NATURAL CONNECTIONS

A Vision of Green Infrastructure for the *Lower Grand River Watershed*

What is Green Infrastructure?

Green infrastructure refers to an interconnected green space network (including natural areas and features, public and private conservation lands, working lands with conservation values, and other protected open spaces) that is planned and managed for its natural resource values and for the associated benefits it confers to human populations. (From: Green Infrastructure—Linking Landscapes and Communities, by Mark A. Benedict and Edward T. McMahon, The Conservation Fund, 2006)

In the Lower Grand River Watershed, the green infrastructure framework consists primarily of upland forests (mostly southern forest communities) typically associated with larger hub areas, and lowland forests (commonly southern hardwood swamp and floodplain forest), and wetlands (commonly emergent and submergent marsh, southern wet meadow, southern shrub-car, and inundated shrub swamp) associated with the riparian lands along rivers, creeks, lakes, and ponds. The hubs and corridors identified on the map have the greatest potential to provide an interconnected network of land and water that supports native plant and animal species, maintains ecological processes and services, sustains air and water resources, and contributes to the health, well-being and quality of life of people and communities throughout the region.

Committed Greenspace Statistics

Management Type	Sq.Miles	Comments:
Conservation Easement	2.2	On private lands, however many CE's are mapped with points only, total area is larger than that reported
Forest Management	3.5	U.S. Forest Service lands
Greenspace	4.7	Includes natural areas not designated park or preserve. Area measured includes cemeteries in urban areas, rural cemeteries are mapped as points
Nature Preserve	5.8	Includes sanctuaries, natural areas, preserves and nature center lands
Recreation Area	19.8	Includes camps, campgrounds and state recreation areas
Park	23.1	Properties with "Park" designation
Wildlife Area	75.2	Includes Michigan state game areas and U.S. Fish and Wildlife Service lands
TOTAL	134.3	

Ownership	Sq. Miles	Comments:
Non-Governmental Organization	1.8	Local land conservancies, Michigan Nature Association, conservation districts, state/local Audubon Society
Federal	3.8	U.S. Fish and Wildlife Service and U.S. Forest Service
Private	5.1	Camps, campgrounds, conservation easements, and some cemeteries
Local	13.5	City, village, and township governments
County	15.9	County government
State	94.2	Michigan Department of Natural Resources and Environment and Michigan Department of Transportation
TOTAL	134.3	

Legend

Committed Greenspace Lands

These areas identify some of the "protected" natural lands in the watershed. Areas mapped include: state parks, state game areas, national forests, local parks, nature preserves, nature centers, trails, cemeteries, conservation easements, and camp lands.

Green Infrastructure Types

Hub

Corridor

These areas are priority areas that may have the greatest potential for supporting a regional green infrastructure network but are not currently in protected status. The network includes large blocks of mostly naturally vegetated areas that serve as network hubs. Narrower natural corridors (typically river/creek corridors) connect the network together.

Conservation Easement - privately owned

Cemetery

Cultivated Land

Regional Non-Motorized Multi-Use Trail Network

North Country National Scenic Trail

0 1.5 3 6 9 12 Miles

0 2 4 8 12 16 Kilometers

N

LOWER GRAND RIVER ORGANIZATION of WATERSHEDS

Grand Valley State ANNIS WATER RESOURCES INSTITUTE Lake Michigan Center

Map Developed by Rod Denning

August 2010

Project Partners:

Fishbeck Thompson Carr & Huber, Inc. (FTC&H)

Grand Valley Metro Council—Lower Grand River Organization of Watersheds (GVMC—LGROW)

Grand Valley State University—Annis Water Resources Institute (GVSU—AWRI)

Michigan Department of Natural Resources and Environment (MDNRE)

Data Sources:

Base Information: Michigan Department of Technology, Management & Budget, Office of Shared Solutions, base framework 9b, 2009.

Committed Greenspace Lands: Identified from county plat books, public information (maps, brochures), Ottawa County Parks Department, Great Lakes Conservation and Recreation Lands (CARL) database, Great Lakes/Atlantic Regional office of Ducks Unlimited, Inc., and personal communication.

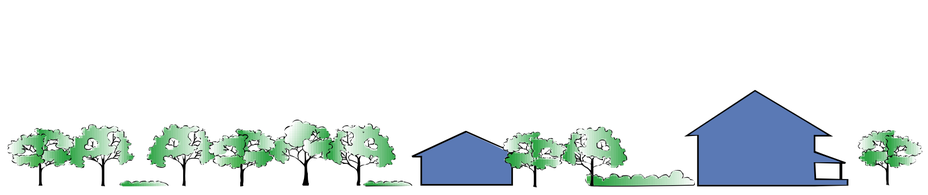
Green Infrastructure Types: Derived from the National Oceanic and Atmospheric Administration (NOAA) Coastal Change Analysis Program, 2006 (C-CAP), Land Conservancy of West Michigan, Natural Connections Map—A Vision of Regional Green Infrastructure in West Michigan, 2004, U.S. Department of Agriculture, Farm Service Agency, National Agriculture Imagery Program orthophotography, 2009.

Trail Information: Regional trails data from the West Michigan Trails and Greenways Coalition, 2010. North Country National Scenic Trail from the North Country Trail Association, 2010.

Natural Connections to Community

Promoting Stormwater Management Alternatives that support Green Infrastructure

Rural



Vegetative Swale

Vegetative swales are usually manmade depressions that filter and collect sheet flow runoff. Planted with vegetation, these swales serve as an overland filtration tool which slows stormwater and controls erosion in rural areas.

Vegetative swales, or bioswales, tend to be broad, shallow, earthen channels designed to slow runoff, promote infiltration, and filter pollutants and sediments in the process of conveying runoff. Water is filtered through the soil to under drains and the swale is quickly dewatered, preventing standing water. Vegetated swales are an excellent alternative to conventional curb and gutter conveyance systems because they provide pretreatment and can distribute stormwater flows to subsequent best management practices (BMPs).

Source: Road Commission for Oakland County

Stone Check Dams

Source: Pennsylvania Stormwater BMP Manual, 2006

Residential Grass Swale

Source: Pokagon Band of Potawatomi Indians

Vegetated Swale at the Pokagonek Edawat Housing Development, Dowagiac, MI

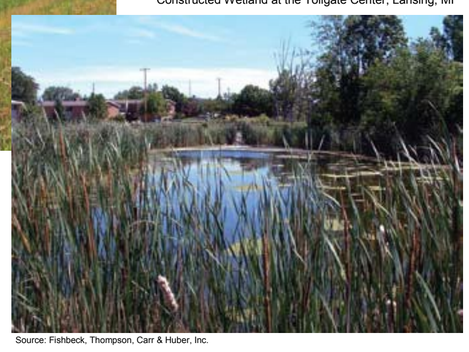
Filtration Pond

Filtration ponds are manmade depressions designed to capture stormwater after rain events, slowly releasing the contents over a period of time. These ponds, typically rural in character, should be strategically located to capture a maximum amount of water and serve as a neighborhood amenity.

Filtration ponds, or detention ponds, provide temporary storage of stormwater runoff to prevent downstream flooding. The primary purpose of the detention basin is the attenuation of stormwater runoff peaks. Generally, detention basins may be dry ponds, wet ponds, constructed wetlands, or underground systems.

Source: City of Troy

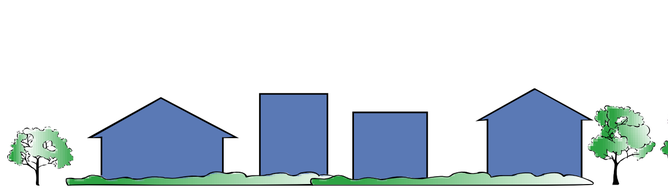
Wet Pond in Residential Area, Troy, MI



Source: Fishbeck, Thompson, Carr & Huber, Inc.

Constructed Wetland at the Tollgate Center, Lansing, MI

Suburban



Vegetative and Stone Swale

Vegetative and stone swales are slight depressions planted with manicured grass and have a three to five inch base of small stones to convey stormwater while encouraging infiltration. This type of swale is best utilized in medium density zones since it has a more natural function combined with a manicured look.

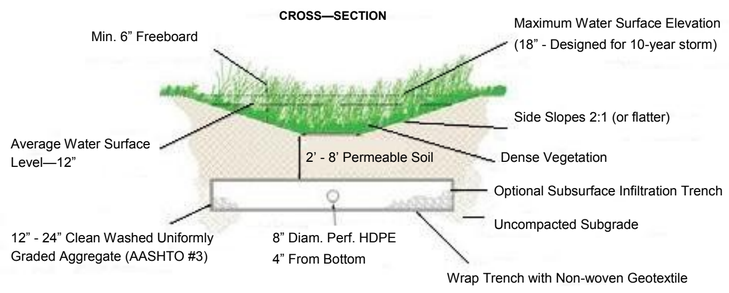
Vegetative and stone swales are best fitted for mild slopes or poorly-drained soils where the addition of the aggregated bed system can help to make sure a maximum allowable ponding time of 48 hours is not exceeded. The subsurface system should be designed like an infiltration trench.

Source: City of Troy

Beech Park Bioretention Area, Troy, MI

Source: Low Impact Development Center, Inc.

Highway Median Stone Swale



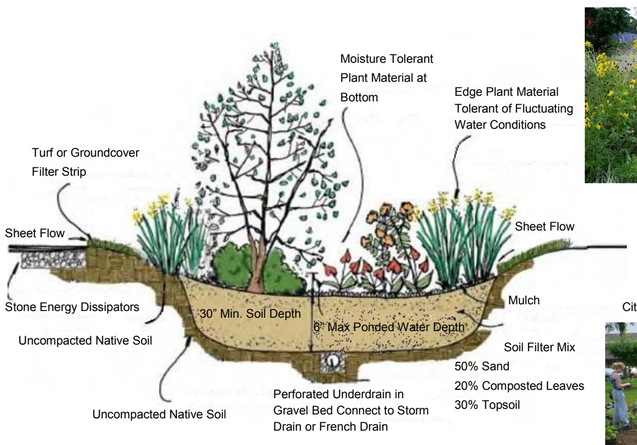
Schematic of a Vegetated Swale with an underlying aggregate layer

Source: Pennsylvania Stormwater BMP Manual, 2006

Rain Garden

Rain gardens are naturally occurring or manmade depressions that temporarily retain water. Rain gardens are planted with specific vegetation underlain with gravel and soil to filter water before it percolates back into the ground. Native species are preferred for rain gardens for their sustainability in local climates.

Rain gardens, or bioretention areas, serve to filter (water quality) and absorb (water quantity) runoff, and enhance infiltration. Plants absorb pollutants while microbes associated with the plant roots and soil break them down. The soil medium filters out pollutants and allows storage and infiltration of stormwater runoff, providing volume control. In addition, engineered soil media may serve as a bonding surface for nutrients to enhance pollutant removal.



Small residential rain garden design

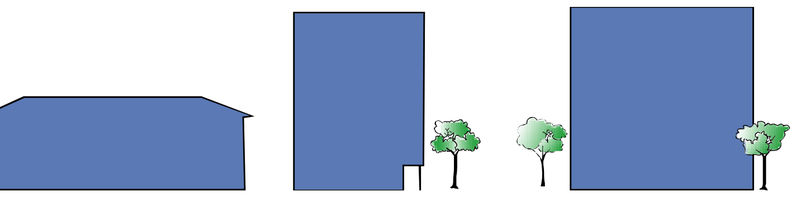
Source: Patricia Pennell

Typical Suburban Rain Garden

City of Walker Rain Garden Planting

Source: GVSU—AWRI

Urban



Planting Strip Trench

Planting strip trenches are gently sloping vegetated areas in street rights-of-way which allow for maximum contact with the vegetation. These trenches are appropriate for urban conditions because they typically have formal plantings which need regular upkeep.

Planting strip trenches, or infiltration/flow-through planter boxes, are probably the most adaptable to all types of sites with all types of site constraints. The infiltration variation is influenced by all factors which are limiting to any infiltration-oriented BMP (i.e., bedrock/seasonal high water table at or close to the surface, very poorly draining soils, etc.). However, both the contained and flow-through variations can be used on virtually every type of urban site.

Source: Tetra Tech, Inc.

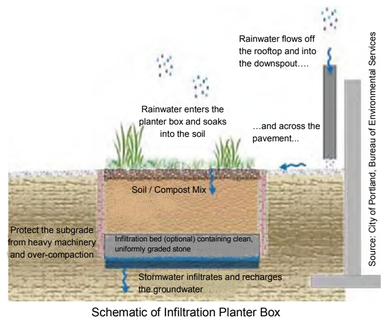
Michigan Avenue Bioretention Planter Box, Lansing, MI

Source: Low Impact Development Manual for Michigan, SEMCOG 2009

Example of Infiltration Planter Box

Source: City of Portland, Bureau of Environmental Services

Example of Flow-through Planter Box



Source: City of Portland, Bureau of Environmental Services

Schematic of Infiltration Planter Box

Vegetative Purification Bed

Vegetative purification beds treat and store stormwater in tight, urban areas. A combination of plant material, sand filtration and cycling water through the media purifies the water in the bed. Vegetative purification beds, or urban rain gardens, are shallow surface depressions planted with specially selected native vegetation to capture and treat stormwater runoff from rooftops, streets, and parking lots. Urban rain gardens can be integrated into a site with a high degree of flexibility and can integrate nicely with other structural management systems including porous pavement parking lots, infiltration trenches, storm sewers and other *non-structural* stormwater BMPs.

Source: Low Impact Development Manual for Michigan, SEMCOG 2009

Urban Formal Rain Garden, Traverse City, MI

The Grayling Stormwater Project:

- Reduce the direct drainage of stormwater into the Au Sable River by 80%
- Constructed 86 rain gardens in the city-owned rights-of-way between the sidewalks and the streets
- Over 60 acres of urban land is treated by the rain gardens

Source: Huron Pines

Typical Rain Garden, Grayling, MI

Urban Rain Garden Characteristics:

- Sloped sides and a bottom below street level allows water to collect
- Curb cut allows water to enter
- Native shrubs and perennials filter pollution

Regional Planning for Sustainability

In our earliest examples of planning communities, simple factors were used such as the ease of manipulating landscape features, the availability of resources such as food or building materials, or just the best stopping points along the way. As our cities have grown in complexity, size, and impact on our environment, we have adopted new techniques for evaluating and guiding our decisions about where and how to build communities.

One of the most significant changes in the way we build towns and cities is the need to create or preserve a real sense of place. We are no longer promoting blankets of homogenized buildings, structures, and uses, especially in wasteful underutilized patterns. Instead, planners are now embracing elements of good urban design and are creating new ways to implement these designs in our neighborhoods, towns, and cities. Planners have recognized that not all parts of a community function in the same manner and therefore require a greater variety in the types of buildings and structures constructed and in the way they are placed in relation to one another. To help better organize these critical urban attributes, appropriate building and structural forms have been catalogued over a series of gradations known as an “urban transect”. Good urban design can now be better understood and encouraged in place-appropriate ways from the most developed urban core, to the small towns and rural neighborhoods throughout our metropolitan areas, and into our rural areas at the urban periphery.

A simplified version of transect zones has been shown in the water management examples above. They have been divided into Rural, Suburban and Urban categories. The urban transect was developed by planners, architects, and new urbanists and usually includes up to 6 zones with various other classifications as needed. This approach allows planners and community developers to promote the right mix of uses, transportation means, planned open spaces, housing choices, and environmentally sensitive building methods, depending on the areas being considered. The transect also includes an area of preserved lands often outside the urbanized area, which at a regional level, might look like the Natural Connections map shown on the front of this poster.

Planning for sustainability over such a large ecological region requires that we step back from our historic city boundaries and analyze a host of environmental factors. Planners can help determine which lands need to be retained in order to maintain ecosystem services such as producing healthy food, establishing recreational pathways and links, maintaining biological diversity and wildlife corridors, and maintaining cool, clean and safe water resources. In West Michigan, the Natural Connections map (see front) was developed by analyzing critical factors related to these services and providing a regional picture of a connected system of places that, taken together, form a kind of “green infrastructure”. The Natural Connections Map represents areas, hubs, and links throughout the Lower Grand River Watershed which must be maintained as a cohesive coordinated whole in its natural state, or to be restored to a prior natural state, in order to sustain a minimum level of ecological function. Doing so will ensure our long-term ability to use and derive ongoing ecological and recreational benefits for the entire region.

Managing Our Water in All Communities

Since water moves through every part of our environment, excessive disturbance to its patterns of flow, and the natural cycles it follows, can have disastrous unintended impacts on our long-term use and our enjoyment of this life sustaining resource. Appropriately managing water is becoming an imperative at all levels of building community: rural, suburban and urban. In each of these general transect areas, human structures and activities can have profound effects on water flow and quality.

Examples of stormwater management techniques for each of three community types (rural, suburban and urban) are shown above. These techniques are based on best management practices collectively known as Low Impact Development or LID practices. Each of these techniques handles stormwater in unique ways, depending on the community characteristics found in surrounding structures, the stability of the area where water is traveling, or the contaminants water may be picking up along the way.

Planners in the Lower Grand River Watershed can use the Natural Connections Map along with their own jurisdictions’ Comprehensive Plans and related regulatory measures to ensure that stormwater is sufficiently handled in all new developments. The selection of the most appropriate techniques should be judged for best fit and function in relation to each community type along the rural to urban transect, and wherever possible, should serve to preserve or restore portions of the Natural Connections green infrastructure presented in this document. Changes should be considered for Comprehensive or Master Plan updates as well as amendments to zoning ordinances, particularly in those provisions dealing with site design standards such as site plan reviews, planned unit developments, zoning district building standards, and yard or setback requirements.

For more information on choosing and applying LID practices in Michigan, please refer to the *Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers, SEMCOG 2009.* For more information on selecting specific LID practices in relation to community type, please refer to *The Light Imprint Handbook: Integrating Sustainability and Community Design, Thomas E. Low, Duany Plater-Zyberk & Company, 2008.*

Natural Connections

A Vision of Regional Green Infrastructure in the Lower Grand River Watershed

Poster Project Partners

Michigan DNRE Department of NATURAL RESOURCES and ENVIRONMENT

Grand Valley State ANNIS WATER RESOURCES INSTITUTE Lake Michigan Center

GVMC

LOWER GRAND RIVER ORGANIZATION of WATERSHEDS

Project funding for this poster provided by the Michigan Department of Natural Resources and Environment, Lower Grand River Organizational Watersheds Initiatives Implementation Project TC#2007-0137

Poster Created by Rod Denning, GISP, GVSU-AWRI, Dennis Cole, PE, LEED® AP, and Andy Bowman, PCP, GVMC — Dec. 2010