3.0 MASTER PLAN RECOMMENDATIONS

3.1 SITE PROGRAM AND RECOMMENDED USES

Increasing youth environmental awareness

Experts and community members identifying fish at the BioBlitz (BCPF)

Many program ideas for the Baird Creek Greenway were received during the master planning workshops and via e-mail or handwritten comment sheets. Meeting participants evaluated the suggested uses to determine their compatibility with the project goals. Based on the workshop discussions, the Master Plan recommends the following program elements for the Baird Creek Greenway:

- Bird watching
- Nature study
- Outdoor classrooms near schools
- Sponsored night hikes
- A hierarchy of trails to provide the following levels of trail use:
  - Pedestrian traffic only (hiking, jogging, snowshoeing)
  - Pedestrian and bike traffic
  - Winter: Designated cross-country ski traffic only to protect the groomed surface
  - Multi-use trail for pedestrians, biking, rollerblading, etc.
  - Signage along trails to include educational information, directional or trail identification, and trail difficulty
  - Benches at key trail intersections or special interest points
- Trailheads with a mix of the following facilities based on level of use:
  - Informational kiosks with trail maps
  - Bike racks
  - Picnic areas
  - Restrooms
  - Demonstration sites for habitat restoration or for use of green building techniques
- Trail connections to the UW-Green Bay Arboretum, Wildlife Sanctuary, and Lily Lake County Park
- Pedestrian access from adjacent residential neighborhoods
- Restoration of native vegetation communities and the stream channel
- Deer management through exclusion fencing at restoration sites and bow hunting
- Stormwater controls in the watershed
- Future facilities constructed using green building techniques, to provide education on stormwater runoff, rain gardens, green roofs, etc.

Through the consensus-building process of the workshops, several potential uses were deemed in conflict with the overall goal to protect and preserve the ecological integrity of the Greenway. Although currently proposed to be excluded from the Greenway, future requests to allow the following uses may be granted if additional studies show that user conflicts and degradation of the natural environment can be avoided:

- Operation of motorized vehicles (ie. snowmobiles, dirt bikes) beyond those required for direct access for restoration activities
- Dog walking
- Horseback riding
- Undesignated camping/fire pits
- Paintball
- Unauthorized removal of plants for any reason other than invasive species control, habitat restoration, education, or research purposes

Education and Outreach Activities

The Greenway offers many opportunities for the public to learn about ecology and environmental processes. The BCPF sponsors events throughout the year, and keeps the public informed about activities through newsletters, a website, display booths at regional festivals, and an annual banquet. In the past year, the BCPF coordinated more than 1,000 volunteer hours in removing approximately 59,000 buckthorn and honeysuckle plants, and eradicated or controlled six garlic mustard and three phagmites infestations. They also sponsor Earth Fest, an Earth Day celebration that removes hundred of pounds of garbage from the Greenway annually. During Earth Fest 2006, three dump truck loads of refuse was removed from "Garbage Gulch" alone. For the future, it is a recommendation of the Master Plan that the BCPF expand upon the success of Earth Fest to create an Adopt-a-Trail stewardship program within the Greenway. This program would allow Boy or Girl Scout troops, school classes, neighbors, or other interested groups to adopt and remove litter from individual trail sections throughout the year. Signage could be placed along the trails to recognize the efforts of the volunteer crews.

In July 2004, the BCPF, Great Lakes Forever, The Biodiversity Project, Sea Grant, and The Cofrin Center for Biodiversity sponsored a one-day BioBlitz of the Greenway. This was a tremendous educational outreach project that brought together scientists, students, naturalists, and community members to perform a qualitative census of all the species they could identify within the Greenway between I-43 and Huron Road. With the help of approximately 70 community members and children, experts documented over 600 species in the Greenway, including plants, birds, mammals, reptiles and amphibians, insects, arachnids, mushrooms, aquatic invertebrates, and fish. It is hoped that the BioBlitz can be repeated again in the future to continue discovering the wonders that Baird Creek has to offer.

Baird Creek has also been nominated as a destination on the Great Wisconsin Birding and Nature Trail. Currently being developed by the Wisconsin Bird Conservation Initiative and the Wisconsin Department of Natural Resources Endangered Resources Program, the trail will be a system of designated high-quality birding sites throughout the state. As part of the Lake Michigan Birding Trail Region, visitors from throughout the state will become aware of the birding resources within the Baird Creek Greenway and will contribute to tourism in Brown County.

In light of the past successes using Greenway resources for educational outreach, multiple opportunities exist to further expand these programs in the future. Working with the UW-Green Bay Education Department, the Einstein Project, and other partners, curricula could be developed for local schools and teachers to explore ecology through Greenway habitats. With the planned construction of a new high school and elementary school bordering the Greenway east of Huron Road, an environmental discovery zone could be created with outdoor classrooms and learning stations. The BCPF should also team with the UW-Green Bay Environmental Science and Policy master's degree program and The Cofrin Center for Biodiversity to sponsor research projects within the Greenway, with topics ranging from water quality to habitat restoration studies.

3.2 OVERALL MASTER PLAN SUMMARY

The Master Plan is a framework to guide the placement of the Greenway's facilities and trails, as well as strategies for habitat restoration, tributary and streambank erosion control, and connections to the surrounding urban fabric. This section gives a general description of Greenway access points and trailhead facilities. Subsequent sections provide greater detail on the Greenway trail system, wayfinding and signage, habitat restoration and management, stormwater management and stream stabilization, and the interface with adjacent development.

West Greenway Boundaries, Access Points, and Trailhead Facilities

The graphic on Page 34 shows the overall master plan for the western portion of the Greenway, from Danz Avenue to I-43. Areas proposed for future acquisition are shown as dashed boundaries. These include 20.0 acres along the major southern tributary to Baird Creek, which would extend the Greenway boundary to Deckner Avenue. An additional 2.6 acres are proposed at the access drive to Triangle Hill Park and Frisbee Golf Course, which would provide greater control over the park entrance experience.

Major trailheads within this section are located at Danz Park and Triangle Hill Park. The Danz Park access point currently provides on-street parking along Basten Street and a picnic area, while Triangle Hill Park has a picnic area, restrooms available through a shelter, and ample parking. Informational kiosks are recommended for both these locations to provide Greenway maps, activity announcements, rules and regulations for Greenway use, and other postings. Bicycle racks are also proposed so that visitors arriving at the Greenway by bike can enjoy hiking or other activities. Restrooms may also be added to Danz Park in the future for both park and Greenway users.

Secondary trailheads are located at the two parking areas along Baird Creek Road near I-43 and at the multi-use trail crossing of Danz Avenue. Informational kiosks and bike racks are proposed for these facilities. Five tertiary trailheads are established at pedestrian access points to the Greenway. These sites are provided with a small identification sign and trail map, and are intended to be used by neighboring residents only. No parking is provided at these locations.

A designated outdoor classroom will provide group gathering space near the crossing of the multi-use trail and Danz Road. This classroom is primarily intended to be used by students at Danz School or Preble High School, but can also provide a meeting location for volunteer activities, Scout groups, or sponsored hikes. The classroom is envisioned as a semi-circular mown area to one side of the trail that is 25 feet in diameter. Two benches should also be provided near the edge of the trail.

Central Greenway Boundaries, Access Points, and Trailhead Facilities

The map on Page 35 shows the overall master plan for the central portion of the Greenway, from I-43 to Huron Road. Future acquisition within the section includes 63.8 acres designated as Greenway by the City's current official map, and 19.9 acres that were previously recommended for addition to the official map. Areas shown in light blue on the graphic are areas previously suggested for acquisition, which should be removed from designated or proposed Greenway maps based on current land use.

Major trailheads are located south of Baird Creek at Christa McAuliffe Park and along the northern boundary at Moore Drive. Christa McAuliffe Park is already equipped with restroom facilities, a picnic area, and bike racks. An informational kiosk and outdoor classroom as

described above are proposed to be added at the park. The Moore Drive trailhead is located at an existing private farm residence that is proposed for future acquisition. This location provides good access to the valley floor via an existing farm drive, and ample space for a new parking lot that would accommodate approximately 20 vehicles. Other proposed improvements include a picnic area, restrooms, an informational kiosk, and bike racks.

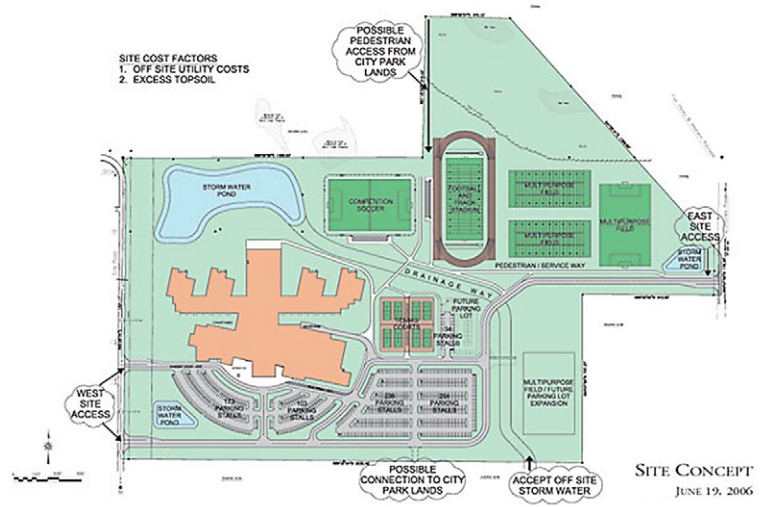
Secondary trailheads with informational kiosks and bike racks are located at the existing parking lot on Superior Road, at a proposed parking lot at the top of the bluff on Superior Road, and at the multi-use trail crossing of Huron Road. Due to the proximity of the existing Superior Road and Christa McAuliffe Park lots, the proposed parking lot on Superior Road would provide limited space for approximately eight vehicles. Eight tertiary trailheads are located at pedestrian access points to the Greenway within the section, which are marked with a small identification sign and trail map only. A designated outdoor classroom will be provided at the tertiary trailhead at Baird Elementary School.

Example of an informational kiosk

East Greenway Boundaries, Access Points, and Trailhead Facilities

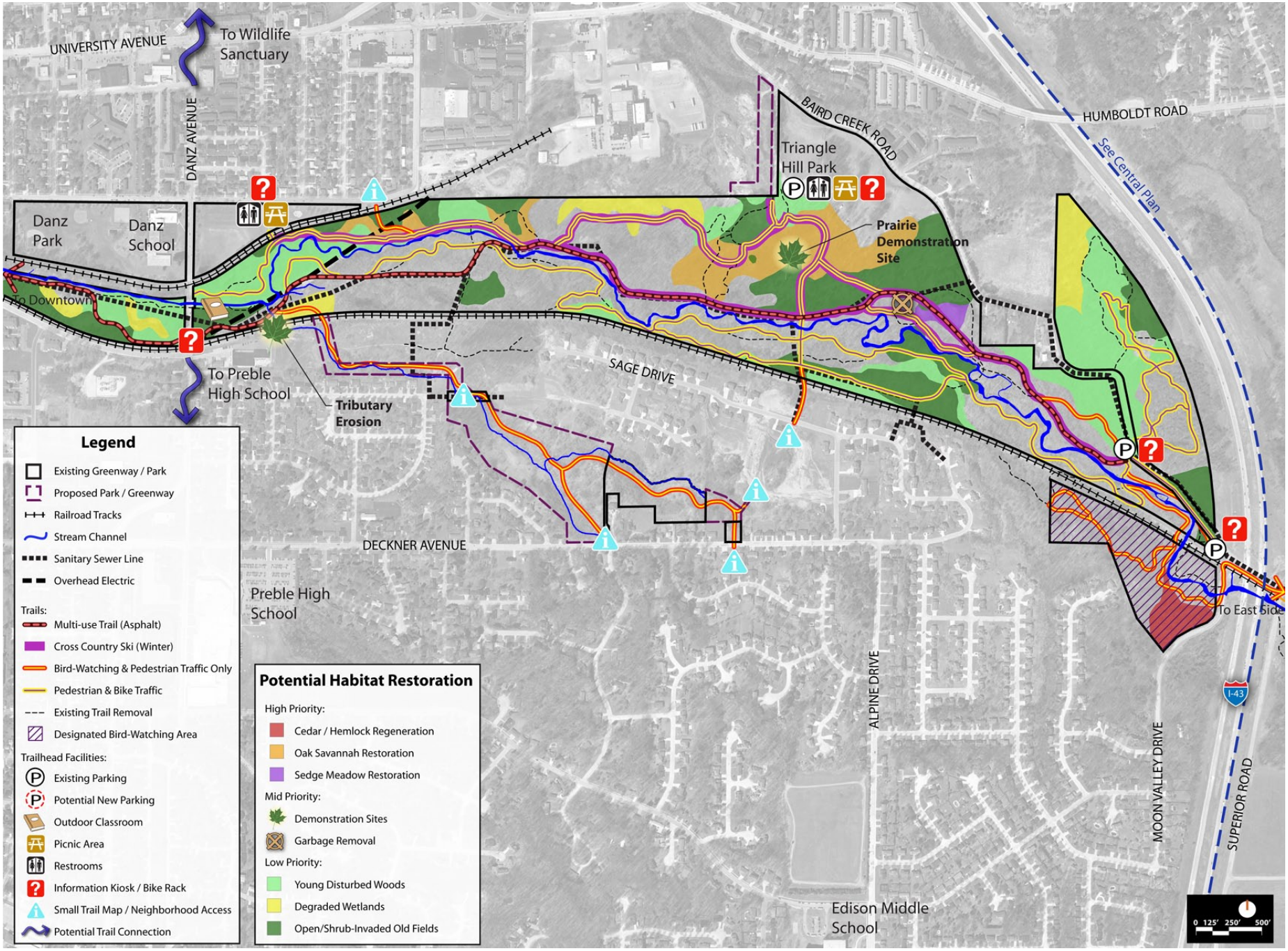
The map on Page 36 shows the overall master plan for the portion of the Greenway east of Huron Road. As the majority of land in this section has not yet been acquired, trail and facility layout is shown at a smaller scale and is generally more schematic. An enlargement is provided on Page 37 for the area between Huron and Grandview Roads along the North Branch of Baird Creek, where more detailed information was available from the recent habitat assessment and from the proposed Middle/High School site concept plan available online from the Green Bay School District website.

Future acquisition within the section includes 131.1 acres designated as Greenway by the City's current official map, and 109.9 acres that were previously recommended for addition to the official map as parks or Greenway. As on the central section graphic, light blue areas designate parcels previously suggested for acquisition which should be removed from designated or proposed Greenway maps based on current land use.

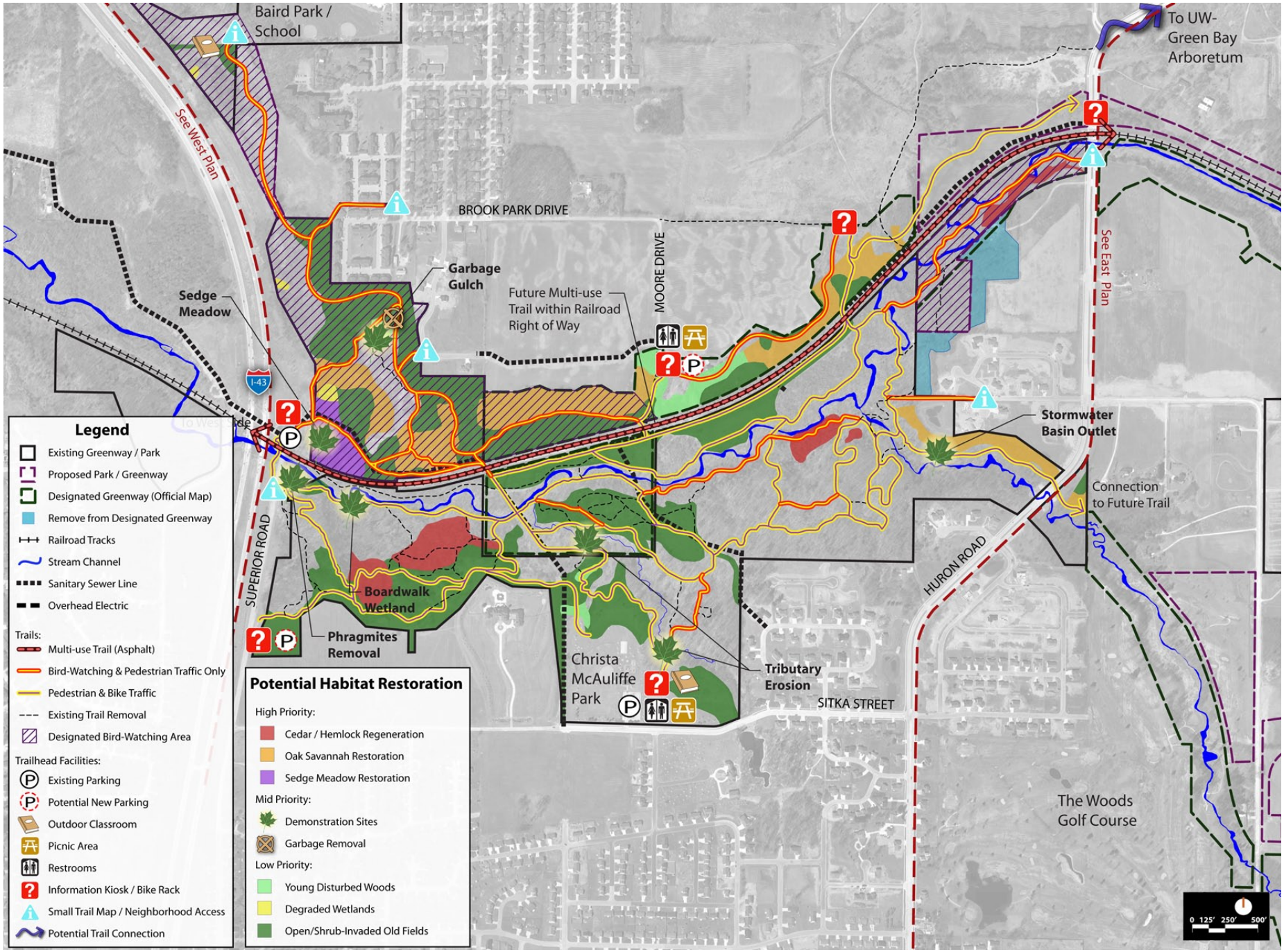


Proposed site plan for the new Middle/High School located between Erie and Grandview Roads (Bray Associates Architects, Rettler Corporation)

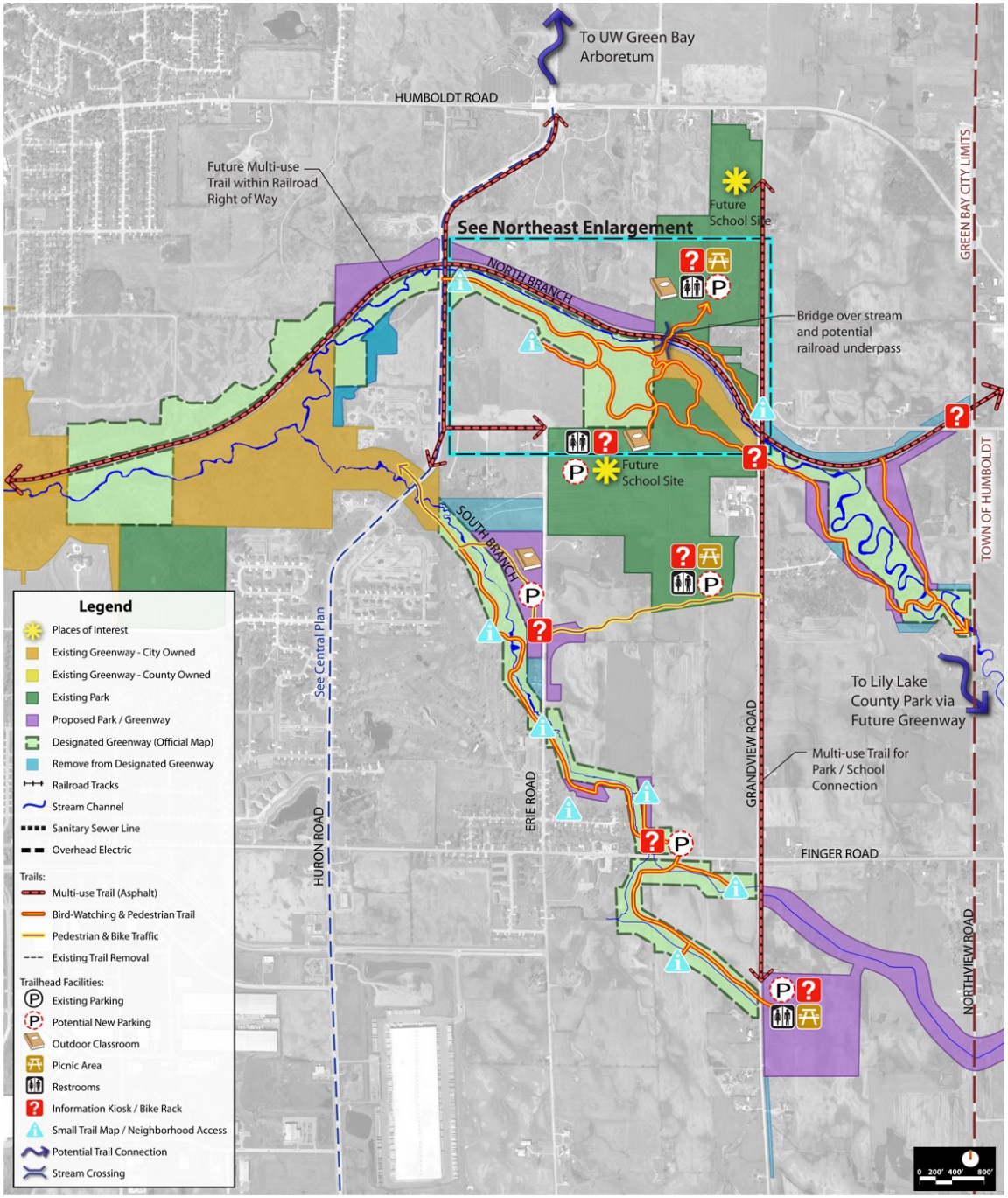
OVERALL MASTER PLAN DIAGRAM, WEST PLAN



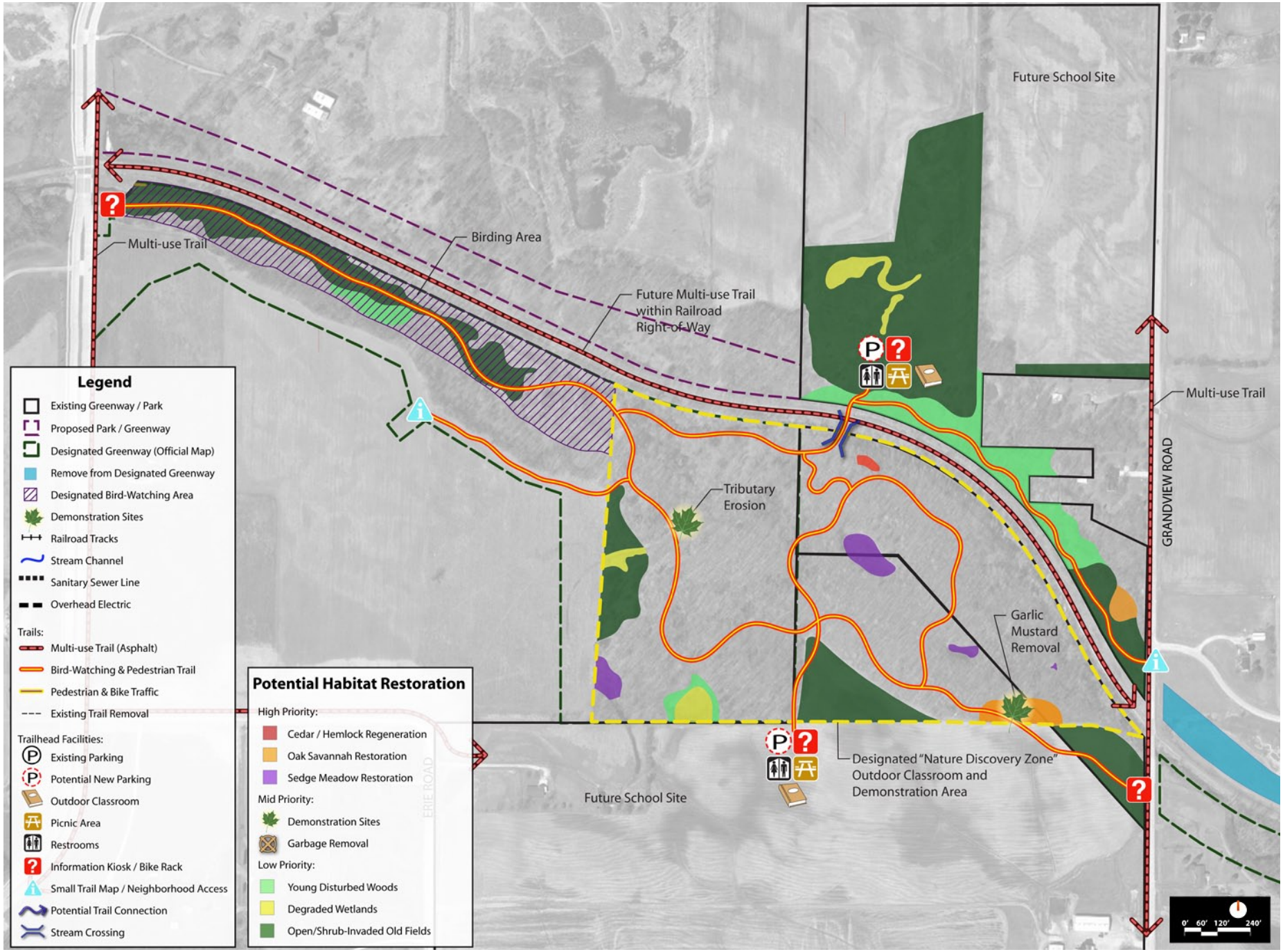
OVERALL MASTER PLAN DIAGRAM, CENTRAL PLAN



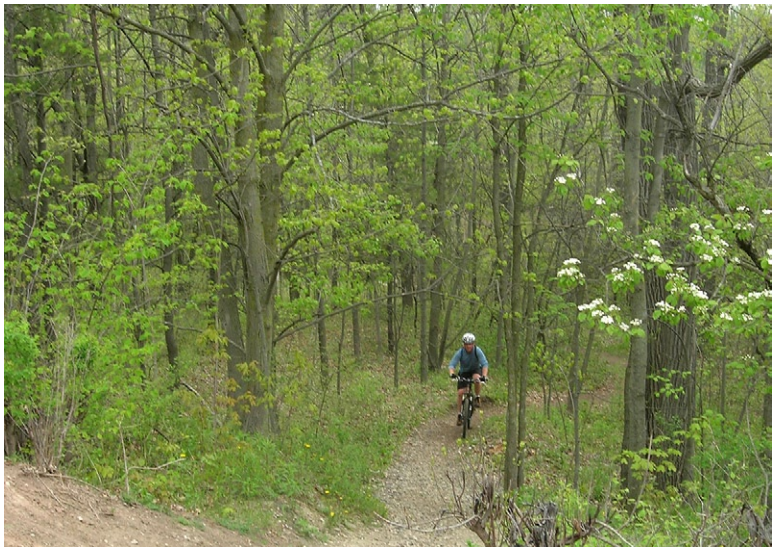
OVERALL MASTER PLAN DIAGRAM, EAST PLAN



OVERALL MASTER PLAN DIAGRAM, NORTHEAST ENLARGEMENT



Birding along the North Branch of Baird Creek



Shared pedestrian and bicycle trail

East Greenway Boundaries, Access Points, and Trailhead Facilities (continued)

Major trailheads are located at all future neighborhood parks, with restroom facilities, picnic areas, informational kiosks, and bike racks. The proposed Middle/High School and Elementary School sites also serve as major trailheads during non-school hours. Outdoor classroom gathering spaces are provided at trails leading from the school sites. The high-quality woodland and wetland area near the High School is established as the "Nature Discovery Zone," which will provide an environmental laboratory for class research projects and demonstrations.

Secondary trailheads with informational kiosks and bike racks are located at proposed parking lots on Erie and Finger Roads and at the trail crossings on Northview and Grandview Roads. The proposed parking lot on Erie Road would accommodate approximately 15 vehicles, while the Finger Road lot would provide 6 spaces. An outdoor classroom space is also located at the Erie Road trailhead to provide gathering space near the South Branch of Baird Creek. Nine tertiary trailheads with small identification and trail map signs are located at potential pedestrian access points to the Greenway. Locations of these trailheads are conceptual, and should be coordinated with future subdivision plats. Trailhead access points from these subdivisions should be at least 30 feet wide to accommodate trail users while providing privacy for adjacent lots.

3.3 TRAIL PLAN

The master plan separates the Greenway trail system into designated uses, including bird watching and pedestrian trails, shared pedestrian and bike trails, multi-use trails, and cross-country ski trails. This trail hierarchy is based on increasing intensities of use, and provides a variety of options and recreational opportunities for visitors to experience the Greenway. The plan also designates existing trails to be moved or closed to avoid environmentally sensitive areas, to eliminate trails on fall-lines or steep slopes, and to reduce overly dense trail networks.

As the Greenway will only be open after dusk for guided night hikes, no lighting will be provided along trails. Lights will be provided in parking lot areas for security purposes, using cutoff fixtures to reduce glare and prevent light spill-over into night skies.

Bird Watching and Pedestrian Trails

Bird watching and pedestrian trails are designated for foot-travel only, with the low intensity uses of hiking, birding, and snowshoeing. Trails should be approximately 3-feet wide with a natural, worn dirt surface, and set back from the stream edge by a minimum distance of 20 feet. Boardwalks should be provided through wet areas to reduce trail widening or erosion. Trails should bend or curve to enhance the feeling of immersion in nature, with straight sections generally less than 100 feet in length.

As part of the Great Wisconsin Birding and Nature Trail, quiet zones are desired for nature observation. Four designated birding areas served by pedestrian-only trails are established in the Greenway, as shown on the west, central and northeast enlargement plans. Pedestrian-only trails also provide access through more sensitive habitats or areas of steep slopes, and offer shorter loops for hikers to return to trailhead facilities.

Pedestrian and Bicycle Trails

Shared pedestrian and bicycle trails are intended for hiking, mountain biking, birding, and snowshoeing. Trails are dirt-surfaced, approximately 3 to 6-feet wide, and set back from the stream edge by a minimum distance of 20 feet. Boardwalks should be provided through wet areas to reduce trail widening or erosion.

Existing fall-line trail to be closed

Example of a paved multi-use trail

Multi-Use Trails

Multi-use trails are high intensity trails proposed to be asphalt surfaced, with a 10-foot path width within a 12-foot clear zone. These trails are accessible to all ability levels, meeting ADA standards. Intended uses are hiking, bicycling, birding, cross-country skiing, snowshoeing, and rollerblading. The multi-use trails also provide alternative transportation routes for commuter travel. The public will be encouraged to stay on the trails to avoid damaging plants and other sensitive areas.

A multi-use trail is currently being designed by the City of Green Bay Parks Department west of I-43. This trail will be installed within the next two years, and connects downtown Green Bay to the central parking along Baird Creek Road. A bridge will provide a stream crossing along this trail segment.

The central plan enlargement shows the preferred multi-use trail route on the railroad right-of-way east of I-43. However, if the railroad has not abandoned the corridor within the next 5 to 10 years when the next section of trail is planned for construction, an alternate route for this trail is proposed on Page 41. This alternate route follows the edge of the railroad right-of-way on an existing sanitary sewer line for the majority of distance between I-43 and Huron Road. Deviations from the railroad ROW are required to avoid wetlands at the west end of the proposed alignment and to traverse steep terrain closer to Huron Road. Two railroad crossings along this route would require coordination with Canadian National Railway.

East of Huron Road, it is proposed that a multi-use trail along the creek be postponed until the railroad right-of-way can be used for the trail corridor. However, several multi-use trail extensions along streets are proposed to continue the trail network to future school and park sites. These trails follow Huron Road, Whittier Drive, and Grandview Road, and may be on-street bike lanes or parallel trails constructed at the time of future road improvements.

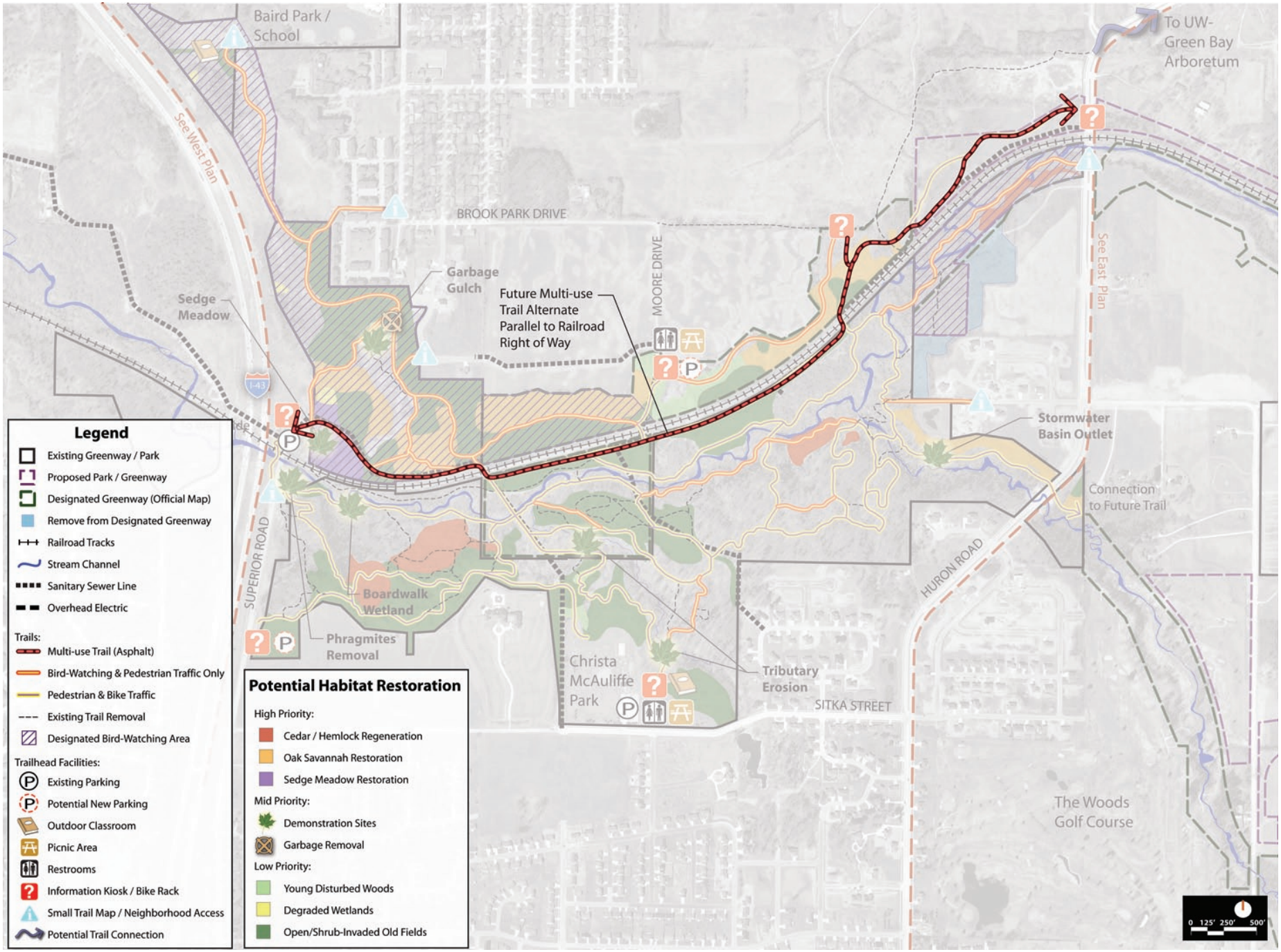
Cross-Country Ski Trails

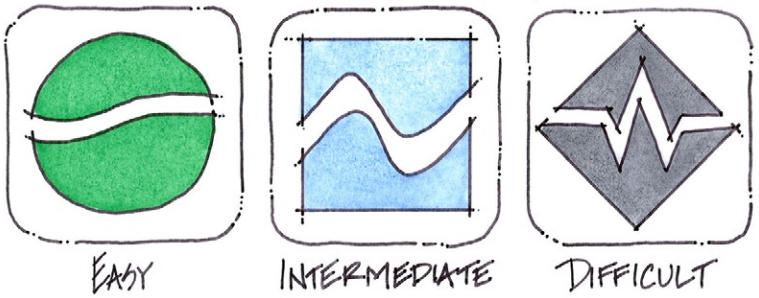
Designated cross-country ski trails are provided west of I-43, following the multi-use and pedestrian/bike trails. These trails are groomed during winter months as weather permits, and may need to be up to 8-feet wide on hills to allow skiers to snowplow or sidestep. Signage should be provided during the skiing season to encourage other trail users not to damage the groomed surface.

Trail Linkages to Other Regional Facilities

As shown on the Regional Context Diagram in Chapter 2 (page 10), several other public green spaces are located near the Baird Creek Greenway, including the Bay Beach Wildlife Sanctuary, the UW-Green Bay Cofrin Arboretum, and Newberry Conservancy near Preble High School. Sidewalks and bike lanes provided by the recent construction of Huron/Bay Settlement Road complete the connection to Cofrin Arboretum. Future improvements along Danz Avenue would provide similar linkages to Bay Beach and Preble High School, completing a trail loop connecting all the facilities. The City's Smart Growth Plan also identifies the possibility of creating a future greenway connection between Baird Creek and Cofrin Arboretum., and suggests that the City explore using Mahon Creek or Hutchinson's Bog as potential routes (City of Green Bay 2003).

ALTERNATE MULTI-USE TRAIL ALIGNMENT EAST OF I-43





Trail difficulty signage (Adapted from Rathke and Baughman 1997)

Example of a trail identification and distance marker

Wayfinding and Signage

As described in the master plan summary, informational kiosks are proposed to greet visitors at highly trafficked entrances to the Greenway. Large maps at these kiosks include places of interest, trails and their allowed uses, trail marker symbols or colors, and distances. Smaller versions of these signs should also be located at all other trailheads and major trail intersections.

Directional signage should be provided at all trail intersections, using names or symbols to identify different trail routes. Common symbols should be used to alert users to trails that restrict bicycles, and to identify trail difficulty as shown at left. Markers should also be placed along trails no greater than 600 feet apart to reinforce trail identity and provide distances, and should be designed to be read from either direction for two-way traffic. Hazard signs for features such as stream crossings, intersections, and steep slopes should be placed 100 feet prior to the obstacle. Signage may be needed in sensitive areas to protect fragile habitats and soils. In general, signs that briefly explain the logic behind these trail rules are more likely to be heeded than signs that are negatively or briefly worded. For example, "Prevent erosion, please keep on trail" may be more effective than simply "Stay on trail."

Finally, interpretive signage can be developed to educate visitors about wildlife, vegetation, history, restoration work, wetland functions, or other site features and activities. Interpretive signage should be provided at the proposed ecological demonstration sites and at other locations with unique vegetation or features.

Design Guidance for Trail Signage:

- Size — Information kiosk maps maximum 6 feet wide x 4 feet high. Directional signs maximum 4.5 feet high x 1 foot wide. Interpretive signs maximum 3 feet x 3 feet.
- Lettering — Font should be easy to read and ADA-compliant, such as Times Roman, Arial, or similar. Bike/Pedestrian directional sign lettering should be a minimum of 1 inch in height. Greenway maps and interpretive signs should use a minimum 12 point font.

- Material — Sign materials should be environmentally sustainable, such as certified wood, recycled plastic lumber, or locally manufactured.

Rest Stops

Benches should be provided at key locations along trails for users to relax and enjoy nature. Major trail intersections or entrances, prominent vistas, and secluded glens are potential settings for rest stops, specific locations of which should be coordinated by the BCPF and City Parks Department. Benches should be rustic in design and made of sustainable materials. Bench construction may provide an opportunity for youth involvement through local schools or Scout troops.

Trail Evaluation and Maintenance

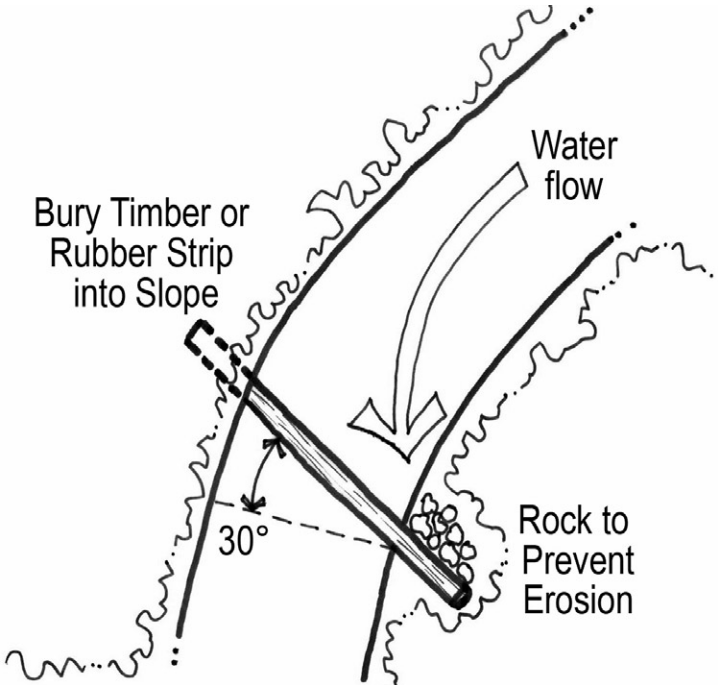
The master plan shows the full build-out of the trail system network, at an appropriate trail density. No additional trails will be constructed, and any trails not depicted on the map should be considered obsolete. However, given the scale of the master plan, trail locations depicted on the maps are general and must be individually evaluated in the field to determine if realignment or stabilization activities are necessary. Representatives from WORBA, the City of Green Bay Parks Department, and the BCPF should walk the Greenway on an annual basis to assess trails, working together to close unauthorized or inappropriate trails, monitor natural ecological communities, and determine the appropriate strategies to repair, maintain, and preserve the authorized trail system.

Several methods may be used to redesign inappropriate trails or stabilize trail sections that have fallen into disrepair. The following techniques discussed in the following section are potential solutions to common trail issues. (Adapted from Hultsman and Hultsman 1996, IMBA 2006, National Parks Service 1996, Rathke and Baughman 1997, Riter et al. 2001, and State of New Hampshire Bureau of Trails 2004.)

Interpretive sign explaining local wildlife

Example of a simple bench built as a Boy Scout project

Example of a seep wetland ESA that trails should avoid



Typical timber waterbar placement

Evaluating Trails through Environmentally Sensitive Areas (ESAs)

Trail relocation or repair should be first and foremost be based on the relationship to the Greenway's ESAs. As noted in Chapter 2, ESAs are classified into three categories: (1) fragile habitats based on vegetation type alone, (2) areas with greater than 7-percent slopes under specific vegetation types, and (3) wetland communities immediately adjacent to the stream channel. Trails should avoid ESAs whereever possible, especially type #1 habitats including hemlock forest remnants, mesic white cedar forests, wet white cedar forests, stream terrace wet mesic forests of the tributaries and South Branch, seep wetlands, and sedge meadows. In addition to these habitats, trails should specifically be located to avoid the following sensitive species:

- *Cardamine bulbosa* (Spring cress)
- *Desmodium illinoense* (Illinois tick-trefoil)
- *Equisetum palustre* (Marsh horsetail)
- *Gentiana alba* (Pale gentian)
- *Solidago patula* (Swamp goldenrod)
- *Solidago ulmifolia* (Elm-leaved goldenrod)
- *Symplocarpus foetidus* (Skunk cabbage)

Of the above species, *Gentiana alba* is classified as a Wisconsin Threatened Species. *Equisetum plaustre* has Wisconsin Special Concern status. *Cardamine bulbosa*, *Solidago patula*, and *Symplocarpus foetidus* are all species of high quality wetlands. *Solidago ulmifolia* is of very restricted distribution in the northeast part of the state and is associated with small outcrops of the Niagara escarpment. Future review may suggest additions to this list that are not particularly rare, but are associated with ecologically sensitive habitats within the Baird Creek area.

In locations where crossing an ESA is unavoidable, such as connecting a trail across a stream or tributary, disturbance to the ESA should be minimized by careful selection of the trail route. In general, the route should be located based on the following criterea:

- Minimize the crossing distance
- Locate the trail as close to the edge of the ESA as possible to avoid fragmenting the habitat
- Avoid placing the trail near the sensitive species listed above
- Design the trail to follow suggestions from the following sections on wetland crossings, streambank access, stream crossings, and steep slopes.

One-Way Trail Segments

Designating single-direction trail segments may potentially solve problems with congestion on a a crowded trail or reduce conflicts between bicycles and other trail users (IMBA 2004). One-way trails can also be designed to heighten the mountain biking experience by allowing shorter sight-lines and tighter corners. However, this alternative may not apply in all situations as it can lead to uneven wear on the trail surface, create difficulties with enforcement, and require increased signage to alert users. This option may be explored on a trial basis for heavily used trails within the Greenway, in order to assess its performance in reducing conflicts.

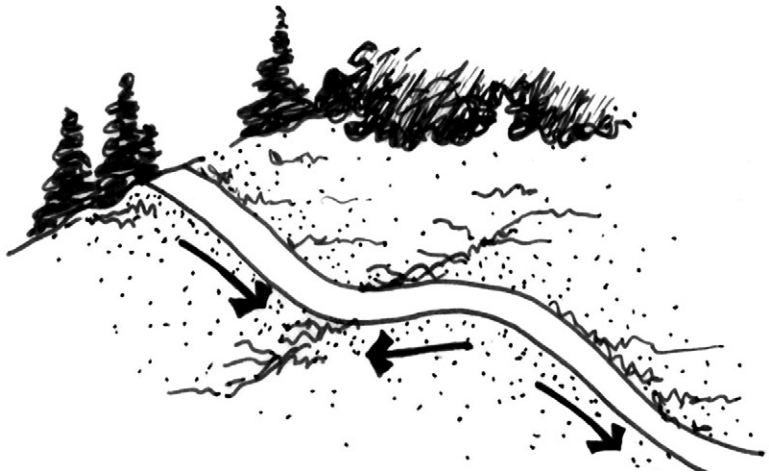
Erosion along Trails on Steep Slopes

Water flow along a trail's length and compaction by foot and bike traffic can cause erosion on steep slopes. The following techniques and guidelines should be used to reduce trail erosion:

- Cross-slope - All trails should slope 2 to 3% towards the downhill side to allow for water to sheet flow across the trail. Normal trail use gradually builds up the outer edge of the trail, causing water to become trapped and flow down the path. Regular maintenance can reduce erosion by moving excess soil on the outer edge back to the center of the trail.
- The 10% rule - Trail grades generally should not exceed 10%. However, it may be necessary for short segments of the trail to be steeper in areas of extreme topography, up to a maximum of 15%. Fall-line trails, which are defined as trails that exceed half the sideslope of the hill (for example, a trail slope of 7% or more on a 14% hill slope), allow preferential water flow along the path and should be closed.
- Switchbacks - Fall-line trails should be realigned to reduce grade by increasing trail length. Minimum turning radii at curves are 4 feet on pedestrian-only trails and 8 feet for shared pedestrian-bike trails. Barriers of shrubs or rocks may be necessary at turns to reduce shortcutting by trail users. Benches may provide rest stops.
- Waterbar - An obstruction placed at a 30° angle to the trail flow to redirect water off the trail into adjacent vegetation. Waterbars may be constructed of 4 to 6-inch diameter rot-resistent timbers or a stiff rubber strip embedded in a buried wood base. The uphill edge of the waterbar is exposed approximately 3-4" to catch water, while the downhill edge is flush with the trail surface. The waterbar should extend at least two feet beyond each side of the trail to prevent users from sidestepping around them. The following table provides general guidance for spacing between waterbars, although they should be spaced closer together near the top of slopes to prevent any runoff from concentrating and gaining speed for the distance of the hill (Rathke and Baughman 1997):

Percent Grade	Spacing between Waterbars (feet)
2	250
5	130
10	80
15	50
25+	40

- Grade Reversal or Dip - A short rise (4 to 6 feet in length) along a downhill section of trail that creates a location for water to leave the trail. Grade dips also break up long segments of steep slopes, providing users with a potential rest stop. The



Grade reversal or dip (Adapted from Rathke and Baughman 1997)

Full-bench (left) and half-bench (right) trail construction

Depressions in level surfaces hold water, causing trail widening

bottom of the grade dip may require geotextile, stone, or log armoring to prevent compaction that ponds water.

- Steps - On pedestrian-only trails with steep slopes, steps may be built using stone slabs, logs, or rough-sawn timbers. Steps should have a 5 to 7-inch riser, and should be spaced according to field conditions to allow a comfortable walking stride.

Erosion of Outer Trail Edges on Steep Slopes

Where trails follow the contour of a steep hillside, the outer edge can begin to erode down the slope.

- Correct drainage issues by allowing a maximum cross slope of 3%.
- Use full-bench instead of half-bench construction on trails wherever possible (see diagram at left). Full-bench construction provides a stable base of undisturbed soil for the outer trail edge.
- Construct a 3" high wooden curb on the outer trail edge to keep users on the stable trail surface. Provide breaks for surface water drainage.
- Establish native shrubs or groundcovers on exposed soils, using a fence or wooden curb edge to keep users off the slope until vegetation takes hold.
- Retaining walls along the outer trail edge may be needed to counteract severe erosion issues. Walls should be constructed of stone or rough-sawn timber, taking care to resolve any subsurface drainage issues. Professional assistance may be necessary for wall design.

Wet Depressions and Trail Widening

A trail built on a relatively level surface may compact over time, creating depressions that catch and hold water. To avoid these wet locations, trail users often walk around the edge of the depression, creating unnecessary secondary loops or continuously widening the trail (as shown at right). The following are solutions to repair the trail surface in non-wetland areas (for depressions resulting from a trail located through a wetland area, see "Wetland Crossings"):

- Build up the trail surface with gravel, flagstone, or soil. Geotextile fabrics or honeycomb-patterned recycled plastic mats can provide additional structure to support the trail surface and prevent movement of replacement material.
- Construct a center crown to direct drainage off the trail surface. Use caution

to ensure that water is not trapped on one side of the trail.

- Restrict passage to only the repaired trail surface through methods discussed below under "Trail Closure," allowing damaged secondary paths to heal.

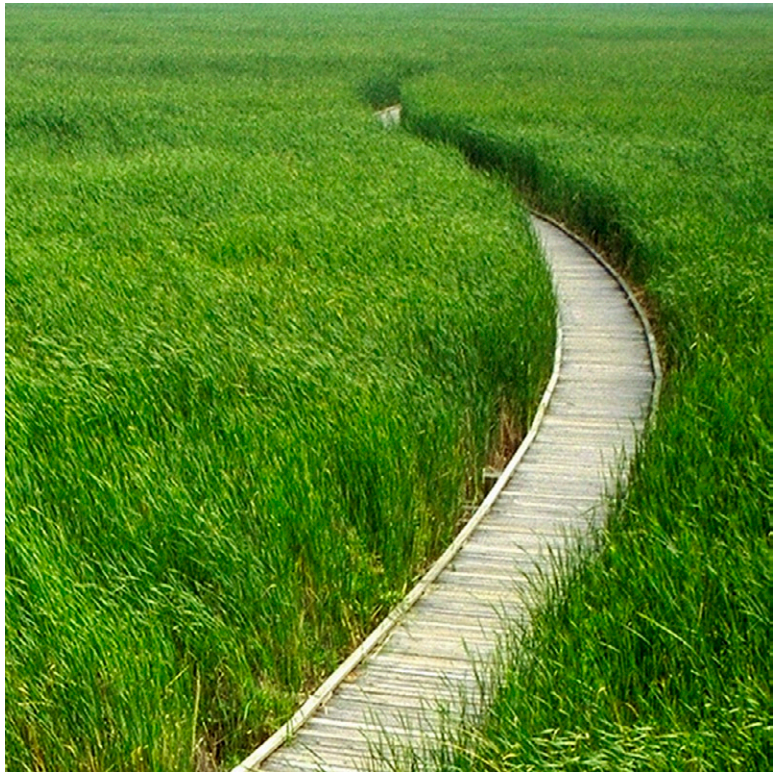
Wetland Crossings

Wisconsin state law prohibits fill for trails through wetlands. This includes any material that raises the ground surface, such as gravel or wood chips. Boardwalks are a viable alternative that protect the ground surface, and although they do not require a water certification or permit under current regulations, WDNR staff should be consulted to review plans and make suggestions prior to construction. Boardwalks necessary to repair trails in the Baird Creek Greenway should be designed as follows:

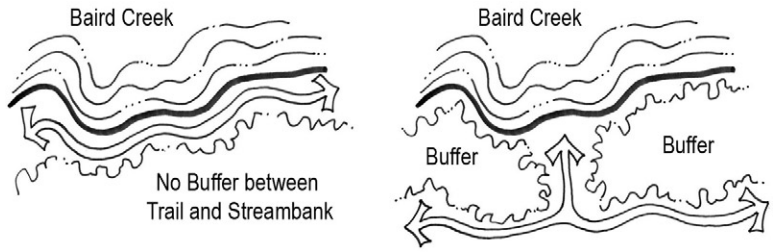
- Provide a minimum width of 4 feet to allow safe two-directional travel.
- Elevate the boardwalk approximately 8 inches from the ground surface to allow for passage of wildlife under the walk.
- Orient boardwalk decking perpendicular to the direction of travel to reduce slipping on wet surfaces and avoid trapping bike tires.
- Ramp down to adjacent trail sections to promote accessibility and allow bike travel.
- Provide a continuous raised outer edge to prevent strollers and wheelchairs from leaving the path.
- Use certified wood or recycled plastic lumber in earth tones or natural finish to promote sustainability.
- To reduce environmental impacts of boardwalk construction, consider using drilled helical piers instead of buried posts for support based on soil conditions.

Streambank Access

People love to be close to water. However, trails located immediately adjacent to the edge of the stream cause bank erosion, reduced water quality, and loss of habitat. Trails should be relocated at least 20 feet from the streambank, creating a buffer that can filter runoff before it reaches the creek. Spur trails may be provided at less sensitive areas to allow controlled water access. However, barriers may be necessary at these spurs to prevent bank erosion along the visible old trail route until vegetation can be established. The stream corridor should be actively monitored to eliminate any new unauthorized trails or spurs before they become heavily impacted by users.

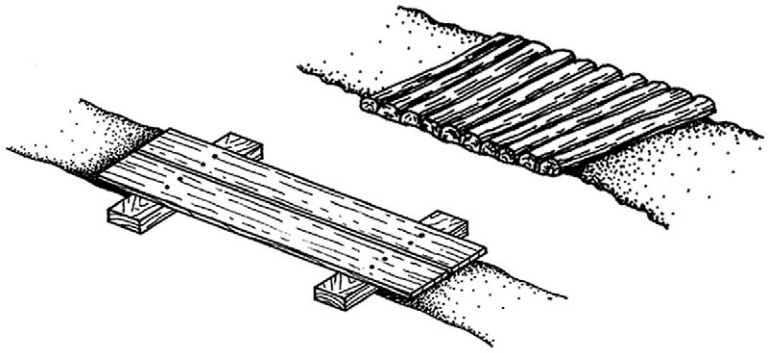


Example of a boardwalk with a continuous raised outer edge



Inappropriate (left) and appropriate (right) access along streambank

Example of an inappropriate streambank access trail causing erosion



Puncheon (left) and corduroy (right) drainageway crossing methods (National Parks Service 1996)

Stream Crossings

Stream crossings are minimized to the extent possible throughout the Greenway. Where crossings are proposed, the following standards provide guidance for trail design. Future consideration should also be given to the construction of a pedestrian and bicycle bridge mid-distance between I-43 and Huron Road that would allow Baird Creek to be crossed during higher flow events, similar to the bridge proposed along the multi-use trail west of I-43.

- Crossing Baird Creek - Provide a ford for traversing the stream at a 90° angle in a shallow location with a gravel bottom. Place in an area with low bank heights to reduce erosion of the trail approach. Banks may need to be regraded to allow safe passage in and out of the ford, and stabilized using bioengineering techniques. For pedestrian crossings, provide large flat rocks (minimum 2 square feet in size) approximately 1½-feet apart, embedded to half their height into the stream bottom. Begin the stepping stones at the typical stream edge during spring baseflow conditions to discourage crossing during high flow events. Stagger stones to reduce debris dams. For bike crossings, provide a path through the creek upstream of the stepping stones, which allows the stones to help stabilize the bike crossing. Permanent geotextiles, honeycomb-patterned mats, or stone may be necessary to reinforce the stream bottom and ford entrances. Consult with the WDNR for approval and permitting of stream crossing improvements, and inspect crossings after major flood events and spring snowmelt for damage.
- Crossing small tributaries - Provide wooden bridges that extend at least two feet past the high water mark on each side of the channel. Tether one downstream corner of the bridge to the bank to allow the bridge to swing open under high flow events, preventing debris dams or washing downstream. Bridges should be inspected after storm events for safety. Avoid culverts that can clog with debris, forcing water to erode the adjacent trail.
- Crossing smaller drainages with no permanent water flow - Use flagstone armoring or short puncheons to cross drainages. Puncheons (see left) are constructed of sawn lumber resting on logs or timbers. Corduroy, or 6 to 8-inch diameter logs placed perpendicular to the flowline, can be used for a temporary repair, but should be avoided as a long-term solution as it provides an uneven, slippery surface that hikers sidestep to avoid.

Trail Closure

Several of the above methods recommend narrowing or rerouting trails to repair damaged sections. The following techniques are recommended for restoring vegetation on old trails (adapted from IMBA 2006):

- Break up the closed trail section to reduce compaction of the ground surface.
- Use log check dams to slow runoff and trap sediment flowing down the old trail route.
- Control erosion by mulching or blanketing the surface. Several options are available, including wood mulch, blown cellulose fiber, and commercial mats. If straw is used, obtain certified weed-free straw from native plant nurseries to minimize the spread of invasive species.
- Replace soil on steep slopes using filled burlap sacks as check dams. Plant native seeds or shrubs directly into these "nurse logs."
- Transplant vegetation from the trail re-route into the old corridor. Consider supplementing with restoration plantings obtained from native plant nurseries, or using native raspberry, blackberry, or gooseberry species where ecologically appropriate to encourage users to avoid closed trail sections.
- Camouflage the old trail using leaves and logs from the surrounding area. Include branches placed across the old route at waist or eye level.
- If necessary, fence off the closed trail section until the landscape can heal. Post signs to educate trail users. Stress the benefits of using the re-routed trail.
- Monitor to verify native vegetation restoration. Aggressively control invasive species that often colonize areas of soil disturbance along old trail routes through pulling or herbicide treatment.

Example of preferential cutting around a corduroy trail repair

Greenway trail closure work performed by WORBA volunteers

Volunteers remove invasive honeysuckle (Photo courtesy BCPF)

Garlic mustard chokes out native species on the forest floor

The Greenway is an incredibly diverse area, with 17 distinct ecological communities. Many of these habitats are significantly intact, high quality representations of their community types; others are in need of substantial restoration work to reestablish native species and create a functioning ecosystem.

Management of Existing Habitats

Control of Invasive Species

Whether Greenway habitats are currently of high quality or in need of restoration, management is necessary to protect them from invasion by exotic species. Exotic or invasive species are organisms that are introduced by humans into areas beyond their native range, either intentionally or otherwise. Lacking the natural competitors and predators of their home ecosystem, these organisms spread rapidly in their new environment, displacing native flora and fauna. "Invasives," as they are often times referred, include species of plants, mammals, insects, worms, birds, aquatic plants and animals, and forest diseases (WI Council on Invasive Species, 2005).

Beginning in 2002, the BCPF has organized a concerted effort to remove invasive species from the Greenway. In 2005, over 1,000 volunteer hours were recorded, including 341 high school and university students at 14 field events. Suppression efforts have included cutting and applying herbicide to honeysuckle (*Lonicera tatarica*, *L. x bella*), buckthorn (*Rhamnus cathartica*), and Russian/autumn olive (*Elaeagnus angustifolia*, *E. umbellata*), as well as pulling herbaceous garlic mustard (*Alliaria petiolata*). A new effort experimenting with control of phragmites (*Phragmites australis*) through burning, cutting, and herbiciding is also underway. The maps on pages 52 and 53 show BCPF documented infestations of these invasive species within the Greenway.

Besides the previously mentioned species targeted by the BCPF in eradication efforts to date, other invasive species also are present in the Greenway. Crown vetch (*Coronilla varia*) was planted along the I-43 corridor by the Department of Transportation to control erosion. This aggressive groundcover is now spreading into the open habitats east of the highway. Control efforts should be undertaken before the infestation spreads far into the Greenway as this species is difficult to manage once established. To remove crown vetch, the Nature Conservancy

recommends first burning, mowing, or hand cutting the area to remove plant litter and then treating with herbicide. Although 2,4-D amine (Weed-b-Gon), glyphosate (Round-up), and triclopyr (Garlon 3A) have all been relatively successful at killing crown vetch, the most promising herbicide is clopyralid (Transline). This herbicide targets only legumes, composites, and smartweeds, thus reducing impacts of overspray. Clopyralid can be applied in a 0.25% solution with 0.5% surfactant and blue dye using a backpack sprayer. Care should be taken to avoid areas of native asters. If native plants are present in the area, they are generally able to recolonize crown vetch eradication sites without assistance. However, supplementary seeding is recommended for rapid regrowth of native communities. (Tu, 2003)

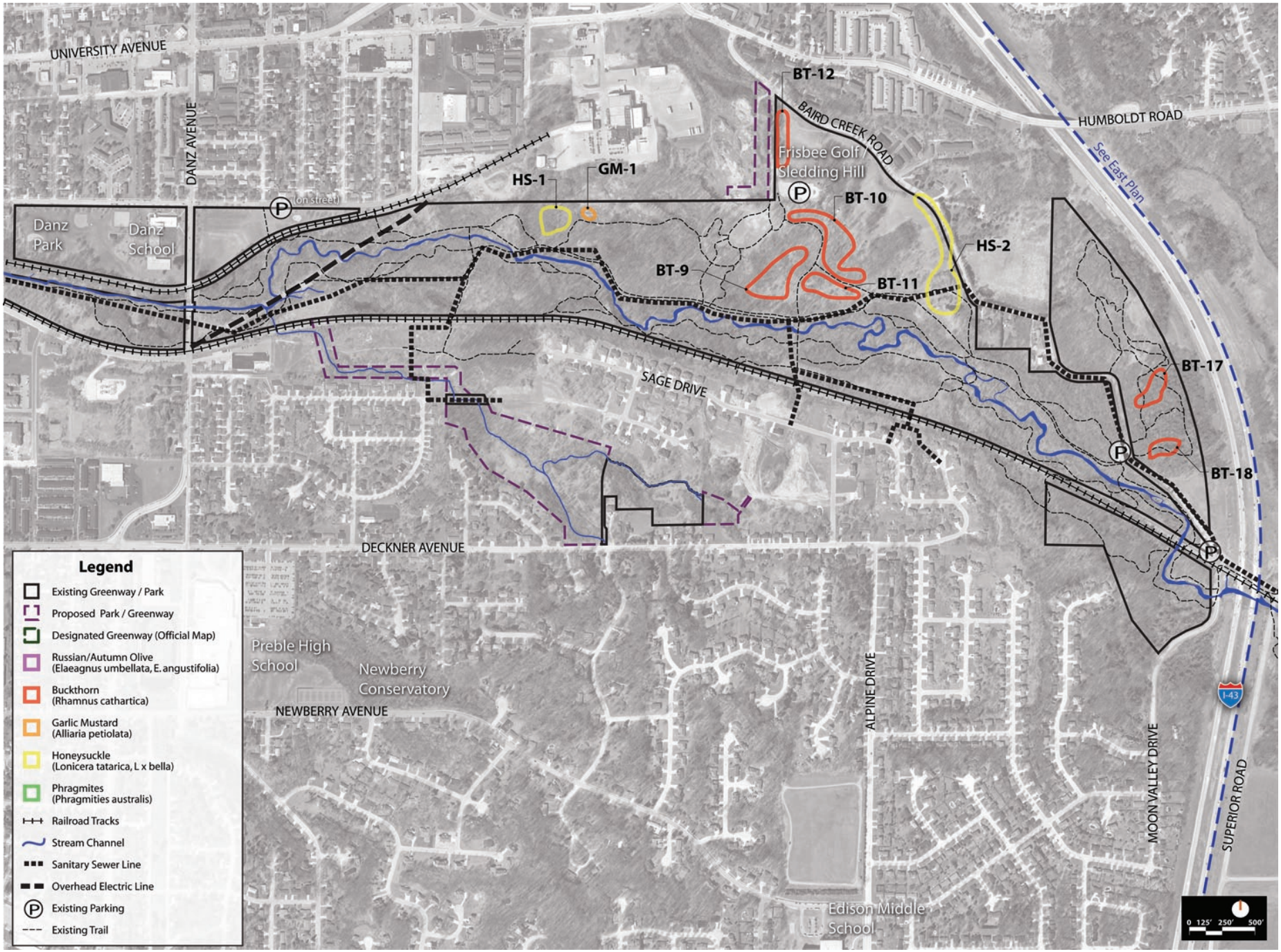
Although purple loosestrife (*Lythrum salicaria*) was documented during the 2003 ecological assessment, it has not rapidly spread through the Greenway's wetlands. Monitoring should continue to ensure that loosestrife does not begin to spread unchecked. If loosestrife does become a problem, biological control efforts using *Galerucella* beetles has proven successful in other Wisconsin locations and may be applicable in the Greenway. Another control method that works for small infestations is spraying with a 1-2% solution of glyphosate containing a non-ionic surfactant (Rodeo) after the bloom period in late August (Bender and Rendall, 1987).

Reed canary grass (*Phalaris arundinacea*) is a wetland invader that creates a monoculture stand in sedge meadows, in wet prairies, and on streambanks. Large colonies of reed canary are established in the Greenway. This invasive is especially difficult to eradicate. Several control methods have been used with varying success, including herbicide, burning, mowing, shading, and soil cultivation (WDNR 2004). Researchers have generally found that a combination of these methods must be used to suppress reed canary. Much research is currently being performed on reed canary control, including studies at the University of Wisconsin-Madison which have shown that multi-year applications of sethoxydim (Checkmate, Poast) combined with seeding of native species may be promising for habitat restoration (Healy and Zedler, 2006). Given the difficulties in control of reed canary and the highly experimental nature of the effort, partnerships may be explored with UW-Green Bay and the Cofrin Center for Biodiversity to attempt eradication of colonies within the Greenway.

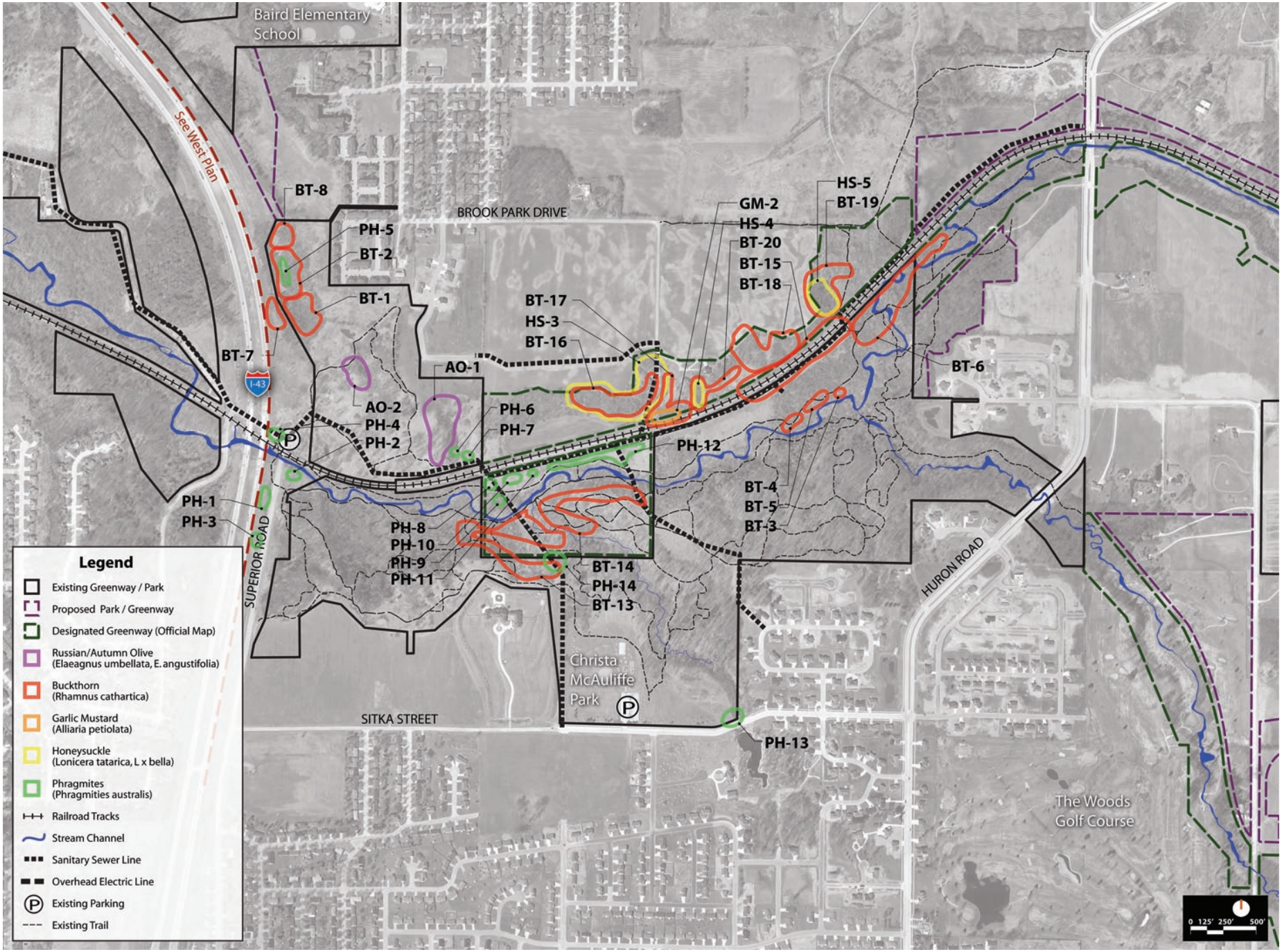
Within the Greenway, black locust (*Robinia pseudoacacia*) dominates a young disturbed woods adjacent to the west side of I-43, as well as several young low woods along the stream corridor. Although the 2003 ecological assessment recommended girdling and herbiciding, this method may not be entirely effective at reducing root suckering. Given that black locust is very rot-resistant, girdling will also likely create stands of dead timber that will persist for some time. An alternate control method is to cut and treat locust stumps with glyphosate or triclopyr; monitoring and follow up treatments may be necessary over several years to ensure root kill (Wieseler, 2005). Logs may be given away, sold, or used in projects throughout the Greenway. Although black locust is an underappreciated wood, its rot-resistant characteristic has led to its use for landscape timbers, garden structures such as trellises, boatbuilding, outdoor furniture, trail stabilization, and boardwalk projects.

Eradication efforts within the Greenway thus far have focused on invasive plants; future monitoring and control may be necessary for insects. An infestation of gypsy moths (*Lymantria dispar*) was recently discovered on the UW-Green Bay campus, which likely indicates that they are present within the Greenway. Gypsy moth caterpillars feed in May and June, and can defoliate large sections of the forest canopy. The BCPF should consider implementing a monitoring and egg mass removal program within the Greenway, especially targeting areas with favored tree species of oak, aspen, birch, and linden (Wisconsin Cooperative Gypsy Moth Program, 2006). Other problematic species with populations

LOCATIONS OF BCPF DOCUMENTED INVASIVE SPECIES INFESTATIONS, WEST AREA PLAN



LOCATIONS OF BCPF DOCUMENTED INVASIVE SPECIES INFESTATIONS, CENTRAL AREA PLAN



Stream terrace wetland in danger of being lost to hydrological changes from upstream development

Oak savanna characterized by wide-spreading tree canopies (BCPF)

in neighboring states that may spread towards the Green Bay region include the emerald ash borer (*Agrilus planipennis*) and the Asian longhorned beetle (*Anoplophora glabripennis*).

Management of Environmentally Sensitive Areas (ESAs)

In general, management in ESAs should be limited to activities that prevent degradation and disturbance, but do not compromise natural succession within these communities. In most cases, active restoration is not needed and management should be limited to the control and removal of invasive species. Human activity should be limited within these areas. No trails should be routed through ESAs and buffers should be provided around their boundaries to limit nearby trail construction impacts including the introduction of invasives and erosion on steep slopes. The following management strategies are recommended for existing habitats within individual ESA types:

- **Relict Hemlock Grove:**
  There is no need for active management within this area except to limit invasion by exotic species. Regeneration of hemlock in nine ESA locations within the Greenway, such as on the periphery of the hemlock grove, may be appropriate (see Cedar and Hemlock Regeneration, page 55).

- **Mesic Cedar Forest:**
  Management within this area should focus on the removal of invasive plant species and overgrazing by white tailed deer. Protection of white cedar seedlings from browsing may be necessary in these areas and other appropriate locations within the Greenway (see Cedar and Hemlock Regeneration, page 55).

- **Wet White Cedar Forest:**
  In order to ensure the protection of these areas, measures must be taken to protect and maintain the groundwater hydrology upon which this forest depends. Management should focus on the removal of invasive plant species and overgrazing by white tailed deer. Protection of white cedar seedlings from browsing may be necessary in these areas and other appropriate locations within the Greenway (see Cedar and Hemlock Regeneration, page 55).

- **Floodplain Forest along the Creek and the Portion of the Floodplain Immediately Adjacent to the Creek:**
  Invasive understory shrubs and herbaceous plants should be removed using appropriate techniques that do not endanger native aquatic plant and animal species. In order to enhance and restore native floodplain forests, it may be necessary to remove aggressive woody species, especially in areas of dense boxelder.
- **Stream Terrace Areas within the South Branch and Other Tributaries:**
  In order to protect these areas, hydrology must be preserved and sedimentation and erosion caused by upstream urban development must be prevented or limited as much as possible. Invasive shrub and herbaceous species should be controlled. Restoration activities should be limited to the removal of trails and stabilization of eroded streambanks.
- **Seep Wetlands:**
  Maintaining proper hydrological conditions, including groundwater discharge, is critical to these habitats. Thus, minimizing impervious surfaces in upland development to allow for infiltration in recharge areas is very important. As in all ESAs, invasive species must be controlled, but special care must be taken within these areas to ensure that native vegetation and soil are not disturbed and that aquatic animal life is not impacted.
- **Northern Dry-Mesic Forests on Steep Slopes (>7%):**
  Succession to a more mesic sugar maple-dominated forest should be allowed to continue in and around areas where sugar maples are established and abundant. Active management should be limited to the control of invasive non-native shrubs.
- **Oak Savannas and Prairie Remnants on Steep Slopes (>7%)**:
  These areas warrant immediate protection and active management. Because these areas are contained within the non-ESA regions of the oak savanna, the management plan to conserve the entire oak savanna should be followed (see Oak Savanna Restoration, page 56).

Several funding opportunities are available for invasive species control efforts and habitat restoration. See Chapter 4 for a list of programs.

High-Priority Habitat Restoration and Conservation Activities

The Baird Creek Greenway Ecological Assessment and Management Plan completed in 2003 describes restoration strategies for all of the Greenway's habitats. The Master Plan builds upon this earlier study by prioritizing identified opportunities. In the future when the BCPF makes the decision to pursue an individual restoration project, the methods outlined in the 2003 study should be compared against current research in restoration science to determine if the recommended approaches are still valid. Projects should also be monitored as they proceed, using an adaptive management strategy to continuously evaluate restoration progress and change tactics if goals are not being met in the field.

Restoration activities proposed under the ecological assessment and master plan are divided into high, mid, and low-priority based on the severity of the environmental problem, opportunity for community education, and effort required for action. Three types of habitats identified under the 2003 ecological assessment are recommended as high-priority sites for restoration, including cedar and hemlock forest, oak savanna, and sedge meadow.

Cedar and Hemlock Regeneration
Three of the most unique forest types within the Greenway are the hemlock groves (*Tsuga canadensis*) and the mesic and wet white cedar woods (*Thuja occidentalis*). However, the overpopulation of deer has led to substantial browsing or foraging damage to both of these species, with

few saplings noted. The lack of replacement saplings for mature trees will eventually result in the disappearance of these habitat types. Active management is necessary to protect young seedlings from damage and browse until they are well established.

Two methods to reduce deer browse on young trees are (1) planting cedar and hemlock seedlings with protection tubes and (2) providing deer exclosures to allow natural regeneration. For the first method, in order to prevent the loss of the local genotype or natural heritage that has adapted to the local microclimate, seedlings should be grown from seeds collected within the Greenway. Because hemlock is at its southern-most range in this region, any hemlock seedlings that are planted should only be planted on north facing slopes. Planting of cedar or hemlock should only occur in naturally occurring openings, as might happen after storm damage. These trees do not normally regenerate under a closed mature cedar or hemlock canopy. As planted or naturally regenerating seedlings may outgrow protective tubes before they are large enough to withstand browse, the second option involves constructing 8-foot tall fenced enclosures of varying size to restrict deer access. This method protects not only the trees, but also the herbaceous groundcover. Potential disadvantages to this strategy may be the need for interpretive signage to inform visitors why fencing is necessary and the concentration of deer browse and further damage to non-fenced areas (Jones-Sauer, 1998).

Areas of cedar or hemlock forest are shown on the master plan in red (see pages 34 to 37). On the west side of I-43, an extensive wet cedar woods is located south of the railroad tracks along Moon Valley Drive. The central plan contains three areas of wet cedar woods, a hemlock grove, and the only mesic cedar forest within the Greenway. Finally, a single hemlock stand is shown on the northeast enlargement south of the railroad tracks towards Grandview Road.

Oak Savanna Restoration

As shown by the spreading canopies of mature oak trees, several areas of the Greenway were once open savanna. Much of this habitat has been invaded by a non-native or aggressive native shrub understory. The 2003 ecological assessment recommended restoring the savanna and the biological diversity it represents through the following techniques:

- Remove invasive species and thin aggressive native shrubs.
- Thin understory to achieve a maximum canopy cover of 40-60%.
- Burn the ground layer every 3-5 years.
- Reintroduce native ground flora through planting if necessary.

Areas of potential oak savanna restoration are identified in orange on the master plan. Of the extensive areas shown on the west and central plans, the areas just east of I-43 may provide the most logical starting point for experimenting with savanna restoration, with relatively good access from Superior Road and a more herbaceous understory.

Sedge Meadow Restoration

The Greenway contains several sedge meadows of varying quality, identified on the master plan in purple. These communities are especially vulnerable to disturbance, and are quickly invaded by reed canary grass, phragmites, or purple loosestrife if unmanaged. Efforts should focus first on evaluating and preserving high quality sedge meadows, such as those located on the northeast enlargement and described in Section 2.4 of this document. In order to effectively preserve these areas, hydrology must first be maintained or restored. Second, invasive species must be controlled before any native vegetation is planted. Efforts can then target enhancement of sedge meadows located in old field areas using seed or root stock, increasing the coverage of native species and preventing further spread of reed canary grass and purple loosestrife. Finally, consideration may be given to restoring areas dominated by reed canary grass or phragmites as research and available resources permit.

Mid-Priority Habitat Restoration and Conservation Activities

Mid-priority actions focus on environmental education for Greenway users, include establishing ecological demonstration sites and removing garbage.

Ecological Demonstration Sites

Several demonstration sites are proposed under the master plan to provide research locations for learning new restoration techniques, educate Greenway users about ecological principles, and aid fundraising by creating momentum for extending projects to larger areas. Implementing demonstration sites will also achieve immediate water quality protection at areas with erosion problems and expose the damage caused by surrounding land use practices.

Page 34 shows the locations of two potential demonstration sites on the west side of I-43. The first is a tributary erosion site located near Danz Avenue. This site is immediately adjacent to the proposed multi-use trail, which provides a highly visible and accessible location for explaining the impacts of stormwater runoff. Potential bioengineering solutions can be explored to improve habitat while reducing bank erosion and sedimentation. The second demonstration site is a prairie remnant near Triangle Hill Park that was burned in the 1990s by the City Parks Department with help from Prairie Nursery of Westfield, Wisconsin. Although the site has not received any subsequent care, the 2003 ecological assessment documented many native prairie species at this site which could be encouraged to spread through burning and augmented planting.

Seven demonstration sites are shown between I-43 and Huron Road (see page 35). Sites located near the existing Superior Road parking lot provide opportunities to research and explain three types of habitat restoration efforts at a busy Greenway access point. First, efforts could be made to restore the degraded sedge meadow north of the creek. The phragmites removal and wetland restoration project along Superior Road could also provide public education for visitors to combat this invasive on their own property. The third site involves building a boardwalk along a highly used and abused trail on the south side of Baird Creek, in order to restore

Deer exclosures allow regeneration of the forest understory (National Park Service)

Proposed boardwalk site, showing parallel trail cuts through wetland

Potential tributary erosion demonstration site near Danz Avenue

adjacent wetland habitat. Additional demonstration sites include addressing two locations of severe erosion along the Christa McAuliffe Park tributary, removing garbage from an old dump site, and celebrating a successful stormwater basin outlet that avoids erosion by piping water through a hillside.

Two demonstration sites are identified on the northeast enlargement on page 37. The tributary erosion that exists on the main drainage channel south of the creek is currently caused by agricultural runoff. As the adjacent property is proposed to be subdivided for housing in the near future, this site represents a clear opportunity to document any changes to the channel and respond quickly to any degradation that occurs. The final demonstration site consists of an infestation of garlic mustard, which affords the opportunity to display removal techniques and information on limiting the spread of invasives by cleaning seeds and dirt from shoes.

Garbage Removal

Three dump sites have been identified in the Greenway that have significant quantities of garbage needing removal. During the 2006 annual Earth Day celebration sponsored by the BCPF, volunteers began the clean-up effort at the first of these sites, located just east of I-43. Over three truckloads of trash were hauled out of the ravine, nicknamed "Garbage Gulch." Despite this great start, additional efforts are necessary to complete the clean-up and begin restoration work.

On the west side of I-43, a site was identified during the prior ecological assessment as a dump site for bricks and other building debris. Due to the relatively close proximity of this site to the proposed multi-use trail, vehicular access may be possible to help clean-up the site after the trail is constructed. The final location for garbage removal is on school district property near Grandview Road, at the edge of the woods. Approximately a truckload of household, architectural, and agricultural refuse are at this site.

Low-Priority Habitat Restoration and Conservation Activities

The low-priority designation for restoration is based on the relatively high level of effort required to achieve success. Considerable energy and resources will be needed to tackle highly impaired habitats such as young disturbed woods, degraded wetlands, and open/shrub-invaded old fields.

Young Disturbed Woods

Young disturbed woods are located in both upland and lowland areas within the Greenway. These areas were most likely cleared for agriculture, logging, or mining gravel, and have only recently began to transition back to forest. They are generally dominated by invasive species or aggressive natives. In the near future, invasives should be controlled to prevent spread to adjacent habitats. Selection of an appropriate target habitat for long-term restoration efforts should be based on historic survey records and soil type.

Degraded Wetlands

Cattails, reed canary grass, and phragmites dominate several wetlands within the Greenway, especially west of I-43. Long-term restoration of these wetlands will require not only the eradication of these difficult to control species, but also an evaluation of the quantity and quality of the water flowing into the wetlands. High levels of sediment or nutrients in runoff will need to be controlled before any restoration efforts will be successful. Again, immediate efforts may focus on containing the spread of invasives from these wetlands while deferring true restoration efforts until resources or partnership opportunities become available.

Open/Shrub-Invaded Old Fields

Open or shrub-invaded old fields are areas generally dominated by cool-season grasses or sparse shrubs that represent the first stage of succession after removing agriculture or mining activities. As with young disturbed woodlands, selection of a target habitat for long-term restoration should be based on soil type, adjacent vegetative cover, and historic survey notes. Because certain target communities such as forest may require more time and effort to establish, a possible strategy for replacing open fields with native cover in the near future may be to plant prairie first, and then allow succession or restorative plantings to transition to the desired habitat type over time.

Increased development in the watershed has led to higher peak flows, streambank erosion, and lower water quality in Baird Creek

Typical section of Baird Creek near Danz Avenue with entrenched banks

Water quality and erosion are major issues facing the Greenway. The banks, bed, and waters of Baird Creek and its tributaries increasingly show degradation associated with a rapidly developing watershed. Studies have shown high concentrations of phosphorus and sediment in the stream, and high peak flows have caused down-cutting, silting, and bank erosion within the ravines leading to the creek. The ESAs associated with the stream and its tributaries continue to decline in quality. Changes are most evident in the sedge meadow and stream terrace communities in the ravines east of I-43, where channel degradation is causing the water table to drop below the root zone necessary to sustain these wetland habitats.

This section addresses the above issues in two parts: 1) stormwater runoff management and 2) tributary and streambank restoration/stabilization. Both of these components are necessary to improve the health of Baird Creek, as simply stabilizing banks and not dealing with the source of the problem is like treating the symptoms and not the disease. The measures recommended below affirm the partnership between the City and the BCPF, and clarify priorities as the BCPF applies for State and Federal funds towards the accomplishment of stormwater goals.

Stormwater Management Recommendations

Previous Stormwater Management Reports

Stormwater runoff has long been identified as a major contributor to water quality problems, streambank and tributary erosion, and habitat degradation in Baird Creek. As a tributary in the Lake Michigan watershed, these issues are of particular concern to the health of Green Bay. Therefore, it is no surprise that there have been a number of previous reports focusing on stormwater issues in the watershed. This master plan is not meant to replace or duplicate these efforts, but rather to build on previous recommendations, identify priorities within the Greenway, and develop an implementation plan. The best approach will take advantage of a collection of various best management practices (BMPs), ordinances, partnerships, cost-sharing sources, and long-term planning to gain the maximum benefit for Baird Creek. The following is a summary of documents which address stormwater in the City of Green Bay and the Baird Creek watershed as they relate to the master plan.

- **<u>Stormwater Management Ordinance</u>, Chapter 30, City of Green Bay Municipal Code**

  The City's Stormwater Management Ordinance was written prior to the issuance of WDNR's NR 151 Runoff Management Rules in 2004, which set in place new minimum performance standards for erosion control at construction sites and stormwater management at new and redevelopment post-construction sites. The state rules address standards for runoff peak discharge rates, total suspended solids control, infiltration, protective areas, and more. The City's ordinance meets WDNR's standards for sediment reduction and exceeds the standards for quantity control; however, it should be updated to reflect the new state regulations and facilitate local permitting, specifically in regard to post-construction sites between 1 and 5 acres in size.

- **<u>City of Green Bay Stormwater Management Plan</u>, Rust Environment & Infrastructure (EarthTech), 1999**

  The City's Stormwater Management Plan (SWMP) was written prior to enactment of NR 151. The City is currently in the process of updating the plan to determine the structural and non-structural practices necessary to implement the state required pollutant reductions for existing urban areas. The undeveloped areas of the City will continue to be regulated by the NR 151 performance standards for new development. The original SWMP focused primarily on traditional practices such as wet detention ponds, including a recommendation to construct 13 regional ponds in the Baird Creek watershed. Stormwater management technologies and strategies have advanced since the plan was created, including alternative approaches which may be more practical, cost-effective, or desirable than regional ponds. City staff is knowledgeable in alternative stormwater BMPs, and is open to using these practices where applicable. The original SWMP also suggests many valuable nonstructural practices and policy decisions which, if implemented, can greatly reduce negative impacts of stormwater runoff. One such recommendation was for the creation of a stormwater utility to fund infrastructure improvements and offset regulatory costs, which was enacted in July 2004.

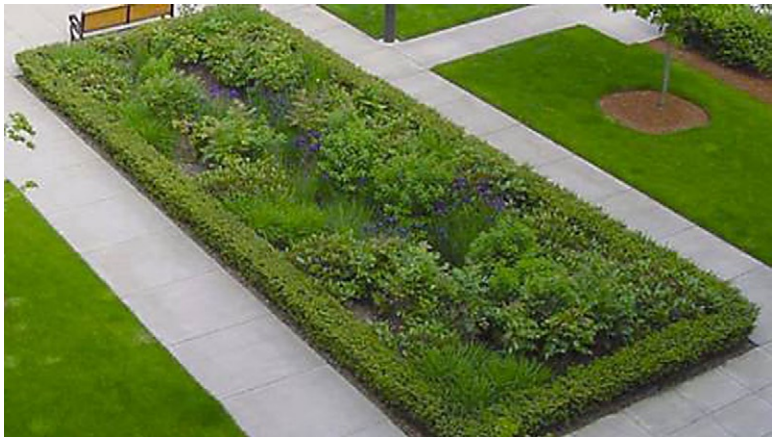
- **<u>Recommendations for Alternative Storm Water Management Practices, Innovative Best Management Practices (BMPs), & Restoration Strategies in the Baird Creek Parkway</u>, Applied Ecological Services, Inc., 2004**

  This plan provides specific alternatives to traditional detention ponds, which balances the approach of the City's SWMP. In addition, the plan highlights the benefits of alternative BMPs, provides examples of their use in both conservation and conventional developments, and gives examples of typical plant species for use in stormwater facilities. Streambank restoration techniques, complete with typical details, are described and recommended for specific locations along Baird Creek tributaries. In all, the recommendations represent the current state of research in stormwater techniques, and should be incorporated, with help from the City and other entities, into the overall strategic stormwater management plan.

- **<u>Baird Creek Watershed Stewardship Assessment</u>, Lake Michigan Forum, 2004**

  This assessment contains many recommendations on watershed-based approaches to stormwater management in Baird Creek. Focusing on public stewardship, participation, and education, the report outlines specific steps that the City, County, surrounding communities, and other organizations can take to improve the watershed. The document recommends designating the Northeast Wisconsin Stormwater Consortium (NEWSC) as the entity responsible for helping the region comply with regulations, and proposes the creation of a partnership between NEWSC and the BCPF to coordinate public outreach and involvement

Residential rain garden (www.urbanwaterquality.org)



Infiltration basin in a courtyard
(City of Portland 2004 Stormwater Management Manual)

related to stormwater in the watershed. The City of Green Bay has been an active member in NEWSC since its inception. As NEWSC is currently assisting communities in complying with their MS4 general discharge permit, the City will be using the information and education (I&E) plan developed by NEWSC as a foundation for the City's I&E program, which will be implemented citywide. The stewardship assessment also discusses other recommendations, such as bolstering local ordinances to provide greater control over development in the watershed and taking region-wide approaches to pollution prevention. In addition, many of the report's suggestions for other non-structural stormwater components such as wetland protection and enhancement, conservation design implementation in new subdivisions, and mitigating agricultural runoff impacts, all directly contribute to improved water quality and streambank health.

In addition to the above-listed resources, the Nonpoint Source Control Plan for the East River Priority Watershed Project briefly touches on Baird Creek and the contribution of agricultural runoff in the watershed to high phosphorus and solids loadings in the East River (Prey, 1993).

Current Research and Activities in the Baird Creek Watershed

In 2006, Baird Creek was placed on the state impaired waters list due to high nutrient and sediment concentrations and loads. This listing was supported by water quality data collected by researchers with the WDNR and a UW-Green Bay team led by Dr. Kevin Fermanich (Reyburn 2003, Fink 2005, Fermanich 2005). Funding has been secured from the U.S. Environmental Protection Agency (EPA) and the U.S. Geological Survey (USGS) to maintain a monitoring station on Baird Creek through September 2007 that will allow the collection of additional data, with supplemental fieldwork and projects performed by university researchers and students. These data are essential in establishing a Total Maximum Daily Load (TMDL) for nutrients and sediment in Baird Creek. The water quality standards defined by the TMDL will provide targets for removing the stream from the state impaired waters list, and will increase funding opportunities for BMP implementation to reduce nutrient and sediment loadings.

The BCPF has been actively working with the City of Green Bay, the Wisconsin Department of Agriculture, Trade, & Consumer Protection (DATCP), Brown County Land Conservation Department (LCD), WDNR, UWGB, and private citizens to respond to nutrient and sediment loads in Baird Creek from urban development, agriculture runoff and other sources. Brown County LCD is currently pursuing the enforcement of a county ordinance requiring the installation of buffer strips along Baird Creek in agricultural areas. However, reducing impacts to the stream and its tributaries from development within the City of Green Bay continues to be of great concern.

Stormwater Management Strategy – Treating at the Source

The most effective stormwater management programs utilize many different tools, and are very decentralized in their implementation. As stormwater is treated farther from its source in downstream, regional detention ponds, facilities become more costly, consume more land, contribute to thermal loading, and are generally less effective. Stormwater is best treated in the headwaters of a watershed, at the "point of contact," in small facilities. Non-traditional BMPs such as bioswales, rain gardens, infiltration basins or trenches, green roofs, permeable pavement, and constructed wetlands work by treating stormwater at the source, infiltrating or evaporating it and preventing it from becoming concentrated runoff. The 2004 report on alternative stormwater techniques discusses many of these strategies. Because the majority of rain that falls in Wisconsin comes less than an inch at a time, even a very shallow infiltration basin or rain garden can capture and infiltrate a great deal of rainwater, recharging shallow groundwater and baseflow in the creek and its tributaries. These basins and rain gardens can be constructed to infiltrate water even in clay soil, by amending the soil structure and choosing plants that will increase infiltration rates. The WDNR publication Rain Gardens: A How-to Manual for Homeowners provides guidelines for design and construction of these treatment facilities (Bannerman and Considine, 2003).

Small detention ponds can be an appropriate and effective technique as part of an overall stormwater treatment system. However, pond outlets need to be designed to have minimal impact on downstream natural areas. The Greenway contains many ridges and steep slopes that separate the stream from the more developable

Lower discharge basin from a wet detention pond at the Royal Woods Subdivision off Huron Road

Rain barrels collect roof water for irrigation and reduce runoff (www.rainsaverusa.com, www.clearwaterconservancy.org)

upland and are very susceptible to erosion and gullying. An example of a well-designed pond outlet that avoids impacts to these slopes is the wet pond located in the Royal Woods Subdivision off of Huron Road, which discharges along the South Branch. A pipe carries stormwater from the detention outfall through a steep slope to a smaller pond at the base of the hill. High velocities at the pipe outlet are dissipated by riprap and partially-buried branches and stumps to prevent downstream gullying, as shown in the picture on the previous page. This pond has been in place for over a year, and has not shown any sign of channel erosion between the outlet and the stream. This design should be considered for other locations in the Greenway with erosion problems.

Dry extended detention basins may also provide an additional stormwater management option. Dry basins are typically used in well-drained soil conditions, allow for infiltration of runoff, and provide filtration of pollutants and evapotranspiration with native vegetation. This type of facility needs to be supplemented with a small settling basin upstream to remove sediment. However, they are less costly than wet detention basins, do not have thermal load impacts on streams, and promote natural groundwater recharge.

Other BMPs such as permeable pavement, rain barrels, and roof gardens, can also help to "disconnect" runoff from the point of contact and the storm sewers. At several subdivisions along the ridgelines, homeowners have redirected their downspouts by burying flexible pipe that conveys roof runoff directly to the edge of the Greenway. One simple solution for protecting the steep slopes from erosion and filtering this water would be to contact these residents, encouraging them to install rain gardens or, at a minimum, allow runoff to flow over a lawn area before reaching the Greenway.

Nonstructural BMPs such as regular street sweeping and sump cleaning are also ways to reduce pollutant loads in stormwater. Because of high phosphorus levels found in Baird Creek, we would encourage use of low phosphorus fertilizers on established lawns to limit possible runoff problems. Soil testing could be used to determine appropriate phosphorus application rates.

Smart Development

Most new structural stormwater BMPs in the Baird Creek watershed will be implemented as part of new developments in the rapidly urbanizing area, giving the opportunity to utilize more natural approaches to stormwater treatment. This underscores the need for smart growth planning and oversight, public involvement and review, and tighter development regulations and standards. Section 3.7 discusses strategies for interfacing with developments immediately adjacent to the Greenway. Although these connected developments may directly impact the Greenway, poorly planned development anywhere in the watershed may threaten the future of Baird Creek. However, these upland developments also have the greatest opportunity to protect the Greenway and the creek, as the most effective stormwater management usually occurs in the headwaters, long before runoff reaches the Greenway.

In several areas of the country, the creation of watershed overlay or stream awareness districts have laid the foundation for citizen education and action. The overall goal of such districts are to work with developers and willing property owners to reduce impervious surfaces, identify premium infiltration sites, disconnect impervious areas from drainages wherever possible, maintain natural drainage routes and features, encourage infiltration with the use of native plants and rain gardens, and provide opportunities for homeowners to reduce runoff from their properties. The watersheds covered by overlay districts serve as pilot locations for demonstration sites that benefit eventual city-wide implementation of alternative stormwater practices.

A partnership should be established that includes the City of Green Bay, Brown County, the BCPF, Bay-Lake Regional Planning Commission, and the Towns of Humboldt and Eaton, to develop minimum standards

for development within the Baird Creek watershed. This recognizes that Baird Creek and the Greenway are unique natural resources that justify extra efforts for protection. The overall goal should be to work with developers to reduce impervious surfaces, disconnect impervious areas from drainages wherever possible, maintain natural drainage routes and features, encourage infiltration with the use of native plants and rain gardens, and provide opportunities for homeowners to reduce runoff from their properties.

Construction Site Erosion Control

Erosion from construction sites remains a threat to the creek. This is especially true considering that the Green Bay Smart Growth 2022 Plan calls for the development of over 1,000 acres of farmland in the watershed to residential, institutional, and commercial land uses in the next twenty years, The state sets standards for erosion control via NR 151, and the City's stormwater ordinance establishes local enforcement. Simple techniques such as silt fences, inlet controls, tracking pads, and temporary sediment basins can provide adequate construction erosion control. However, tighter enforcement and tough fines for violations are needed to ensure that these devices are properly installed and maintained.

Stream Stabilization and Tributary Erosion Control

Locations of severe tributary erosion on Baird Creek and its tributaries are shown on the site analysis graphics (Section 2.2). However, these represent only the most critical areas of eroding streambank within the Greenway. While alignment changes, meandering, and bank sloughing are natural processes in every stream system, these can be greatly exaggerated and worsened by high stormwater peak flows created by new development upstream. One large storm event can cause damage to a bank or tributary that would take decades to produce under natural conditions. Implementation of streambank stabilization and restoration techniques in key areas may be effective at stemming premature bank erosion and preventing further sediment transport downstream.

Failure to properly maintain inlet protection at construction sites increases sediment delivery to a stream

Severe erosion on a tributary to Baird Creek

Log J-hook vane diverts flows away from bank (U.S. Fish and Wildlife Service, www.fws.gov)

Root wads, boulder vanes, and erosion matting on the Vermillion River (Friends of Mississippi River, www.fmr.org)

Stream restoration techniques generally fall under one or more of the four following categories:

- Bank protection
- Bank stabilization
- Grade control
- Flow deflection

Bank protection and stabilization techniques do not necessarily have to include stone riprap. Native material revetments can hold soil in place, increase overall bank stability, reduce stream sediment load, and direct flow velocities away from the bank. While there are many different strategies available for restoring streams and rivers, the following is a short list of practices which could potentially be employed on Baird Creek or its tributaries:

- Littoral shelf
- Crib wall
- Soil lift
- Live staking
- Root wads
- Lunker structures
- Rock or vegetation revetment
- Wing deflectors
- Cut-off sills
- Linear deflectors
- J-hooks
- Boulder vanes
- Brush mattresses
- Erosion mats
- Live fascines and wattles
- Coir fiber rolls
- Rock vortex weirs
- Step pools

Details on these techniques and others can be found in an online slide show by the Center for Watershed Protection (*http://www.stormwatercenter.net/Slideshows/restoration_files/frame.htm)* and in Stream Corridor Restoration Principles, Processes, and Practices (FISRWG, 1998). The 2004 alternative stormwater recommendations (Applied Ecological Services, 2004) also provides information on many of these methods, and identifies potential locations for implementation of strategies along two tributaries to Baird Creek: the west ravine (east and adjacent to Christa McAuliffe Park, also referred to as Tributary to Main Stem), and the east ravine (also referred to as Tributary to South Branch), downstream of a new detention pond.

A combination of the above strategies is often the best means of restoring and protecting streams. However, selecting the proper techniques for a given stream

reach involves a detailed engineering assessment of watershed drainage area, soil conditions, water velocities and flow rates, and overhead forest cover. Some practices, such as live fascines, require locations with conditions favorable for growth of streamside vegetation where the overhead canopy is less dense. Other strategies, such as log vanes or lunker structures, are less dependent on sunlight. Choosing appropriate techniques for a given forested or open stream segment should make it unnecessary to purposely clear canopies over the creek bed to provide stream stabilization.

The difficulty in streambank restoration and stabilization projects usually lies in the implementation. Sites with severe erosion are often not easily accessible, especially for machinery needed for extensive earth moving. The use of manual labor from many volunteers can in some cases eliminate the need for heavy equipment, which can be damaging to vegetation and slopes. However, this may prevent techniques using large boulders or tree trunks. Stabilization activities should also be coordinated with periods of low stream flow to avoid difficult and costly temporary rerouting of the stream channel.
Efforts are currently underway to perform the necessary engineering modeling at several severe erosion sites on tributaries to Baird Creek. The BCPF is working with Brown County Land Conservation, DATCP, and City of Green Bay staff to determine which methods will be effective at controlling erosion and restoring habitat while minimizing damage to the Greenway from construction activities.

There are many cost-sharing grant programs available to help municipalities and local groups implement stream restoration practices, such as the Urban Nonpoint Source Grant and River Protection Grant Programs through the WDNR. See Section 4.3 for more funding information.

Public Information and Education Programs

The City will be developing a public information and education (I&E) program as part of its MS4 general discharge permit. The plan will be city-wide as its message transcends watershed boundaries. The City will develop I&E programs within specific watersheds as needed to address unique situations.

The BCPF is in a strong position to effectively contribute to the implementation of I&E programs concerning stormwater and erosion in the Baird Creek watershed. In many ways, the group is already active in this role by leading hikes, working with City and WDNR staff, and facilitating public involvement in the master planning process. Listed below are examples of how the BCPF and other partners can further involve the public in stormwater awareness:

- Sponsor the Lower Fox River Watershed Monitoring Program in local schools (*www.uwgb.edu/watershed*). Consider expanding the program to more age levels or additional sites. Younger classes may try using similar "Water Action Volunteers" monitoring techniques (*http://clean-water.uwex.edu/wav/*).
- Sponsor water quality education exhibits at City Hall, the Green Bay Metropolitan Boat Launch, and the Neville Public Museum.
- Continue to organize annual Earth Day events, and include streambank restoration and stabilization projects for volunteers.
- Exhibit at area expositions like a Home and Garden Show to educate homeowners about things they can do to reduce stormwater runoff from their properties.
- Encourage school-aged groups to participate in demonstration sites for stormwater management techniques like planting rain gardens or installing rain barrels.
- Nominate Baird Creek volunteers for the annual "Clean Bay Backer" awards.
- Organize school-aged groups to stamp "Do Not Dump – Drains to Creek" on storm sewer inlets.

- Distribute leaflets to landowners in the watershed about the benefits of avoiding phosphorus-containing fertilizers, constructing rain gardens, and directing roof downspouts appropriately.
- Host workshops for developers and contractors about conservation design and good construction site erosion control.
- Invite nearby university experts to give seminars to homeowners.
- Assist residents in constructing rain gardens on their property. Consider securing grants to help purchase plants or other materials for the installations.

3.6 INTERFACING WITH ADJACENT DEVELOPMENT

The City of Green Bay is rapidly developing on its east side along the Baird Creek corridor. As land use changes around the Greenway and within the watershed, special consideration needs to be given to reduce potential impacts of development on habitats, water quality, slope stability, and scenic viewsheds.

Many studies have shown that accessible urban green space increases property values, ranging from 5 to 20 percent more than comparable lots located over 2,000 feet from a park or greenway (TPL 1999, Community Open Space Partnership 2003a). Increased revenue from property taxes generally results in a positive effect on a City's budget, despite increases in costs for park maintenance. The Baird Creek Greenway is no exception; new residents in the surrounding neighborhoods are drawn by the scenic beauty of the area. However, it is only by protecting the quality of the Greenway that it can remain a valuable community asset, providing safe, enjoyable recreation and supporting property values in the area. The following strategies are recommended to maximize protection of the Greenway's resources while creating attractive developments with a high quality of life for Green Bay residents.

Rapid development is occurring in the Baird Creek watershed

Prairie borders in setbacks provide protection to steep hillsides and beauty to residential lots

Setbacks

The topography surrounding Baird Creek in the urbanizing area between I-43 and Grandview Road is characterized by highly erodible, steep slopes. Concerns were raised during the master plan process to not only protect the habitats and the drainage ravines on these hillsides from damage, but also to preserve the viewsheds within the Greenway to maintain a feeling of wildness. For these reasons, a minimum 50-foot setback is recommended for developments along the ridgeline. This setback should be maintained in native vegetation, either as a prairie or a woodland with an intact understory. Clearing of vegetation, removal of logs, and mowing should be prohibited, with exceptions for removing invasive species and establishing prairie.

Three ownership options exist for these setbacks. First, the land can be dedicated to the City when the plat is recorded. Under this option, the City assumes management responsibilities for the land. The second alternative is to retain the land as privately-owned open space for the residential subdivision. A neighborhood association would need to be established to maintain the property in an acceptable condition, as

specified in an open space management plan. The third option is to record the setback on the title of the individual lots extending to the Greenway boundary, under which the property owners assume responsibility for land management. Under options two and three, it is recommended that a conservation easement be recorded on the setback to ensure that the vegetative cover will be appropriately maintained. This easement could also provide the City Parks Department with the right to construct and maintain a trail within the setback, so that they can direct pedestrian access from the neighborhood to an appropriate location to negotiate the steep slope in order to reach the lower elevation of the creek.

Greenway Access

Accessibility is a key component to maintaining the quality of life and property value benefits from green space. Small entries such as the tertiary trailheads described in Section 2.2 are designed to allow neighbors who live just across the street from the Greenway to access the trail system by foot without having to drive or bike to a distant park or large trailhead. These trailheads can be provided during platting of adjacent subdivisions as pedestrian easements along lot lines.

Current City ordinance 14.04(5)(c) requires dedication of pedestrian easements to greenways and parks that are no less than 30 feet wide, with a path width and design approved by the Parks Department. This ordinance also requires that the path be constructed by the developer at the time of street construction in the subdivision (City of Green Bay 2006). Both of these provisions are adequate for the design of Greenway access points. Attention should be given to enforcing the second provision, which would alleviate recent difficulties in constructing access paths after lots have been sold and homes built. The City may consider amending the ordinance to include spacing of pedestrian access points, which should include a minimum of one pedestrian access point per subdivision adjacent to the Greenway with a maximum distance of 800-feet between easements.

Conservation-by-Design and Low-Impact Development Strategies

As alternatives to conventional land subdivision, recent development strategies have gained recognition for reducing environmental impacts while increasing the quality of life for residents. In urban areas, conservation-by-design techniques can be used to cluster the development by reducing lot size, increasing the amount of land left as permanent open space, and conserving key natural features. As a rule of thumb, 25-40% of the total land should be set aside as open space. Density bonuses can be used to provide incentives for developers to protect these larger amounts of open space. Bonuses allow developers to build more dwelling units in the cluster than the maximum permitted under zoning regulations in exchange for community benefits. Schueler (2000a) recommends a density bonus of 10% more units be provided as an incentive for protection of 35-40% of the development as open space or for the use of innovative stormwater management practices.

Another strategy called low-impact development (LID) is similar to cluster development, the exception being that pre-development hydrology is solely used as the integrating framework for the road and lot layout (Prince George's County Maryland, 1999). The site to be developed is first assessed to identify and preserve all hydrologically sensitive areas, including streams, floodplains, wetlands, steep slopes, highly permeable soils, and wooded areas. Buffers are then provided around these areas to ensure their continued ability to function. These areas are declared off limits to construction equipment to prevent compaction and disturbance. Efforts are then taken to minimize and disconnect the impervious surfaces created by the development. Stormwater controls are decentralized to keep water closer to the source of the runoff as discussed in Section 3.5, and flow paths are increased to provide a longer time of concentration and more opportunity for natural treatment.

These types of development have proven to be environmentally sensitive through multiple research projects. Depending on the road layout, conservation-by-design developments can decrease the amount of impervious surfaces by 10-50% from conventional development (Schueler, 2000c). Brander (2004) found that cluster development produced the least amount of stormwater runoff in an assessment of four different development techniques. Other research found that the export of phosphorus and nitrogen from these developments before any stormwater treatment was already as low as the export of these nutrients from conventional subdivisions with stormwater facilities (Schueler, 2000b).

A common misconceptions regarding conservation-by-design is that use of this strategy results in less marketable homes and lots. Although clustering creates smaller lot sizes, market surveys have shown these types of developments actually appreciate in value faster than conventional subdivisions because home buyers value natural areas, recreational amenities, and smaller, lower maintenance yards (TPL, 1999). Also, the reduced lot frontages and smaller lot sizes associated with clustering does not necessarily preclude the construction of larger homes. As the image at left shows, an attractive 2,400 square foot dwelling with an attached two-car garage can be designed to fit on a 50-foot wide lot by building up instead of out (Natural Lands Trust, 2001). In addition, significant cost savings for both developers and home buyers can be attributed to the more efficient site layout and reduced infrastructure required by clustering. Finally, municipalities economically benefit from cluster design as property tax yield increases on a per acre basis, and the maintenance costs decrease due to reductions in infrastructure (Schueler, 1995).

Based on these benefits, conservation-by-design and LID are desirable to promote sustainable development adjacent to the Greenway. Brown County has adopted a conservation subdivision ordinance; the City of Green Bay should use this example and others to create an ordinance which tailors regulations to an urban setting. The BCPF may also consider sponsoring workshops for local developers to learn the advantages of conservation-by-design, and handing out literature at Home Building Expos to educate potential home buyers on the possibilities of green design.

Design for a 2,400 square foot home to fit on a smaller lot frontage (Natural Lands Trust, 2001)

LID integrates open space with hydrology to filter stormwater

Crafting Ordinances to Promote Greenway Protection

Several of the recommendations made in this and previous sections include amending the existing City of Green Bay municipal code or writing new ordinances to better manage impacts of development on the Greenway. The following links are internet resources and examples for developing ecologically sensitive ordinances:

Establishing a Watershed Overlay District for Stormwater Management

- Macomb County, Michigan:
  http://macombcountymi.gov/planning/Model_Envir_Ordinances.asp
- North Carolina Model Ordinance:
  http://h2o.enr.state.nc.us/wswp/forms/modelord500.pdf
- US Environmental Protection Agency Model Ordinances:
  http://www.epa.gov/owow/nps/ordinance/sitemap.htm
- Minnesota - Model Ordinances for Sustainable Development:
  http://server.admin.state.mn.us/resource.html?Id=1927

Stormwater Management and Erosion Control

- State of Wisconsin Regulations and Model Ordinances:
  http://prodwbin99.dnr.state.wi.us/org/water/wm/nps/admrules.htm
- Dane County, Wisconsin:
  http://www.danewaters.com/resource/stormwater.aspx
- Center for Watershed Protection:
  http://www.cwp.org/index.html

Phosphorus Lawn Fertilizer Restrictions

- Dane County, Wisconsin:
  http://www.danewaters.com/management/phosphorus.aspx
- State of Minnesota:
  http://www.mda.state.mn.us/appd/ace/lawncwaterq.htm

Conservation Subdivision Ordinances in Wisconsin

- Brown County, Wisconsin:
  http://www.psat.wa.gov/Programs/LID/LID_ordinances.htm
- UW-Extension Model Ordinance for Conservation Subdivisions
  http://www.doa.state.wi.us/dhir/documents/conserv_subdiv_Model_ordinance_Feb2001.pdf
- Wisconsin Chapter of the American Planning Association:
  http://www.wisconsinplanners.org/law/index.htm
- Southeast Wisconsin Regional Planning Commission (SEWRPC):
  http://www.sewrpc.org/communityassistance/conservationsubdivisions/

Low-Impact Development

- The Low-Impact Development Center:
  http://www.lowimpactdevelopment.org/
- US Environmental Protection Agency:
  http://www.epa.gov/nps/lid/
- Pacific Northwest:
  http://www.psat.wa.gov/Programs/LID/LID_ordinances.htm
- Prince George's County, Maryland:
  http://www.epa.gov/owow/nps/lidnatl.pdf