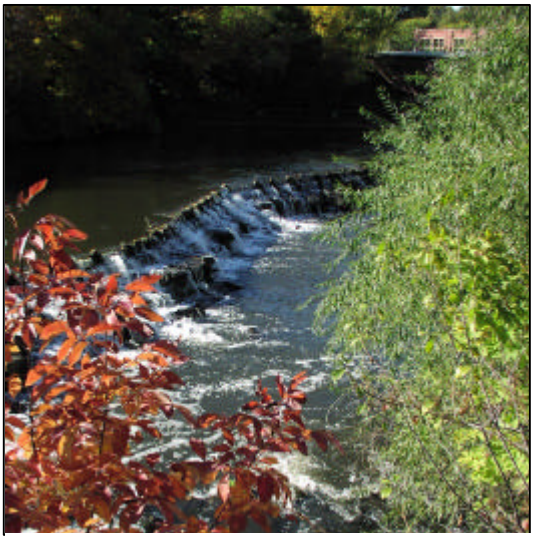

Figure 4: Wooden dam and falls.

Moving north from the dam, the band of trees right at the river's edge becomes thicker, and the water is not as visible from the dirt path. However, steps leading right to the water's edge bring the visitor down to the riffles below the dam. Great blue heron were frequently seen in this section, a wood duck was noted during Spring migration, and rose mallow flowers in the shallows in late summer. Using another mental subtraction to remove the rather unattractive Centennial Island building from the scene, this point provides pleasant views all year.

Walking on to the current location of a chain-link fence, a narrow footpath leads back to the river's edge and a low wall of large stones built long ago to maintain the river channel. At this point the channel is roughly 50 feet wide and the tall silver maples growing on both sides of the river create a cathedral-like canopy over the river. A taller stone wall forms the far bank and vegetation obscures the buildings on Centennial Island. At this point, with the gently

Figure 5: Centennial Island channel

tumbling water silencing sounds of the city, the visitor feels hidden away on the river (Figure 5).

From this point north, the river bank is quite narrow and steep, squeezed between the water and the Bradford Industries parking lot above. Windblown paper and plastic trash from the building have blown into the shrubs here and should be removed. But after only 400 feet of walking atop the bank a path leads back into the trees and reaches a large bedrock outcrop standing high above the river and affording a spectacular view of the first large rapid on the river, known to rafters as Twisted Sister. The outcropping of Nashoba Formation schists enriches the soil somewhat, creating conditions for a few hophornbeam trees, which are found nowhere else along the river.

A little scrambling brings one closer to the river's edge and the thundering rapid – another point at which one feels truly hidden from the city. At low water, the adventurous can walk on the exposed rocks right to the middle of the river and are rewarded with a fine view upstream, into the cathedral canopy mentioned above (Figure 6).

Figure 6: View above rapids.

Walking north from the rapid, the bank widens to a flat area atop another retaining wall where an apparently little-used picnic table sits in the shade of several boxelder trees. This area could be improved to a pleasant picnic spot with views down onto the river. Additional small outcrops just north of this point afford more views of the rapids and a great view downstream to the broad slower water just south of Rogers Street. Barn swallows, northern rough-winged swallows, and chimney swifts are regularly seen here flying acrobatically above the water feeding on insects.

Figure 7: Riverside litter.

The riverbank stretch from the final rapid to the Rogers Street Bridge includes a few broad riverside openings which are frequented by fishermen and others. Several of these sites are well-littered with beer cans and other trash (Figure 7), and paths up the steep bluff above the river are heavily eroded. The northern-most stretch, right to the Rogers Street bridge, is mostly overgrown, with only an obscure, narrow path at the bottom. The bit of dry land under the bridge is heavily littered.

North of Rogers Street the river bank is still steep and is heavily vegetated with non-natives such as tree-of-heaven, black locust, and Japanese knotweed. It would be difficult to locate a trail anywhere near the water here. This steep bank continues for roughly 500 feet. The top of the bank is a broad flat area including some parking, electric company facilities, storage trailers, and a weedy meadow.

Beyond this 500 feet of steep bank there is good access to what is perhaps the most pleasant stretch of the river. Rock outcrops and high banks frame an attractive stand of American beech over witch hazel shrubs; a small island screens the residential development on the west side of the river; and a long gentle rapid winds between the two. Of all points within the study area, this seems the greatest piece of 'nature in the city' (Figure 8).

Figure 8: Nature in the city.

Below these rapids the river once again opens up to a wider, slower stretch with dabbling ducks and swallows rocketing above the water's surface. Small floodplain stands of river birch extend into the river, and low water exposes several islands which sustain a wet meadow alongside open water (Figure 9). The wide bank here would permit a trail near the water, well away from the industrial properties atop the bank. Several concrete structures alongside the river allow good views of the river from above; they could be used to locate a trail well above water level, which would ensure access when the river is higher.

Figure 9: Open water at Andover St.

The final stretch before the Andover Street bridge is not as wide at the river's edge, but the top of the bank here is a wide shrubby meadow which would be a very pleasant spot to walk through, and would provide variety for the visitor. The meadow is currently fenced at the roadside.

North of Andover Street, the river runs through the back yard of a restaurant and an apartment building. Just past the apartment building is another of the small gems along the river: a wet meadow with high diversity of grasses and wildflowers, the best habitat within the study area for dragonflies and damselflies, and views up and down the river. This small patch is screened from adjacent parking lots by a tall stand of boxelder.

North of this meadow the river bank becomes too narrow for any trail and soon ends altogether as the river enters a concrete channel. There is one final set of falls with an island between. A concrete structure at the southwest corner of the lower parking lot

allows a nice view of the island and of the river's side channel. River birches hug the base of the retaining walls which constrain the river from here to its confluence with the Merrimack. From this point the Greenway would be sited atop the retaining walls at the edge of parking lots to East Merrimack Street.

Conclusion

Although Lowell has been shaped by centuries of urban land use, the study area represents a slice of Nature in the city. Highlights of the study area include:

- Extensive stands of river birch (*Betula nigra*) on small floodplain patches – river birch is a watch list species in Massachusetts;
- Regular sightings of Great blue heron in river along Centennial Island;
- Several red-tailed hawks working area of powerlines;
- A migrating wood duck in the riffles near Centennial Island;
- Very active dragonflies and damselflies under powerlines and in wet meadow at northeast end of study area;
- Narrow band of silver maple, white ash, box elder, American elm, black willow along river;
- Very attractive views onto rapids north of Rogers Street – native trees and shrubs, impressive rock outcrops;
- Barn swallows, northern rough-winged swallows, and chimney swifts regularly flying above open sections of water below falls – chimney swifts are on the Partners In Flight National Watch List of birds which are in danger of becoming threatened;
- Signs of recent beaver activity on southern end of Centennial Island.

An observant visitor can find all of this and more on a short stroll up the Concord River.

Literature Cited

Swain, P.C. and J.B. Kearsley. 2000. Draft classification of the natural communities of Massachusetts. Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries and Wildlife, Westborough, MA.

Zen, E-an, ed. 1983. *Bedrock Geologic Map of Massachusetts*. Reston, VA.: US Geological Survey. Scale 1:250,000. 3 sheets.

Appendix: Plant Species List

All plants mentioned in the report are given here, in alphabetical order by common name, with scientific name. Non-native species are indicated.

Common Name	Scientific Name	Non-natives
alfalfa	Medicago sativa	*
alsike clover	Trifolium hybridum	*
alternate-leaved dogwood	Cornus alternifolia	
American basswood	Tilia americana	
American beech	Fagus grandifolia	
American elm	Ulmus americana	
apple	Malus sp.	
arrowwood	Viburnum dentatum	
asparagus	Asparagus officinalis	*
Aster	Aster sp.	
autumn olive	Elaeagnus umbellata	*
smooth brome	Bromus inermis	
barren brome grass	Bromus sterilis	*
bayberry	Myrica pensylvanica	
bell's honeysuckle	Lonicera x bella	*
bigtooth aspen	Populus grandidentata	
bittersweet nightshade	Solanum dulcamara	*
black cherry	Prunus serotina	
black gum	Nyssa sylvatica	
black locust	Robinia pseudoacacia	*
black medick	Medicago lupulina	*
black nightshade	Solanum nigrum	*
black oak	Quercus velutina	
black swallow-wort	Cynanchum louiseae	*
black willow	Salix nigra	
bladder campion	Silene vulgaris	*
blue toadflax	Nuttallanthus canadensis	
blueflag iris	Iris versicolor	
box elder	Acer negundo	
Bracken fern	Pteridium aquilinum	
bracted plantain	Plantago aristata	*
bull thistle	Cirsium vulgare	*
bush clover	Lespedeza sp.	
butter and eggs	Linaria vulgaris	*
Canada bluegrass	Poa compressa	*
Canada goldenrod	Solidago canadensis	
celandine	Chelidonium majus	*
celandine poppy	Stylophorum diphyllum	
chickory	Cichorium intybus	*
choke cherry	Prunus virginiana	
clearweed	Pilea pumila	
cleavers	Galium aparine	
common arrowhead	Sagittaria latifolia	

common blue violet	Viola sororia	
common buckthorn	Rhamnus cathartica	
common chickweed	Cerastium arvense	
common dandelion	Taraxacum officinale	
common elderberry	Sambucus canadensis	
common evening primrose	Oenothera biennis	
common juniper	Juniperus communis	
common milkweed	Asclepias syriaca	
common St. Johnswort	Hypericum perforatum	
common wintercress	Barbarea vulgaris	*
cottonwood	Populus deltoides	
cow vetch	Vicia cracca	*
Crested sedge	Carex cristatella	
crinkled hairgrass	Deschampsia flexuosa	
cuckooflower	Cardamine pratensis	
curly dock	Rumex crispus	*
daisy fleabane	Erigeron annuus	
dayflower	Commelina communis	*
deertongue	Dichanthelium clandestinum	
Deptford pink	Dianthus armeria	*
dewberry	Rubus flagellaris	
dogbane	Apocynum androsaemifolium	
early goldenrod	Solidago juncea	
English plantain	Plantago lanceolata	*
false solomon’s seal	Maianthemum racemosum	
fescue	Festuca sp.	
field madder	Galium mollugo	*
field pennycress	Thlaspi arvense	*
field scabious	Knautia arvensis	*
flowering dogwood	Cornus florida	
forget-me-not	Myosotis scorpioides	*
forsythia	Forsythia sp.	*
garden current	Ribes rubrum	*
garlic mustard	Alliaria petiolata	*
goldenrod	Solidago sp.	
grape	Vitis spp.	
gray birch	Betula populifolia	
gray dogwood	Cornus racemosa	
great wood sorrel	Oxalis grandis	
greenbrier	Smilax rotundifolia	
ground ivy	Glechoma hederacea	*
grove meadow grass	Poa alsodes	
hairy vetch	Vicia villosa	*
hawkweed	Hieracium sp.	
hawthorn	Crataegus sp.	
hay-scented fern	Dennstaedtia punctilobula	
heart leaved umbrella-wort	Mirabilis nyctaginea	*
hedge bindweed	Calystegia sepium	
highbush blueberry	Vaccinium corymbosum	

hoary alyssum	Berteroa incana	*
honeysuckle	Lonicera sp.	*
hophornbeam	Ostrya virginiana	
horse-chestnut	Aesculus hippocastanum	*
horsetails	Equisetum spp.	
jack-in-the-pulpit	Arisaema triphyllum	
Japanese barberry	*Berberis thunbergii*	
Japanese knotweed	Polygonum cuspidatum	*
Kentucky bluegrass	Poa pratensis	*
lady fern	Athyrium filix-femina	
lady's thumb	Polygonum persicaria	*
late goldenrod	Solidago gigantea	
lilac	Syringa vulgaris	
lily of the valley	Convallaria majalis	*
little bluestem	Schizachyrium scoparium	
lowbush blueberry	Vaccinium angustifolium	
maple-leaved viburnum	Viburnum acerifolium	
marsh rose mallow	Hibiscus moscheutos	
meadowsweet	Spiraea alba var. latifolia	
milkweed	Asclepias syriaca	
mother wort	Leonurus cardiaca	*
mouse ear	Hieracium pilosella	*
mouse ear chickweed	Cerastium vulgatum	*
mugwort	Artemisia vulgaris	*
mullein	Verbascum thapsus	*
multiflora rose	Rosa multiflora	*
musclewood	Carpinus caroliniana	
Norway maple	Acer platanoides	*
ohio spiderwort	Tradescantia ohiensis	*
orchard grass	Dactylis glomerata	*
Oregon grape	Mahonia bealei	*
oriental bittersweet	Celastrus orbiculata	*
oxeye daisy	Leucanthemum vulgare	*
panic grass	Panicum sp.	
pathrush	Juncus tenuis	
Pennsylvania sedge	Carex pensylvanica	
phragmites	Phragmites australis	
pigweed	Amaranthus retroflexus	*
pin cherry	Prunus pensylvanica	
poison ivy	Toxicodendron radicans	
pokeweed	Phytolacca americana	
prairie switchgrass	*Panicum virgatum*	
purple loosestrife	Lythrum salicaria	*
pussy willow	Salix discolor	
quackgrass	Elytrigia repens	
rabbit's foot clover	Trifolium arvense	*
ragweed	Ambrosia artemisiifolia	
raspberry	Rubus spp.	
red clover	Trifolium pratense	*

red maple	Acer rubrum	
red oak	Quercus rubrum	
red raspberry	Rubus idaeus	
red-osier dogwood	Cornus sericea	
reed canary grass	Phalaris arundinacea	
river birch	Betula nigra	
riverbank grape	Vitis riparia	
round headed bush clover	Lespedeza capitata	
scarlet oak	Quercus coccinea	
sedges	Carex spp.	
sensitive fern	Onoclea sensibilis	
sheep fescue	Festuca ovina	*
sheep sorrel	Rumex acetosella	*
silver maple	Acer saccharinum	
smartweed	Polygonum sp.	
smooth sumac	Rhus glabra	
soft rush	Juncus effusus	
solomon's seal	Polygonatum pubescens	
speckled alder	Alnus rugosa	
spotted joe-pye weed	Eupatorium maculatum	
spotted knapweed	Centaurea biebersteinii	*
spotted touch-me-not	Impatiens capensis	
spurge	Euphorbia sp.	*
sulphur cinquefoil	Potentilla recta	*
swamp dewberry	Rubus pubescens	
sweetfern	Comptonia peregrinus	
sycamore maple	Acer pseudoplatanus	*
tall blue lettuce	Lactuca biennis	
tatarian honeysuckle	Lonicera tatarica	*
tower mustard	Arabis glabra	
tree-of-heaven	Ailanthus altissima	*
trembling aspen	Populus tremuloides	
tulips	Tulipa sylvestris	*
Venus's looking glass	Triodanis perfoliata	
Virginia creeper	Parthenocissus quinquefolia	
weeping willow	Salix babylonica	*
white ash	Fraxinus americana	
white birch	Betula papyrifera	
white clover	Trifolium repens	*
white mulberry	Morus alba	*
white oak	Quercus alba	
white pine	Pinus strobus	
whorled loosestrife	Lysimachia quadrifolia	
wild carrot	Daucus carota	*
wild garlic	Allium canadense	
wild geranium	Geranium maculatum	
wild madder	Galium mollugo	*
wild peppergrass	Lepidium virginicum	
winged euonymus	Euonymus alata	*

witch hazel	Hamamelis virginiana	
wood sorrel	Oxalis stricta	
yarrow	Achillea millefolium	*
yellow clover	Melilotus officinalis	*
yellow goatsbeard	Tragopogon pratensis	*
yellow iris	Iris pseudacorus	*